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(15th Year of Publication)

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EMPIRE BROADCASTING.

SINCE the publication of our last issue matters in connection with Empire broadcasting have proceeded apace. The B.B.C. have made an announcement to the effect that they are immediately undertaking the erection of a short-wave station at Daventry, and they excuse themselves for not having gone ahead earlier on the score that they did not feel justified in spending public money on an enterprise which was only experimental in character. If that is the correct explanation, it seems strange that they are now prepared to proceed with the station although, to the best of our knowledge, they still have obtained no special authority to authorise the expenditure.

However, even though the step taken is so delayed, we are yet glad to see that action is being taken. Capt. Eckersley has stated that it will be some six months before the station is completed, and a very long time—perhaps years—before Empire broadcasting can be inaugurated. It seems to us that there is no justification for such a delay. It should only take a comparatively short time to erect a suitable station, and no one expects that the results can be perfect all at once. As we have pointed out before in our early appeals for an Empire station, the Colonies and remoter sections of the Empire would be well satisfied for the time being if a station in this country could give them results equal to those they obtain at present from the Dutch broadcasting station.

It appeals to us as almost pathetic that on the occasion of our recent celebration of Empire Day a request should have been addressed to the Dutch station authorities at Eindhoven for the Empire Day programme to be broadcast to the British Empire through that station. The request was turned down, and with good reason, we consider, for what possible excuse have we for asking a foreign broadcasting station to distribute a programme of that character to our own Empire, when it is merely lack of enterprise on our part which has prevented us from being able to carry out such a transmission for ourselves?

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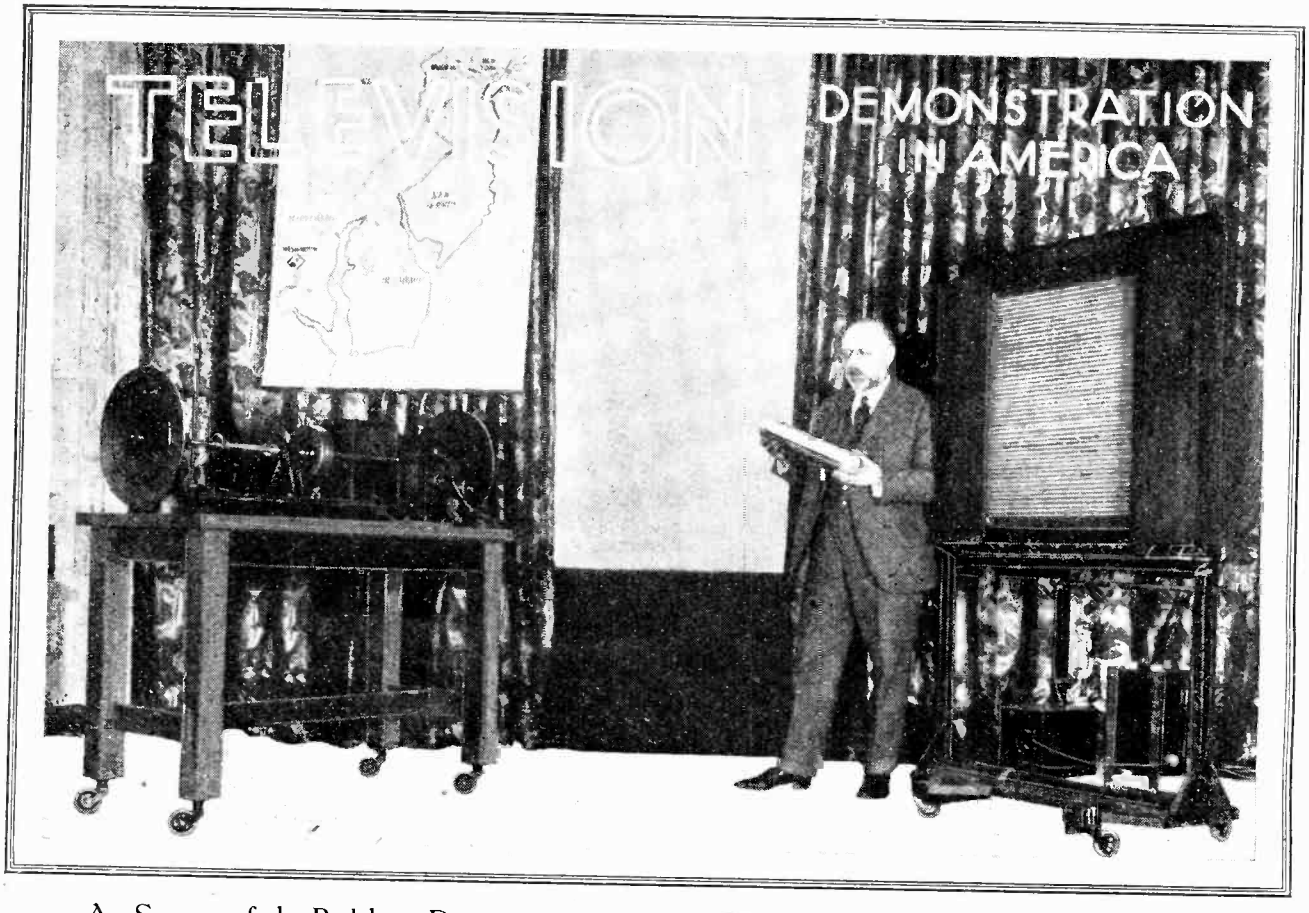
TELEVISION.

IN this issue we publish the first detailed account of what is, without question, the first successful public demonstration of television. The article provides a fascinating story, indicating the extent to which science has brought us in the direction of achieving what, a year or two ago, would have been regarded as an impossibility. It is clearly pointed out by those responsible in America that this demonstration must not be regarded as a service which promises early commercial practicability. The demonstration was carried out irrespective of cost and complexity of the apparatus; for the purpose of carrying out the experiments nearly 1,000 men were employed, and when the transmission was conducted by wireless three wavelengths had to be utilised; but television has been successfully demonstrated, and the task of the future is to simplify the methods by which it is achieved.



A Successful Public Demonstration of Television between Washington and New York.

By A. DINSDALE.

FOR some time past great interest has centred round the problem of television—seeing at a distance by telegraphy, either wire or wireless. Ever since the discovery of selenium by May in 1873 television has been the dream of scientists all the world over, and of recent years more and more research workers have entered this fascinating field, until there is now an international race for final success along practical lines.

The latest experimenters to enter the field are a group of engineers associated with the great American Telephone and Telegraph Co., one of America's largest industrial companies, which depends for its scientific progress upon vast organised laboratories staffed by some of the cleverest telephone and radio engineers in the world.

A group of engineers attached to these laboratories (The Bell Telephone Laboratories, Inc.) have been working away quietly on the problem for some years, until, on April 7th last, they were able to give a public demonstration of television over both wire and wireless circuits.

This demonstration was given before a party of guests which included business executives, newspaper editors, engineers, and scientists. The party assembled at the Bell Telephone Laboratories in New York, and were enabled to speak to, and simultaneously see, friends over the ordinary long-distance telephone line to Washington, 200 miles away.

In his introductory remarks Walter S. Gifford, President of the American Telephone and Telegraph Co., stated that "the elaborateness of the equipment required by the very nature of the undertaking precludes any present possibility of television being available in homes and offices generally. What its practical use may be I shall leave to your imagination."

Mr. Gifford then introduced Dr. Herbert E. Ives, under whose direction the research work on television has been carried out. Dr. Ives then gave the party a brief lecture, in the course of which he outlined the details of the invention, and gave a demonstration of its operation between one end of the laboratory and the other. In this demonstration he was assisted by Dr. Frank Gray, who is responsible for several of the developments which made possible the complete system.

Following this demonstration Mr. Gifford then talked over the telephone with General John J. Carty, vice-president of the company, who was in Washington, and

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afterwards with Secretary Hoover, of the Department of Commerce.

As Mr. Gifford talked to the General the latter's face became visible on a small screen, measuring about two inches by three inches, which was mounted in front of Mr. Gifford's telephone.

"How do you do, General? You are looking well," said Mr. Gifford.

The face of General Carty smiled and his voice enquired after the health of the speaker on the New York end.

"You screen well, General," said Mr. Gifford. "You look more handsome over the wire."

"Does it flatter me much?" General Carty asked.

"I think it is an improvement," was the reply.

Loud-speaker and Large Screen.

Mr. Hoover was then called to the telephone, and his speech was made audible to the assembled guests by means of a loud-speaker, whilst the distant speaker was rendered visible on a large screen for auditorium use, measuring about two feet by three feet.

This large illuminated transparent screen seemed somewhat corrugated. This was due to the fact that the squares which make up the picture are arranged in 50 rows, one on top of the other. As the eye became accustomed to looking at the screen in the darkened room the face was easily recognisable, although the features, which had been sharp and distinct on the miniature screen for individual use, had become considerably blurred by the enlargement.

It was plain that, enlarged to the size of an ordinary motion picture film, the detail would have been completely lost. The invention is admitted to be far from the motion picture-house stage.

The images reproduced upon the small screen have been described as being comparable to excellent daguerreotypes which have come to life and started to talk. In these small pictures the detail of the face appears in clear-cut black lines against a shining gold background, which is due to the orange light from the neon tube which is used in reproducing the small images.

During this demonstration the pictures were projected only one way—from Washington to New York—it having been considered unnecessary for the purpose to establish two-way television-telephone communication, but there is no technical reason why this could not have been done had it been so desired.

Television by Wireless.

Following the wire demonstration between New York and Washington the visitors were entertained to a repetition of the experiments, the transmission on this occasion being by wireless from the company's experimental station, 3XN, at Whippany, N.J., about 30 miles from New York.

The first face to appear upon the screen was that of an engineer, who gave a technical description of what was taking place. Next came a vaudeville act by a comedian, followed by a regular radio programme item—a short humorous dialect talk by a lady. Before and between the acts the announcer of the Whippany studio made a television appearance during announcements.

An important feature of these demonstrations was that there was no difference in the quality of the reproduced image, whether it was transmitted from one end of the laboratory to the other, by wire from Washington, or by wireless from Whippany.

The engineers responsible for this latest scientific development are well aware, and have made no secret of the fact, that one of the serious problems in perfecting the invention for general commercial use is that of cost. For the purpose of the demonstration on April 7th,

Mr. W. S. Gifford, President of the American Telephone and Telegraph Co., talking from New York to Secretary Hoover in Washington. The image of Mr. Hoover's face appears on the small framed screen. Behind Mr. Gifford is Dr. Ives, who was mainly responsible for the development of the system.

when Secretary Hoover in Washington was seen and heard in New York, *nearly 1,000 men* were required.

Furthermore, the transmission of television requires the use of a large group of frequencies, and the transmission of these frequencies requires a considerable number of ordinary telephone circuits.

In the case of the transmission of television by wireless, utilising the system under review, one wavelength is used for sending the picture and two for the synchronisation process. Dr. Ives himself emphasised the difficulty here, in view of the congested condition of the ether.

No new principles are involved in this latest television development; many old principles have simply been applied under the guidance of recently acquired scientific knowledge. Principal in all this has been the knowledge obtained during the past few years in the research and development which has made it possible for the American Telephone and Telegraph Co. to augment its national

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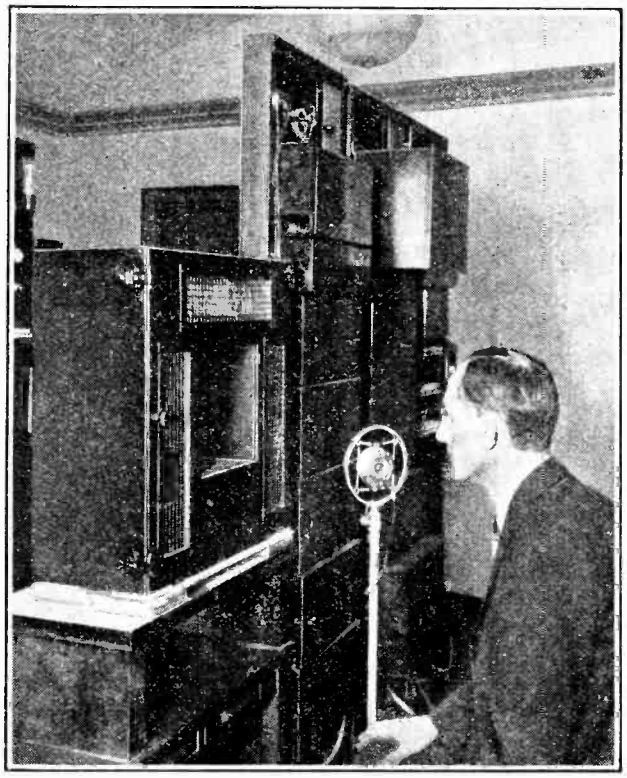
telephone service by a transcontinental phototelegraphy service.

The methods and apparatus used for this service have already been described in the pages of this journal by the present writer.[1]

Television and the transmission of pictures by wire or wireless have many points in common. In an electro-mechanical system of picture transmission it is not possible to send the entire picture at once; it has to be sent over the circuit, or through the ether, piece by piece. Similarly, in television, the scene to be transmitted must be carried over the transmission circuit bit by bit, and the



General view of the television transmitting apparatus. The light beam is projected from the square aperture in front of the sitter, the reflected light being picked up by three photoelectric cells mounted behind grilles inside the cabinet. In the background may be seen the associated amplifiers.

received picture recreated bit by bit. In the case of television, however, and in contrast to phototelegraphy, the details transmitted must follow each other so rapidly that to the eye and brain of the observer at the receiving end the effect will be that of seeing the scene reproduced as a whole, complete with natural movement.

This effect is rendered possible of achievement by what is called retentivity of vision, which means that the eye retains for an instant the impression of an object which it has seen after the object itself has been withdrawn from the actual field of vision.

Broadly speaking, the apparatus for television consists, first, of an electro-optical device, substituting for the eye, which "looks at" the scene to be transmitted. Viewing a small portion of this scene at a time, it transforms the variations of light and shade which it "sees" into variations in the strength of an electrical current.

The next factor is the transmitting medium, which may be either a wire or a wireless circuit. The third factor is the receiving apparatus by means of which the variations of current may be transformed back into terms of light and shadow, and the picture thus reconstructed piece by piece.

The fourth and final factor is the apparatus used to keep the sending and receiving mechanism in step.

The Transmitting Mechanism.

An essential feature of all television transmitters is that the scene to be transmitted must be illuminated. The intensity of the illumination depends largely upon the sensitivity of the light-sensitive device used to transform the light impulses into electrical impulses.

With all systems so far developed it has been customary to flood the entire scene with light, and this light, in most cases, has had to be so intense as to cause considerable discomfort to any person facing it.

The intensity of the light has had to be made so great because, when an alkali photoelectric cell is used as the light-sensitive device, its response to light impulses is extremely feeble, the output requiring enormous amplification before it will perform the work required of it.

It must be borne in mind that the light which reaches the cell is *reflected* light, and some idea of the feebleness of reflected light may be obtained from the calculation of one scientist who estimates that, if the human face is illuminated with a 1,000 c.p. lamp, the total amount of light reflected from it will scarcely amount to *one* candle-power.

In the matter of intense illumination the television system under review is no exception. Photoelectric cells are used to transform the light impulses into electrical currents, and a very intense illumination is employed, which is provided by means of arc lamps.

Unlike other systems, however, the scene to be transmitted is not constantly flooded with this great light. Between the arcs and the scene there is interposed a revolving disc which has drilled in it, near the circumference, a series of small holes which form a single spiral. Through these holes there shines, at any given moment, only one single spot of light.

The rotary action of the disc causes this spot to travel from left to right across the scene or individual to be transmitted, then the next hole, set a trifle nearer the centre of the disc, allows another spot of light to pass through, which travels across the scene on a parallel track, but a trifle lower down than did the last one. As the disc continues to rotate, this action continues till the entire scene has been covered, or "explored."

The Photoelectric Cells.

The disc rotates so rapidly that the whole scene or object is lighted up, a little spot at a time, in less than a fifteenth of a second. There are fifty holes in the disc, so that the scene has fifty illuminated lines traced across it.

By this method an intense illumination of the sitter can be obtained without undue discomfort. All that can be

[1] *The Wireless World*, April 27th, 1927.

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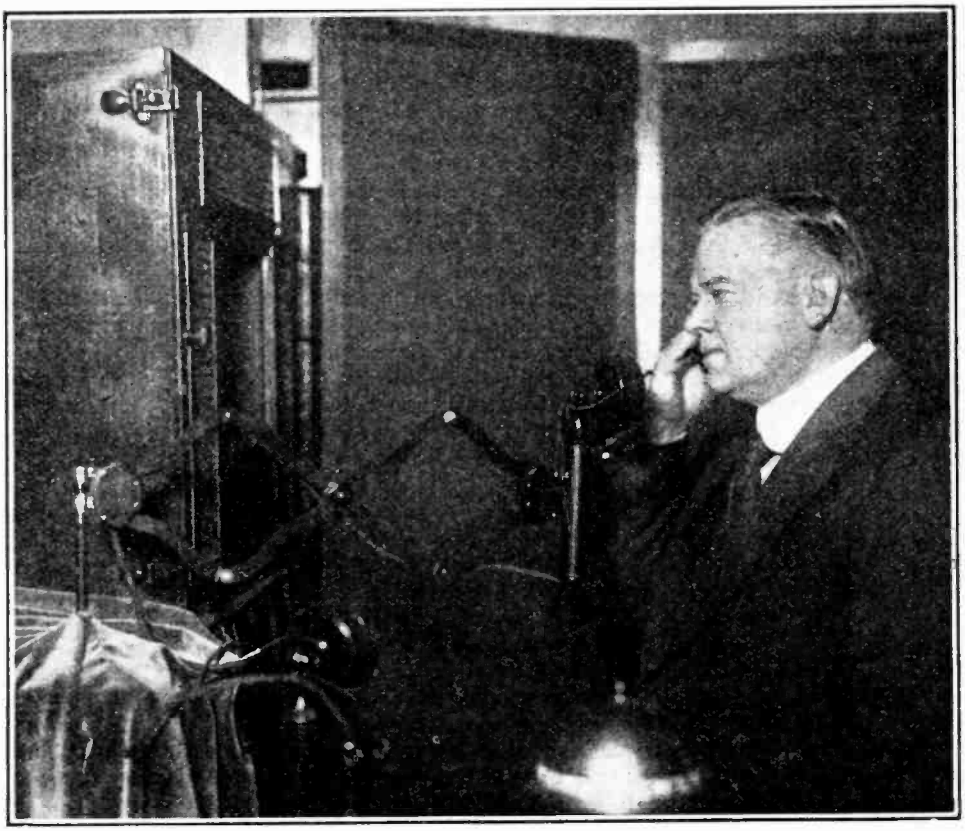
seen is a flickering spot of light which crosses and recrosses the sitter's face at an incredible speed. Even when using this method of illumination, however, it is said that the sitter begins to feel discomfort after a few minutes' exposure to the intense light spot.

The lines, contours, and colours of the face of the sitter cause variations in the degree of brilliancy of the spots of light they reflect, and these, in turn, cause a similarly varying effect when they strike the photo-electric cells.

In the photograph on page 682 is shown a close-up of the transmitting apparatus. The backs of the panels upon which are mounted the associated amplifiers can also be seen.

The light spot which covers the scene to be transmitted shines out from the cavity in the middle of the box-like arrangement before which the figure is sitting. Around this cavity, behind the metal screens, are placed three huge photoelectric cells. In the photograph in the title of this article Dr. Ives can be seen holding one of these. They are probably the largest photoelectric cells ever made.

The ability of these cells to conduct electricity varies in direct proportion to the light falling upon them. As any particular part of the object is illuminated by the travelling spot of light, the fluctuations of current thus produced are transmitted, after amplification, to the receiving apparatus.



Secretary Hoover before the television transmitter in Washington.

As has already been explained, the total amount of light reflected from a human face is very small indeed. Coupled with this there is the well-known fact that the electrical output of a photoelectric cell is extremely minute, and requires considerable amplification before it can be utilised to operate a circuit. The current which was sent out by radio at Whippany, for example, had to be amplified 5,000 million million times before it was broadcast from the antenna!

Increasing Sensitivity to Light.

Hence the reason for such large cells. Three are used in parallel, partly to augment the total response and partly to secure the effect, by virtue of their arrangement, which would be obtained if the sitter were flooded with light from three directions—from above, from the right, and from the left.

As each detail of the sitter is illuminated, the photo-electric cells instantly respond, initiating a current proportional to the light reflected to them, and hence proportional to the light and shade of the particular detail. As the beam of light swings across the scene, working its way from top to bottom, the current from the cells varies correspondingly.

So swiftly does the beam sweep the scene that the current variations are wide and rapid—sometimes corresponding to a change from a maximum current to a minimum and back to a maximum in a twenty-thousandth of a second. These variations, the so-called alternating current components, comprise the electrical impulses which are transmitted to the distant receiver. The speed of signalling is therefore about 20,000 per second.

At the Receiving End.

Two forms of receiving apparatus have been developed. In both forms of receiver a neon gas tube is an important element. Such tubes, which the reader has no doubt seen used in advertising display devices, are hollow glass vessels in which the air has been replaced by neon gas at a very low pressure. Electrical discharges passing through such a tube cause it to glow, the brilliance of the light being directly proportional to the strength of the current.

It will at once be appreciated that, in regard to the relation between light and electricity, the properties of a neon tube are exactly opposite to those of a photo-electric cell.

In the apparatus for use by a single individual a small

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neon tube is used, and the entire tube glows in accordance with the strength of the current being received from the transmitting station at any particular instant.

Between the tube and the observer, who looks through a small aperture about two and a half inches square, there is interposed a disc exactly similar to the one at the transmitting station, rotating in step with it. The result is that the observer sees at successive instants successive portions of the field of view, each of which is illuminated by the glowing neon tube, the brilliance of which is constantly fluctuating.

So rapidly is the scanning of the field of vision carried out that the observer's sensation is that of seeing the scene as a whole recreated just as it appears at the transmitting apparatus. What the observer would actually see if the mechanism were suddenly stopped dead would be a tiny spot of light, admitted to his line of vision through one of the holes in the disc. At each instant the position of this spot of light is caused to correspond to that of the detail of the scene at the sending end.

The entire scene, in successive details, is thus reproduced for the observer, and the complete process of reproducing in proper order the light details of the scene occupies less than a fifteenth of a second. It is then automatically repeated, so that the observer views the complete scene fifteen times per second, which, due to retentivity of vision, gives a motion picture effect.

The Large Screen.

For the presentation of the image to a large audience a different method must be employed. Instead of using a relatively small neon tube, successive portions of which are viewed at successive intervals, a very long tube is employed which is folded back and forth upon itself to form a grid. A near view of one of these grids, taken during the pumping process, is shown on page 685.

The tube is bent into fifty loops, corresponding with the number of holes in the scanning disc at the transmitting end. Instead of being fitted with a single pair of electrodes, like the smaller tube, this grid is equipped with 2,500 electrodes, fifty per loop. Each electrode corresponds to a single elemental area of the picture plane which is scanned by the photoelectric cells at the sending station.

These electrodes are connected by wires to a distributor which, in turn, is connected to the circuit coming from the transmitting station. The distributor revolves in exact synchronism with the rotating disc at the sending end.

When a particular spot on the object at the sending end is illuminated, its position and light intensity are transmitted, in the form of an electrical impulse, to the receiving station, as has already been described. In this case, however, the distributor selects the proper connection with the neon tube and lights a spot on the grid corresponding with the spot on the original scene, the illumination of which set up the impulse.

Only one spot on the grid is illuminated at a time, but these glowing spots follow each other with such rapidity that the audience sees the entire grid lighted up, its degrees of illumination corresponding with those of the original scene, thus producing a complete picture before the eyes of the spectators. The grid may be viewed directly or through a screen of ground glass or other translucent material.

The distributor consists of a brush contact which is revolved in synchronism with the scanning disc at the sending end. This brush, as it revolves, makes contact with a commutator arrangement, composed of 2,500 segments, to which the leads to the neon tube electrodes are connected.

Each segment picks up from the rotating brush the appropriate electrical impulse intended for it, and conducts it over the connecting wire to the appropriate electrode on the grid. To each one of the 2,500 wires 15 impulses per second must be delivered. The most minute error would scramble the portrait completely.

Synchronism.

The question of synchronism is of vital importance in any television system. The mechanism at both the transmitting and receiving ends of the circuit must run exactly in step. In this latest system dots of light are put together at the rate of about 45,000 a second to give the effect of a motion picture. Each dot has to be in its exact place.

The mosaic of dots, or picture elements, would be a jumble—the picture would be completely "pied"—if there was an error of 1-90,000th part of a second in the synchronisation between the sending and receiving apparatus.

The moving parts at each end of the circuit are driven by exactly similar motors, and, to ensure steadiness, two motors are used at each end. One of each pair of motors is a "synchronous" alternating current motor, the function of which is to control the speed of the main driving motor.

The main motor operates at a frequency with which complete images of the scene can be formed. To prevent this motor from "hunting," that is, from varying slightly in speed alternately above and then below that corresponding to 18 cycles per second, the second and smaller motor assists the drive.

This synchronous motor, operated at 2,000 cycles, in the range of telephonic rather than power frequencies, ensures that the rotating mechanisms at the two ends of the system shall not be out of step with each other by more than the amount represented by half of one of the small holes in the disc. This corresponds to an interval of time of 1-90,000th of a second.

The two motors can be seen, together with the transmitting scanning disc, in the photograph on the front cover of this issue. The main drive motor is on the right, and the control motor on the left, close to the disc, the control mechanism being in the centre.

Success the Result of Co-ordinated Research.

The successful development of this system of television is not the isolated work of any one man; as already stated, many engineers took part in the necessary researches, and their method of attack and the record of progress forms an interesting story in itself.

Dr. Ives, who was put in charge of the work, has many outstanding achievements to his credit, amongst them being the first practical lamp for producing artificial day-

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light. Throughout his career his researches have many times touched upon photoelectric cells and their various uses, and to him is due the work upon photoelectric cells in connection with the development of television.

Prior to commencing work upon television, Dr. Ives was engaged upon phototelegraphy, and it was he who developed the system which is now in daily use by the American Telephone and Telegraph Co. for the transmission of commercial and Press pictures to all parts of the United States.

This method of directing the research attack to the elemental phases of the problem is illustrated by the investigation of methods for producing currents in response to light variations and lights in proportional response to currents.

This was separated from the other investigations (such as those of methods for synchronisation and of the characteristics of transmission channels) by driving on the same shaft the scanning disc and the similar disc for reproducing, and thus operating the transmitting and receiving equipment in close proximity.

In a later form of experiment a stage of final accomplishment was reached which might seem to have justified publication, but was withheld therefrom as being only a step in the research programme.

Cinematograph Films Transmitted First.

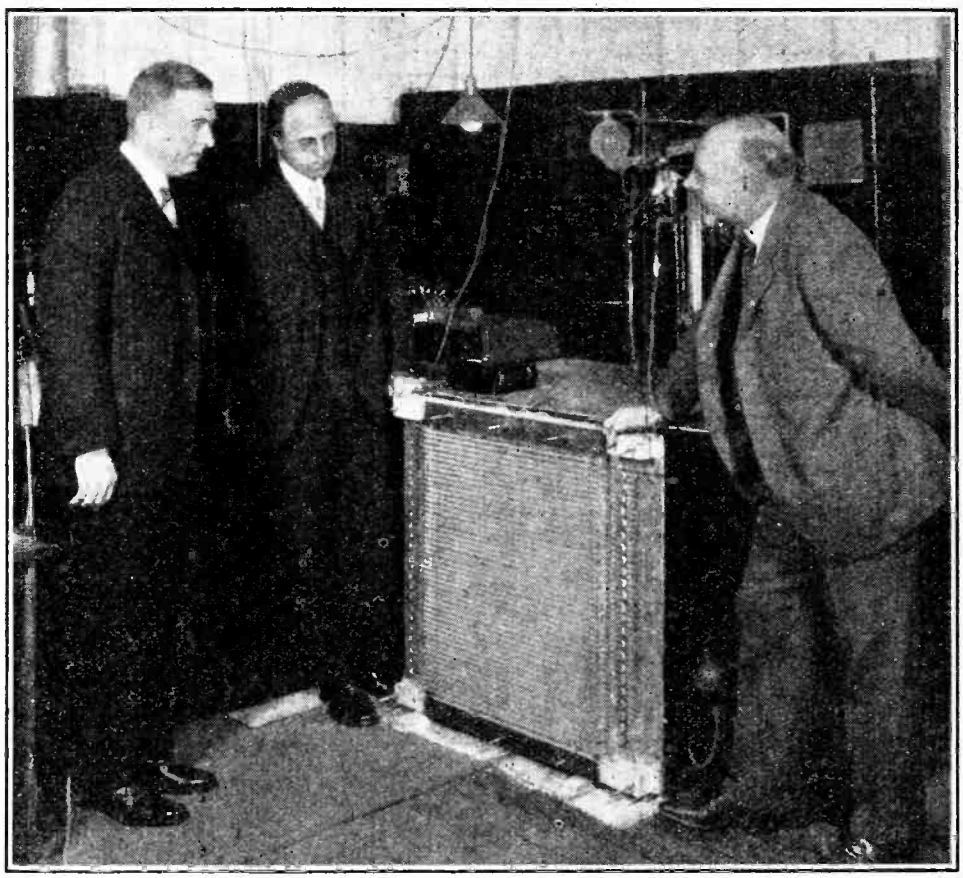
In this experiment a strip of motion picture film was projected from a standard projector upon a photoelectric cell, and the moving picture of this film was then recreated for an observer by means of a receiving equipment involving the use of a suitable neon tube and a scanning disc as already described earlier in this article.

This apparatus eliminated the problem of the illumination of the scene, for the photoelectric cell was influenced by directly transmitted light, which could be made as powerful as desired. This line of experiment thus permitted concentration on the other phases of television. Its adoption facilitated very much the study of synchronous motors, which were then developed under the direction of Mr. H. M. Stoller, whose work has for many years been connected with the exact regulation of the speed of electric motors.

To the apparatus for talking motion pictures, known as the Vitaphone,[1] Mr. Stoller contributed the speed-control and synchronising devices, embodying the first commercial application of the thermionic valve for speed regulation. This method has a much higher precision than any other.

The Development of Scanning Devices.

One of the next developments was that by Dr. F. Gray, a member of the technical staff of the Laboratories, who had previously been responsible for certain early forms of the experimental apparatus. He devised the method of projecting a minute spot of very intense light upon the object to be transmitted, and of moving this spot back and forth to illuminate successively the details of the entire area.



Large-size screen used for demonstration purposes. It consists of a continuous glass tube containing neon gas into which 2,500 electrodes are sealed at the back. The photograph shows a screen grid in process of pumping.

Following the development of this method, Dr. Ives constructed and arranged the large photoelectric cells which have previously been described.

Other phases of the research problem were met in the development by Dr. Gray of the large neon tube for the production of an image large enough to be viewed by a considerable audience, and the development and use of such a tube, with its present total of 2,500 external elec-

[1] See "Wireless and the Gramophone," *The Wireless World*, Sept. 15th, 1926.

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trodes, required the development also of the current distributor from which 2,500 wires, like a gigantic optic nerve, extend to the tube.

Dr. Gray is responsible also for the application to television of the basic principles of amplifier design.

As the terminal apparatus approached its present form there were studied other problems which were to be encountered in the transmission of the light-generated and synchronising currents over great distances, both by wire and by wireless. To transmit an image formed by 2,500 elements requires a channel capable of carrying without distortion the entire range of frequencies from 18 cycles per second to about 20,000 cycles per second. In order to give a high-grade telephone line such an extended characteristic, special equipment for the equalisation of attenuation and of phase shift had to be devised.

Similar problems in radio equipment were also solved by new designs and adaptations arising from the underlying researches, and these developments of wireless equipment resulted in an operative radio-television system of equal reliability to the wire-connected system.

When, according to the most conservative judgment of the scientists concerned, and of the Laboratories' executives, the experiments had progressed far enough to assure operation over long distances both by wire and by wireless, field experiments were undertaken, and these experiments finally led up to the successful public demonstration of long-distance television described at the beginning of this article.

MR. A. W. WATT, the Editor of "Radio in Australia and New Zealand," has kindly sent us a list of amateur stations corrected to December 31st, 1926. Space does not permit us to reproduce this in full, but we give below the stations which are not included in the R.S.G.B. Diary and Log Book, and any alterations and corrections in addresses published therein.

Amateur Stations in Australia.

COMMONWEALTH OF AUSTRALIA.

New South Wales.

2BA	Trawler "Bar-eu-Mal," Red Funnel Fisheries, Ltd., Killara.
2BC	N. J. Hurll, Northcote Ave., Killara. (Dealer.) (Change of address.)
2BR	Trawler "Brolga," Coastal Trawlers Co., Goldsborough Chr., Sydney.
2DN	G. E. H. Blanchard, 47, Foord Ave., Hurlstone Park. (Change of address.)
2FG	F. Gibbons, 64, Thrupp St., Neutral Bay.
2FK	F. Welch, 1, Augusta Rd., Manly.
2HC	H. R. Carter, The Armidale School, Armidale.
2HH	H. H. Davis, Torrington Rd., Strathfield.
2HT	H. K. R. Thomas, Strathearn, Murdoch St., Neutral Bay. (Change of address.)
2JB	P. J. Browne, 131, Avoca St., Randwick.
2LL	L. S. Lane, "Narbeth," The Avenue, Randwick. (Change of address.)
2LM	L. M. Wilson, 6, Kalima Flats, Reginald St., Cremorne. (Change of address.)
2LY	R. H. Shaw, 129, Grafton St., Woollahra.
2NO	D. B. Knock, 102, Cremorne Rd., Cremorne.
2PS	P. G. Stephen, Mona St., Granville. (Dealer.)
2RC	R. Chilton, c/o J. E. Sleemer, Gloucester. (Corrected address.)
2RE	R. M. E. Rees, 83, Northumberland Ave., Stanmore.
2RM	R. A. Macfarlane, Wakalen St., Griffith.
2RV	R. V. Thomas, 18, Plowman St., N. Bondi.
2SA	W. E. Salmon, Polchu, Cor. Park Rd. and Olympia St., Naremburn.
2SH	A. Short, Young St., Lambton.
2SM	H. W. S. Caldecott, 52a, Quinton Rd., Manly.
2UI	Illawarra Radio Club, 75, Montgomerie St., Kogarah. (Change of address.)
2WK	W. D. Kennedy, 16, Mabel St., Willoughby. (Change of address.)
2XT	Austr. Made Preference League Ex. Train, 28, Martin Place, Sydney.
2ZU	N. S. Gilmour, 101, Wycombe Rd., Neutral Bay. (Change of address.)
2ZY	N. Wollett, 33, Wolseley Rd., Mosma.

Victoria.

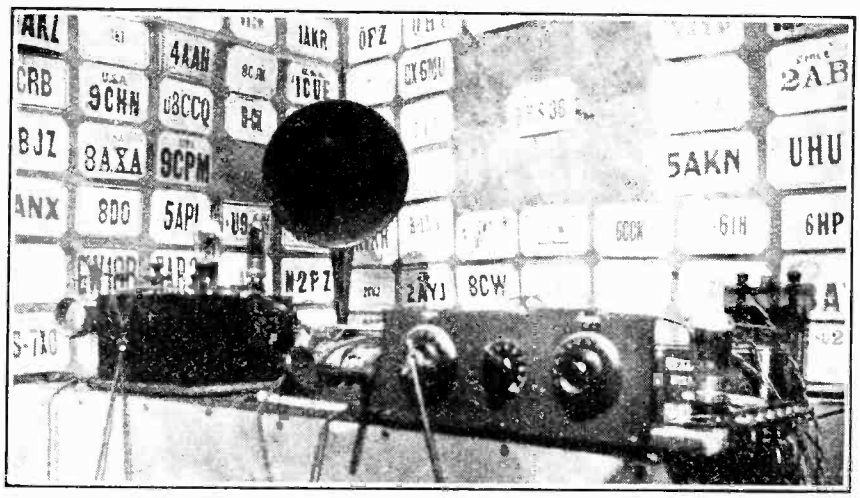
3AD	J. A. Davey, 28, Cole St., Elsternwick. (Change of address.)
3AH	A. H. Faul, 3, St. Leonards Ave., St. Kilda.
3AL	H. D. Kerr, 1214, Sturt St., Ballarat.
3AM	A. Forecast, 22, St. George's Rd., Malvern.
3AU	S. H. Milligan, Allawah, Nicholas St., Chilwell. (Change of address.)
3CH	H. C. Harris, Sherwood St., Birchip. (Dealer).
3CI	Cliffy Island Lighthouse.
3CK	Ernest Cook, Glenhope, Tresco.
3DA	R. S. Dawson, 23, Kensington Rd., South Yarra.
3DB	Drewliegh Business College.
3EM	H. W. Doudney, 7, Dickens St., Baladava.
3ER	E. H. W. Read, 147, Lygon St., East Brunswick.
3FA	Nerang Motors, Scoresby St., Kerang. (Dealer.)
3GG	G. A. Gamon, 201, Page St., Mid. Park. (Change of address.)
3GN	H. G. Selman, 35, Queen St., Geelong West. (Change of address.)
3GS	G. S. C. Semmens, State School, Queenstown. (Change of address.)
3HR	A. H. Reid, 3, Kingston St., East Malvern.
3JG	Jones & Glew, 122, Toorak Rd., Camberwell. (Dealers.) (Change of address.)
3JS	J. Schultz, 24, York St., Glenferrie. (Change of address.)
3KM	D. Kerr and Muir, Ltd., 241, Bay St., North Brighton. (Dealers.)
3KN	R.A.A.F., Victoria Barracks, St. Kilda Rd., Melbourne.
3LD	Deal Island Lighthouse.
3MH	M. H. Stuart, 571, Mt. Alexander Rd., Moonee Ponds.
3ND	Police Patrol Car No. 1, Melbourne.
3PD	Police Dept. (H.Q.), Russel St., Melbourne. (Special.)
3PX	N. S. Taylor, 24, Dalgety St., St. Kilda.
3RI	Railways Inst. Wireless Club, Flinders St., Melbourne.
3TM	A. H. Buck, 7, Carrington St., Glenferrie. (Change of address.)
3TR	W. S. Treagear, 22, Cole St., Upper Hawthorn.
3UI	R. M. Dalton, 105, Murray St., Caulfield. (Change of address.)
3WX	W. Cavanagh, 22, Mary St., St. Kilda.
3XW	C. A. Cullinan, Bayview, Digger's Rest.

Queensland.

4AC	A. C. Walker, Oxford St., Sandgate.
4AW	A. E. Walz, Cor. Eton St. and Sandgate Rd., Nundah.
4BD	D. D. Grimes, Farragindi Rd., Annesley.
4BM	A. B. Milne (Milrose Motors), Mackay. (Dealer.)
4CR	C. F. Rich, London Bay Missionary Stn., Fife Bay, Papua.
4CW	A. T. Buck, Geebung, North Coast Line.
4HL	H. L. Miller, Cor. Ryan & Hoogley Strs., Hill End, Brisbane.
4HW	H. D. Walsh, Vailima, Toorak Hill, Hamilton.
4LG	The Grand, S.W., 7th Ave., Windsor, Brisbane.
4LJ	L. J. Feenaghty, Dickson St., Wooloowin.
4MC	M. J. McPherson, Merinda, via Bowen.
4RG	H. J. Stephenson, Thorold St., Wooloowin.
4SM	W. G. Ikin, River Rd., New Farm, Brisbane.
4WE	W. E. Vining, Brickland Rd., Nundah.
4WR	H. D. Walsh, Dickson Terrace, Hamilton.
4YN	D. J. Harkin, 101, Flight R.A.A.F., Bowen.

South Australia.

5AX	A. H. Traeger, Brigalow Ave., Kensington Gardens.
5BG	H. A. Kuiper, 6, Rothbury Ave., Tusmore. (Change of address.)
5BR	Blackwood Radio Club, Waite St., Blackwood. (Change of address.)
5JA	P. J. Brewer, 21, Douglas St., Parkside.
5SA	E. R. Turner, 10, Godfrey Terrace, Leabrook.
5SR	South Suburban Radio Club, Castle St., Parkside.
5WI	Wireless Institute (S.A. Division), 6, Bakewell Rd., St. Peters. (Change of address.)
5WP	W. S. Pitchford, 318, Wakefield St., Adelaide.
5WS	West Suburban Radio Club, 44, King St., Mile End.



Receiving station, BRS-38, owned by Mr. B. C. Bedwell at 204, Swansburst Lane, Mosley, Birmingham. On the left is a straight-circuited 0-v-1 receiver with a tuning range of 140-4,000 metres, and on the right a short-wave 0-v-1 Reinartz with a range of 15-200 metres.

HINTS and TIPS for NEW READERS

A Section Devoted to the Practical Assistance of the Beginner.

HIGH-MAGNIFICATION VALVES IN AN H.F. AMPLIFIER.

Although the majority of up-to-date H.F. transformers are designed to work in the anode circuit of a valve having an impedance of the order of 20,000-30,000 ohms, it is possible, as has already been stated in these columns, to improve selectivity without introducing any great reduction in amplification, by substituting one having an impedance of 50,000 to 70,000 ohms, with a correspondingly increased amplification factor. Before making this change, however, there are one or two points to which special attention should be paid. The grid bias should be reduced, if necessary, to a maximum of 1½ volts negative, although a lower figure is often desirable. The high-tension voltage applied to the plate should be increased to the highest value available, even beyond that specified by the makers.

By observing these precautions it is possible to keep down the actual working impedance to a reasonably low value, with the result that the transformer will be able to extract a good proportion of the available amplified H.F. energy in the anode circuit for transference to the grid of the succeeding valve.

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THE POSITION OF THE FILAMENT RESISTANCE.

The present arrangement of battery connections, in which H.T. −, L.T. − and G.B. + leads are connected together and earthed and the filament resistance placed in the positive lead, became standard some time after broadcasting actually commenced, and has since been accepted more or less without question as being the best, as indeed it is, except under special circumstances.

The advent of the type of valve specifically designed for resistance capacity coupling, however, leads one to doubt whether there is not some justification for altering this arrangement and placing the filament resistance in the negative lead of such valves.

Fig. 1 shows that providing the grid return circuit is taken to − L.T., the grid will be negatively biassed to the extent of the voltage dropped across the resistance. Polarities are marked in the figures to enable the voltage drops to be appreciated.

In this connection it may be borne in mind that the anode current in a valve with a megohm or more in series is so small that adequate emission may be obtained with considerably less than the normal filament voltage. For instance, one would expect a two-volt valve to work efficiently under the above circumstances at 1.5 to 1.6 volts, leaving, say, 0.4 volt for grid bias.

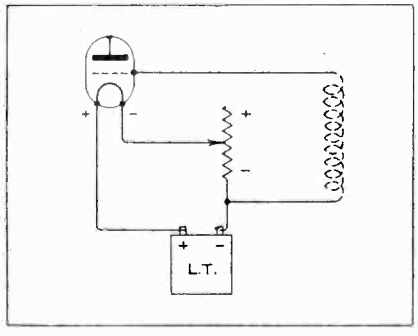


Fig. 1.—"Free" grid bias.

Examination of the static characteristic curve of this type of valve will show that even with 120 *actual* anode volts this bias is as much as can be used without lowering the efficiency of the valve somewhat.

SELECTIVITY.

A knowledge of the fact that the selectivity of a receiver may be improved by increasing the ratio of its capacity to inductance may be turned to good account in the operation of perhaps the majority of receivers. In other words, the combination of a small coil and a large condenser gives a selective circuit. This being so, the beginner may wonder why designers go to the trouble of producing elaborate arrangements when by simply making a suitable change in values the desired results might be obtained. Unfortunately, however, an increase in capacity results in a reduction of H.F. voltage built up across the circuit, and consequently signals will generally be weaker. As to whether this reduction may be tolerated or not will depend entirely on circumstances.

The principle may often be applied with advantage when working the "Everyman Four" receiver on the long waves, for which no H.F. stage is provided, and a direct-coupled aerial circuit is used. Thus there may be interference on the Daventry wavelength from a powerful and near-by short-wave transmitter. To obtain the necessary conditions for maximum selectivity, a small condenser of about 0.0002 mfd. or even less should be inserted in series with the aerial, while the loading coil should be of such a size that the parallel tuning condenser is set nearly at maximum capacity for the reception of the desired station.

The "All-Wave Four" may also be improved in selectivity by judicious choice of coils; when this quality is particularly necessary, both aerial and secondary inductances should be of the smallest size which can be tuned by means of the variable condensers to the wavelength required.

THE BEST EARTH CONNECTION.

The advantage of a good earth connection cannot be urged too often. The best aerial is wasted if the earth connection is poor. The ideal earth consists of a number of good conductors buried just below the surface of the ground and extending under the aerial very much as the roots of a tree extend beneath its branches. Further, the lead from the earth up to the set should be as short and direct as possible. The average water-main earth, though usually giving passable results, is anything but ideal, as it nearly always goes to the street in front of the house, whereas the aerial generally extends backwards at the rear of the house. For this reason there must be many instances where better results could be obtained by burying two or three thick copper wires below the aerial and parallel to it.

Of the various conductors, such as water-pipes, etc., which are found available for earthing purposes, it is impossible to make any general statements as to which is the best, since the course pursued by such conductors varies so greatly in different establishments. The best plan is to take separate connecting wires to the various possible earths and to try them one by one, in various combinations and all bunched together. Indiscriminate bunching together of all possible earths does not, however, invariably give good results, as there are sometimes one or two earth connections which make matters worse instead of effecting an improvement.

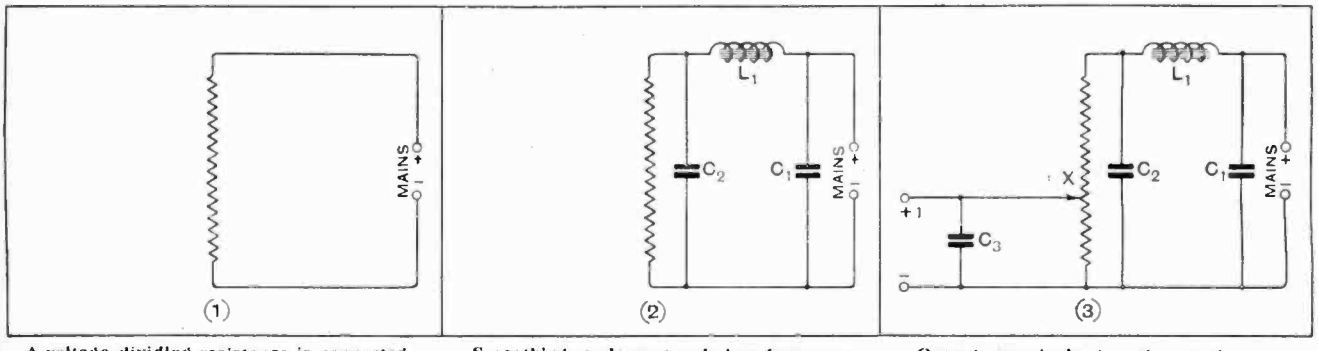
DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 72.—A D.C. High-tension Battery Eliminator.

(To be concluded in next week's issue.)

The present series of diagrams is intended to show progressively, and in an easily understandable manner, the various points to which special attention should be paid in the design of typical wireless instruments, and at the same time to assist the beginner in mastering the art of reading circuit diagrams. The simple H.T. eliminator shown below is intended to operate on direct-current supplies of from 200-240 volts, and will give good results except where there is a heavy "ripple" on the mains current.



A voltage-dividing resistance is connected directly across the mains.

Smoothing condensers and a low-frequency choke are inserted as shown.

Output terminals for the receiver are added, with extra shunt condenser C_3.

THE resistor should be wire-wound, and should have a resistance of about 7,000 ohms, assuming the supply to be in the neighbourhood of 220 volts, and that ordinary valves are to be used in the receiver. About a dozen equally spaced tappings should be provided. Suitable coils are obtainable commercially, or they can be wound with No. 40 Eureka wire, of which about 190 yards will be required. Note that it is advisable to insert fuses in each lead, as close to the main input as possible.

The resistance specified above will pass about 30 milliamps, so the smoothing choke L_1 must carry at least that current without saturation; this is a very important point, as a badly designed instrument may fail entirely in its function of suppressing irregularities. It should also have a low ohmic resistance. The reservoir condensers C_1 and C_2 may have capacities of 2 mfds. each, although a larger size may be desirable; additional parallel condensers should be connected if "hum" is loud enough to be annoying.

In (3) the output connections to the receiver are shown. The voltage applied to the valve will depend on the position of the tap X; this can only be determined approximately unless accurate measuring instruments are available, but it is an easy matter to make a sufficiently accurate adjustment.

Ignoring the resistance of the choke (from a practical point of view it is generally possible to do so) the voltage across the output terminals is proportional to the amount of resistance in circuit, provided that no current is flowing. Thus, if the tap X is joined to the centre point, on a 240-volt supply there will be 120 volts between − and +1. As soon as current is taken, however, there will be a voltage drop in the part of the resistor still in circuit (that between X and the end connected to the choke), so it will be necessary to move up the tap to a position slightly nearer to the positive end.

The condenser C_3 should have a capacity of at least 2 mfds. This value may be found sufficient when a comparatively simple receiver is to be operated, but 5 mfds. may be necessary in certain cases to prevent L.F. oscillation in the receiver.

COIL-DRIVEN LOUD-SPEAKER with Permanent Magnets.

Reducing the Maintenance Costs of Coil-driven Loud-speakers.

By H. LLOYD, M.Eng.

ALL those who have heard an open diaphragm coil-driven speaker will agree that the realistic quality of reproduction obtainable with this type of instrument when operated under the best conditions is of an amazingly high order. Many people are now using or experimenting with this form of sound reproducer, but there must be a very large number who have reluctantly decided that for them, at any rate, the maintenance of such a speaker is out of the question on account of the energy consumed by the field windings. In the days when receivers consumed as many amperes as they possessed valves this additional drain on the accumulator would not have represented a very large percentage increase, but to-day, unless one is among the few who have D.C. supply mains, the prospect of increasing the L.T. consumption perhaps three- or four-fold is naturally viewed with dismay.

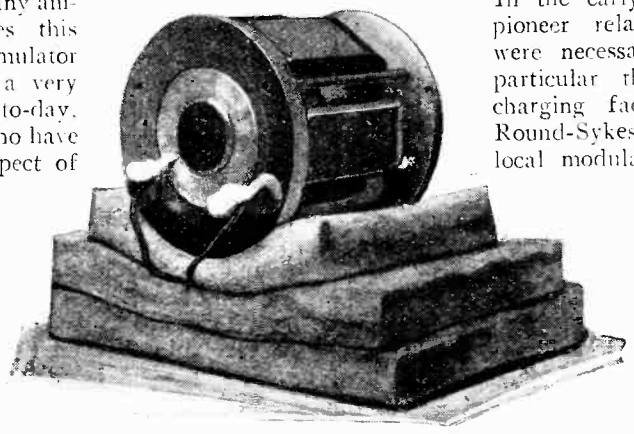


Fig. 1.—Electro-magnetic microphone with permanent magnet field.

In this article the results are given of some experiments that have been made with coil-driven units, which show that quite adequate volume for all domestic purposes can be obtained without any polarising battery. The characteristically high quality of reproduction is maintained, and the input can easily be provided by a medium-power receiver of modern design, such as the "Everyman Four."

High Flux Density Necessary.

The axial force on the moving coil is proportional to the density of the radial magnetic flux in the air-gap of the magnet, and to get the greatest sound output from a given diaphragm assembly the flux density must naturally be made as high as possible. The amount of electrical energy that it is necessary to dissipate in the windings of an electro-magnet in order to maintain this flux depends considerably upon the distance across the gap, but since a rather wide gap, whilst requiring more ampere-turns, at the same time greatly simplifies the mechanical requirements in coil suspension, the electro-magnet generally is arranged to give ample clearance for the moving coil. After all, if polarising current has to be used, it does not very much matter about the expenditure of a few more watts for the sake of greater tolerances in the matter of construction. The prospect of dispensing entirely with the polarising supply, however, alters the question considerably. The speaker immediately becomes a more economical and adaptable instrument; it has only one pair of supply leads, and can, if required, be installed at a distance from the receiver without the necessity for relay devices for cutting off the field current when the set is not in use.

The first attempts made by the writer to substitute permanent magnets for the electro-magnet commonly used in this type of moving coil device were carried out in connection with magnetophones during 1923, whilst in charge of the Sheffield Relay Station of the B.B.C. In the early experimental stages of this pioneer relay station the arrangements were necessarily very primitive, and in particular the pressure on the battery-charging facilities was very great. A Round-Sykes microphone was in use for local modulation purposes, and this was the last straw of the battery load, so the writer decided to try to produce something at any rate approaching the normal flux of 1,500 gauss by means of permanent magnets. Exceptional opportunities were available, owing to the fact that a good deal of special work had been done in Sheffield to produce magnet steels of high coercive force. Several microphones were constructed privately, and fully justified the trouble taken. The output in no case was quite up to that of the battery-excited microphone, but the addition of another D.E.R. valve to the amplifier brought the strength up to standard, and a considerable saving of energy was effected. A photograph of one of the actual microphones is shown in Fig. 1. Later the pole-pieces of one of these magnets was modified to suit the drive-coil of a large pleated diaphragm loud-speaker,[1] but as D.C. "juice" became more easily available this was neglected in favour of the rather more compact electro-magnet.

In order to give an idea of the flux that is necessary for reasonable acoustic efficiency, the curve for a well-known type of electro-magnet unit is reproduced in Fig. 2. This shows the value of "B" in the air-gap of a Magnavox field magnet corresponding to different currents through the windings. With the normal excitation, the flux density is about 9,200 gauss. Reducing the current to 0.75 ampere brings the flux density down to 7,000 gauss, the diminution in sound output as experienced by the ear not, however, being very serious in a room of ordinary size. Field strengths of this order can

[1] *The Wireless World*, Oct. 14th, 1925, and Aug. 4th, 1926.

Coil-driven Loud-speaker with Permanent Magnets.—be obtained with permanent magnets of not too bulky dimensions, and at a cost which is not excessive when it is considered that there is no maintenance charge. Steels of the cobalt-chrome series have been used for the magnets in preference to tungsten steel on account of the saving in weight and dimensions, and in Fig. 3 is shown one of these magnets applied to a coil-driven speaker unit. Quite sufficient volume is obtained from this instrument for comfortable listening in a moderately sized

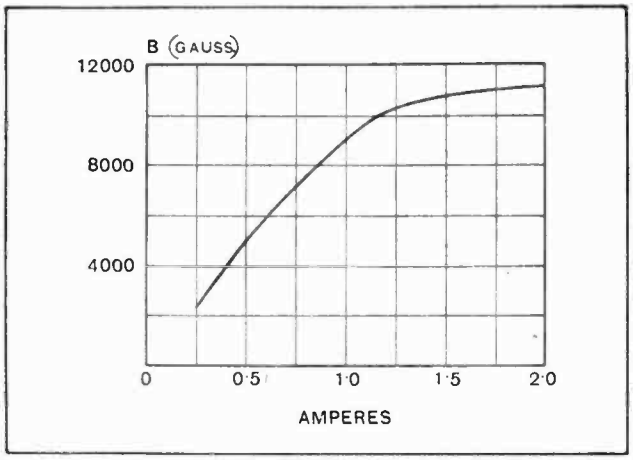


Fig. 2.—Variation of flux density with polarising current in air-gap of Magnavox loud-speaker.

room, using a receiver with a 3,000-ohm valve in the last stage, and 120 to 150 volts H.T. Modern gramophone records are also very pleasingly reproduced, using an electro-magnetic pick-up. The six magnets, one of which is shown separately in the photograph, are of the same shape as those used in the microphone, being bent, heat treated, and ground accurately to fit the pole-pieces. Fifteen per cent. cobalt steel was used, the 35 per cent. cobalt steel not showing sufficient advantages to justify the extra cost. The cross-section of each piece is 3.8 cm. × 1.1 cm., giving a total flux of 130 kilolines at the $(BH)_{max}$ point. A good deal of this is manifested as leakage field, but with the length of air-gap reduced to a minimum there is sufficient useful flux for the purpose for which this speaker is intended. As a basis of comparison for different magnets, the product $(B \times \pi D)$ was taken as a figure of merit, representing the force on a one-turn coil of diameter D centimetres. Thus for the Magnavox magnet normally excited the figure of merit was 57,700, whilst for a current of 0.75 ampere it was 43,600. The permanent magnet just described was found on measurement to reach 38,800. The length of air-gap (distance between pole-pieces) in this case was 0.14 cm. of 0.055″, and the clearance between the moving coil and the pole-pieces, inside and outside, was but 10 mils.

Coil Suspension.

To prevent the coil during its excursions from being able to come in contact with the magnet, it is necessary when using such small clearances to employ some form of suspension for the coil in addition to the usual diaphragm suspension of washleather or stockinette. This suspension must apply a minimum of constraint on the movement, and must not be of such a nature as to introduce resonance effects appreciable to the ear. Fig. 4 is a rear view of the movement of the speaker referred to above, with the magnet removed to show the method of centring the coil. The boss of the aluminium casting to which the magnet is bolted carries three attachments arranged at 120°. The two upper ones each consist of a short strip of brass slotted, drilled, and tapped 8B.A. to take a screw through the end of which is a small hole. The lower one is a similar sized strip, but of thin spring steel, again with a small hole drilled through it near the end where it overhangs the slot in the aluminium. In the coil former, near the point of junction between the former and the diaphragm, there are three small holes about $\frac{1}{32}$in. diam. so located as to be opposite the three attachments mentioned. Three threads of thin machine-silk are passed through these holes, each thread being passed through two holes, and each pair of ends coming out from the former are threaded through the small hole in the adjacent centring attachment and secured with a spot of melted wax. Reference to the figure should make this clear; the threads are drawn only just taut, the weak spring at the bottom applying ever so slight a tension. If on plucking the threads with a pin the diaphragm is caused to emit a decided note due to the vibration of the silk, the tension should be reduced by letting out a little more thread or by weakening the spring. After this adjustment is satisfactorily made the suspension is completed by serving the threads with a coat of rubber solution, especially at the points where they pass through the coil former.

With regard to the coil former itself, when this has to be very thin the best material seems to be mica, built

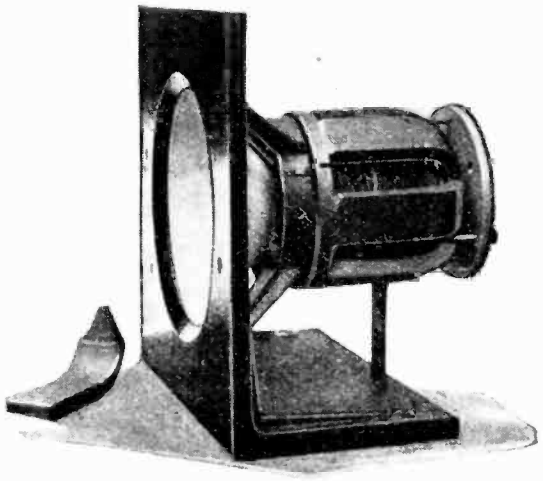


Fig. 3.—Complete loud-speaker unit. On the left is shown one of the magnet elements.

up to the required thickness from strips split down to a thickness of about 1 mil. A few inches of brass rod or tube is turned up truly cylindrical and polished, its finished diameter being about 6 mils less than the internal diameter of the coil former to be constructed. One end of the brass should be faced up square so that it may be used as a guide for the blade when trimming

Coil-driven Loud-speaker with Permanent Magnets.—

up the finished coil. The brass is heated to about 100° C., and one or two layers of paraffin waxed tissue paper are wound tightly on it and bound with cotton to keep the paper in position until the wax has cooled. After removing the cotton the diameter is checked, and if correct the winding of the mica strip is commenced. About four layers will generally be required, and they are wound as tightly as possible, filtered shellac varnish being used to hold the layers together. A binding of cotton should be put over the mica when the proper thickness is reached, and about 24 hours allowed for the preliminary hardening of the shellac. Before proceeding with the winding it is well to build up the portions of the former which will not be carrying wire up to the same height as the wire will occupy. This will further strengthen the former, at the same time supporting the end turns of wire during and after winding. Strips of paper, accurately cut, and stuck round the mica with thick filtered shellac, are suitable for this. In the coil illustrated the former is $\frac{3}{8}$in. in length, and the paper collars at each end are respectively $\frac{5}{32}$in. and $\frac{1}{32}$in. in width, leaving a winding length of $\frac{3}{16}$in. When the winding—which should be of enamel-covered wire to preserve a high copper space factor—is finished a final coat of varnish is given to the coil and the whole thoroughly baked. The effect of this will be to melt the wax underneath the mica, and no difficulty will be experienced in removing the coil from the brass tube. It is convenient at this point to trim the ends of the coil former with a razor blade, using the faced end of the brass tube as a guide for the blade.

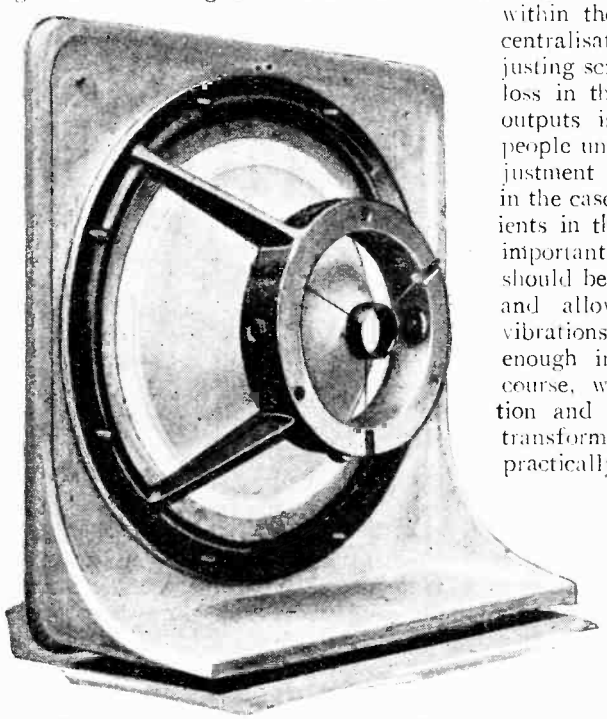


Fig. 4.—Rear view of loud-speaker with magnet removed showing moving-coil suspension

From Fig. 4 it will be seen that the flexible leads from the coil are brought to terminal sockets fitted in insulating bushes in the casting. The leads consist of short lengths of 3/40 Litz wire, bound tightly to the coil former with silk thread, and carefully soldered to the ends of the coil winding. Vibration between the strands of the Litz is damped by painting it with rubber solution.

Constructing the Diaphragm.

A few words in connection with the diaphragm construction may be of interest to those readers who have experienced difficulty in turning out a really presentable job with a professional air about it. Do not use the heavy grades of cartridge paper; thin drawing paper gives better results and is easier to handle. The edges which overlap to form the radial joint should be shaved down with a safety-razor blade to a feather edge, so that there is not a thick lump of paper at the seam; a little practice on some scrap pieces of paper will enable a joint to be made which is difficult to discover with the eye. In the opinion of the writer, Seccotine, though excellent for attaching the edge suspension and coil former, is not so suitable for the seam as a form of mountant such as Higgins' or Grip-fix. Before applying the adhesive the symmetry of the finished cone is improved by drawing the paper upwards with a curved sweeping motion from beneath the edge of a ruler held firmly down in contact with the table top. This gives the paper a bias in the direction in which it has to bend, and prevents the tendency otherwise present for the joint to pull apart during drying. In the speaker illustrated the central portion of the cone has been left open. The reason for this is so that the position of the moving coil within the air-gap can be seen, and centralisation by means of the adjusting screws easily carried out. The loss in the low register at moderate outputs is very small and to most people unnoticeable, although the adjustment never needs attention except in the case of accidents through transients in the moving coil. It is very important that the entire moving mass should be very free; when displaced and allowed to return freely the vibrations should be almost low enough in frequency to count. Of course, when the magnet is in position and the coil connected to the transformer the movement will be practically dead-beat.

Straight Bar Magnets.

The magnet generally used with the movement shown in Fig. 4 employs L-shaped strips of cobalt steel, but straight bars may be used with success. In Fig. 5 are shown the dimensions of a magnet assembly giving equivalent results to the above type, whilst reducing to a minimum the machining to be done on the actual magnet steel. Machining on this steel, even in the annealed condition, is difficult, and in any case the finishing has to be done by grinding after hardening, so that the avoidance of machining justifies the apparent complication of the clamping arrangements. The bars are of standard commercial rolled section, heat-treated and machine-ground flat on one face, and can thus be obtained ready for use from the makers of the steel. The two end yokes and the central core are of soft iron, the lower yoke being bored to take the core, whilst the upper one is recessed and fitted with a brass bush. This holds the core pole-piece central, and is secured to the core by two grub-screws sunk in holes tapped through the yoke and bush; one of these can be seen in the sectional view. The magnet clamps are small brass castings, drilled to slide on 0B.A. studs screwed into three of the corners of each of the hexagonal yokes. The earlier yokes were carefully slotted with the idea of reducing eddy currents in the pole-faces, a precaution recently pointed out to be

Coil-driven Loud-speaker with Permanent Magnets.—

neither necessary nor even desirable, the eddy current reaction at the higher frequencies tending rather towards an improvement in response characteristic than otherwise.

The most important operation of all, upon which success or failure depends, is, of course, that of magnetising. It is no use magnetising the bars separately and then assembling them on the yokes: the whole magnet unit must be magnetised at once, the air-gap being preferably bridged during the process with soft iron. If a number of similar magnets were to be built, the best method to magnetise them would be to construct an electro-magnet of special shape for the purpose, but when only one or two are to be flashed the simplest way is to put a winding on the core of heavy-gauge cotton-covered wire, say No. 14, filling the available space, and passing a very large current momentarily through the winding.

A Job for Specialists.

Not many constructors will be in a position to obtain the sudden rush of current necessary for this purpose, and in any case the operation should in no circumstance be carried out except in the presence of someone thoroughly acquainted with the particular type of work. The magnet should therefore be assembled after carefully removing all traces of metallic filings from the parts, and sent to a firm of repute who specialise in magnetising. It must not be dismantled after being magnetised, so that the winding must be left *in situ*, where it will at any rate be available in the unlikely event of remagnetising being necessary.

The magnets described do not represent the highest stage of development possible in this direction, but they are simple in shape and comparatively easy to construct. By employing more complicated forms, much greater flux densities could without doubt be obtained, and here is a possible field for the cast magnet, in which the shape can be modified so as to use the material to the best advantage without having recourse to expensive machining operations.

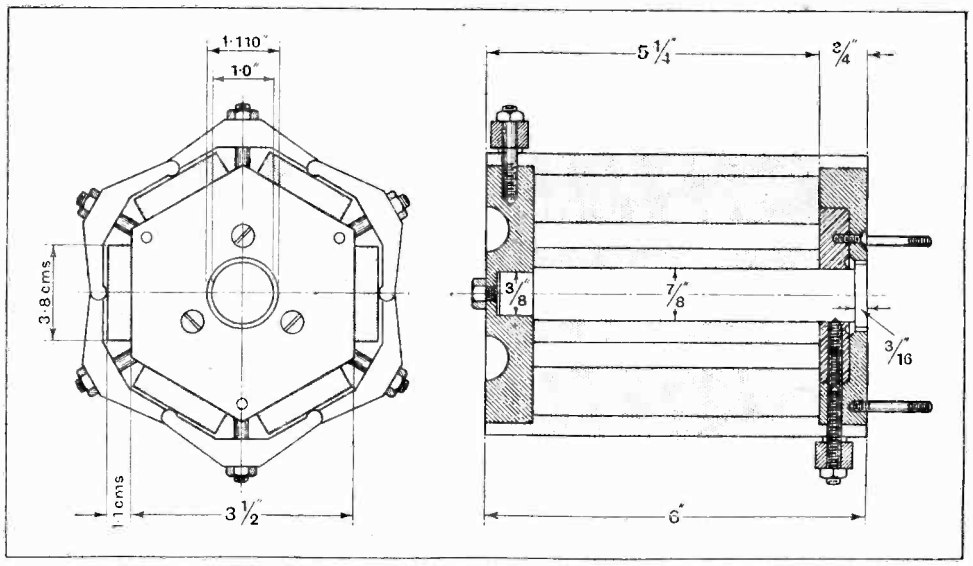


Fig. 5.—Leading dimensions of magnet assembly using straight bar magnets.

The loud-speaker with moving-coil drive is beginning to enjoy a well-deserved revival in popularity, and an effective permanent magnet system will remove what in the writer's opinion is the one serious drawback to a device which, although in itself not new, possesses the power, when used in conjunction with the recent developments in diaphragm technique, to set up a new standard of quality in broadcast reception.

TRANSMITTERS' NOTES AND QUERIES.

Mr. A. J. Baker (G 6QH), 23, Third Ave., Bush Hill Park, Enfield, tells us that he has received a report from a listener in Bellerive, Tasmania, who overheard his two-way communication with 1CW in Tripoli when using only 6 watts input. He has also worked with amateurs in 32 different countries during the past twelve months on 45 metres, the input never exceeding nine watts. Mr. Baker informs us that he is temporarily giving up his station.

Mr. Louis Era (EB 4BC), 46, Avenue Van Put, Antwerp, was in two-way communication on Sunday, May 15th, at about 1800 G.M.T. with Lieut. E. S. Earle, Ichiban, Keppel Harbour, Singapore, who is now using the call-sign VS 1AB in place of SS 2SE and AM 2SE, by which this station was formerly distinguished.

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New Call-signs and Stations Identified.

G 2LW F. H. Lawrence, Lyncroft, Albion Rd., Sutton, Surrey. (Transmits on 8, 45 and 90 metres.)
(This call-sign was stated, in error, in our issue of May 18 to belong to Mr. W. E. Benham.)

G 6LY (ex 2BWO). J. H. Blakeley, 5, Hazel Grove, Blackpool. (Transmits on 45 and 440 metres.)
(This call-sign was formerly held by Mr. H. W. Sellars, at Chorley, Lancs.)

G 6WD G. A. Woods, 81, East Parade, Harrogate, will welcome reports giving details of weather conditions, etc.

2APQ J. A. Cornell, 53, Trent Rd., Brixton, S.W.2.

2BHW B. T. Chapman, 3, Carlton Rd., Sunbury-on-Thames. (Change of address.)

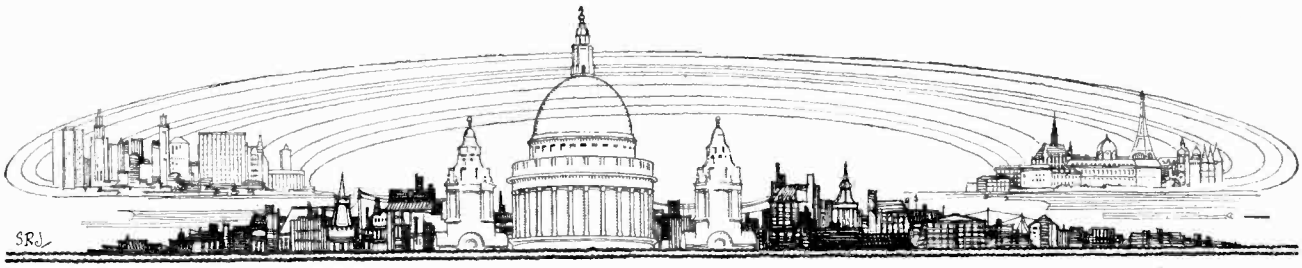
CATALOGUES RECEIVED.

Electradix Radios, 218, Upper Thames Street, E.C.4. 68-page catalogue of all classes of Wireless Apparatus, Components, and Accessories.

Metrovick Supplies, Ltd., 155, Charing Cross Road, London, W.C.2. Broadsheet descriptive of the "Cosmos" Three-Valve Resistance Capacity Coupled Set.

Ward and Goldstone, Ltd., Frederick Road, Pendleton, Manchester. List No. E/12, dealing with "Goltone" H.T. Battery Eliminators and Kits for the Radio Constructor.

Tungstone Accumulator Co., Ltd., St. Bride's House, Salisbury Square, London, E.C.4. Folder describing the *Tungstone* Pure Lead Accumulator.



CURRENT TOPICS

News of the Week in Brief Review.

THE HAPPY WORKHOUSE.

A broadcast receiving system is being installed in the Marylebone Workhouse.

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STRAIGHT FROM THE UMPIRE'S MOUTH.

Loud-speakers are to be used on the tennis courts at Wimbledon this year to enable onlookers to hear the scores.

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DERBY TRAFFIC CONTROL.

To-day's Derby traffic will be controlled without the aid of wireless vans, which have been used in previous years. It has been found that the best arrangement is a system of telephone posts in conjunction with the facilities offered by the A.A. and R.A.C.

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FREE STATE'S WIRELESS IMPORT DUTY.

Despite the appeals of the Irish wireless trade for the removal of the duty on imported wireless apparatus in the Irish Free State, a motion in favour of the step has been defeated in Dail Eirann. The Minister of Posts and Telegraphs states that the duty is essential to cover the difference between the expenditure upon broadcasting and the receipts from licence fees. The question may receive further consideration when a substantial increase occurs in the number of licences.

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AERIAL DRILL TO MUSIC.

A novelty at this year's Royal Air Force Display will be musical drill by wireless telephony. This is a variation of an old favourite in which complicated manœuvres were carried out on radiotelephonic instructions. At Hendon on Saturday, July 2nd, a series of popular tunes played by the R.A.F. Central Band and transmitted by wireless will provide the setting to which the aircraft will carry out a musical aerial ride.

This new form of jazz will be carried out by No. 41 Squadron, which is part of the Home Defence Force, with headquarters at Northolt.

ORCHESTRAL ECONOMY.

Broadcast receivers are displacing orchestras on the boats of the Hudson River Navigation Corporation.

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UNWANTED.

A temporary ban has been placed on mobile broadcasting stations by the American Federal Radio Commission. Stations of this type are said to have caused "a considerable amount of interference."

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COLD COMFORT.

A recent cold spell in Lithuania has been attributed by a certain sect to the harmful influence of wireless aerials, which picked up "waves of cold."

The same phenomenon has been observed by a Wigan listener who states that certain broadcast transmissions leave him cold.

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GRIMSBY BEAM STATION.

On page 632 of our issue of May 18th the wavelength of the Grimsby beam transmitting station (GBH) was erroneously given as 29.906 metres. The actual wavelength is 25.905 metres.

DOES IT EVER CLOSE DOWN?

A broadcasting station controlled entirely by women has been established at Stephen's College, Columbia, Missouri.

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CALLS ACROSS THE ATLANTIC.

Up to Tuesday, May 17th, the number of wireless telephone calls between this country and the United States amounted to 893.

In a written Parliamentary reply, Viscount Wolmer, Assistant Postmaster-General, stated that the receipts covered working costs but not interest or depreciation.

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SHORT WAVES AND SOLAR ECLIPSE.

The Radio Society of Great Britain invites the general public to participate in the experiments which the society will conduct with short waves during the period of the eclipse of the sun on June 29th.

Details will be sent to non-members on receipt of one shilling in stamps. Communications should be addressed to the society at its offices, 53, Victoria Street, London, S.W.1.

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BOGUS WIRELESS INSPECTORS.

Three owners of broadcast receivers in Toronto were recently the victims of thieves who represented themselves as officers of the radio service on a tour of inspection. The "officers" confiscated the sets and made their escape. They have not been heard of since.

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THE WIRELESS TYPEWRITER

A device for sending typewriting by wireless is reported to have aroused the interest of Signor Mussolini, who will shortly witness demonstrations between Rome and New York. The rights of the invention, which is based on short waves, are stated to have been acquired by the Marconi Company, but at the time of going to press no information on this point had been received at Marconi House, London.

SUMMERTIME WIRELESS. This photograph, taken recently on the River Lea, is an effective reply to those who suggest that wireless is only a winter pastime.

WIRELESS ACROSS ARABIA.

Wireless communication has been established across Arabia between Rayad, Mecca, Huile, and Medina. King Ibn Saud left Rayad on Friday, May 20th, after sending the first wireless message between his two kingdoms.

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THE FINISHING TOUCH.

The importance of wireless as a recognised feature of modern home life is being more and more emphasised, and it is significant of the trend in this direction that wireless sets are being incorporated as an integral part of housing schemes. An interesting example of this is the Richings Park Estate at Iver, Bucks.

When complete, this estate will comprise 2,000 houses, some 200 of which have already been completed. Each house is equipped with a two-valve Gecophone set, complete with loud-speaker and Osram valves, the aerial being erected beneath the roof.

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THE VOLTA CENTENARY.

The Volta Centenary Exhibition, to commemorate the death of the great physicist in 1827, was opened by the King of Italy at the Villa Olmo, Lake Como, on Saturday last.

The exhibition includes an international section devoted to electrical communications, while the Italian Admiralty has erected a special 25-kilowatt short-wave transmitter which will work during the period of the exhibition and will link up Como with Milan by wireless telephony for the first time.

The national commemoration of Volta is to take place on September 19th in Rome, and will be opened with a speech by Senatore Marconi in the Capitol.

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SATURDAY'S SHORT-WAVE TEST FROM WGY.

On Saturday next, June 4th, the General Electric Co.'s station, WGY, at Schenectady, will launch its second 24-hour test, transmitting simultaneously on 22.02 and 32.77 metres, both transmissions being modulated from the same source with voice and music. It is possible that both transmissions may not be heard at the same time. The test will begin at 5 p.m. (B.S.T.).

The station director of WGY, Schenectady, is anxious to receive reports from British listeners. It is pointed out that observations between 10 p.m. and 6 a.m. B.S.T. will be of particular interest. The principal data required are time heard, signal strength, quality, and amount of fading.

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A WORD FOR THE CONSTRUCTOR.

"Wireless does more than provide us with a supply of dance music and news bulletins. It develops character, it elevates, and it educates. It teaches us to be determined, resourceful, patient, and proud. You cannot build a set and finish it without being a bit better than you were before you commenced, even if the darned thing won't work."—"Aerio" in the *Glasgow Weekly Herald*.

LATOUR PATENTS PROBLEM.

There are indications that the Radio Corporation is intending to follow the lead of the Hazeltine Corporation of America and the British Marconi Co. by issuing licences under its patents to manufacturers who desire them, writes our New York correspondent. One or two large manufacturers have already acquired such licences, only to find that they are not enough, in that the Latour Corporation (a subsidiary of the Hazeltine Corporation) claims that certain Latour patents are essentially involved in a modern broadcast receiver. It appears to have been overlooked that, although the R.C.A. was licensed under these Latour patents, it had not the power to sub-license.

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UNIVERSITY COLLEGE APPEALS TO LONDON.

In celebrating its centenary this year, University College, London, is making a special appeal to Londoners for funds to

A STUDY IN CONTRASTS. The large valve is one of the latest Cossor transmitter type; its small brother is a Stentor Six.

meet some of the essential needs of its work.

University College, which is the Mother College of London University, was founded in 1827 to provide a centre of university education open to all without distinction of race, class, or creed; moreover, it was the first university institution in this country to establish laboratories for the teaching of chemistry, physics, and engineering. It was in the electrical laboratories of University College that Prof. J. A. Fleming invented the thermionic valve.

The increase in the number of students and the necessary expansion in buildings has laid on the college a serious financial burden, because its endowments have not kept pace with its growth; actually the college derives less than 15 per cent. of its income from this source. £235,000 is needed for endowment, while only £36,000 has as yet been raised. A large proportion of the sum already received has come from the provinces and abroad. Hence the special appeal to the business houses, industries, and citizens of London to help London's own university.

The total amount which the college is endeavouring to raise is £500,000, to cover, besides endowment, the erection of new buildings and the provision of new electrical and engineering equipment.

Cheques should be drawn in favour of the University College, London, Centenary Appeal Fund, and crossed National Provincial Bank, and should be sent to Sir Robert Kindersley, G.B.E., University College, London, Gower Street, London, W.C.1, who is the honorary treasurer of the Centenary Appeal Fund.

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WIRELESS AND THE CROWN COLONIES.

The development of wireless in the Crown Colonies and Protectorates is one of the questions under discussion at the Colonial Conference now meeting in London. During the past fifteen years about thirty small stations have been erected, being used mainly for local requirements and communication with shipping, but they are regarded as the preliminary links in a chain of Empire communication which may be ultimately established.

Ceylon has taken the lead in establishing a broadcasting service, while the possibilities of development in this direction are being considered by Hong Kong, Palestine, the Gold Coast, Cyprus, and Zanzibar.

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IMPORTANT U.S. "NEUTRODYNE" JUDGMENT.

A legal decision regarded by many as one of the most important in the history of American radio has been handed down by the United States Circuit Court of Appeals, writes our New York correspondent. Briefly, it is decreed that every "neutrodyne" receiver involves infringement of the neutralising patents issued to Hartley and Rice.

The sole licensee under these latter patents, in the broadcasting field, is the Radio Corporation of America. If the decision stands—and it is unusual to carry an appeal in such a case to a still higher court—its effect upon the American industry will be tremendous, as the Radio Corporation will have very heavy royalties to collect and will be in control of practically all the important radio patents. Possible exceptions are those of Latour, relating, amongst other things, to a method of neutralising and the use of a common battery.

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"HOT STUFF."

An idea that station WEAF, New York City, was about to broadcast some "hot stuff" recently brought a flood of enquiries from newspaper reporters. They were disappointed to learn that the "hot stuff" was merely a talk on chemistry entitled "A Modern Inferno."

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TRANSMISSIONS FROM HOLLAND.

As we go to press we learn of an alteration in the times of transmission from PCJJ given on page 702 of this issue.

To-morrow evening (Thursday) transmission will be from 5 to 8 p.m. G.M.T., and the same schedule will be observed on June 7th and 9th.

The Experimenter's Notebook

The Use of a Milliammeter in Receiving Circuits.

By "EMPIRICIST."

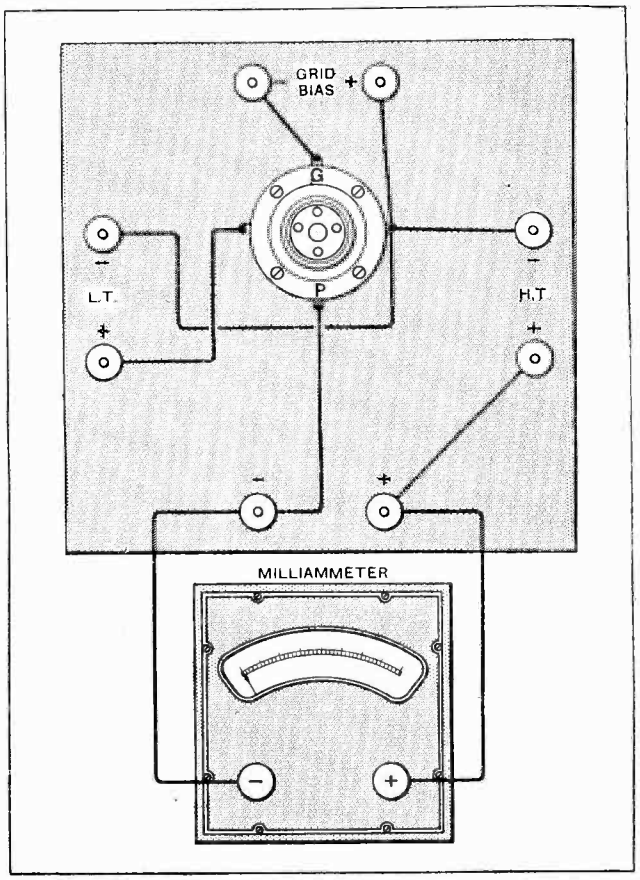
ALL things considered, it is amazing how little attention is paid by experimenters in general to the plate currents of the valves they are using. Milliammeters that are suitable for measuring these currents can be obtained quite cheaply, and their utility seems to be as great for the purposes of experimenting as is a clinical thermometer to a doctor.

In the first place, it really is essential that experimenters should know the condition of the valves they are using. Nowadays, when nearly every valve is a dull emitter of a type which must some day or other lose its emission, the only means of checking valves in this respect is to measure the plate current under the standard conditions laid down by the manufacturer as appropriate for use with the particular type of valve. Plate currents of valves under working conditions vary from half a milliamp. up to 20 milliamps. or even more, and it is therefore useful to have an instrument with two ranges, say, 0 to 10 milliamps., and 0 to 50 milliamps.; this, however, is not essential, and we might quite well consider the experimenter as being in possession of a milliammeter of good quality reading from 0 to 20 milliamps.

Checking Emission.

It is convenient, in order that the process of checking valves may be adequately carried out, to have a small valve testing board, arranged as shown, with either a pair of terminals or a jack to which the milliammeter can be connected. Valves when first bought should be checked against their published characteristics by the application of suitable H.T. and grid bias voltages, and a record may advantageously be made of the readings obtained. It is naturally assumed that the correct H.T. and L.T. voltages are applied to the valve at the time that measurement is made, and it is very convenient to have some handy means of ensuring this.

Assuming, then, that the valves are in order, we may next proceed to consider how the instrument may be employed in connection with reception experiments. First and foremost, provided that we can measure individual valve currents (and as a last resort we can do this by putting the valves into the receiver one at a time), we can ascertain first that the plate circuits of the valves are continuous, and, if the current is normal, we know further that the resistance in these circuits is not abnormally high. This serves as a check on continuity and also on partial discontinuities, such as dry joints and so forth. If the valve filaments have an abnormally high series resistance, which in the writer's experience is a case not infrequently met with, a milliammeter in the common feed circuit will show this up, if not in an individual valve, then as the valves are being successively put into circuit, the effect being that the feed current, instead of rising, as valves are inserted in their holders, one after another, will fall owing to the decreasing voltage across the filaments. This point should always be watched for, in any case of doubt, as it is an extremely easy matter to set it right. It is most frequently encountered with two-volt valves,



Simple testing board for measuring valve anode current under standard conditions.

inasmuch as a small volt drop in the supply lead represents a large percentage change in the filament voltages.

A milliammeter used in the above manner is also a very useful check on the continuity of grid circuits. If we are measuring the plate current of any one valve and vary the grid voltage we can see at once if the plate current varies in conformity, or, in other words, if the valve "answers to bias." This is easy to arrange if the grid return lead is connected to a separate terminal to which grid bias can be applied, but is, of course, impossible when the return is direct to the filament, unless the grid lead is disconnected. The latter course being perhaps advisable when tracing a difficult fault. The point of these tests which seems to be of outstanding importance is that they include every possibility of error. We may test for continuity of grid and plate circuits in the ordinary way and then be misled by a bad contact, either between the valve holder and valve legs, or else within the valve itself. A test carried out as above described with a milliammeter tests right up to the valve electrodes.

Testing for Self-oscillation.

Another useful purpose to which a milliammeter can be applied is in checking whether a set is in a state of self-oscillation. When oscillation occurs, it is invariably accompanied by a rise or fall in the feed current to one of the valves in the circuit, and this will be indicated by a change in the common feed current. The milliammeter for a test of this kind is best connected so as not to include the heavy current usually passing through the power output valve. If the set is made to work with the aerial disconnected, so that no signals of appreciable magnitude are being picked up, the reading of the milliammeter may be noted, first with the set as it stands, and secondly when each of the grid terminals are either touched with the finger or else connected direct to their appropriate bias points. If there is no change in feed current in these conditions the set is not oscillating, but if a change occurs it certainly is. The tracing of the causes of oscillation in a set is too big a matter to be dealt with here, but systematic analysis of the various possibilities with the aid of a milliammeter is the real method of attack.

We come now to the uses of a milliammeter in a set which is functioning correctly under actual working conditions, and in this connection there are two most useful applications, the first being with the instrument in the plate circuit of the detector valve, and the second using it in the plate circuit of the power amplifier.

In the first case, the current will vary to a greater or less degree when a strong station is being tuned in. If the grid condenser and leak method of rectification is being used the tuning-in or a carrier wave will result in a drop in the current which should be quite perceptible in the case of a station of moderate strength, and will thus give an indication of a rough-and-ready character as to the signal strength of such a station.

A comparison between a number of different stations (if this is possible according to the position of the receiver) will show whether the set is at fault or whether certain stations are abnormally weak.

If the "bottom bend" method of detection is being used the plate current of the detector valve will rise when a station is tuned in. In general the deflection of the milliammeter will be less under corresponding conditions as this method of detection is comparatively inefficient, though on the other hand if the high-frequency amplifier used in conjunction with it is of really good efficiency the change in current will be equally satisfactory and can be used just as readily for making observations above described.

Grid Bias Adjustment.

The last use of a milliammeter, namely, in the plate circuit of a power output valve, is of such importance as to be almost a necessity. Power valves, as is well known, are specially designed so as to have a large range of "straight characteristic," and provided the voltages on plate and grid do not pass outside the limits where this condition of straightness holds good, the average value of the current passing through the milliammeter should not change and its pointer should in consequence remain steady.

If, on the other hand, the limits of "straight characteristic" are exceeded a movement of the pointer will occur in one direction or the other in conformity with the signals being received.

The first use of the instrument is to get the value of grid bias correct. This can be done by tuning in a strong station first of all at low volume so that no kick on the milliammeter needle takes place, and then gradually increasing the volume until the needle begins to move. If the movement of the needle under these conditions is in a downward direction corresponding to each signal impulse, then the value of grid bias is too low. If on the other hand the needle kicks in an upward direction, the value of bias is excessive. By careful adjustment and observation the bias can be so set that the direction of movement of the needle, when overloading just begins, is indeterminate, and this is the right setting.

Locating Source of Distortion.

The grid bias being correctly adjusted the instrument can be used as a check on overloading and as a means for differentiating between distortion which is taking place at the transmitting end and that at the receiving end. The distorted quality popularly known as "blasting" is quite unmistakable, but it is often a matter of difficulty to determine whether the transmitter or receiver is at fault. The milliammeter used as just described is a sure guide on this point.

A receiver with a milliammeter permanently connected in the plate circuit of the last valve has an immense advantage, inasmuch as that not only can the question of distortion be checked, but also a watch kept on the state of the batteries. The course of discharge of the accumulator will be accompanied by a drop in the plate current of the valve, and the latter will be a guide as to the condition of the accumulator. A fall in plate current apart from this regular drop will indicate either a fall in H.T. voltage or else a loss of emission in the valve. These points can be separately checked up, but the use of the instrument lies in the first warning which is given that something is wrong.

READERS' NOVELTIES

A Section Devoted to New Ideas and Practical Devices.

SHORTING-PLUG.

An emergency shorting-plug for certain screw-in resistance holders may be made from a burnt-out flash-lamp bulb by connecting a wire from the outer threaded casing to the centre contact, or by bridging the space between them with solder. E. W. W.

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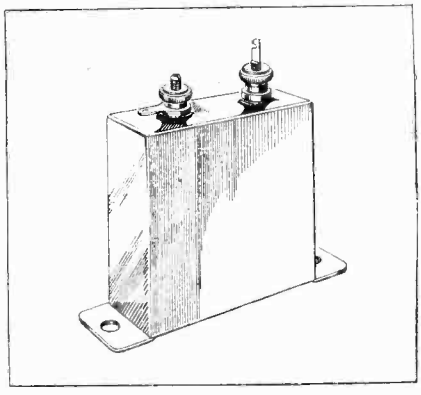
CONDENSER CONNECTIONS.

In many circuits—the "Everyman Four," for instance—it is advisable to earth the container of the Mansbridge reservoir condensers. A method of doing this which is exceptionally neat and which considerably simplifies wiring, is shown in the diagram.

The knurled terminal and lower locking nut are unscrewed from one side of the condenser, and the Bakelite insulating washer removed. The paint on the top of the metal case is then scraped away over the area covered by the Bakelite washer. The soldering tag, or one of larger size,



Simple method of earthing case of Mansbridge condenser.

is then replaced so that it makes contact with the metal case, and is clamped in position with the knurled terminal. This provides a good electrical contact with the case and also with one side of the condenser. If desired, a plain washer may be assembled beneath the soldering tag in order to raise it slightly to facilitate soldering. B. H. N. D.

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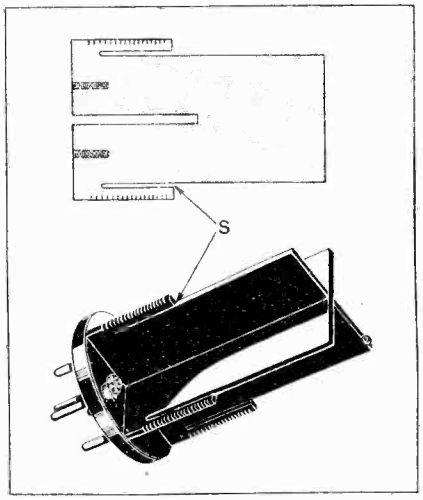
H.F. TRANSFORMER CONSTRUCTION.

Although the form of construction indicated produces a coil of square section it will be found that, as far



Plug-in former for interchangeable H.F. transformers.

as actual results are concerned, the efficiency will be but little less than that of cylindrical or hexagonal coils.

It will be seen from the diagram that two spacers are cut from ebonite sheet (⅛in. thickness is suitable) and "halved" together in the manner of egg-box partitions. The spacers are secured to a circular ebonite base with screws fitting into holes drilled and tapped upwards into the edge of the spacers.

The primary and neutralising windings are supported on the strips left at each side of the spacers, the commencement of the primary winding being wound in the back-saw slot S. The end of the primary winding is terminated at the small round-head screw shown in the top of one of the spacers. C. S.

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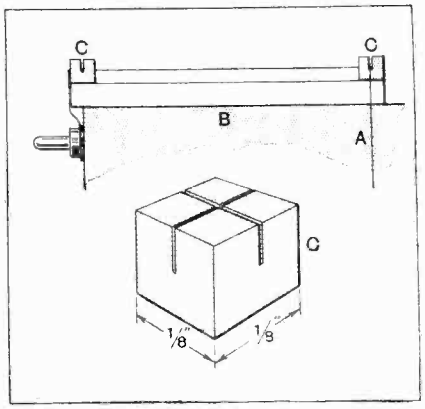
"ALL-WAVE FOUR" SPACERS.

In the "All-wave Four" receiver the ends of the primary and neutralising windings of the transformers are anchored to screws in the ebonite spacers, and connection to the pins of the coil former is made by means of an additional lead. The following method dispenses with the screws:—

Small ebonite blocks about ⅛in. square are cut from a spare spacer. Two saw-cuts are made at right angles on one side of each block. The little blocks are mounted with adhesive on the face of the spacers, one at each end. The ends of the transformer windings can then be taken through the saw-cuts, across



Method of terminating primary and neutralising windings in "All-wave Four" transformers

the windings, and so to the pins on the base of the coil former, as shown in the accompanying sketch.

W. R. P.

NEWS FROM THE CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Remote Control.

Remote control was the topic chosen at an informal meeting of the Muswell Hill and District Radio Society on May 18th, when details of the "Lotus" remote control, which had been sent for the society's inspection, were discussed. Mr. L. Hirschfeld, B.Sc., gave an interesting impromptu talk, in which he described practically every possible method of using remote control. He dealt with his own ingenious system, whereby his mains receiver could be switched "off" and "on" from any room. This was worked by a "Weston" relay with a rotating ratchet switch and mercury contacts. The device had given excellent service for over a year.

Particulars of future meetings can be obtained on application to the hon. secretary, Mr. Gerald S. Sessions, 20, Crasmere Road, Muswell Hill, N.10.

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A Portable Super-Het.

Mr. Alford, of the Igranic Electric Co., Ltd., lectured before a large audience of the Hounslow Wireless Society on May 17th, demonstrating the Igranic Neutrosonic seven-valve portable receiver. The lecturer said that, as its name suggested, the Neutrosonic was a super-heterodyne receiver in which the H.F. stages were neutralised. A stage of H.F. amplification preceded the first detector, while a separate valve was used for the oscillator, and there were two stages of intermediate amplification. He explained that only one stage of L.F. was required, owing to the very high amplification obtained in the intermediate amplifier.

The receiver and its frame aerial were housed in one case and the requisite batteries and loud-speaker in another. The complete outfit was of fairly considerable weight, and although an ideal set for the motorist it was certainly not the portable for a country ramble. The construction of the instrument was of an excellent standard throughout.

Hon. secretary: Mr. W. R. Collis, 7, Algar Road, Isleworth.

FORTHCOMING EVENTS.

WEDNESDAY, JUNE 1st.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove. Business Meeting, followed by Discussion Evening.

THURSDAY, JUNE 2nd.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, N.W.11. Exhibition of Members' Apparatus.

WEDNESDAY, JUNE 8th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Demonstration and Lecture on "Electric Accumulators," by Mr. W. Schofield (of Messrs. The Hart Accumulator Co., Ltd.).

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H.F. Problems.

Some useful tips were gleaned by the less expert members of the North Middlesex Wireless Club at the last meeting, when the erection of a new aerial was undertaken, the work being carried out under the supervision of Mr. W. Gartland.

The club hopes to hold a field day on July 9th.

The subject of high-frequency amplification was dealt with in a lecture by Mr. Gartland, who admitted that since a recent debate on the topic he had become converted to the idea that one stage of H.F. amplification might be distinctly worth while. After relating his disappointing experience in H.F. amplification using the ordinary general-purpose valve, the lecturer opened a discussion on the advantage of the neutrodyne method of securing stability. He concluded with particulars of an efficient short-wave circuit using plug-in coils of a well-known make. In this circuit the aerial was coupled by a single turn, and there was no earth connection. The circuit had proved remarkably efficient in the reception of American signals.

Hon. secretary: Mr. H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

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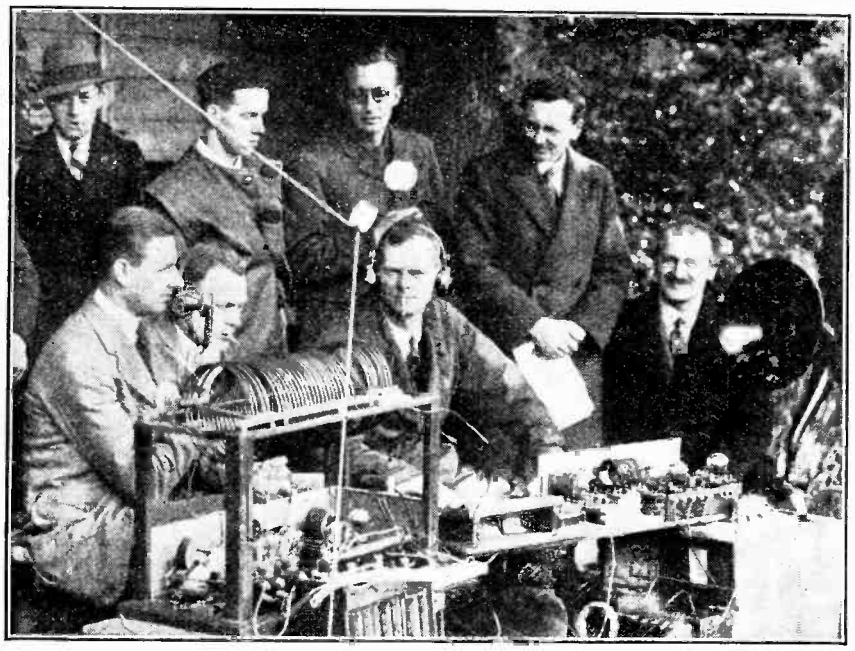
Carrying on in Summertime.

The summer season will not be an idle one for the Ilford and District Radio Society, which has decided to hold monthly meetings on the following dates: June 23rd, July 21st, August 25th and September 15th. In addition it is expected that the society will hold a field day.

Hon. secretary: Mr. H. H. Carr, 39, Lynford Gardens, Goodmayes.



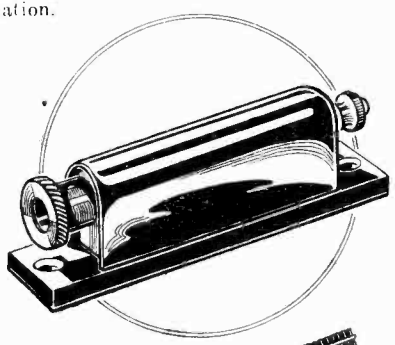
FIELD DAY AT MILL HILL. Members of the Golders Green and Hendon Radio Society photographed with their temporary transmitter at Mill Hid on a recent Sunday, when communication was secured with amateurs in Nottingham, Isle of Wight, Scotland, and Ireland.

NEW APPARATUS

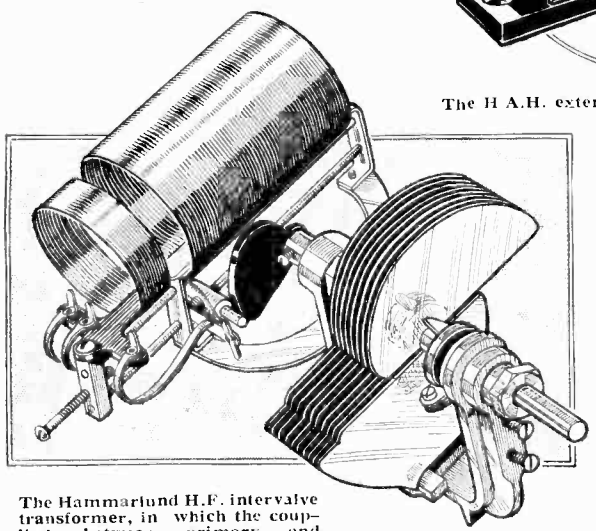
A Review of the Latest Products of the Manufacturers.

STAPLE H.F. COUPLING UNIT.

Uniform stability over the entire tuning range of the condenser can be obtained in a high-frequency amplifier by carefully arranging the neutralising and primary windings so that the bridge which is formed remains correctly balanced over the range of frequencies to which the circuit tunes. This is accomplished by providing a tight coupling between the primary and neutralising windings, making them exactly similar and so placing the turns that both windings are equally influenced by changes in the tuning of the winding forming the grid circuit. If not balanced self oscillation usually arises when the tuning condenser is near the zero of its scale, owing to the reduction in damping. It is desirable, therefore, in an H.F. intervalve transformer to increase the extent of coupling between primary and secondary as the capacity of the condenser advances. This requirement is achieved in the new Hammarlund Auto-Couple Coil obtainable from Rothermel Radio Corporation of Great Britain, Ltd., 24-26, Maddox Street, Regent Street, London, W.1, by fitting a cam to the projecting end of the variable condenser shaft, which, moving against a stop, alters the position of the primary with regard to the stationary secondary winding. Adjustments are provided so that the extent of coupling can be regulated either at maximum or minimum setting. The primary winding is centre tapped, so that neutralising can be arranged in the usual manner, whilst the user can carefully adjust the cam action so as to produce just the required increase in primary to secondary coupling as the tuning capacity approaches a maximum and in combination with the particular type of valve adopted for H.F. amplification.



The H A.H. extension jack.



The Hammarlund H.F. intervalve transformer, in which the coupling between primary and secondary windings varies with the capacity of the tuning condenser.

The tuning condenser is beautifully finished and is practically perfect both mechanically and electrically. The tuning coils, which at first sight appear to be self supporting and air spaced, are stiffened by attachment to a thin sheet of celluloid.

H.A.H. JACK.

In wiring up the extension points from a broadcast receiver to the various rooms of a house, the use of some form of plug and jack connector is to be preferred to fitting terminals elevated on ebonite.

Messrs. A. H. Hunt, Ltd., H.A.H. Works, Tunstall Road, Croydon, have recently introduced a useful form of jack with cover and secured to an ebonite mounting plate. The jack is intended for mounting vertically against the wall, and being only about ½in. in width can usually be secured to the beading of woodwork so as to be quite inconspicuous and occupy very little space.

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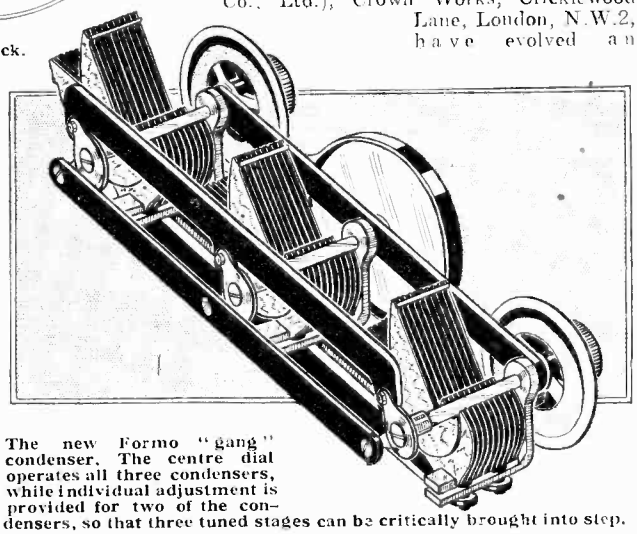
FORMO GANG CONDENSER.

No provision is usually made when linking condensers together on a common shaft for the purpose of simultaneously tuning several circuits, such as is required in a two-stage high-frequency amplifier for making small adjustments individually to any one condenser.

The Formo Company (Arthur Preen & Co., Ltd.), Crown Works, Cricklewood Lane, London, N.W.2, have evolved an entirely new form of construction for linking together several condensers for simultaneous tuning. The main geared dial drives all three condensers, being positively locked on to the shaft of the centre condenser, subsidiary dials providing separate adjustment to the other



The new Formo "gang" condenser. The centre dial operates all three condensers, while individual adjustment is provided for two of the condensers, so that three tuned stages can be critically brought into step.

two. By this means all three condensers are rotated on one knob, whilst small differences in the setting of any one condenser can be readily made without disturbing the settings of the others. It is obvious that even if correctly set in one position the three tuning condensers, unless the plates are shaped to follow a logarithmic law, cannot for any given movement produce a corresponding change of wavelength in each of the several tuned circuits. This new Formo condenser makes provision for critically adjusting each of the condensers, at the same time bringing all three dials roughly to the required position. The method of transferring the rotation from the centre condenser is ingenious, and makes use of two parallel ebonite bars.

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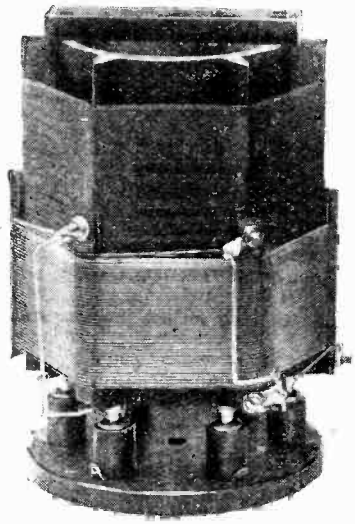
INTERCHANGEABLE H.F. COUPLINGS.

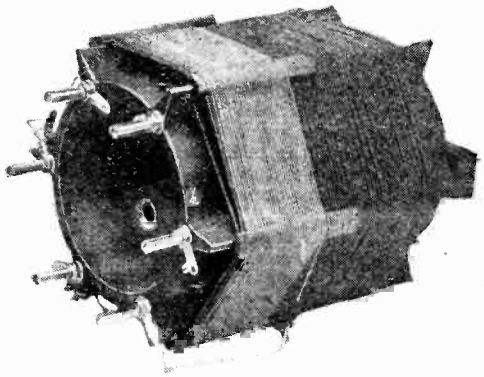
The H.F. transformers described in connection with the "All-Wave Four" [1] were primarily designed for amateur home construction, and not for commercial production. It is, therefore, all the more gratifying to find that manufacturers are turning their attention to these coils, and, moreover, that they have apparently overcome the difficulties which must be encountered when attempting to produce them on a commercial basis.

[1] *The Wireless World*, April 27th, 1927.

The transformers made by Messrs. Wright & Weaire, Ltd., of 740, High Road, Tottenham, London, N.17, are in every way equal to the originals, and it is interesting to note that this firm have added a non-reversible fitting, in order to minimise the risk of an accidental short-circuit of the H.T. battery by incorrect insertion of the transformer into its base. The latter is fitted with a short brass rod, which, when the pins and sockets are registering correctly, engages in a hole drilled through a small triangular piece of ebonite screwed to the inside of the tube.

The terminal points on the base are marked with appropriate lettering which coincides with that shown in the practical and theoretical circuit diagrams published with the original descriptive article. This feature will help to simplify the wiring of the set.





Wearite interchangeable transformers for use in the construction of the "All-Wave Four" receiver.

TRADE NOTES.

Cossor's Radio Mail.

The current issue of Cossor's "Radio Mail" contains several topical articles of particular interest to the dealer, and includes a useful contribution on the subject of resistance amplification.

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A Transatlantic Feat.

The Mullard Co. have received a letter from Mr. O. B. Kellett (G5KL), Southport, giving details of remarkable low power transmissions. During these transmissions Mr. Kellett used a Mullard "0/40" valve as oscillator, and succeeded in working the Canadian transmitting station NC-1DM, owned by Mr. S. H. Appleton, Caledonia Mines, Nova Scotia, with the exceptionally low input of .925 watt and on a wavelength of 45 metres.

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Valve Manufacture—a Forgotten Factor.

So much attention is paid to the internal construction of a valve that one is inclined to overlook the care and trouble involved in the manufacture of the glass container. The importance of glass as a valve constituent is the interesting subject of an article in the current number of the "Osram" G.E.C. Bulletin. The writer describes the processes under which "Osram" valve glass is obtained from the raw material comprising sand, red lead, alkali and sundry other ingredients. The Bulletin also contains a contribution on the "Gecophone" H.T. battery eliminator.

Electrical Measuring Instruments.

To obtain maximum receiver efficiency no amateur can neglect to pay attention to the electrical adjustment of his set. In this connection a booklet entitled "Radio Control," issued by the Weston Electrical Instrument Co., Ltd. (15, Great Saffron Hill, London, E.C.1), is of special interest. This little book includes some admirable advice on the intelligent use of voltmeters, ammeters and galvanometers, besides illustrating and describing the various instruments in the "Weston" range. Readers who are alive to the importance of this subject would be well advised to obtain a copy of "Radio Control" from the above address.

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New Offices.

Mr. W. A. Appleton, M.B.E., M.I.R.E., advises us that he has resigned his directorship in Messrs. Radio Instruments., Ltd., and is not associated with the present amalgamation between that company and the Varley Magnet Co. He is now conducting business in his own name at Gloucester House, 19, Charing Cross Road, W.C.2, where laboratories and offices are equipped for the design and manufacture of radio and other apparatus.

For the Radio Dealer.

Houghton's "Radio News" for May, intended for the radio dealer, is more than a catalogue of leading lines; it is also the little magazine of topical trade information. Houghton's "Radio News" is published by Houghton-Butcher (Great Britain), Ltd., 88-89, High Holborn, London, W.C.1.

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Electric Soldering Irons.

We learn from the Automatic Coil Winder and Electrical Equipment Co., Ltd., Winder House, Rochester Row, London, S.W.1, that they have just been appointed sole distributing agents for the "Zeva" electric soldering irons and crucibles.

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All About the "Clarostat."

"The Gateway to Better Radio" is the title of a booklet describing the "Clarostat," a special form of variable resistance manufactured by General Radio Instruments, Cambridge, Mass., U.S.A., and obtainable in Great Britain solely from Messrs. Claude Lyons, 76, Old Hall Street, Liverpool. Besides containing useful information on securing the best results from the "Clarostat" in the elimination of distortion, regulation of the plate voltage, etc., etc., the book includes some general advice on how to obtain maximum receiver efficiency. The book is obtainable from Messrs. Claude Lyons at the price of 1s. 6d. post free.

By Our Special Correspondent.

To-day's Derby Broadcast.—Is "Daventry Junior" Delicate?—Empire Broadcasting Queries.—Those Nightingales.—PCJJ's Schedule.—The Dying Oscillator.

To-day's Running Commentary.

The running commentary on the Derby will be carried out this afternoon by Mr. Geoffrey Gilbey, while "local colour" will be supplied in the form of a description by Mr. George F. Allison, who is already well-known as a broadcast commentator on football.

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Special Microphones.

Desensitised microphones fitted to special headgear will be used, thus enabling the commentator to keep the microphone at a uniform distance from his mouth while having his hands free to wield his field glasses.

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Weak Signals from 5GB.

A number of listeners report reception of signals from "Daventry Junior." The general impression is that these signals are too weak.

If "Daventry Junior" is to succeed it must have a reasonable power, and the report—which reaches me from a reliable source—that only 10 kilowatts is being used is scarcely reassuring.

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No Flowers, by Request.

No definite time schedule of experimental transmissions from 5GB has been issued, the engineers being apparently content to rely on reception reports from a few picked listeners who have been provided with a secret time-table. Most of these listeners are engineers at the different provincial stations.

So it seems that if you send in your report of 5GB's transmission to Savoy Hill you will not be overwhelmed with bouquets and thanks.

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B.B.C. and PCJJ.

The delicious enterprise—one might almost say the delicious audacity—of the Dutch valve firm in rebroadcasting a 2LO programme to the uttermost parts of the British Empire throws a scorching spotlight on the shortcomings of our own broadcast resources. Nevertheless, the B.B.C., which has probably been just as dazzled by the performance as everybody else, has recovered itself sufficiently to issue a dignified statement.

FUTURE FEATURES.

London.

JUNE 5TH.—British Legion Service from the Cenotaph. Chamber Music.

JUNE 6TH.—Thé Dansant and Clarkson Rose's Concert Party from Westcliff. Popular Concert.

JUNE 7TH.—"The Wandering Jew," a play by E. Temple Thurston.

JUNE 9TH.—Light Symphony Concert.

JUNE 10TH.—The Sea Symphony (Vaughan-Williams) relayed from Cambridge.

Birmingham.

JUNE 8TH.—Liza Lehmann Programme. Promenade Concert.

JUNE 10TH.—The "Tweenies" Concert Party. Light Operatic Music.

Bournemouth.

JUNE 7TH.—Speeches on the occasion of the visit of the Prince of Wales to the University College of the South West of England, Exeter.

JUNE 10TH.—Comic Opera and Bohemian Music.

Cardiff.

JUNE 7TH.—"La Serva Padrona," comic opera by Pergolesi.

Manchester.

JUNE 10TH.—An Evening at Blackpool.

Newcastle.

JUNE 9TH.—Neapolitan Programme.

JUNE 10TH.—Concert Performance of "The Grand Duchess" (Offenbach).

Glasgow.

JUNE 8TH.—"Once Upon a Time"—a vocal and instrumental programme.

JUNE 11TH.—The "Concord Follies" Concert Party.

Aberdeen.

JUNE 10TH.—Scottish Programme.

Belfast.

JUNE 9TH.—"Clearly and Concisely"—a farce by Robert Higginbotham.

A Point of View.

The B.B.C. announces that since the end of 1925 it has indicated its desire to co-operate effectively in any practicable enterprise designed to interchange programmes between various parts of the Empire or simply to make the B.B.C. programmes available in other parts of the Empire. But it points out that sentimental considerations should not outstrip practical considerations, and draws attention to a paucity of funds and uncertainties regarding technical efficiency.

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Another Daventry?

However, in the face of PCJJ's triumph and the undoubted fact that short-wave broadcasting to the Dominions is not an impossibility, the B.B.C. proposes to erect a short-wave experimental station at Daventry, though whether the project will materialise very quickly is a matter for doubt.

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Marking Time.

The impression I gained at Savoy Hill is that nothing fresh will be attempted at Daventry until the new regional station begins regular transmissions. *Officially*, this will not occur for three or four months, but there are reasons for supposing that the service will be opened much sooner.

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Hopes and Fears.

The B.B.C. betrays extreme diffidence in pushing forward an Empire short-wave station, owing to the fear that it might be impossible to realise a regular and dependable service which would give satisfaction after the novelty had worn off. Well, the only way to combat these fears is to experiment.

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A 24-Hour Service?

The time problem is more formidable. There are gentlemen in the Himalayas who might rise from their beds at any hour of the night to hear a speech by the King or the Prime Minister, but such important items would be rare.

During the ordinary programme time in this country half the Empire is in bed,

while a considerable portion is too busy to listen-in, which goes to show that an Empire-wide broadcasting service would have to last pretty nearly twenty-hour hours per diem.

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Finance.

Then, too, the Aberdeen point of view must be considered. Would the money for an Empire service be derived from licence receipts?

The Colonial Conference now sitting in London has been asked to consider the question of Empire broadcasting, and on the financial side I understand that two suggestions have been made. First, it is suggested that the Dominions should contribute towards the scheme, and alternatively that a regular interchange of programmes between England and the Dominions could be arranged so that the indebtedness would be mutual.

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What Not to Do . . .

When the announcer intimates that the voice of the nightingale will be broadcast from Oxted in an hour's time. Get out the car and rush off to Oxted.

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Nightingales and Motor Cars.

Last week's nightingale broadcast would have been a greater success, Capt. West tells me, if the army of motorists who invaded the district had been good enough to keep away. Apart from the fact that the birds are easily scared by even the most magnificent motor cars, it is as well to note that an exceptionally sensitive microphone is employed—a specially designed magnetophone—which will pick up sound almost beyond earshot. Who thirsts to hear a ticking motor? As Capt. Eckersley remarked: "The goods train *had* to pass, but . . ."

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The Sensitive "Mike."

As demonstrating how sensitive the magnetophone was last week, it is interesting to learn that Capt. West and other engineers at Oxted failed to hear a second nightingale in the far distance, although many listeners heard the lonely songster quite clearly.

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Why Oxted?

If motorists are becoming so troublesome, why not shift the venue? Is Oxted the only place in this England of ours where the nightingale can be cajoled into song? And is Miss Beatrice Harrison's 'cello such a very necessary stimulant after all? I have an idea that the poet Keats, when he listened to the nightingale, had neither 'cello nor saxophone, but only paper and pencil.

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An Idea.

Another attempt to broadcast the nightingale will be made, I understand, within the next few days. I think the B.B.C. might do worse than transmit the notes of other wild birds; the microphone could be taken to some secluded woodland—there are still some in this country—where as many as twenty different bird songs might be picked up. Given a naturalist as *compère*, the item would make an excellent "Children's Hour" and would give our hard-worked friends at Savoy Hill a well-earned rest.

OPEN-AIR NEWS BULLETIN. An everyday scene in Soviet Russia, where the various towns and villages are equipped with receivers and loud-speakers.

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Dublin's Coup.

It is interesting to learn that the Dublin Broadcasting Station first announced the safe arrival of Capt. Lindbergh over Ireland at 5.30 p.m. on Saturday, May 21st. A message to this effect was broadcast from 2RN at 9.40 p.m. This was the first definite message to be received by the public as to the airman's whereabouts.

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Short Waves from Holland.

PCJJ, the Philips station at Eindhoven, Holland, will be transmitting tomorrow evening (Thursday) from 7 to 11 p.m. (G.M.T.) with a wavelength of 30.2 metres.

On Tuesday and Thursday of next week the station will transmit from 6 to 10 p.m. (G.M.T.).

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Voices of the Past.

Gramophone records of late music-hall stars are a feature of the programme entitled "Voices from the Past" to be broadcast from 2LO on June 18th.

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Another Debate.

Major John Hay Beith (Ian Hay) and Mr. Douglas Woodroff (late President of the Oxford Union Society) will take part in a broadcast debate on Friday next, June 3rd, the motion being "That Sport is a Menace." Lord Thomson will be in the chair.

Prince of Wales this Evening.

H.R.H. the Prince of Wales has consented to broadcast to all stations from London (2LO) at 7 o'clock this evening (Wednesday), speaking on the urgent need for more public playing fields.

His address will be in support of the £1,000,000 appeal of the National Playing Fields Association, which is to be launched as from this morning. The Prince will be acting on behalf of his brother, the Duke of York, who is President of the Association, but who is not yet back from Australia to broadcast the appeal himself.

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Some Hopes!

Can it really be that the oscillator is dying out? Shall we yet hear, with a gulp in the throat, "The Last of the Howlers"?

Savoy Hill keeps a record of the number of oscillation complaints received each week, and the following is an interesting extract.

Week Beginning	No. of Complaints
April 17th	... 200
,, 24th	... 251
,, 30th	... 187
May 6th	... 145

M-yes, it looks pretty on paper; but a physician will be ready to admit that fewer people suffer from indigestion through eating roast chestnuts in summertime because fewer roast chestnuts are eaten.

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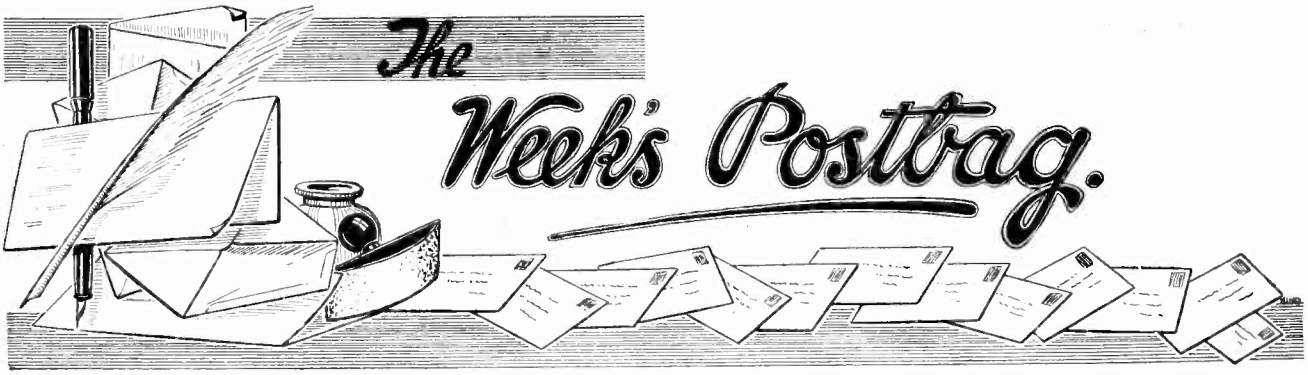
Perhaps . . .

Perhaps if detected offenders had their licences endorsed in the same manner as the reckless motorists . . . ?



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

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

BROADCASTING AND THE PATENT POSITION.

Sir,—Our attention has been called to the Editorial entitled "Broadcasting and the Patent Position," which appeared in *The Wireless World* for May 18th, in connection with which we should like to make the following remarks.

In the first place, we desire to point out that, although we defined the valve holder (used as a basis of royalty) referred to in our broadcast licence as applicable only to a valve containing the usual three elements, it is not our intention to interpret this in a strictly literal sense. For example, we should agree to count as single valve holders supports for certain multiple grid or independently heated cathode valves, in view of the fact that the number of high-frequency or low-frequency circuits and the extent to which they are employed remain in these cases the same as with the ordinary three-electrode valves.

For the purposes of legal definition, however, we had to adopt the wording as set out in our circular, but where the principle explained above holds good we shall always be pleased to consider favourably applications from holders of our amended licence.

The second point we wish to make is in connection with the concluding remarks of your article, from which it would seem that it is apprehended that we are aiming at creating a monopoly for this company. This is not the case.

It is intended that the future policy of this company as regards licensing shall remain the same as in the past, that is, the granting of licences to *all* bona fide and responsible British manufacturers of broadcast receivers.

I. SHOENBERG,
Joint General Manager,
Marconi's Wireless Telegraph Co., Ltd.

London, W.C.2, May 19th, 1927.

CERTIFICATES OF MERIT.

Sir,—I have read Mr. Lyons' letter in the May 4th issue with very great interest.

I have no particular comments to offer, but am writing to say that such a scheme would receive our support, as we consider that, carried out under your control, it would do much to give confidence to the public and stabilise the trade.

London, E.C.4, May, 1927. G. D. OZANNE,
Wingrove and Rogers, Ltd.

RESISTANCE OR TRANSFORMER COUPLING?

Sir,—I rather take exception to the Ferranti advertisement in *The Wireless World* for May 18th, 1927.

Surely the makers of this transformer must themselves admit that it is just a little bit unfair to compare a really high-class transformer with a resistance-capacity unit that is obviously far from perfect.

Just because a certain designer of a resistance-capacity unit is quite content to cut off at a frequency of about 1,000 it is unjustifiable, in my opinion, to leave the impression that *all* amplifiers of this type suffer from this complaint.

It is, of course, possible, by juggling with coupling condensers and grid leaks, to get most weird results from a resistance-capacity unit; just as it is possible to get weird results from a modern car by juggling with the carburetter.

It is only fair to state that a properly designed resistance-capacity unit can be made to give even amplification from 50 to nearly 8,000 cycles per second. As regards the overall amplification it is recognised that for good results this cannot be as high as with a transformer.

But after all valves are cheap, and it is doubtful whether a 2-valve resistance amplifier would come to much more than a transformer unit. E. A. ANSON.

London, S.W.5, May 18th, 1927.

Sir,—By the courtesy of the Editor we are able to reply to Mr. Anson's letter of May 18th.

In our opinion, the unfairness commences in the vigorous attack upon the transformer method which has been made by makers of resistance-capacity units and valve manufacturers.

We consider it to be quite fair and reasonable to state our case in advertisements when we are attacked.

Hollinwood, May 20th, 1927. FERRANTI LIMITED.
R. H. Schofield, General Sales Manager.

B.B.C. TRANSMISSION OF PIANOFORTE MUSIC.

Sir,—I think your correspondent, Mr. Frank Smyth, has hit the right nail on the head in his letter of May 9th, when he suggests that poor quality reception of music is often due to slight heterodyning or local oscillation. I frequently get very poor quality of music and at the same time increased loudness on my crystal set and also on my 2-valve set. (N.B.—The latter has no provision for reaction and does not oscillate.) The trouble is apparently due to a valve set with an aerial parallel to and about 20ft away from mine.

As in many cases the owner does not realise that his set is just oscillating, this trouble is rather difficult to deal with.

Teddington, May 23rd, 1927. A. K. TAYLOR.

Sir,—I have been extremely interested in the correspondence about the transmission of piano music from poor old 2LO.

I am not a "highly technical gentleman," but I would add my voice to those who say "look to your set."

In my opinion the key to the whole trouble is reaction; not intentional reaction—that will spoil any music—but the very slight degree of accidental reaction which is present in all but the most carefully constructed sets.

I do not wish to offend your correspondents who have written you on this subject; I do not doubt that their sets are most carefully constructed; but if they will take the trouble to go over them and eliminate absolutely all possibility of reaction in any shape or form—if necessary introduce a slight amount of reverse reaction—and use a good diaphragm speaker with plenty of power, a super-power valve in the last stage and a choke filter, they will find that the engineers of 2LO are not the sinners they are supposed to be.

Croydon, May 18th, 1927. R. G. KENNARD.

LITZENDRAHT.

Sir,—The writer has been interested in reading the question and answer under the heading "Litz or Litzendraht," page 542 of the April 27th issue of *The Wireless World*, and in support of reputable manufacturers who are out to supply the trade and the public with reliable and proper material I shall be glad if you can find space to publish this letter.

For some time past it has been very evident to us that material is being marketed by unscrupulous dealers under the name of Litz or Litzendraht wire, the construction of which is as far removed from the proper construction as chalk is from cheese; consequently, it is not to be wondered at that people buying this material are unable to obtain the results which are intended from Litz wire.

It is obvious that the reason substitutes are marketed for Litz wire is to swell the profits of unscrupulous dealers. When quoting for what is known as genuine Litz wire, we have been told we are much too dear, and this, in cases where we have quoted only a very small margin over and above material and labour costs, which is self-explanatory.

Further, fo your explanation as to the origin and derivation of Litz or Litzendraht wire: The word Litzendraht was the name originally given to high-frequency cables some years ago by a German firm, and it has since become a generic term for high-frequency cables in conjunction with wireless throughout Europe and America, but, of course, high-frequency cable still remains the correct designation. W. W. NORRIS,

London, W.1, The Standard Insulator Co., Ltd.
May 9th, 1927.

SMALL LECLANCHÉ CELLS.

Sir,—As there is a large number of people using wet or Leclanché cells for H.T. supply, possibly a few hints may prove of interest.

The chief source of the trouble which some users experience lies in the employment of excessivly small sacs; obviously, since wet and dry cells are the same thing in a slightly different form, it is unreasonable to expect the wet cells to give a very much greater output than the correspondingly small dry cell. But large-size wet cells are comparatively cheap, and it is here that the advantage of the fluid battery is found.

In order to obtain good results it is, of course, essential to use only best quality materials. The sac must be well tied, and should contain no impurities. It is essential that the zinc be of first-class quality and, if possible, be amalgamated. Chemically pure zinc cannot be used on account of its very high cost, but the best obtainable commercial material is satis factory. Care should be taken in purchasing, as the stuff sold by the ironmonger is often very impure.

The strength of solution required varies between 2 oz. and 4 oz. to the pint of water, according to the composition of the sac. The water should be distilled, or, at least, boiled.

A little thin oil is preferable to paraffin for preventing evaporation, while a cork or other cover is desirable.

The advantage of the wet cell lies in its lower internal resistance, which allows of a greater output, and in the fact that the solution can be kept at a constant strength, while the sac and zinc can be renewed as required.

London, S.W.11. R. S. SMETZER.
April 27th, 1927.

LOGARITHMIC CONDENSERS.

Sir,—With reference to your article on logarithmic condenser design, we regret to find that you have mentioned three firms only as supplying this particular type of condenser, whereas we have been making an instrument of this type, conforming with your particulars, since 1924.

Cambridge, May 18th, 1927. W. G. PYE & CO.

Calls Heard.

Extracts from Readers' Logs.

WE often receive criticisms that the extracts published from Readers' Logs are composed mainly of European stations and the 1st, 2nd and 8th districts of U.S.A.—in short, the stations which any listener can receive.

Time does not permit of holding an inquest on every list received and considering each individual "Call Heard" on its merits; we would, therefore, ask those who so kindly send us extracts from their logs to keep their lists as short as possible and to observe the following rules:—(1) Write (or preferably type) on one side of the page only; (2) start with the town in which your station is situate and the dates between which the calls were heard; (3) only record foreign or distant stations unless there is any special reason for including one or two at short range; (4) give the international indicating prefix *once* only, after the name of each country; arrange each group of calls in alphabetical order and in capital letters; (5) for the sake of uniformity we prefer each group to be prefaced by the name of the country and *not* the nationality (e.g., "Holland" and not "Dutch"); (6) end with nature of receiver (e.g., 0-v-2), waveband on which the calls were heard, name, and (if a transmitter) your own call-sign.

London, S.W.11.

April 1st to April 30th. 1927.

Australia :—OA 2TM, 2YJ, 5ES, 5HG, 5LF, 5SM, 2SH. New Zealand :—OZ 2BG, 2BX, 3AE, 4AE. Brazil :—SB 1AJ, 1AK, 1AL, 1AR, 1AW, 1IB, 1AX, 1BO, 1BU, 1BR, 1BK, 1BW, 1CK, 1GW, 1IC, 1IO, 2AA, 2AB, 2AD, 2AG, 2AM, 2AR, 2AU, 2AV, 2AX, 2ID, 2EG, 2IG, 2IN, 5AA. Argentine :—SA AD5, BQ6, CB8, DB2, DE3, DR4, DT9, FC6, HG1, KA7, HD4. Uruguay :—SU 1AM, 1CD, 1CC, 1BU, 1OA, 2AK. U.S.A. :—NU 1ALR, 1AKM, 1RF, 1MV, 1AAO, 1ABG, 1ADS, 1TR, 1ALA, 1BHM, 1ABA, 1AXA, 1AOT, 1ASY, 1MV, 1WBJ, 1DX, 1KKK, 2GKM, 2AGS, 2AVW, 2AMF, 2ASE, 2ASM, 2BUY, 2AMJ, 2UW, 3GP, 3QW, 3CCO, 8BKM, 8AVD, 8ADG, 9ARA, KDO. Chile :—SC 2AH, 2AS, 2BL. Morocco :—FM 8VX, OCRB. Miscellaneous :—FO A9A, OH 3KK, SE B4, NC 1AD, FC F2, NJ 2PZ, FI 1CW, AS 11RA, NR CTO. A. H. Broomfield.

On 30 to 40 metres (0-v-1 Reinartz).

Hampton, Middlesex.

April, 1927.

Argentine :—SA DB2, DE3, HB1, HD4. Australia :—OA 2AY. Belgium :—EB 4AR, 4AU, 4FT, 4DD, 4RK, 4WW, 4XS, 4XX, K6, V9. Brazil :—SB 1AJ, 1AK, 1AR, 1AW, 1AT, 1BO, 1BR, 1BU, 1BW, 1IC, 1ID, 2AB, 2AD, 2AJ, 2AP, 2AR, 2AU, 2AV, 2ID, 2IG, SNI. Cameroun :—FQ PM. Canada :—NC 1AD. Czecho-Slovakia : — EC 2YD. Denmark :—ED 7ZG. Finland : — ES 2CO, 2NM, 7NB. France :—EF 8KX, 8ZB, 8WEL, 8MSM, 8XAM, 8TIS, 8SSW, 8ARO, 8AKL, 8BRN, 8BMY. Germany :—EK 4ABK, 4ABR, 4JL, 4UAH. Holland :—EN OGA, OJF, OLY, ONM, 2PZ. Italy :—EI 1DA, 1DR, 1FC, 1MA, 1NO, 1PL, 1UB, 1UU, 1WW. Jamaica :—NJ 2PZ. Japan :—JES. Mexico :—NM 1J. Morocco :—FM OCRB. New Zealand :—OZ 2BX. Norway :—EL LA1, LA1A, LA1E, LA1X. Poland :—ET TPAI, TPAR. Portugal and Madeira :—EP 1AE, 3FZ, 3GB. Rumania :—ER 5AA. Spain :—EE EAR 6, 30, 48. Sweden :—EM SMUF, SMUK, SMUV, SMWR, SMWQ. Switzerland :—EH 90C. Uruguay :—SU 1CD, 1CX, 1OA, 2AK. U.S.A. :—1AJF, 1AUR, 1ASA, 1MDB, 1MV, 1ACI, 1BUX, 1DEE, 1BHM, 1CJC, 1II, 1NW, 1BFX, 1CNZ, 2AWX, 2CUQ, 2AMH, 2AWQ, 2ATX, 2APD, 2IHM, 2BUY, 2BUR, 2CX, 3CPN, 3GP, 4JM, 4DU, 5OA, 6BAV, 8SG, 8XE. Austria :—EA PY, GP, MM, WY, MP. Miscellaneous :—WH4, SQAZ, ANC, PCJJ ('phone), OCDJ, AGB, GBH, WIK, ET 2XA, EASL, 2XT (15 metres), SUC, W1Z. A. F. Elton-Bott.

On 15 to 50 metres (0-v-1 Mod. Reinartz).

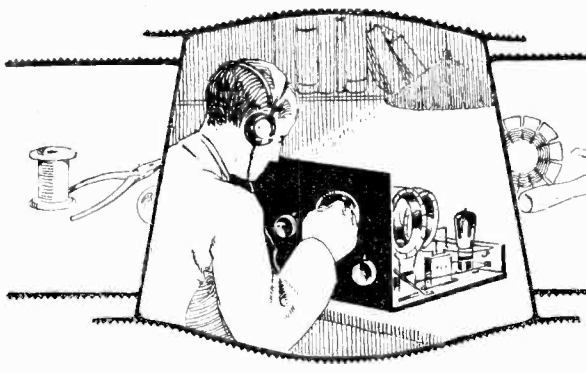
Pirbright, Surrey.

April 19th to May 1st.

Great Britain :—G 5BY, 5 HS. Belgium :—B 4AU. Sweden :—SMUK. France :—F 8HO, 8CT. U.S.A. :—NU 1AIR, 1CAW, 1CRA, 1RY, 1VK, 1ZD, 2ARM, 2BSL, 2CST, 6CC, 7AHC, 8BGX, 8BAU, 8CAN, 8CSR, 9CN. Brazil :—SB 1AK. Saigon :—AF 1B. Various :—ANF, AGC, GBM, OXZZ, PCRR, RKV, SS7, WIK.

On 20-metre band (0-v-1).

E. H. Robinson (G 5YM).



READERS' PROBLEMS

"The Wireless World" Information Department
Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

The B.B.C. "Quality Four."

I am desirous of building the "Quality Four" B.B.C. receiver described in your May 4th issue, since good quality is my main consideration. I wish, however, to add a switch to cut out one H.F. stage and also another switch to enable me to change over to crystal rectification if necessary. Could you give me the necessary circuit diagram? B. T. R.

It would be undoubtedly possible so to alter the circuit recommended by the B.B.C. that your proposed modifications could be carried out, but we would point out to you that the set would no longer be in the sense of the word the B.B.C. "Quality Four." However, even if you were intent on carrying out these modifications, after full realisation that the receiver would no longer be in accordance with B.B.C. specification, we should be doing you a disservice by providing you with such a circuit, since it would most certainly not be one that we could recommend. Briefly, if, as you say, quality is your main consideration, we advise you to give up complicated juggling with switches in resistance-coupled amplifiers, and to confine yourself to a straightforward receiver specially designed for quality, such as the one we have been discussing, or any of the special high-quality receivers described in this journal from time to time.

o o o o

Single Valve Circuit.

Some time ago I built up the single-coil single-valve receiver which was described in your columns and obtained great success with it. I have mislaid the issue in which this set was described, however, and should be glad if you would repeat the necessary circuit diagram together with details of the number of turns. S K.

This receiver was first described on page 509 of our issue dated March 31st, 1926, and proved very popular. We repeat the circuit diagram in Fig. 1 herewith. The single tuning coil should consist of a total of 100 turns of No. 22 D.C.C. wire wound on a former of 3in. diameter, tappings being taken at the 60th and 75th turns. The commencement of the winding should be connected to the grid condenser of the valve as shown in the diagram, the earth and L.T. plus connections being joined at the 50th turn and the aerial should be connected to the 75th turn; the other end of the coil going to the reaction condenser. Using this circuit reaction control will be found exceedingly smooth, thus greatly facilitating the reception of distant stations, whilst the selectivity obtainable is equal to that of any other single valve set, with the exception, of course, of single valve frame aerial receivers. Owing to the fact that the single coil required is quite easily made up at home, the instrument can be constructed at quite small cost and is specially to be recommended to those who wish for distant headphone reception at a minimum of expense and trouble. The H.F. choke shown in dotted lines in the diagram is entirely optional. It can be omitted if desired, but if it is omitted then the condenser shunting the telephones must also be omitted. It should be pointed out that the H.F. choke adds nothing to the distance-getting properties of the circuit, and is intended for the sole purpose of reducing capacity effects to a minimum. Needless to say, any of the commercial H.F. chokes upon the market will be suitable in this position. There is, however, not the slightest need to go to the expense of purchasing a choke if you desire to experiment with one, since full constructional details of an excellent H.F. choke were given on page 60 of our issue of January 12th, 1927. It should be pointed out that this set is very economical to run, a 2-volt accumulator and an ordinary 30-volt H.T. battery of the small cell type being all that is needed in the matter of fuel.

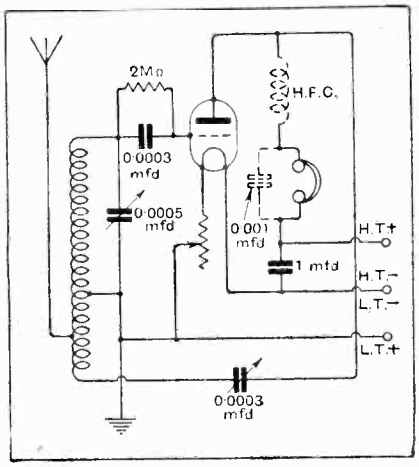


Fig. 1.—Single-valve long-distance receiver for headphone reception.

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Eliminator Hum.

I have heard it stated that if a battery eliminator is used on any given set and hum and noises are experienced that it is often possible, after all other attempts to cure it have failed, to eradicate the trouble by running the detector valve from a separate source of H.T. H. D.

Your information is quite correct, and it is often possible to remove apparently incurable troubles of this nature by running the detector valve from a separate source of H.T., such as an ordinary small cell dry battery. The popular leaky grid rectifier does not usually require more than 40 volts H.T., and since its current consumption is not high, as in the case of power valves, it is really quite a good plan to use a 40-volt H.T. battery of normal size for this valve, using the mains for all other valves. The detector valve is an old offender in the matter of preventing a battery eliminator from having a really silent background.

o o o o

Long Waves.

I have commenced to make the "All-Wave Four" and should like to wind an H.F. transformer suitable for tuning to the Eiffel Tower wavelength of 2,600 metres. I particularly desire to receive this station, and would be willing to sacrifice efficiency on the 900-1,400-metre waveband. P. M. C.

As you presumably wish to use the commercial coil-formers adopted in the original receiver, we would suggest that you wind the secondary with 320 turns of No. 38 D.S.C. wire. There should be 50 turns of No. 40 D.S.C. in the primary and neutralising sections.

Reaction Condensers.

I am building a Hartley receiver to work from a centre-tapped frame aerial. This will be followed by two transformer-coupled L.F. stages. Can you tell me the correct value of the reaction condenser?

T. R. B.

The value of the reaction condenser need not exceed 0.00005 mfd., and indeed usually an ordinary neutralising type of condenser is sufficient for the purpose. Doubtless you have noticed that in Hartley receivers described by us this type of condenser has been used for reaction purposes in conjunction with the usual centre-tapped frame aerial. This must not be confused with the value of reaction condenser usually advised in the Reinartz type of circuit where the value is much higher, being usually 0.0003 mfd.

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Volume Control.

I have installed loud-speakers in three different rooms in my house and wish to fit some simple form of volume control so that each instrument may be adjusted separately without interfering with any of the others, and should be grateful for any advice on the subject. N. C. R.

Provided that your loud-speakers are connected in series it will be a fairly simple matter to obtain the desired control of signal strength without appreciably altering the volume of the other instruments. You should connect across each of them a variable non-inductive resistor having a maximum resistance of about 100,000 ohms or even more.

If they are *not* series-connected we recommend you to make the necessary alteration, and would advise the inclusion of a choke-condenser output filter in the anode circuit of the last valve.

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An Eliminator Problem.

I have constructed a battery eliminator delivering output voltages of 60, 120 and 200, and on adding an extra choke in the positive supply lead find that the output voltages are now lower than formerly. Can you please explain the reason for this reduction?

R. E. M.

The voltage obtainable from any tapping on the potentiometer in a battery eliminator as shown in Fig. 2 is dependent upon the ratio of the resistance R_1 to the total resistance across the supply leads. For example, if the resistance R is 10,000 ohms, and choke A has a resistance R_2 of 500 ohms, then the voltage dropped across half the resistance R, which we will call R_1, will be proportional to: $\frac{R_1}{R+R_2}$ of the supply voltage. We will assume that in this case 200 volts are available across XY, so that the volts dropped across R_1 will be :—

$$\frac{5{,}000}{10{,}000+500} \times \frac{200}{1} = 95 \text{ volts.}$$

If, now, another choke B having a D.C. resistance R_3 of 500 ohms be included in the circuit, then the volts dropped across R_1 will be less than formerly. This will be seen from the following :—

Volts across $R_1 = \frac{R_1}{R+R_2+R_3}$ of the supply voltage

$$= \frac{5{,}000}{10{,}000+500+500} \times \frac{200}{1} = 91 \text{ volts.}$$

It will be seen from the above that if the chokes A and B have a relative high resistance, the omission of one will materially affect the output voltage from fixed tappings on the potential divider R.

The above figures refer to the theoretical voltage developed across any portion of the potential divider when no load is taken from the eliminator. When the device is used to supply H.T. to a receiving set, current will be taken from it and the voltage will drop below the theoretical value. The actual voltage will be governed by the current taken, and for this reason it is difficult to determine its value by calculation.

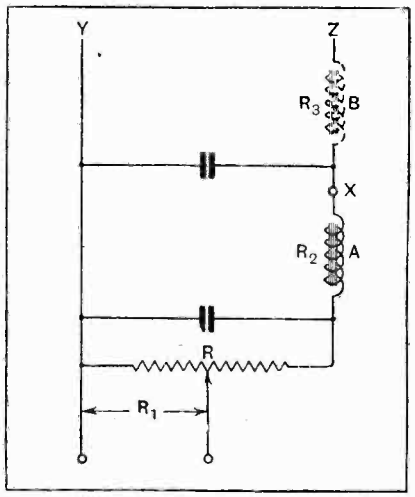

Fig. 2.—D.C. battery eliminator circuit showing resistances affecting final output voltage.

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A Question of Henries.

I am building a receiver in which I shall incorporate the choke-filter method of feeding the loud-speaker. Can you tell me the correct inductance of the choke? P. R. A.

It can be taken as a good rule that an inductance value of 20 henries is sufficient for all types of power valve, and naturally you will use a power valve of some sort in your output stage. Not the slightest harm will be done by a higher inductance *per se*, but the point is that increase of inductance indicates an increase of ampere-turns, or in other words we may say that increase in the number of turns on the coil to get higher inductance means that the magnetising force exerted by a given current passing through the choke windings will be increased, and if we do not increase also the dimensions of the iron core, the effect will be that magnetic saturation will set in and cause distortion.

The modern power valve passes a fairly heavy plate current and supposing we wind a 20 henry choke which will comfortably accommodate the plate current of such a valve without getting magnetically saturated, we shall find that if, for any reason, we increase the number of turns in order to raise the inductance value, we shall eventually come to a point where the iron core becomes magnetically saturated. If, however, we redesign our choke with a larger core suitable for accommodating the plate current of the power valve, then all will be well even though the inductance be higher. Many of the 100-henry chokes on the market designed for use after a high impedance detector valve have quite a small core because the plate current of the detector valve is small and they amply accommodate it. They would be useless, however, in the plate circuit of a power valve. It would be quite possible to make a 100-henry choke which would be capable of being put in the plate circuit of a power valve, but the whole point is that such inductance is unnecessarily large, 20 henries being quite sufficient, and, moreover, it would be cumbersome and expensive. On the contrary, a 20-henry choke capable of being put in the plate circuit of the power valve would be reasonably small and inexpensive. It should not be assumed, however, that every 20-henry choke on the market is capable of carrying the plate current of a power valve because there are many cheap instruments of foreign manufacture which will not do so. On the other hand, it should not be assumed that any choke exceeding 20 henries inductance is incapable of being used after a power valve; indeed, at least one manufacturer has on the market a 32-henry choke which, apart from being compact and reasonably priced, will deal adequately with a plate current of 80 millamperes.

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Overloaded.

I find that when my receiver, the circuit of which is shown on the attached diagram, is accurately tuned to the local station, signals are distorted and broken and the only way to obtain good reproduction is to move the condenser dial several degrees away from the point giving loudest results. I should be glad if you could suggest any possible cause for the trouble.

G. W. C.

Your circuit is a simple and conventional one, and, although we note that a "super power" valve is used in the output position, it should be stated emphatically that at your very short distance from the local station it is very easy to overload one of these valves, and we are quite confident that this is the cause of your trouble. Unless you are willing to go to the expense of using a valve with a still larger power-handling capacity you must satisfy yourself with weaker signals, and it would, perhaps, be as well to fit one of the many forms of volume control which have been discussed in recent issues of this journal.

The Wireless World AND RADIO REVIEW

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VALVE PRICES.

NO doubt our readers will have noticed that the question of valve prices is being taken up by the daily Press following on the campaign conducted by *The Wireless World* for a reduction in price. Our readers will remember that in our editorial reference to the subject in our issue of May 11th we closed our campaign for the time being because we were satisfied that a price reduction within a reasonable time could be confidently anticipated.

The daily Press is now going over again the ground already covered in *The Wireless World*, but apparently without having the advantage which we have had of being closely in touch with the Valve Association and individual valve manufacturers in this country. No subject of this kind can be fairly discussed unless one is intimately acquainted with both sides of the question.

In case there is any possibility that our attitude in closing our campaign for the time being is not clear to our readers, we again emphasise that our close acquaintance with the whole position leaves us satisfied that a substantial price reduction in all excepting perhaps the newest types of valves will come about within what we regard as a reasonable space of time when the difficulties involved are taken into consideration. Under these circumstances we see no purpose in pursuing a policy of criticism unless we should find that our confidence in the intentions of the valve manufacturers has been misplaced.

CONTENTS.

THE MARCONI LICENCE AGREEMENT.

IN our issue of May 18th we commented editorially on the modification which the Marconi Company seeks to make in its general licence agreement with manufacturers of broadcast receivers, and in our issue of last week we published a letter of reply from the Marconi Company.

In our opinion, that letter still left certain points not clearly explained, and we therefore sought an interview with an official of the company. In conversation with us the position was explained in more detail. We were assured that the modification in the agreement does not indicate any change of policy on the part of the Marconi Company, but that its aim is merely to avoid misunderstanding and litigation where, under a somewhat literal interpretation of the old agreement, it might now have been possible for manufacturers to utilise a multiple valve such as the "Loewe" type, which is in fact two or more valves combined in one bulb, and yet claim to pay the same royalty of 12s. 6d. which manufacturers of other sets would pay on the use of a single three-electrode valve. We were assured that, with the exception of the "Loewe" multiple valve and other valves of that type, all valves at present in existence came under the old royalty of 12s. 6d., including the four-electrode valve, the "Hull" screened valve, and reflexing as at present used in various receivers.

We were told that at one time the company had considered so wording the modification to the agreement that the basic unit, on which a 12s. 6d. royalty would in

future be payable, should be a stage of amplification equivalent to the use of a three-electrode valve. This wording, however, would have precluded the use of reflexing, which it is the intention of the company should still be permissible on the charge of 12s. 6d. per valve holder as at present, and therefore the present wording, although admittedly not ideal, was adopted.

We were most emphatically assured that there is no intention on the part of the Marconi Company to endeavour to create a new monopoly nor to impose a royalty in excess of the present charge for the use of any new type of valve which may give special performance, unless such valve is, in point of fact, a combination of two or more valves, when the royalty would then be calculated on the basis of 25s. for a dual valve, or 37s. 6d. for a triple valve.

We have submitted a copy of this, our interpretation of the amending clause of the agreement, to the Marconi Company, and are informed that our interpretation is correct.

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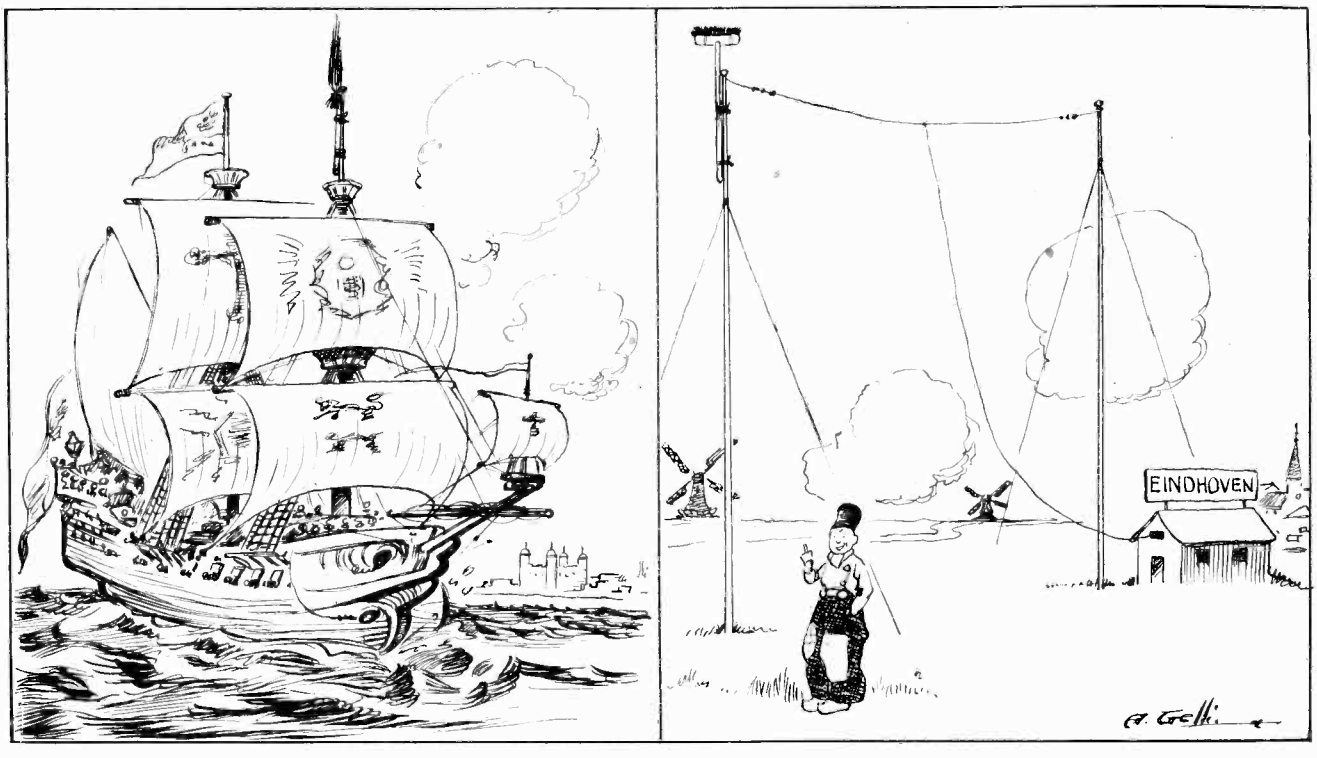
THE B.B.C. AND THE QUEEN'S HALL.

AFTER months of negotiation between the B.B.C. and Messrs. Chappell and Co., Ltd., the lessees of the Queen's Hall, an agreement has at last been reached which, it is stated, will insure the continuance of the Queen's Hall as a home for music and the resumption of the promenade concerts.

At the time of writing, the precise nature of the agreement has not been disclosed, but it would appear that, in return for permission to install microphones in the Queen's Hall and to broadcast concerts and other events taking place there, the B.B.C. has entered into an arrangement whereby they will run a series of concerts and, presumably, contribute either directly or indirectly to the expenses of Messrs. Chappell and Co. in connection with concerts during the coming season. The lessees of the Queen's Hall have maintained for some time past that it was not possible to compete with the B.B.C. and they contemplated having to give up the promenade concerts.

Whilst the direct result of this agreement between the B.B.C. and Messrs. Chappell and Co. is a matter for congratulation, yet there is, of course, another point of view which may be taken. We have, in the past, on different occasions expressed our disapproval of the policy of the B.B.C. in conducting their own concerts to which the public have been invited. In our opinion, the B.B.C. should not compete with organisers of concerts which are open to the public, but should confine their musical broadcasts to what is performed in the Studio or to the broadcasting of outside entertainments organised for purposes other than broadcasting and not under the direction of the B.B.C. As things stand at present we may expect the B.B.C. to build its own theatre and, by using the microphone for publicity, get a very unfair advantage over other theatre proprietors; similarly, in almost every direction there is the opportunity for the B.B.C. to compete in this way with other interests, unless the present policy is checked.



In 1652 Admiral Tromp, the courageous Dutch commander, defeated the British fleet under Admiral Blake at Dover, and, according to tradition, sailed up the Channel with a broom hoisted to his masthead to denote that he had "swept the seas." In 1927 the Dutch station of the Philips Company at Eindhoven "sweeps the ether" on short waves and again scores off Britain, but this time in the friendliest spirit of rivalry.

WIRELESS AND THE ECLIPSE.

How Experimenters can Assist in Collecting Data.

By Prof. E. V. APPLETON, F.R.S.

THE total eclipse of the sun in the early morning of June 29th of this year will be a unique event in the lives of the majority of us. Thousands of people from all parts of the world will make the journey to the North of England in order to witness one of the most awe-inspiring spectacles of all the varied phenomena of Nature. Many wireless experimenters will, no doubt, be among these thousands who, by going to Yorkshire, will see the rapid progress of the dark shadow crossing the hills just before the sun is completely hidden and see the stars flash out as if at midnight. But there will also be many wireless enthusiasts who will find the eclipse a unique opportunity for studying the vagaries of reception and who, throughout the eclipse, will be at their receivers making observations on the special wireless transmissions that will be taking place at that early hour. The American wireless experimenters had an opportunity of making such observations on January 24th, 1925, when they experienced a total eclipse, and now such an opportunity has come to British observers. The present article deals with the eclipse from the wireless standpoint, and in it I propose to discuss the possible types of observations which the amateur can make.

First of all I will say a few words about eclipses in general, in order that the later discussion of the effects on wireless may be the more easily understood.

We experience eclipses of the heavenly bodies in two ways. In the first type of eclipse the obscuration of one body is brought about by the intervention of another between it and the eye of the observer. In the second type the body is eclipsed because another body intervenes between it and the source of its illumination. Both of these types can be illustrated by the case of the sun, moon, and the earth. A solar eclipse is of the first type mentioned, in that it is due to the passage of the moon in front of the sun.

This state of affairs is illustrated in Fig. 1 (which, of course, is not to scale), which shows diagrammatically how the light from the sun is completely cut off so far as a small part of the earth is concerned. This small area is called the area of totality. Round the area of totality there is a region where only a portion of the sun is visible, and here a partial eclipse is to be seen.

The second type of eclipse is caused by the intervention of a solid body between the obscured body and the source of illumination. This takes place when the earth prevents the sun from illuminating the moon. This type of eclipse is represented diagrammatically in Fig. 2.

Now although we are at present unable to say whether the moon has any marked influence on wireless propagation, we do know, thanks to the recent intensive study of wireless propagation by many investigators, that the sun has a very marked influence on transmission. A solar eclipse is, therefore, likely to yield data of great interest and importance.

Path of the Solar Eclipse.

First of all, a few facts concerning the time and place of the eclipse may be useful. The actual path of the shadow of darkness is about thirty miles wide and extends fifteen miles on each side of a line drawn through Criccieth, Colwyn Bay, Southport, and Hartlepool. The eclipse begins about 5.25 a.m. (summer time), and lasts about 110 minutes, so that totality will occur about 6.20 a.m. to 6.30 a.m. The totality or time of darkness will last about thirty seconds. Wireless observations will, of course, have to begin very early, well before sunrise on the morning in question, in order that the complete series of phenomena may be studied.

The facts given immediately above concerning the place of totality have been calculated by the astronomers, who are themselves making great preparations for observing the eclipse and photographing the sun during the moments of totality. Until recently the astronomers were the chief scientific workers who found eclipses occasions of special interest, but now they are joined by wireless observers, and the question arises whether the places of totality predicted and calculated by the astronomers for their photographic observations are really the best regions for the wireless observer. This is a very interesting and important question, and to answer it I must first deal with one or two fundamental facts about wireless transmission.

The enormous number of observations made on signal

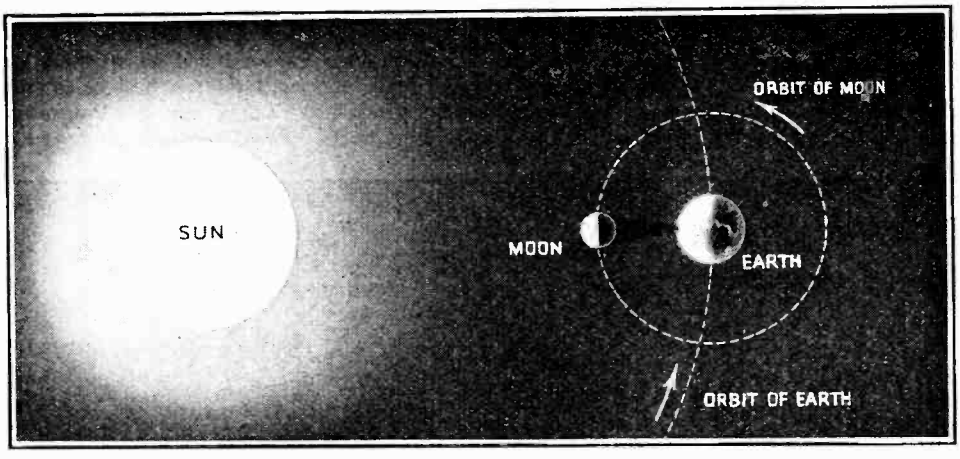


Fig. 1.—Solar eclipse in which the moon is interposed between the earth and the sun.

Wireless and the Eclipse.—

intensities during the last few years have shown very marked differences between day and night phenomena, especially on the shorter wavelengths. For very long waves the difference is not so marked, but for broadcasting wavelengths and ultra-short waves the differences are very pronounced. The differences are curious in that they do not always bend in the same direction. For example, in the case of the broadcasting signals at distances of 200 miles or so the night-time signals are usually stronger at night than during the day. On the other hand, with very short waves (*e.g.*, 15 metres), which are used for long-distance working, the signals are often stronger by day than by night. It is not easy to give satisfactory explanations of all these phenomena, but it is obvious, from the marked changes in reception which take place at sunset and sunrise, that the sun is a controlling factor. Recent experiments have shown that the sun exerts its influence *via* the Heaviside layer of electricity, which is situated in the upper atmosphere and which is altered in height and properties by the action of the sun.

Track of the Heaviside Large Eclipse.

Bearing the above facts in mind, we are in a position to appreciate an important difference between the eclipse from the points of view of the astronomer and the wireless observer. This difference (which was first pointed out by Dr. E. H. Rayner, of the National Physical Laboratory) is that the eclipse belt for the Heaviside layer at a height of, say, sixty miles will be at an entirely different part of the country from the eclipse belt for the photographic astronomical observations made at the ground. The cone of darkness caused by the shadow of the moon does not meet the earth's surface vertically, and the result is that the eclipse at the Heaviside layer is along a track roughly parallel to the one on the ground but 100 miles south-east of it. This very important difference suggests that if experiments are made on the nature of reflection from the Heaviside layer the experiments ought to be carried out near a line from Cardiff to Grimsby. The Radio Research Board of the Department of Scientific and Industrial Research is, therefore, arranging for experiments to take place along the belt of the Heaviside layer eclipse, as well as on the ground eclipse belt, to see if any difference in signal strength can be detected between the two places.

There are two further points in which the wireless observers will work under different conditions from the astronomical observers. Dr. Rayner and Dr. Comrie have estimated that the eclipse on the Heaviside layer will take place a little earlier than that for the ground. They estimate that the centre of the shadow at a height of sixty miles will have passed over England (between 6.20 and 6.22 a.m. B.S.T.) before the centre has arrived from the west at the Welsh coast in its journey across the North of England. In the case of the eclipse at the ground, the centre of the shadow will travel across Wales and England from 6.23 a.m. to 6.25 a.m.

A second and very important difference between the cases of the wireless and astronomical observer is that the weather will not matter to the former, but will be all-important to the latter. So far as we know, the wireless observer will be able to make his observations even if the sky were cloudy, but in such a case photographs of the sun's corona would be useless. There is, of course, the possibility that atmospherics may upset some of the wireless observations, but, on the whole, this seems unlikely, as the eclipse takes place at a time when atmospherics are not usually very strong.

How to Make Observations.

I now turn to discuss a question which no doubt will be uppermost in the minds of most readers of this journal. The wireless experimenter will be asking himself: How can I assist in adding a few observations to the great mass of data we hope will accrue from the special eclipse wireless transmissions? This question I will do my best to answer. In the first place, I think we may rule out long-wave observations for the amateur. These are best made using galvanometers and voltmeters and other measuring instruments. Observations ought to be confined to wavelengths of the broadcasting range and below. Let us consider the broadcasting range first. Here accurate measurements of signal strength will be made by the Radio Research Board observers, and from these the height of the Heaviside layer will be estimated at various times during the eclipse. But these observations can be supplemented very considerably by amateur estimates of signal intensity on other stations which are modulating. But a very important factor comes in here. We may expect the eclipse to cause a sunset and a subsequent sunrise *after* the normal sunrise has taken place. Thus the eclipse is really a special opportunity of studying sunrises and sunsets. It, therefore, cannot be too strongly emphasised that observations made on the day of the eclipse will be of little value

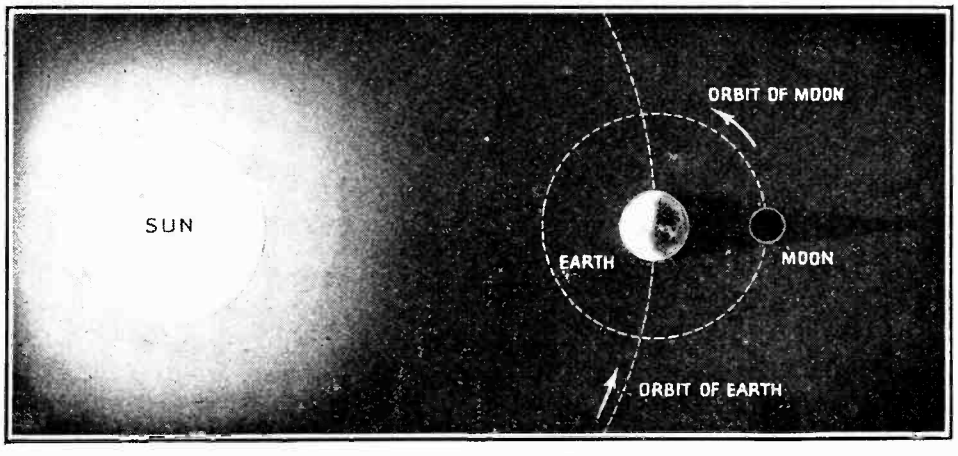


Fig. 2.—Lunar eclipse in which the earth's shadow is cast across the moon.

Wireless and the Eclipse.—

unless they can be compared with normal reception results. Thus observations of a similar character should be made at least the morning before and the morning after the eclipse. Only in this way shall we be able to say what is the effect of the eclipse itself as compared with normal sunset and sunrise. In order to make similar observations from morning to morning and have the results comparable, it is necessary to have the receiver sensitivity constant. Thus filament and anode volts should be kept the same, and the set should only be used for stations which are comfortably received without strong reaction. The last point is very important, for a set on the verge of oscillating is useless for signal estimates, apart from the possibility of its interfering with other workers. Thus to the workers with a broadcast set I would say: Study the sunset (and, if possible, sunrise) characteristics of a station you can receive *with great ease* and note what extra phenomena you observe on the morning of the eclipse.

Short-wave Tests.

I now turn to the question of ultra-short-wave observations. The Radio Research Board, in conjunction with the Radio Society of Great Britain, are arranging for a series of transmission on various short wavelengths. A transmission on 90 metres will take place from Caterham and one on 100 metres from Iceland. Arrangements are also being made for signals on 23 metres and on 44-46 metres. The two latter stations will be situated one north and one south of the line of totality for the Heaviside layer. Amateurs will here find plenty of scope for audibility estimates of signal intensity. In particular, they will be able to make the check measurements for a normal day, which, I have pointed out, are so necessary, for the above transmissions are also to take place on the mornings of the two days preceding and the two days succeeding the morning of the eclipse. Thus the experimenter will have plenty of opportunities of making observations on short-wave intensities on a fair range of wavelengths.

A final word on small but important details may not be out of place. It is essential to record any observation immediately it is made. Do not trust to the memory. Also it is important to time each observation correctly with a watch or clock checked before and after the series of observations by means of time signals. Sometimes confusion arises between B.S.T. and G.M.T. The times relating to the eclipse have been given above in B.S.T.

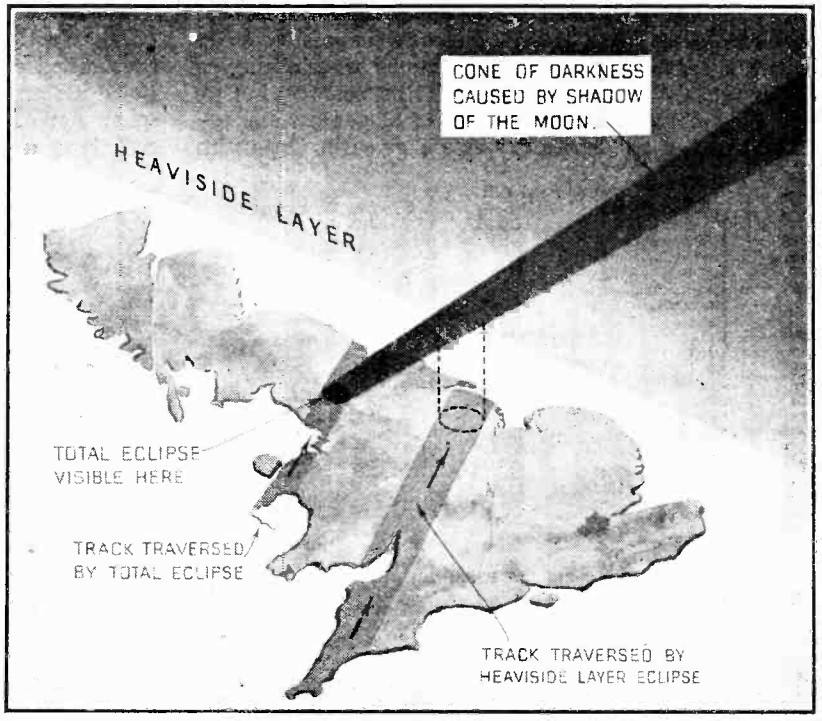


Fig. 3.—The shadow cast by the moon passes through the reflecting surface of the Heaviside layer approximately 100 miles S.E. of the path of the visible eclipse and the path of totality for wireless observations will therefore pass through Cardiff and Grimsby.

TRADE NOTES.

Chloride Rugger Success.

The Rugby team of the Chloride Electrical Storage Co., Ltd., of Clifton Junction, Manchester, has distinguished itself by winning for the second time the Workshops Cup Competition organised by the Broughton Rangers Rugby Football Club. In the final match the Chloride team defeated the Salford Municipal Employees team by 11 points, after a splendid display of high-class football by both sides.

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Constructing an "M.H." Portable.

Owing to the success of the "M.H." five-valve Supersonic Block Unit, Messrs. L. McMichael, Ltd., Wexham Road, Slough, Bucks, have issued constructional details for a six- or seven-valve portable receiver incorporating this unit. The completed receiver covers both the Daventry and normal band of wavelengths, and gives good loud-speaker results on a number of stations.

The cost of the complete instrument, including all valves, batteries, etc., is £21 16s.

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Osram Valves and the "Everyman Four."

In a letter to the General Electric Co., Ltd., in appreciation of the new G.E.C. range of 4-volt valves, Mr. F. Egerton Parker, of Highgate, London, N.7, describes how he embodied these valves in his "Everyman Four." "My reception," he writes, "is improved by about 25 per cent. more stations, greater volume and purity, whilst my current consumption is greatly reduced. Now that I can reduce the bulk of my accumulator I am thinking of constructing a portable—a cross between the 'Everyman Three' and the 'Wireless World Five.'"

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Address Wanted.

Messrs. The Dubilier Condenser Co. (1925), Ltd., have received an enquiry from Mr. R. King, of Torquay, for details concerning certain components. Unfortunately the gentleman has omitted to give his address, and the company is, therefore, unable to comply with his requirements. They trust that this paragraph will come to his notice.

REGULAR TRANSMISSIONS.

Useful Data for Checking Wavemeters and Calibrating Receivers.

HOME constructors and experimenters generally who wish to calibrate their receivers will find the list of Regular Transmissions which we give below of considerable service. It is, of course, impossible in so limited a space to give all the stations transmitting at regular times which may be heard in this country, but we think the following list gives all those of general interest.

The times of all transmissions are given in Greenwich Mean Time. During the period of Summer Time it will, therefore, be necessary to deduct one hour from Summer Time to arrive at G.M.T.

Included in the list are the International Time Signals transmitted simultaneously on 32 and 18,940 metres from Bordeaux and Paris at 0800 and 2000, the well-known spark signals from the Eiffel Tower at 0925 and 2245, and those from Nauen at 1155 and 2355.

Wave-length.	Name of Station.	Call Sign.	Times of Transmission.
20	Mourillon, Toulon	OCTN	1530—1540.
24.7	Bellevue D.C.	NKF	2130.
32	Paris–Eiffel Tower	FL	0755, 0801, 1955, 2001, 2250
	Rome	IDO	1950.
33	Issy-les-Moulineaux	YZ	0940.
	Mourillon, Toulon	OCTN	1545–1555.
	Paris	OCDJ	0945, 2250.
36	Rabat	OCRB	0750, 2210.
50	Tunis	OCTU	2100.
51	Ain Beida	AIN	0830, 1930.
57	Mourillon, Toulon	OCTN	1600–1610.
58	Beyrouth	OCBY	2015, 2130, 2145.
75	Paris–Eiffel Tower	FL	0420, 0840, 1600, 2250.
270*	Portland Bill	FB9	0918, 2018.
300*	N. Hinder	PCN	0700, 1500, 1800.
400*	Flushing	PCD	0705, 1305, 1805.
	Helder	PCB	0707, 1307, 1807.
600*	Bergen	LGN	0755, 0950, 1530, 1855, 2050.
	Blaavand	OXB	0100, 0500, 0900, 1300, 1700, 2100.
	Copenhagen	OXA	0300, 0700, 1100, 1500, 1900, 2300.
	Cullercoats	GCC	0948, 2048.
	Niton	GNI	0930, 2030.
	Seaforth	GLV	0930, 2030.
	Valentia	GCK	0948, 2048.
660*	Borkum Lightvessel	KBR	0645, 1245, 1745.
800(T)	Bergen	LGN	0950, 2050.
800*	Memel	RYM	0645, 1245, 1745.
900	Air Ministry	GFA	0759.
	Le Bourget	FNB	0844.
1,000*	Monsanto	CTV	1130, 1350, 1850, 2309.
	Terceira	PQT	0030, 1330, 1830.
1,100	Lausanne	HB2	0700, 1300, 1800.
	Swinemunde	KAW	1030, 1300, 1620, 1800, 2145.
	Utrecht	PIMR	1025, 1235, 1525, 1925, 1945.
1,100(T)	Lausanne	HB2	1200, 1755.
1,100*	Norddeich	KAV	1015, 2130.
	Rame Head	BYO	0918, 2018.
1,130	Aldergrove	GFH	†0705, 1005, 1305, 1805.
	Cranwell	GFC	†0105, †0705, 1005, 1305, 1605, 1805.
	Leuchars	GFD	†0705, 1005, 1305, 1805.
	Renfrew	GER	†0705, 1005, 1305, 1605, 1805.
	Sealand	GFO	†0705, 1005, 1305, 1605, 1805.
1,200	Calshot	GFL	†0705, 1005, 1305, 1605, 1805.
	Felixstowe	GFF	†0705, 1005, 1305, 1605, 1805.
	Guernsey	GEY	†0705, 0905, 1005, 1305, 1805.
	Plymouth	GFM	†0705, 1005, 1305, 1605, 1805.
1,330	List	KAL	0150, 0500, 0650, 1040, 1250, 1640, 1750, 2220.
	Wilhelmshaven	KAN	0720, 1300, 1820.
1,400	Air Ministry	GFA	0745.
	Le Bourget	FNB	0847.
	Riga	KCA	1350.
1,450	Tromsö	TUT	1030, 1515, 2015.
1,460	Worthy Down	GFG	†0705, 1005, 1305, 1805.
1,500*	Bilbao	EGH	0735, 1335, 1835.
1,525	Marignane	FNM	0504, 0704, 1004, 1304, 1504, 1804.
1,525(T)	Toulouse	FNT	0508, 0708, 1008, 1508, 1808.
1,550	Breslau	BU	0755, 1420, 1855.
1,575	Hamburg	AEM	0640, 0840, 1440, 1940.
1,600	Barcelona	EGE	0810, 1345, 1825.
1,650	Kiel	KBK	0720, 1010, 1320, 1615, 1820.
	Pillau	KAP	0730, 1330, 1830.
1,680	Air Ministry	GFB	0536 and hourly to 1636, 0800.
	Cologne	GEK	0716 and hourly to 1516.
	Le Bourget	FNB	0728 and hourly to 1628, 0850.
	Lindenberg	AEQ	0125, 0650, and hourly to 1650.
	Uccle	OPO	0622 and hourly to 1822.
	Utrecht	PIMR	0745 and hourly to 1445.
1,800	Blaavand	OXB	1005.
	Lyngby	OXE	0123, 1005.
1,800*	Fauske	LDW	0715, 1315, 1815.
1,800*	Reykjavik	TFA	1030, 2005.
1,840	Cherbourg	FUP	0105, 0515.
1,850	Andover	GFI	†0700, 1000, 1300, 1800.
	Bergen	LGN	0950, 2050.
1,900	Utrecht	PIMR	0710, 1310, 1810.
1,950	Danzig	DG	0705, 1305, 1805.
1,980	Zurich	HBK	0708, 0808, 0908, 1008, 1108, 1308, 1408.
2,000	Le Bourget	FNB	0750, 1650, 1750.
	Stuttgart	SX	0850.
2,000*	Revel	AZA	0725, 1250, 2050.
2,650	Warsaw	WAR	0200, 0550, 0835, 1115, 1230 1435, 1900.
2,100	Devizes	GKU	0044, 0444, 0844, 1244, 1644, 2044.
	Paris–Eiffel Tower	FL	1200.
	Paris	YA2	0550, 1040.
	Rochefort	FUR	0516, 0716, 1016, 1316, 1516, 1816.
	Sandhama	OJA	0812, 1412, 1912.
2,170(T)	Lyngby	OXE	0740, 0945, 1045, 1340, 1840.
2,300	Norddeich	KAV	1205.
2,400	Tripoli	ICK	0750, 1850.
2,400(T)	Monsanto	CTV	1140, 2310.
2,450	Königsberg	KÖ	0805, 1030, 1905.
2,525(T)	Berlin (Wolff's Bureau)	—	1050, 2020.
2,650	Libau	KCQ	0735, 1025, 1335, 1835.
	Madrid	EGC	0705, 0820, 0845, 1305, 1420, 1445, 1805, 1920, 1945.
	Paris–Eiffel Tower	FL	0220, 0400, 1715, 2230, 2235.
2,650(T)	Paris–Eiffel Tower	FL	0640, 1115, 1900, 2210.
2,650*	Paris–Eiffel Tower	FL	0755, 0801, 0925, 2245.
2,677	Washington (Arlington)	NAA	0300, 0330, 1530, 1700.
2,800*	Nantes	UA	1230.
2,930	Scheveningen	PCH	1115.
3,000	Monsanto	CTV	0835, 1435, 1935.
3,050	Vienna	OHO	0750.
3,100	Nauen	POZ	1155, 2355.
	Warsaw	WAR	0835, 1435, 1920.
3,300	Berlin	DL	0745, 1345, 1845.
3,350	Königswusterhausen	AFR	0720, 1320, 1820.
3,400	Berne	HB8	0715, 1315, 1815.
3,500*	Sofia	FF	0655, 1355.
3,600	Brest	FUE	0455, 0900, 1500, 2000.
	Bizerta	FUA	0810, 0910, 1130, 1410, 1910.
	Casablanca	CNM	0155, 0800, 1400, 1900.
3,700	Juliana Haab	OXF	1200, 1800, 2400.
4,100	Air Ministry	GFA	0200, 0600, 0800, 0835, 0850, 0900, 1050, 1400, 1450, 1650, 1900, 1935, 2000.
4,200	Karlsborg	SAJ	0740, 1050, 1340, 1840, 2200.
4,400	Budapest	HAR	0835, 1315, 1845.
4,409	Washington (Arlington)	NAA	0300, 0330, 1530, 1700.
4,500	Porquerolles	FUQ	0145, 0750, 1050, 1350, 1900.
4,800	Leningrad	RET	0915, 1100, 1530, 1858, 2030.
	Malta	GHA	0707, 1307, 1807.
	Moscow	RAI	0900, 1040, 2055.
	Rome	IDO	0850, 1950.
5,300	Lyngby	OXE	0735, 1100, 1335, 1835.
5,400	Ismalia	GHK	1100.
5,454	Oslo	LCH	0750, 1040, 1350, 1640, 1850.
6,000	Belgrade	HFB	0850, 1450, 1950.
	Paris	YG	1600, 1920.
6,120	Prague	OKP	0740, 1340, 1840.
6,700	Gibraltar	BWW	0705, 1805.
7,300	Paris–Eiffel Tower	FL	0820, 0840, 0940, 1420, 2100.
9,000	Nantes	UA	1415.
10,300	Grudziadz	AXK	0800, 1400, 1900.
10,500	Rome	IDO	1600.
11,000	Abu Zabal	SUC	0955.
11,700	Bucharest	CVM	0900, 1030, 1350, 1850.
17,040	Washington (Annapolis)	NSS	0300, 0500, 1700.
17,630	Varberg	SAQ	0740, 1000, 1340, 1840.
18,060	Nauen	POZ	1155, 2355.
18,940	Bordeaux	LY	0800, 1955.

* Spark Transmission. (T) Radio Telephony. All other transmissions are C.W. † Times approximate.

SECRET RADIOTELEPHONY SYSTEMS.

A Review of the Problems Involved and Solutions Suggested.

By O. F. BROWN, M.A., B.Sc.

THE recent inauguration of the Transatlantic Telephony Service has directed attention to the problem of secrecy in radio communications. Hitherto comparatively little serious consideration has been directed to this matter, partly owing to obvious difficulties of the problem, and partly owing to the fact that where telegraphic communication was concerned the disadvantages of a lack of secrecy could be overcome by the use of code or cipher. Although code words can be employed to a certain extent in telephonic communications, it is obvious that serious inconveniences are introduced by their use. It seems probable, therefore, that the general use of long-distance radiotelephone services is likely to be prejudiced by the fact that at present portions of the conversations, at any rate, can be picked up by unauthorised persons over considerable areas without great difficulty, and it is natural that the removal of this difficulty should be receiving consideration.

Fundamental Principles.

The object of the present article is to review the difficulties to be met in the problem of providing some adequate degree of secrecy while at the same time preserving the requirements of efficient radio communication, and to indicate the lines along which a solution seems likely to be found. It may be stated that little or nothing has been published on the matter, and the only source of information is the study of patent literature.

Obviously, with line telephony the area over which the speech can be picked up is limited to the region near the wire or cable conveying the current, and systematic eavesdropping is only possible to persons having access to the wire in question. The case of a radio station is different. If the signals are capable of being received at one station they can, with suitably designed apparatus, be received at another station. The only way in which radio communication could approach line communication, with regard to the area over which interception is possible, would be to concentrate the wireless waves into an extremely narrow beam. Now it has been suggested by writers in the non-technical Press that the Marconi beam stations radiate in a manner approximating to a beam of this nature. This is certainly not the case. A study of the published data of the beam stations shows that the radiation is directed not in a narrow band, but in a fan several degrees wide. The result is that at a distance of, say, 2,000 to 3,000 miles the radiation can be picked up over an ever-widening belt of not less than two or three hundred miles wide. In giving this value to the width of the belt it is assumed that the "cut off" at the edges of the "fan" is sharp. No reliable evidence is available on this point, but it is extremely likely that the edges of the fan are not sharp, so that the area over which the energy can be received with sufficiently sensitive apparatus is greater still.

It has also been suggested in the non-technical Press that the reflector or directive aerial systems employed at the beam receiving stations are essential for the reception of the radiation from the corresponding transmitting station. These reflectors are extremely valuable, in that they make the receiver more sensitive to radiation from a particular direction, and by so doing reduce interference both by atmospherics and by signals from transmitting stations arriving in directions other than that in which it is desired to receive. It is not true, however, that without the reflectors the signals are so weak that they cannot be picked up with suitable apparatus having a high factor of amplification. The long-distance communication obtained by amateurs employing extremely small powers affords good evidence on this point. The importance of the reflector aerial lies in the fact that the ratio of signal strength to atmospheric noise is increased, and thereby the number of hours possible per day for satisfactory working is increased. Hence, without a complicated aerial system which could not be erected surreptitiously, reception at long distances from a short-wave beam station would be possible only under comparatively favourable atmospheric conditions, and without the reflector there would be periods at which eavesdropping would be extremely difficult or impossible. Except in this sense, however, it can be said that present-day beam transmission would be unlikely to provide any adequate degree of secrecy.

Silent Zones.

The use of short waves, however, has one advantage which must not be overlooked, namely, the fact that on short waves the energy is radiated for a considerable distance by waves travelling through the upper layer of the earth's atmosphere, while any energy travelling along the ground is absorbed at a comparatively short distance from the transmitter. Apart from a short distance round the transmitting station, therefore, there is a zone of silence of perhaps several hundred miles—the exact radius depending on the wavelength used. After this distance the waves deviated from the upper atmosphere reach the earth and signals become comparatively strong. In certain particular cases the existence of the silent zone could no doubt be used to assist in providing a service which could not be intercepted.

On the other hand, the beam system is proving successful in the main for telegraphic communication; and it appears to be generally accepted that the variations in signal strength and fading effects due to the influence of the upper atmosphere on the propagation of short wireless waves render it still desirable that long waves and comparatively high power should be employed in such a service as radiotelephony over long distances where it may be essential for two subscribers to be put into communication at a prearranged time without delay. Since there can be no possibility of guiding long waves in a beam, the problem of securing secrecy resolves itself

Secret Radio Telephony Systems.—

into transmitting the speech in such a way that reception becomes difficult without very complicated apparatus.

In using radiotelephony on long waves, one matter which has to be considered is the amount of interference produced on other communications. So great is the amount of signalling by wireless now taking place that the task of fitting in of new lines of communication on long waves presents the greatest difficulty. One of the most important criteria by which a method of radio communication has to be judged is therefore whether it could be introduced into the existing crowded condition of the ether. As will be seen later, many of the suggested secret systems proposed can stand no chance of general adoption on account of their failure to conform to this important condition.

Width of Side-bands.

It may therefore be desirable here to consider briefly the causes of the greater interference of radiotelephony services compared with radiotelegraphic services, and to indicate why the system developed by the Western Electric Co. and the British Post Office for transatlantic working has alone made telephony on long waves a practicable proposition.

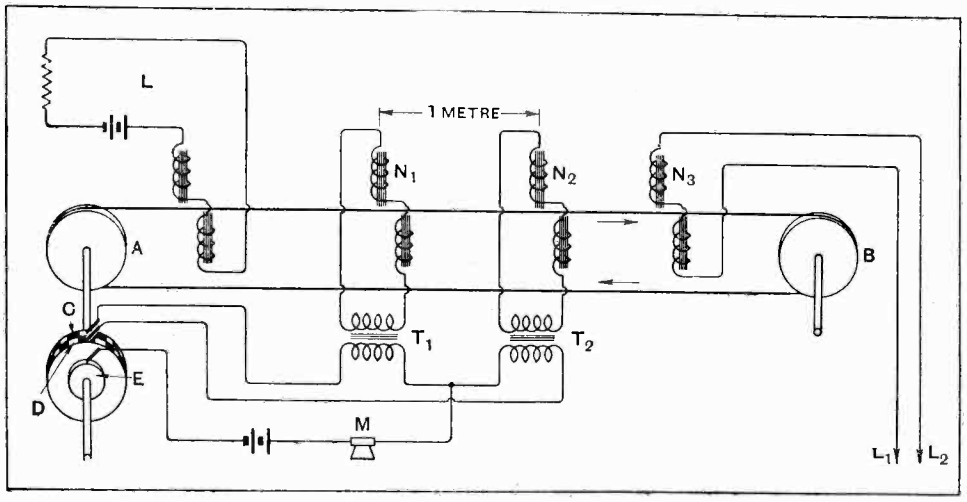

Fig. 1.—The system advocated by Tigerstedt (1918) makes use of a continuous magnetised steel band.

Probably every reader of *The Wireless World* is aware that the essentials of an ordinary telephony transmitter are the production of a pure and steady continuous wave oscillation and the means of modulating this wave by the audio-frequency vibrations due to the sounds it is desired to transmit. Now, the audio-frequency vibrations corresponding to a sound can be shown to be made up of a large number of waves corresponding to frequencies of between, say, 200 to 2,200 cycles in the case of speech and perhaps 100 to 10,000 cycles in the case of music.

The result of modulating the carrier by a complicated speech form is the same as modulating the carrier wave simultaneously with a number of simple component waves into which the ordinary speech can be resolved. If we assume the frequency of the carrier wave is f and that p is the frequency of any one of the component speech vibrations modulating it, the resulting carrier wave can be considered at any moment as consisting of three waves whose frequencies are f, $f + p$, and $f - p$. Now, in an ordinary system of radiotelephony, such as that used in broadcasting, these three frequencies heterodyne in a simple receiver so as to produce a beat note of frequency p. It is clear from this way of looking at the matter that the carrier wave (frequency f) has no effect on the transmission of the sound, except to provide a wave which will be of use in heterodyning the frequencies $f + p$ and $f - p$, which really contain the sound to be transmitted. In the Western Electric Co.'s system a considerable saving of power is effected by not transmitting the carrier wave at all, but by suppressing it along with one of the side-band frequencies $f + p$ or $f - p$ at the transmitting end, and in reintroducing the necessary frequency needed for heterodyning the remaining side-band by means of a weak local oscillator at the receiver.

Not only is there a saving of power of about 75 per cent. in transmitting only one side-band, there is a great reduction of the amount of interference. If both the side-bands are transmitted, frequency bands of between 200 and 2,200 cycles are present on both sides of the carrier-wave frequency; thus a band about 4,000 cycles wide is taken up by the transmission. If we put the shortest wave suitable for long-distance communication at, say, 4,000 metres, *i.e.*, 75,000 cycles, and the longest at 25,000 metres or 12,000 cycles, the whole number of cycles available for such communication is 60,000, and it is clear that the maximum possible number of radiotelephony services which can be got in between these wavelengths without direct overlapping is only fifteen. Even then no allowance has been made for the various telegraph services taking place on long waves. The number of cycles occupied by a telegraph service is only a few hundred cycles. Comparing this with the 4,000 cycles required for telephony, it is clear that any proposal for starting telephony services must have a difficult passage with the authorities responsible for the international allocation of wavelengths. Obviously the chance of fitting in such a service is increased in the case of a system such as the present Western Electric system, where the band taken is only about 2,000 cycles, *i.e.*, half of that required by other systems.

The Western Electric "side-band" system as at present used is secret only so far as speech cannot be received on a simple broadcasting receiver, and cannot, therefore, be inadvertently overheard. The Western Electric Company have, however, covered by patents several schemes for making interception extremely difficult, if not impossible, and the principles of these will be described in due course.

Secret Radiotelephony Systems.—

Before dealing with the Western Electric methods, however, it may be of interest to review briefly some other suggestions that have been made. One of the most ingenious was patented by a Danish engineer named Tigerstedt in 1918. His method is applicable both to line telephony or telegraphy and to wireless, and he proposes to provide secrecy by splitting up the Morse signs or words to be transmitted into sections which are rearranged in different order so as to produce an unintelligible jumble which is transmitted into the ether. At the receiving end the components of the speech are automatically rearranged in the proper order so that speech becomes intelligible. In principle, the result is much the same as that achieved by the man who repaired his cuckoo clock so that it "cooed" before it "cucked."

Tigerstedt's System.

The method proposed in this invention is somewhat as follows:—An endless, easily magnetisable steel band runs round the two rollers A and B in the direction of the arrow (see Fig. 1). Mounted on the same shaft as the roller A are three circular discs. The edges of discs C and D are divided into alternate conducting segments so arranged that when the discs rotate together an insulating segment on C is opposite a conducting segment on D. The conducting segments on C and D are connected with a third conducting disc E on the same shaft. Conducting brushes bear on the discs for making external connections. When the microphone M is spoken into the speech currents are conveyed across the brush on disc E and out through whichever of the brushes bearing on the discs C and D is in contact with a conducting segment. If the current passes through disc C it flows through the primary of a transformer T_1; if the current flows by disc D it passes through the primary of a transformer T_2. The secondary of the transformers T_1 and T_2 are connected with coils N_1 and N_2 respectively, and when speech currents pass through these coils the magnetism of the endless band round the rollers is altered, and corresponding speech currents are introduced by the magnetic band in the coils N_3, whence the currents flow out into the line or to the wireless transmitting apparatus by the terminals L_1 and L_2. The currents from the microphone are thus conveyed to the terminals L_1 L_2 alternatively by the coils N_1 and N_2.

To show in a simple case how the speech could be mixed up by this arrangement, let us assume that the distance between the rollers A and B is two metres, and that the band is running at the rate of 50 cms. per second. Let us also assume that the distance between the coils N_1 and N_2 is one metre, and that the conducting segments and discs C and D are so designed that the current path is changed from one to the other after the band has run 50 cms. In other words, the current will cease to flow through N_1 when the band has run 50 cms. forward from N_1, *i.e.*, half-way between N_1 and N_2. The remaining 50 cms. of the band up to coil N_2 is not magnetised, and is now affected by N_2 for half a second, *i.e.*, while the clean 50 cms. of the band runs under coil N_2. At the end of this half-second coil N_1 begins acting again on the clean band running up to it, and the process is repeated. The general result is that the speech is cut up and sections of it are continually being reserved before reaching the coil N_3 through which it reaches the line. The receiving arrangement is exactly similar to the transmitting apparatus. The received speech is passed through a transformer and is applied through rotating discs similar to C and D, alternatively to similar transformers to T_1 and T_2. If, however, in the transmitter T_1 is working on coil N_1, and T_2 on coil N_2, then in the receiver T_1 must work on coil N_2, and T_2 on coil N_1 to get the

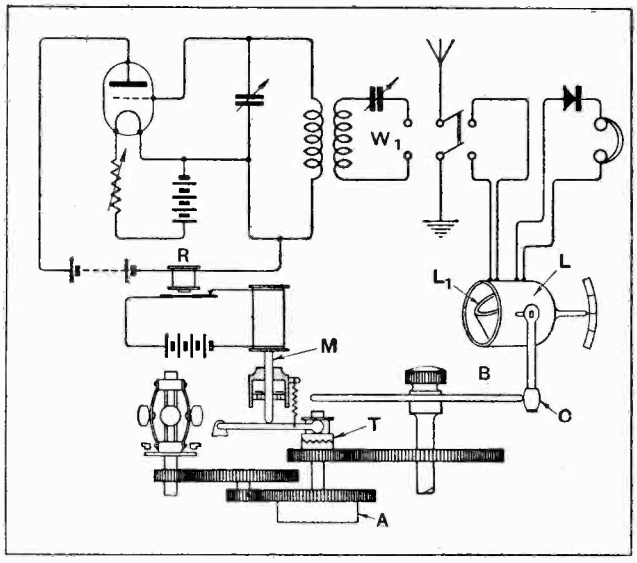

Fig. 2.—Circuit and apparatus for continuously varying the carrier frequency in the method patented by R. Howe-Gould (1922).

speech rearranged correctly so as to be intelligible. A circuit L is arranged to wash the steel band free from magnetism before it reaches the coils N_1, N_2, and N_3.

Synchronisation.

The method, of course, depends on the velocity of the moving band and the discs being adjusted so as to be identical in the transmitter and receiver, and suitable methods must be provided for synchronising and correctly adjusting the position of the discs C and D and their segments with regard to one another.

The accurate synchronisation required would probably be difficult to achieve and maintain in practice. No doubt the exchange of sections of the speech could be made at other rates than at the half-second interval described, and the best speed arrived at for confusing a listener. It might be possible, however, for a determined eavesdropper to write down or record the sounds heard and piece them together correctly when the conversation interesting him was completed. If the mechanical difficulties could be overcome this latter objection could be got over by cutting the speech up into three or four sections instead of the two described.

A considerable number of methods proposed for secret telephony depend on the variation of the length of the carrier wave. One of the simplest methods suggested is to transmit alternately on two wavelengths. The aerial is coupled to two identical generators of continuous waves which are modulated in turn by the same microphone circuit. The exchange between the transmitters is ob-

Secret Radiotelephony Systems.—

tained by a rotating mechanical switch. This is so arranged in one device that transmission begins on one wavelength before it has ceased on the other; any interruption of the radiation during the change over is avoided. The receiving apparatus consists of two detecting circuits connected to the same audio-frequency amplifier leading to the receiving telephones. The receiving circuits are only complicated by the double reception necessary, and apart from the inconvenience of this the method described does not appear to give real degree of secrecy. On the other hand, the occupation of two carrier waves in the ether for the same communication would for the reasons already stated probably render the practical development of the system impossible.

Other systems vary the wavelength of the carrier by regular or irregular variation of the tuning arrangements of the transmitting circuits. The means which have been suggested include the use of condensers with irregular-shaped plates which are caused to rotate mechanically, or the movement of the moving coil of a variometer. It has also been suggested that the transmitting inductance should be designed on the principle of a concertina, so that by mechanical means the coils of the inductance could be brought close together or separated, and its self-inductance thereby varied. In receiving the signals the receiving apparatus must be fitted with similarly variable condensers or inductances the moving parts of which are synchronised with the transmitting instruments.

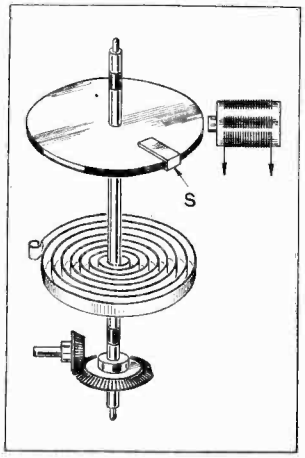

Fig. 3.—Electrical governor for selecting predetermined message-bearing wavelength in the system due to L. D. G. Morrison (1923).

In one method a motor A (Fig. 2) running at constant speed rotates, by means of suitable gears, an irregularly shaped cam B, which, by an anti-friction roller and a lever C, imparts movements to the moving coil L_1 of a variometer L. A similar variometer is provided at both transmitting and receiving stations. At the receiving station an auxiliary detecting circuit is provided in which is included a relay R. The action of the relay causes the movable core M of a solenoid to be raised. The upward movement is controlled by a dashpot so as to occupy a prearranged time.

When starting a communication the variometers at the transmitting and receiving stations are set at the same point on their scales and an auxiliary signal from the transmitting set consisting of a long dash is sent out. The throw-over switch W_1 at the receiving end is set so that the auxiliary receiving circuit is coupled to the aerial which is tuned to the wave on which the long dash is being sent out. The core of the solenoid is raised, but the termination of the long dash automatically releases the solenoid core, which falls so as to make the clutch T engage, which causes the motor to begin to rotate the cam C. Similarly, at the transmitting station the termination of the long dash allows a similar clutch to engage and set the transmitting variometer in motion. If the speed of the motors in the transmitter and receiver are the same the receiver will then remain in time with the transmitter during its wavelength variations. At agreed times cams of various shapes can be substituted to make the wavelength changes more irregular.

Other Variable Wavelength Schemes.

In another proposed system an electrical governing arrangement is suggested. On the shaft of the motor driving the apparatus for varying the wavelength is mounted a balance wheel in the form of a disc. The angular movements of the shaft are controlled by a spring and sufficient external motive force is provided to make up energy losses. The balance wheel has inset on its rim a small laminated piece of soft iron S (see Fig. 3). Mounted close to the balance wheel is a small electro-magnet which is energised through a relay by energy from an auxiliary receiver, as in the case of the solenoid shown in Fig. 2. The auxiliary receiver is tuned to a particular wavelength, and every time this wavelength is reached in the ordinary wavelength variations of the transmitter the electro-magnet will be energised and an attractive force exerted on the soft iron inset on the balance disc, provided this is adjusted to be near the solenoid at the proper moment. In this way it is suggested that any error in the time of rotation of the apparatus in the receiver will be corrected by the acceleration or retardation produced by the magnetic force.

In another method proposed it is suggested that the variation of wavelength of transmitter and receiver be carried out by the motion of synchronised pendulums and an arrangement is provided for stopping the pendulums by wireless means at any selected instant so that a signal can be transmitted on a chosen wavelength which would be unknown to the intercepting station. In any of these methods, however, the band of wavelengths necessary would be so large as to make the method impracticable for actual communication, while if a smaller band were used the signals could be easily picked up on a flatly tuned receiver.

(To be concluded.)

Two-Range All Station Receiver.

A Three-unit Set Covering the Entire Broadcast Band.

By A. J. BULL.

IT must not be thought that the receiver about to be described supersedes any of the sets recently put forward in these pages and which have attained such widespread popularity. Each set fulfils particular requirements, and the aim of this "All Station Receiver," as the name implies, is to provide a sensitive long-range set without wavelength limitations. This instrument consists of three units, A, B, and C, all of which are contained in one cabinet and connected together to form one receiver complete in every detail (except L.T. and H.T. batteries), and covering a wave-range from 200 to 2,000 metres. Two valves amplifying at high frequency followed by a detector valve and two stages of low frequency are employed. For reasons which will be stated later, the two H.F. valves and associated tuned circuits are in duplicate, so that in all there are seven valves housed in the containing cabinet.

Unit A, the short-wave amplifier covering the normal broadcast band of wavelengths, consists of two H.F. valves transformer coupled, the primary winding of which is tapped for neutralising purposes, aerial coil, and three variable condensers, together with necessary valve holders, filament rheostat, etc. The tuning range of this unit is 200 to 600 metres. Unit B, the long-wave H.F. amplifier, consists of two H.F. valves, tuned anode coupled, aerial coils, and three variable condensers, together with filament rheostats and the neutralising condensers necessary. The wave-range of this unit is 600 to 2,000 metres. Unit C consists of three valves, viz., one detector and two amplifying at low frequency, together with transformers, jacks, and filament rheostats, etc. Included as part of this unit, there is what might be termed a distribution panel, on which are mounted, parallel with the three valves, six special spring terminals arranged in two groups of three and to which the output of the high-

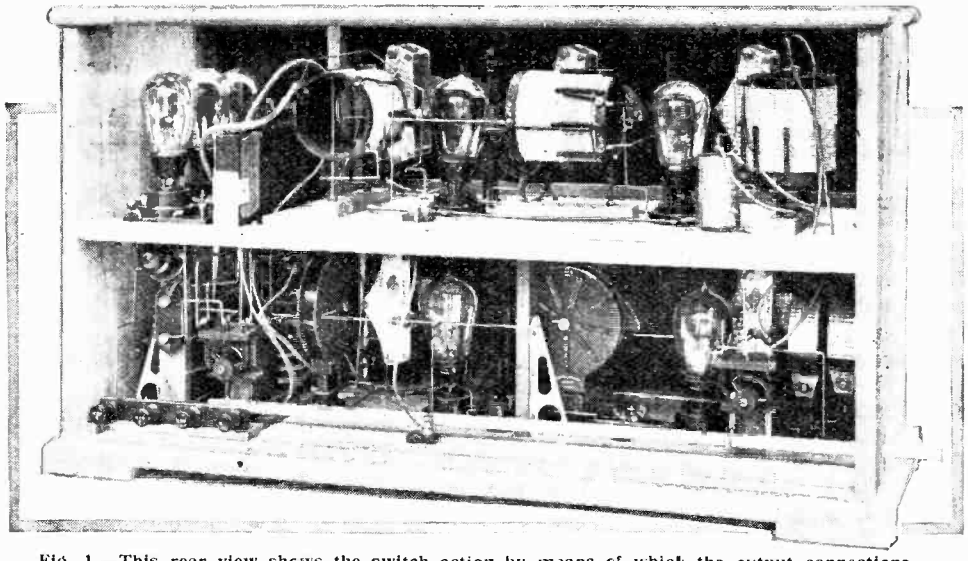

Fig. 1.—This rear view shews the switch action by means of which the output connections of either of the H.F. amplifiers is applied to the detector valve.

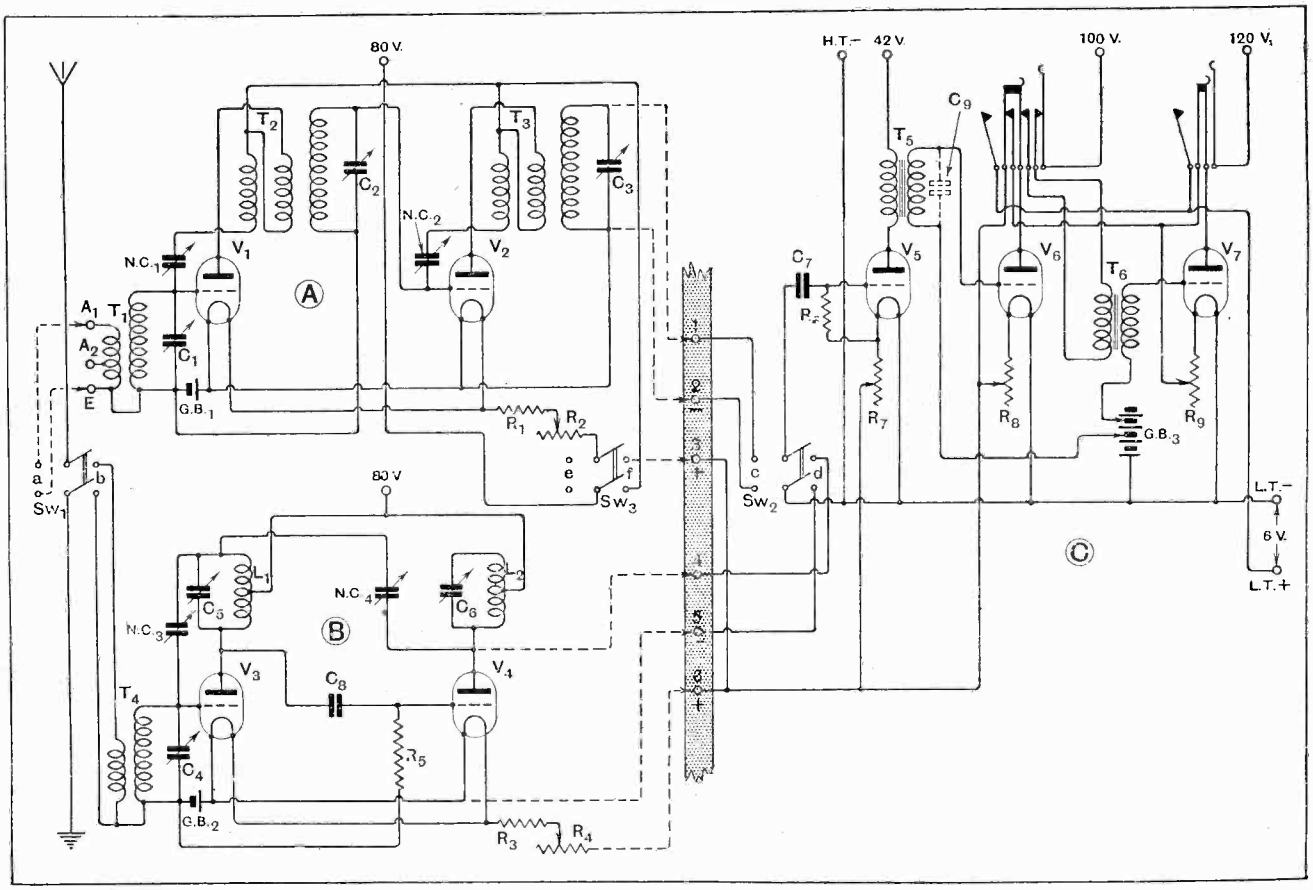

Fig. 2.—Circuit diagram of two-range broadcast receiver comprising two stabilised high-frequency amplifying stages and valve detector followed by a power amplifier. C_1, 0.0005 mfd.; C_2, C_3, 0.0003 mfd.; C_4, 0.0005 mfd.; C_5, C_6, 0.001 mfd.; C_7, 0.0002 mfd.; C_8, 0.0002 mfd.; C_9, 0.001 mfd. R_1, R_3, 4 ohms; R_2, R_4, 10 ohms.; R_5, R_6, 2 megohms; R_7, 30 ohms; R_8, R_9, 10 ohms. T_1, T_2, T_3, "Wireless World" H.F. transformers. T_4, coupled plug-in coils. L_1, L_2, centre tapped plug-in coils 1,400 micro-henries. T_5, T_6, low ratio L.F. transformers. Switch positions: Sw_1 and Sw_2, a and c, 200 to 600 metres; b and d, 600 to 2,000 metres; Sw_3, e, battery "off"; f, H.T. and L.T. batteries "on."

frequency units A and B respectively are connected. These terminals are shown numbered 1 to 6 in Fig. 1 and also on the valve platform Fig. 7.

Two-range Switching System.

Referring to the circuit diagram Fig. 2 and also to Fig. 1 (which is a back view of the complete receiver), there is shown diagrammatically and in photograph two "Utility" double-pole change-over switches, one of which can be seen mounted in an inverted position on unit B on the extreme right, and the other on unit C in a similar position. The two switches are linked together by a $\frac{3}{8}$ dia. wood curtain rod 2ft. 4in. in length, which is pivoted at the knobs of the lever of the switches and extended to pass through a small hole in one end of the cabinet. It is free to move in a horizontal plane over a distance governed by the length of throw of the switch levers (Fig. 3). By further inspection of the circuit diagram it will be appreciated that by pushing the rod slightly into the cabinet the aerial and earth connections are transferred from the lower H.F. unit to the top one, and the detector valve disconnected from the lower unit and connected to the upper one. Consequently, if unit A is tuned to, say, Hamburg (395 metres), and unit B to Radiola Paris (1,750 metres), a rapid change from one to the other can be effected by slightly moving the rod into or out of the cabinet as required.

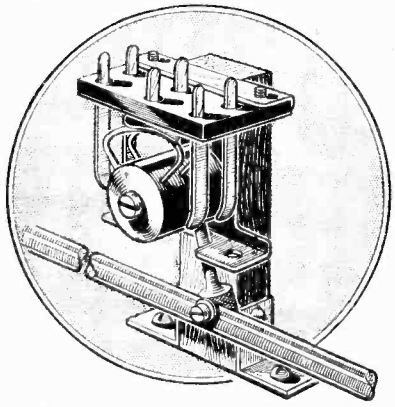

Fig. 3.—Method of mounting "Utility" switches for wave change switching.

For loud-speaker reception of the local station up to, say, twenty miles, where an average aerial is used, the

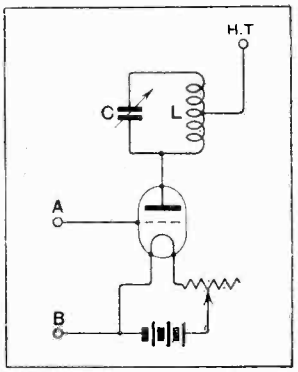

Fig. 4.—H.F. intervalve coupling for considering selectivity and amplification produced by various ratios of inductance to capacity.

Two-range All Station Receiver.—

H.F. valves are not wanted, and they can be cut out of circuit by means of the switch on panel A seen to the right of the third condenser dial. This switch breaks L.T. and H.T. supply to that panel only. The aerial remains connected to the grid of the first H.F. valve of top panel, and the dials are set to the tuning of the local station, which will be received at full strength. No other adjustments are necessary. By making use of the jacks and switch just described, the following combination of valves are possible: (i) Detector and one L.F.; (ii) detector and two L.F.; (iii) two H.F., detector, and one L.F.; (iv) two H.F., detector, and two L.F.

All Apparatus Easily Accessible.

The instrument and containing cabinet are designed to permit of the components of the receiver being inspected without removal from the cabinet and to enable each unit to be readily withdrawn. For example, in order to withdraw unit A, all that is necessary is to depress the tops of spring terminals numbered 1, 2, and 3 accommodated on unit C and thus release the three output connections of the unit. Aerial and earth plugs coloured red and black respectively are withdrawn from sockets correspondingly coloured, and the unit is free to be removed from the cabinet. Absolute stability is obtained over the entire wave-range of the instrument, viz., 200-2,000 metres, which is due mainly to the inclusion in the design of nothing but first-grade parts, a general layout giving liberal spacing between components, the disposition of the wiring, which is rigid, good insulation, and, what is of equal importance, the use of a good earth. Often the domestic water pipe does not constitute an ideal earth. Usually a good earth can be obtained by driving into damp ground one or a number of iron pipes about 4ft. in length and 2in. diameter, the larger the diameter the better, and where two or more are used they should be connected in parallel by copper wire. The connection to the receiver should be as short as possible and of insulated wire not smaller than 7/.028in. (7/22 S.W.G.)

The range, quality of reproduction, and selectivity is excellent. With an average aerial, say, 20ft. above

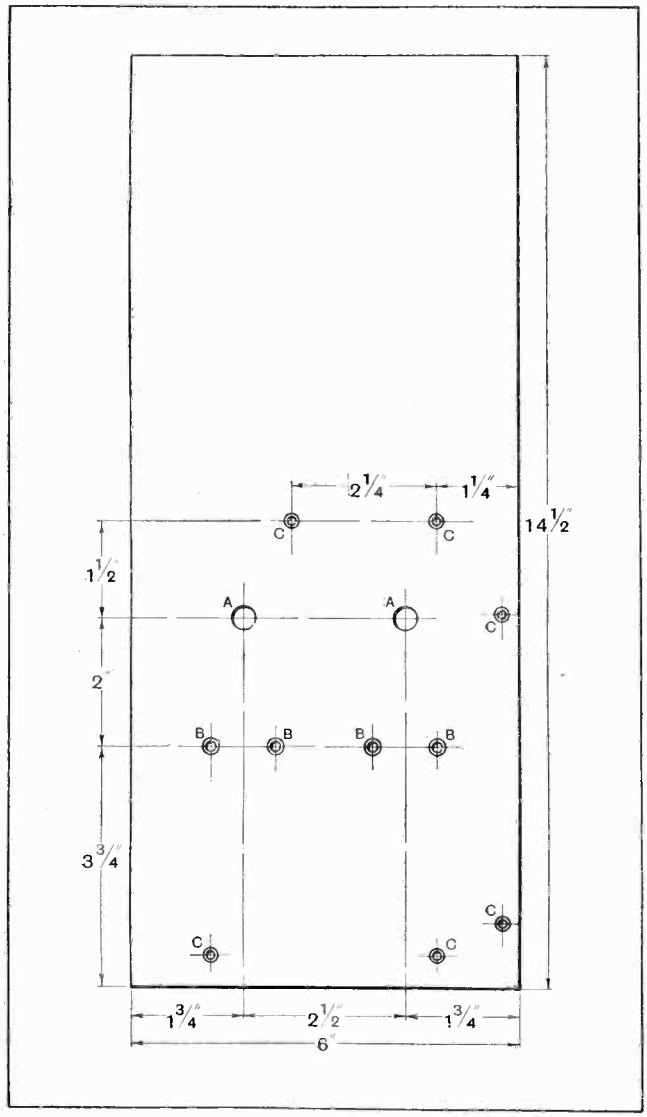

Fig. 5.—Drilling details of L.F. amplifier panel. Sizes of holes A, 3/8 in. B, 5/32 in. and countersunk for 4BA. C, 1/8 in. and countersunk for No. 4 wood screws.

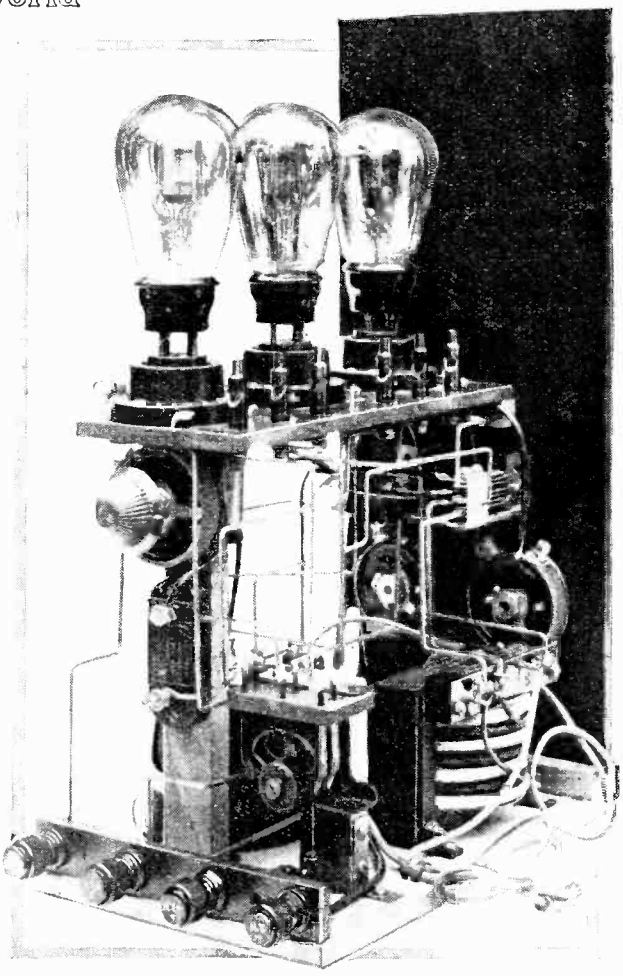

Fig. 6.—This view shows the terminal connectors for making easy connection with the leads from the adjoining units, one of the change-over "Utility" switches, the method of supporting the valve platform, the rheostat in the detector valve filament circuit and the two "fixed" filament rheostats connected to th L.F. valves.

Two-range All Station Receiver.—

ground, and situated about three miles from 2LO good loud-speaker results from most of the European stations have been obtained with four valves in circuit with a good reserve of amplification.

A useful feature in the design of the instrument which may appeal to experimenters rather than to those whose primary interest is in listening to the programmes is the ease with which other circuits may be introduced into the cabinet and tried out. For example, supposing either as an experiment or because the component parts are already possessed, anode rectification followed by two stages of low-frequency resistance coupling is required, all that is necessary is to mount the parts required on a baseboard and panel to the dimensions of unit C and to substitute for the one in use at the moment. Should this particular experiment be made a 0.0002 mfd. fixed condenser

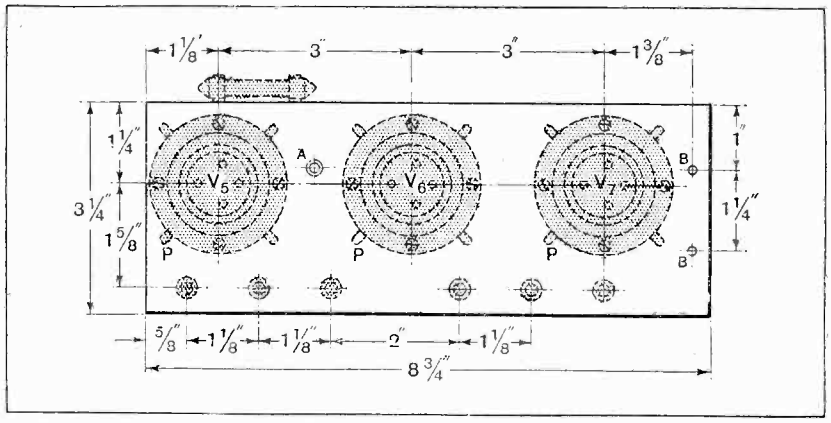

Fig. 7.—Constructional details showing drilling and assembly of the valve platform. Holes should be made at the side of each terminal tag.

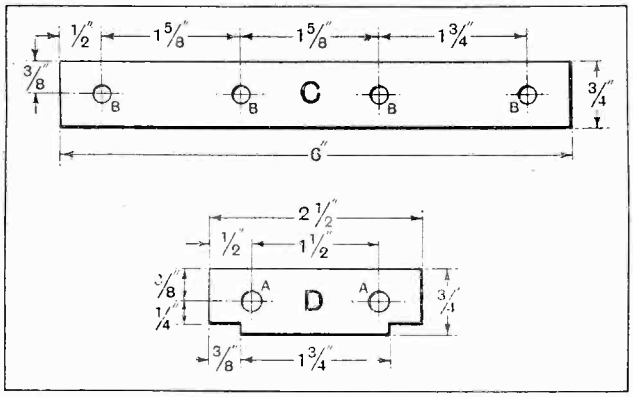

Fig. 8.—Details of terminals and connector strips. Sizes of holes: A, 1/4 in. B, 7/32 in.

and 2 megohms leak should be added to unit B, together with a biasing battery.

Why the H.F. Amplifier is Duplicated.

Let us now consider briefly whether duplication of the H.F. part of the receiver is justified.

It is manifest that a receiver intended for reception of distant B.B.C. and Continental broadcast must be reasonably selective, and especially if one lives under the shadow of the local station. To obtain that result it is necessary to employ some form of filter and to include it preferably in the anode circuit, in which position it can also be made use of for coupling purposes (Fig. 4), which symbolically represents the ordinary tuned-anode coupling consisting of a fixed inductance L (tapped for neutralising purposes) and a variable condenser C. As is well known, magnified oscillating potentials are developed across inductance L as a result of signals impressed at A B; the value of these potentials (the amplification factor of the valve and other factors considered) will depend upon the ratio of L to C, the greater L is made the greater the potentials will be. If C is made large, L in consequence must be made small, and therefore potentials will be reduced and a less powerful signal result. That being so, what values of L and C should be used in order to obtain selective reception from the principal broadcast stations as they are to-day?

For loud-speaker results (with an aerial approximately 20ft. high) no fewer than four valves should be employed, two of which must be H.F. (filter coupled) amplifiers, in which case the suitable value of the variable condensers (C) to cover wavelengths of 200 to 600 metres is 0.0003 mfd. maximum. For wavelengths 600 to 2,000 metres (thus including Daventry, Radio-Paris, Hilversum, Warsaw, etc.) a condenser value as high as 0.001 mfd. maximum may be used and is recommended, as such a value stiffens the filter coupling and renders it less liable to shock excitation.

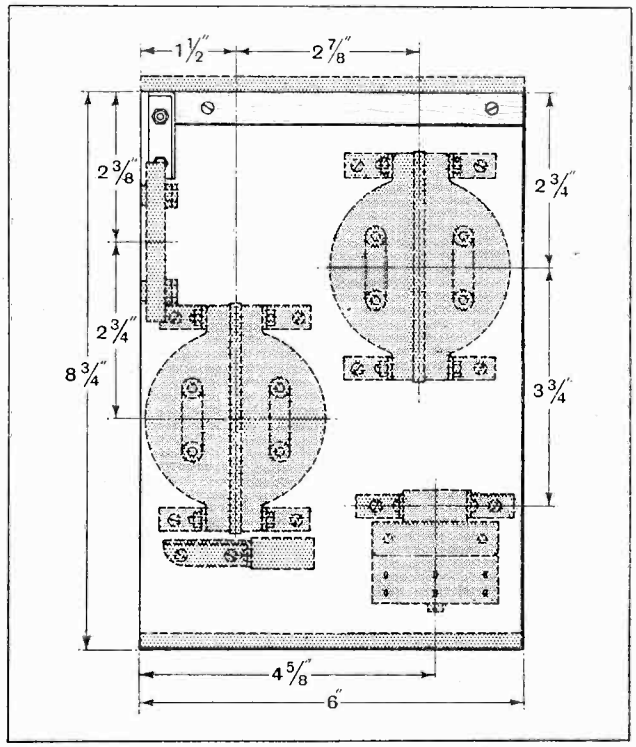

Fig. 9.—The location of the components on baseboard.

Two-range All Station Receiver.—

It may be asked why not make L variable as well as C so as to cover the waveband 200-2,000 metres and select for a particular wavelength those values of L and C found most suitable for good reception. Theoretically it is possible to do so, but it has been the writer's experience that where two or more H.F. valves are employed in a multi-stage amplifier designed to cover a wide range of wavelengths (either tuned anode or stabilised tuned transformer coupled) and L is made variable, unless exceptional precautions are taken, it is extremely difficult to maintain the set in a stable condition when approaching the limits of inductance, owing to the slight resultant deviation caused from the original value of the counter reaction which gave stabilisation at the time of balancing the receiver.

Where, however, the value of L is fixed and no form of switching in the oscillatory circuits has been introduced, then there is no difficulty whatsoever in obtaining a balance and maintaining it indefinitely. It was principally owing to contrast in results obtained and to the simple manner in which an alternative programme could

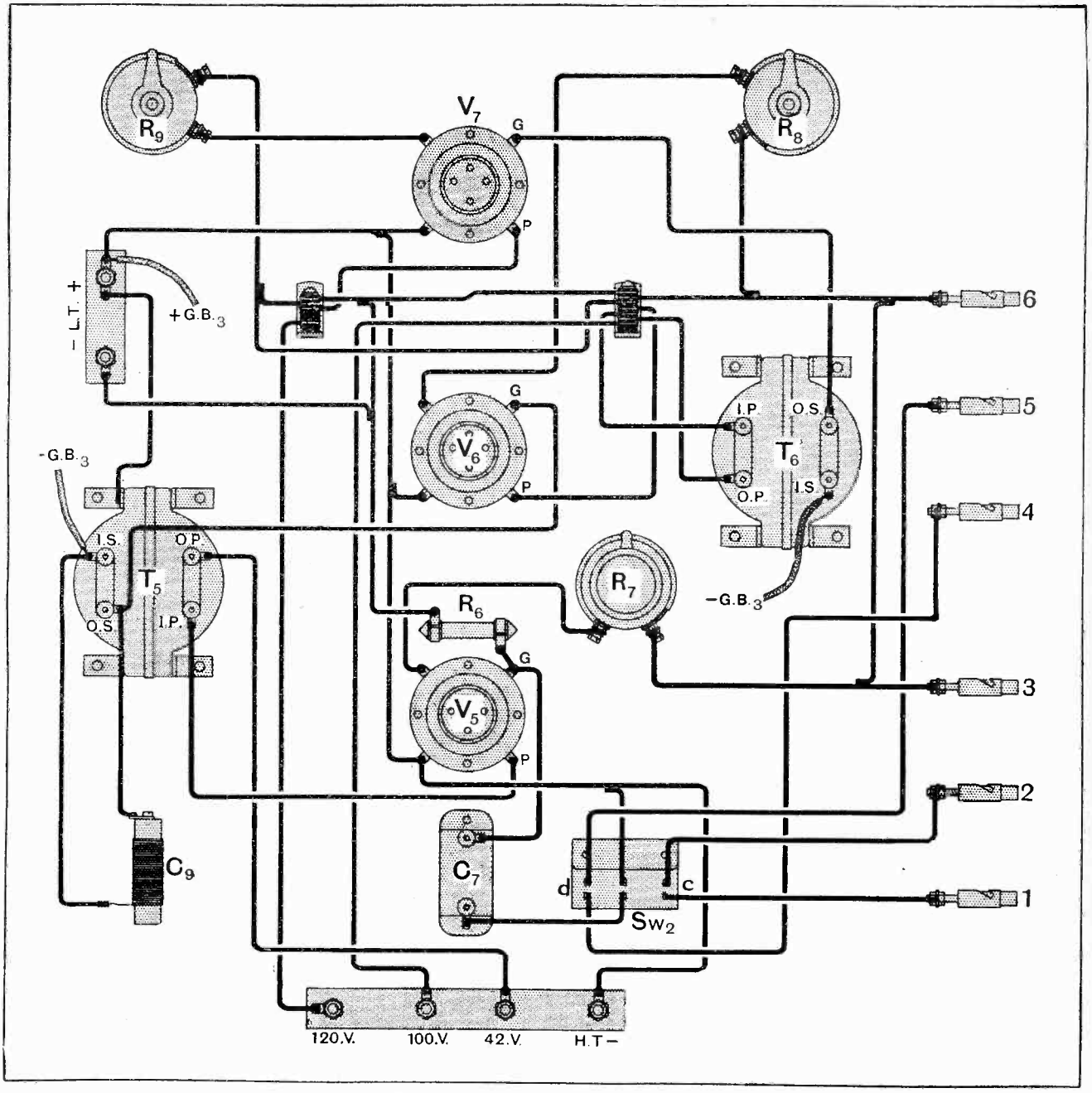

Fig. 10.—Practical wiring diagram.

Two-range All Station Receiver.—

be made instantly available if a second H.F. panel was adopted that led the present design.

Constructional Details.

Having obtained the necessary parts and compared them with the working drawings, the process of assembling can be commenced. It may be found most convenient to construct the units in the following order, C, B, and A, so that upon completion of C and B they can be put into service for reception of long-wave stations, whilst unit A is in course of construction.

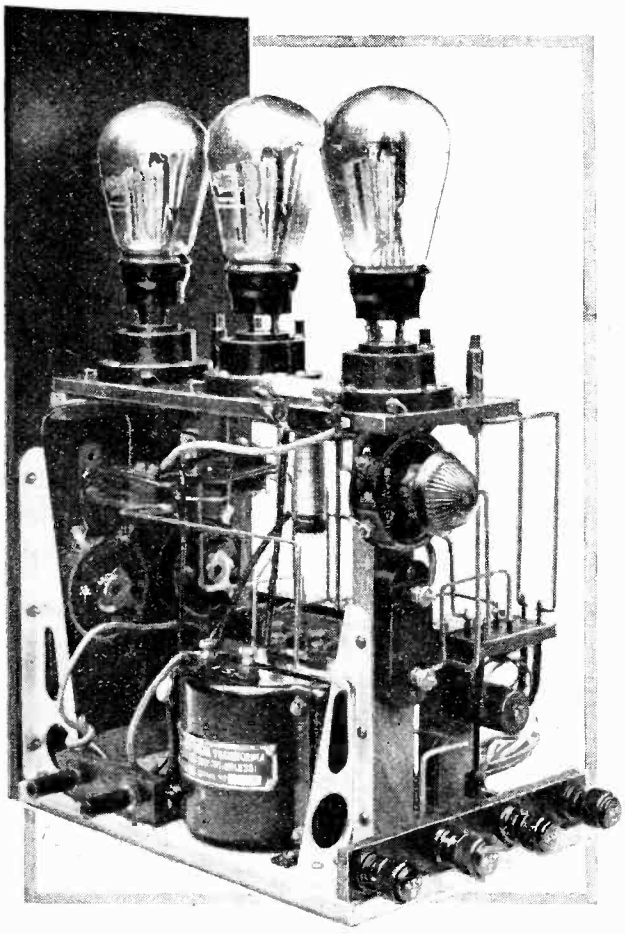

Fig. 11.—Another view of the L.F. amplifier showing output plugs and method of supporting valve platform.

Having thus decided, the ebonite panel of C measuring 14½in. × 6in. × ¼in. should be drilled as indicated in the drawing (Fig. 5) and the two jacks and two filament rheostats fitted to it. The panel is then attached to the base measuring 6in. × 8¾in. × 5/16in. by means of two 6in. × 1¼in. aluminium angle brackets. A piece of hard wood 7in. × ½in. × ¼in. is now attached to the base by means of one right-hand angle bracket (4in. × 1¼in. aluminium), as indicated in Figs. 6, 9, and 11, to form a support for one end of the valve platform, the other end of which is attached to the main ebonite panel by screws and a piece of wood 3¼in. × ½in. square. Before

THE FOLLOWING IS A LIST OF PARTS NECESSARY FOR THE CONSTRUCTION OF UNIT C:—

1 Baseboard of 5/16in. wood, 6in. × 8¾in.
1 Ebonite panel 14½in. × 6in. × ¼in.
1 piece ebonite, 8¾in. × 3¼in. × ¼in.
3 Anti-microphonic Valve holders.
1 seven-spring Jack, Cat. No. P67. (Igranic Electric Co., Ltd., 147, Queen Victoria Street, London, E.C.4.)
1 four-spring Jack, Cat. No. P68 (Igranic).
1 2.7 to 1 Transformer (Marconiphone Co., Ltd., 210/212, Tottenham Court Road, London, W.1).
1 4 to 1 Transformer (Marconiphone).
1 Grid bias battery and plugs, 15 volt.
1 Fixed condenser 0.0002 mfd.
1 Grid leak, 2 megohms.
1 30-ohm variable filament rheostat (Igranic Pacent).
2 10-ohm variable filament rheostat without dials (McMichael, Ltd., Hastings House, Norfolk Street, London, W.C.2).
2 Plugs and sockets, marked L.T.—, L.T.+.
1 Terminals, H.T.—, H.T.+1, H.T.+2, H.T.+3 (Belling & Lee, Queensway Works, Ponder's End, Middlesex).
1 D.P.D.T. Utility switch, lever pattern (Wilkins & Wright, Ltd., Utility Works, Kenyon Street, Birmingham).
6 Spring terminals (Grafton Electric Co., 54, Grafton Street, London, W.1).

In the list of parts included in the descriptions of THE WIRELESS WORLD receivers are detailed the components actually used by the designer and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and lay-out of the set any variations in the size of alternative components he may use.

screwing together to form the rigid arrangement, the three valve holders and six spring terminals should be fitted to the platform, also holes drilled in accordance with Fig. 7. The object of the holes is to enable short wire connection to be made between the valve terminals and components mounted below.

It should be noted here that the sequence of the valves is as shown in Fig. 7.

Immediately below the detector valve on the wood support a 30-ohm filament rheostat controlling that valve is fixed, and below that the grid condenser is mounted. To the right of the support (as viewed from back of instrument) a Utility switch controlling the output of the H.F. units is mounted. For the method of fixing the switch see Fig. 9, which also shows positions, etc., of transformers.

Having fitted L.T. and H.T. terminals and screwed two clips to the edge of valve platform near the detector valve for the reception of the grid leak, the unit is ready for wiring (Fig. 10). Do not rush the wiring, and wherever possible well space the leads, making symmetrical point-to-point rigid connections. The filament circuits are made with No. 22 tinned copper and Sistoflex laid snugly to the underside of the valve platform.

CURRENT TOPICS

News of the Week — in Brief Review

PCJJ SHORT-WAVE STATION.

A slight change has been made in the times at which regular broadcasting is transmitted from Messrs. Philips' experimental station in Eindhoven. On Thursday, June 9th, Tuesday, June 14th, and Thursday, June 16th, the station will broadcast from 5 to 8 p.m. G.M.T.

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SOUTH AFRICAN BEAM TESTS.

The Marconi Company has completed the preliminary tests with the beam stations at Bodmin and Bridgwater which are being erected for the G.P.O. for communication with South Africa. During these preliminary tests speeds of between 200 and 250 words per minute have been maintained with South Africa over long periods daily. Further tests by the company under ordinary traffic conditions are now being made, and if these prove satisfactory the stations will be handed over to the General Post Office for the official seven days' trial.

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THE ECLIPSE.

The Radio Association has made arrangements for undertaking the collection of data in regard to the effect of the eclipse on wireless telephony and telegraphy. They have issued a specially designed log-sheet for this purpose, copies of which are obtainable from the hon. sec., Mr. S. Landman, M.A., 22, Laurence Pountney Lane, E.C.4.

The South African branch of the Association, in conjunction with the Natal Astronomical Association and the International Union of Scientific Radio Telegraphy, is also preparing to use this opportunity of collecting important wireless data.

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THE N.B.C. EXTENDS ITS NETWORK.

The National Broadcasting Company of America is rapidly extending the sphere of its activities and has now acquired the well-known station WOW, in Omaha, Nebraska, owned and operated by the Woodmen of the World Life Insurance Association. This station, which transmits on a wavelength of 526 metres, will afford a large number of listeners in the Middle West an opportunity of listening in comfort to the N.B.C. programmes instead of being compelled to reach out for the more distant stations controlled by the company.

RUNNING COMMENTARIES.

The running commentaries upon a bull fight broadcast from Madrid do not appear to be as interesting or exciting as those of a football match, the Boat Race, or the Derby, to which we are now getting accustomed. If we may judge from a letter from the *Times* correspondent in Madrid, the spectacle did not offer many chances for vivid word-pictures. The speaker at the microphone, we are told, was one of the best-known bull-fight critics and described every phase of the fight, yet at one time he warned his listeners that the show was such a poor one that they might soon be hearing the snores of the multitude.

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PIGEON FANCIERS AND AERIALS.

Many inconveniences and discomforts, such as a rainy summer, are often unjustly attributed to the malign influence of wireless, but it is possible that there may be some justice in the complaint of pigeon fanciers that their homing birds are sometimes hampered by the number of aerial wires encountered in their racing flights.

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ATMOSPHERIC IDIOSYNCRASIES.

The report of the Royal Meteorological Society's Committee on Atmospherics and Weather, which contains a mass of useful data obtained from observations by Mr. R. A. Watson Watt and other observers in Europe, tends to show that certain spoken words are more easily disturbed than others. Thus, of the two consecutive words "for his" the disturbance on the first word was strong, while that on the word "his" was only moderate.

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AN INGENIOUS FRAUD.

The French wireless operator who was recently reported to have inherited a large fortune is doubtless repenting at leisure his wily scheme for obtaining almost unlimited credit, but it must be admitted he probably had a good time while it lasted.

Being anxious to infuse some excitement into a possibly dull and monotonous life, he conceived the idea of sending out a message that he had come into a fortune of some 25 million dollars. The message was picked up in mid-Atlantic by a ship coming to Europe and in due course retransmitted to Rochefort, where the delinquent was besieged with offers of marriage and loans from prospective fathers-in-law. Unfortunately for him, enquiries were made concerning another of his ventures and these led to the discovery of the fraud.

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AN INTERESTING EXHIBIT.

The manufacture of valves is in itself a fascinating study, and many wireless enthusiasts as well as the general public have doubtless availed themselves of the present opportunity of witnessing the actual processes through which a valve passes in the course of manufacture. For the opening of the new wireless department at Messrs. Whiteley's valve-making machinery has been transferred from the Osram valve works at Hammersmith, and during the first ten days of this month expert operators are working on these machines throughout the day illustrating the intricate building up of Osram valves.

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BROADCASTING IN JAPAN.

Listeners who delight in reaching out for distant stations may be interested in learning the times at which stations in Japan and Manchuria transmit, and for their benefit we give the following particulars of these stations:—Tokyo, JOAK, on 375 metres; Osaka, JOBK, on 385 metres; and Nogoya, JOCK, on 360 metres: all transmit daily from 9. a.m. to 10 p.m.; Keijo, JODK, on 367 metres, from 9.40 a.m. to 9.30 p.m.; Harbin, Manchuria, XOH, on 430 metres, from 12.15 to 12.45 p.m. and from 7.30 to 9.0 p.m. daily. These times are local and are nine hours ahead of G.M.T., 9.0 a.m. in Japan being midnight by G.M.T.

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WEATHER STATION IN GREENLAND.

Scientific meteorology is daily extending; a permanent weather station is to be established in Greenland by Dr. W. H. Hobbs, Professor of Geology at the University of Michigan, and director of the university's Greenland expedition. Dr. Hobbs expects to begin transmitting weather reports on short waves this month. The Rumanian Greenland expedition, headed by Dr. Dumbrava, will also establish a base at Angmagsalik, in South-East Greenland. "Secondary depression" will therefore stand no chance of being overlooked.

TRANSMITTERS' NOTES AND QUERIES.

Nationality Prefixes.

In view of the fact that many amateur transmitters have their call signs preceded by the nationality prefix G, GC, or GW, as the case may be, printed on their letter paper as well as on their QSL cards, it may be advisable to remind them that according to the regulations laid down by the G.P.O. the use of the nationality prefix is allowed only when experiments are being conducted with stations abroad.

We mention this matter as we have recently heard of cases in which amateurs using the nationality prefix before 3-letter call-signs or not being licensed for communication with foreign stations have been requested by the authorities to discontinue the use of the prefix.

New Call Signs and Stations Identified.

5XQ (ex 2BPB) J. Cyril Adams, Towerhill, Newton Street, Greenock, N.B. Transmits on 23.45 and 90 metres.

AI 2AJ Lieut. E. J. H. Moppett, "A" Cavalry Signal Troop, Roorkee, U.P., India. Transmits on 30 and 45 metres.

EB 4DP L. de Bruyn, 79 Ave. des Eglantiers, Antwerp.

FM 8MC Dr. C. Vevre, 83 Ave. du Général Moinier, Casablanca, Morocco.

6 DP (ex 2 BQK) W. P. Dolphin, 53, Higham Road, Tottenham, N.17. Transmits on 23, 45, 90 and 180–200 metres.

6 PP (ex 2 BZC) M. W. Pilpel, 38, Purley Avenue, Cricklewood, N.W.2. Transmits on 45 metres and will welcome reports from listeners outside 100 miles radius.

2 AZP L. Sanderson, 39, Bonham Road, Brixton Hill, S.W.2.

Amateur Stations in Australia and New Zealand.

(Continued from page 686 of our issue of June 1st.)

WESTERN AUSTRALIA.

6DH D. C. Hardisty, 2, Duncan St., Victoria Park.

6GL G. A. Lorden, 30, Thomas St., West Perth. (Change of address.)

6HR (not 6HE) H. F. Cox, Marine Terrace West, Geraldton. (Correction.)

6JJ T. J. Jewell, Leithfield St., Victoria Park.

6JL J. L. White, Brooklands, via Grass Valley.

6KM A. Saar, Post Office Building, Eucla.

6KX H. T. Simmons, 75, Nicholson Rd., Subiaco.

5VP Victoria Park Radio Club (O. E. Kernick), 70, Mackie St., Victoria Park.

6WP W. R. Phipps, 83, Carnarvon St., Victoria Pk.

TASMANIA.

7BT E. C. Sheldrick 15, Richards Ave., Launceston.

7HL H. F. Lovett, 14, Summerhill Rd., West Hobart.

7MK E. E. Cooper, Edgeley House, Youngtown.

7RS R. S. Hope, 210, George St., Launceston.

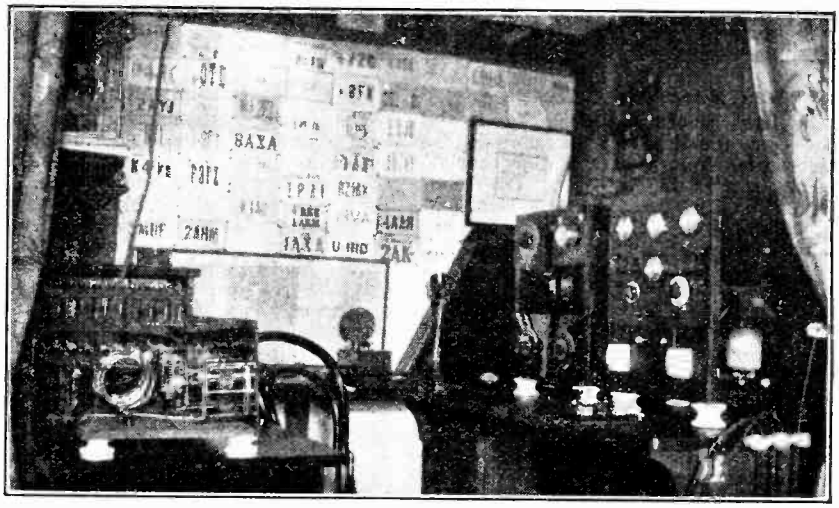
NEW ZEALAND.

1AN H. B. M. Arthur, 12, Clarence St., Herne Bay, Auckland. (Change of address.)

1AO R. G. White, 125, Grafton Rd., Auckland.

2BB C. Ward, 63, Murray St., Kelburn, Wellington. (Corrected address.)

3XB J. M. Bingham, 24, Carrington St., Christchurch.



5 X Q. A new transmitting station in Scotland owned and operated by Mr. J. Cyril Adams, Towerhill, Newton Street, Greenock.

A SIMPLE TEST FOR OVERLOADING.

MANY an amateur, possessing no milliammeter, is left in doubt whether to blame his loud-speaker, his receiver or his valves when quality of reproduction is poor. Since the most usual cause of poor quality lies in the overloading of the last valve, it becomes necessary to apply some test to discover whether the signals applied to its grid are greater than it can handle without distortion. The usual test of connecting a milliammeter in series with the loud-speaker and making volume and grid-bias adjustments until the needle does not "kick" on loud signals is naturally not possible when no milliammeter is to hand. There is, however, another fairly satisfactory test that can readily be applied when resistance or choke coupling is in use.

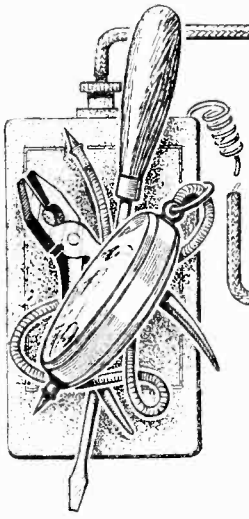
Effect of Increasing Grid Leak Resistance.

If the grid-leak of the last valve is removed and is replaced by one of very high resistance it will be found that any distortion due to overloading will be very considerably increased. This is so because if the valve is being given too large a voltage input there are moments when the grid becomes positive, and during that time it collects electrons as they stream past it to the plate. The negative charge so produced can leak away reasonably quickly through a leak of low resistance so that the distorting effect is not outrageously great, but if a very high resistance leak is substituted this charge grows to a higher value and takes longer to disperse, and, in consequence, the distortion produced is much more noticeable. If, on the other hand, no overloading is taking place, the grid of the valve never becomes positive and does not acquire a charge, so that the change of grid-leak value will make no difference whatever to the quality.

If, then, it is found that this change of grid-leak has an adverse effect upon the quality, one may quite safely infer that the last valve is being overloaded with signals, and that it is necessary either to be content with a smaller volume or to increase largely the high-tension voltage and grid-bias on this valve. Where no change in quality follows on the use of the high resistance leak, it is necessary to look elsewhere for the cause of inferior reproduction.

By a slightly greater temporary alteration to the receiver, this same test can also be applied where the last valve is coupled by means of a transformer. In this case it is necessary to insert a condenser of about 0.01 mfd. capacity between the grid of the valve and the secondary of the transformer. A grid-leak holder is then connected between the grid of the valve and the grid-bias battery and the test applied by inserting in the holder, alternately, leaks of low and high resistance. The effects that may be observed and the conclusions to be drawn from them are then exactly the same as those already detailed.

A. L. M. S.



PRACTICAL HINTS AND TIPS

A Section Mainly for the New Reader.

SOLDERING NOT NECESSARY.

IT is a mistake to imagine that the only way of obtaining a satisfactory connection is by soldering; this is not the case, and for all practical purposes a wire fitted under a terminal head or nut makes a junction of equally low resistance, provided that the surfaces are first cleaned with emery paper or by scraping. It is as well to have as large an area of metal in contact as possible, so the end of the wire should be bent into an eye—preferably with the aid of a pair of round-nosed pliers.

Soldering has probably gained its present popularity because a number of connections may be made more quickly by this method than by the other alternative—a statement which the beginner in the art may doubt, but one which is nevertheless true. Provided that soldered joints are properly made, they have an undoubted advantage from the point of view of permanency, but a so-called "dry joint" is likely to be a source of trouble, and those who have not acquired the art may do well to use screws and nuts or terminals, remembering that connections made in this way should be cleaned and tightened up periodically.

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THE CHOKE CONDENSER FEED CIRCUIT.

THERE are certain undoubted advantages in using a choke-condenser output circuit, the chief of which is that the windings of the loud-speaker are no longer subjected to the steady anode current of the last valve or valves, which with a modern receiver is likely to be heavy.

Fig. 1 (*a*) represents what is now probably the standard circuit for choke feed and has several advantages over other arrangements.

It should be noted that the loud-speaker is at earth potential, and if at any appreciable distance from the set only one extension lead is necessary if an earth connection can be made at the loud-speaker. The larger the value of both the choke and the condenser, the lower the frequency at which "cut off" or a diminution of output sets in. Good average values for first-class results are 20 henries and 4 mfds. respectively, although 2 mfds. is generally sufficient.

The circuit shown in Fig. 1 (*b*) may be used when it is desired to

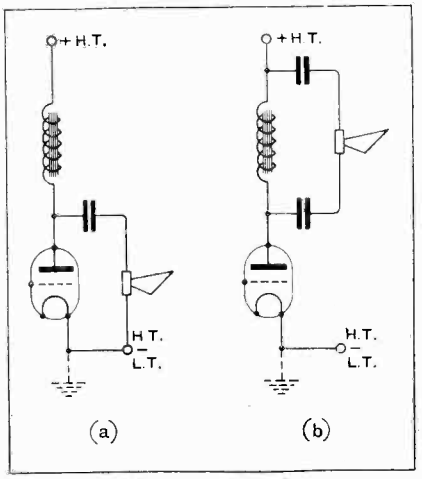

Fig. 1.—Alternative output filter connections.

isolate the loud-speaker from the set entirely; for example, when it is of a type with an electromagnetic field system which may be fed from house service mains. This circuit suffers from the disadvantage that since the condensers are in series, each must be twice the size of the one condenser used in the circuit shown in Fig. 1 to obtain the same tonal output characteristics.

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HOWLING DUE TO MICROPHONIC VALVES.

IT often happens in loud-speaker sets that when one of the valves is given a slight jar a low ringing note is emitted by the loud-speaker. The sound from the loud-speaker reacts on the valve and a continuous howl may be set up. This trouble, which is due to the vibrating of the electrodes, usually occurs in the detector or perhaps in the first L.F. stage. The simplest and most obvious remedy is to have the set and loud-speaker in different rooms. This is frequently inconvenient, however, and another remedy is to use a less microphonic valve in the offending stage. It is often our luck to find that our favourite detector valve is particularly microphonic, and we are unwilling to replace it by another valve, which, though less microphonic, is also less sensitive. The remaining expedient is to surround the valve by some sort of sound-proof enclosure; much can be accomplished with a wrapping of cotton-wool and a valve box. The so-called non-microphonic valve-holders are not usually very effective by themselves, but may be very effective if the valves are artificially weighted by attaching heavy pieces of metal to them. This weighting may be effected by fixing some sort of lead collar round the valve base; this weighting should be at least a quarter of a pound, but, of course, not too much for the springs in the valve-holder to support.

JACKS ON METAL PANELS.

AS has been previously stated in these columns, the constructor of a receiver with a metal panel must bear in mind the necessity of insulating those parts of components attached to it which are not at the same potential. By taking a little care, however, and

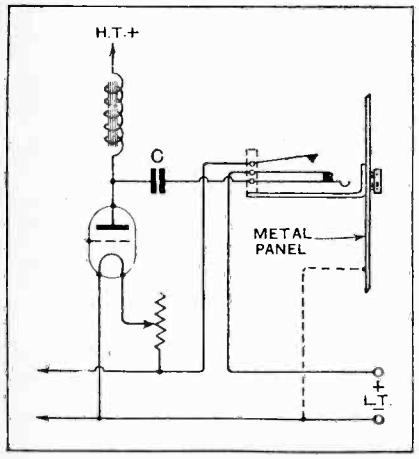

Fig. 2.—An "earth return" output circuit.

making one or two minor circuit alterations, it is possible to avoid the fitting of a number of insulating bushes which would ordinarily be required.

The majority of "on-off" switches on the market are designed for mounting on an ebonite panel, while the output terminals or jack for connection to telephones or loud-speaker will also need bushings if conventional practice is followed. The fitting of these may be avoided if the increasingly popular choke-condenser filter output circuit is adopted in conjunction with a jack, which, to save the mounting of a switch, may be connected in such a way that the valve filaments are automatically lighted when the plug is inserted. The arrangement is shown in Fig. 2, from which it will be seen that the "speech current" circuit from the plate of the output valve is completed through the usual large condenser, the loud-speaker (the plug of which picks up contact with the longer spring), and the earthed frame of the jack, which is in metallic contact with the plug shank. The proper jack for this purpose is sold as a "single open, filament control" type.

A consideration of the circuit will show that a breakdown in the insulation of the condenser will result in a short circuit of the high-tension battery; this disadvantage, however, is not peculiar to this special form of connection, the risk being present with other arrangements. To reduce the possibility of trouble a condenser of good make should be obtained, and it may be advisable to test it before applying the battery voltage.

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FLASHLAMP FUSES.

WHEN bright-emitter valves, consuming about 0.75 amp., were in general use, there was complete justification for the frequent recommendation that a flashlamp bulb should be inserted in the high-tension lead in order that it might act as a safety fuse. Nowadays, however, when few valves consume more than 0.25 amp., reliance on such a device is apt to be dangerous, as the average 3- or 4-volt lamp will often pass as much as 0.5 amp. for a considerable period. Before fitting such a fuse it is as well to assure oneself that it will "blow" at a lower current than that consumed by the valves actually in use.

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SOAP AND SECCOTINE.

FROM time to time experimenters may require to make parts which have afterwards to be stuck together with Seccotine and which require lubrication during the making. An instance of this occurs with the small conical washers required to attach a paper diaphragm to a reed or similar mechanism. These small washers may be punched out or spun, but in either case lubrication will be necessary.

The natural inclination would be to use a heavy oil for the purpose, but if soap be used instead it will be found that the parts will, after a good rinsing in cold water, take Seccotine quite well; whereas if oil had been employed a special solvent, such as very good petrol or benzine, would be required to render the surfaces sufficiently free of grease to allow a reliable joint to be made.

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BUILDING A PORTABLE.

PORTABLE receivers, particularly those to be carried in a car, are always subjected to a good deal of vibration, and special precautions must be taken to prevent the loosening of connections. A lock-nut should be fitted wherever this course is possible, and in the case of such components as L.F. transformers, filament rheostats and variable condensers, etc., which are often provided with small terminals, it is a good plan to remove the heads, and to substitute two nuts.

Similar precautions should be observed in dealing with bolts and nuts which do not actually carry current, but merely serve to hold the various components in position.

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H.F. TRANSFORMER CONSTRUCTION

FAILURES with receivers using the type of H.F. transformer having space-wound primary and neutralising windings are not infrequently traced to partial or complete short circuits of one of the windings. This is often due to contact between the wire and one of the terminal screws mounted on the spacing strips. It is important that each wire should make contact only with its appropriate terminal screws, and, moreover, it should be emphasised that the silk covering of the wire is not sufficient insulation; air spacing is necessary.

The sketch given in Fig. 3 (A) has been made from a transformer offered for sale as suitable for the "Everyman Four" receiver; it shows what is distinctly the wrong method of construction. Sketch (B) indicates the amount of spacing which should be allowed between the winding and terminal screw.

Although a defective transformer

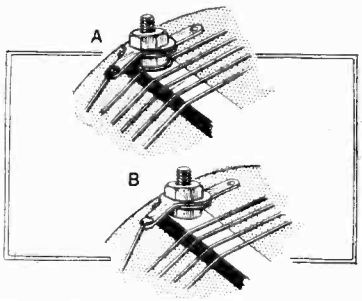


Fig. 3.—Showing correct (A) and incorrect (B) relative positions for windings and terminal screws on an H.F. transformer.

may operate passably when it is perfectly dry, it is almost certain that a fault of the nature under discussion will manifest itself when the atmosphere is damp. This is because a considerable difference of H.F. potential exists across adjacent ends of the parallel windings.

MEASURING THE OUTPUT OF ELIMINATORS.

THE class of voltmeter likely to be found in the possession of a wireless amateur will have too low a sensitivity figure (in ohms internal resistance per volt of full scale reading) to give a true idea of the voltage produced by a battery eliminator, whether such be a small generating machine, a rectifying valve or valves, or merely a potentiometer across D.C. mains.

Such an instrument will probably require at least 5 milliamperes to give a reliable reading, and the additional load thrown upon the eliminator by the application of the meter will cause a serious drop in the output volts.

An improved method of obtaining an indication of the eliminator's performance is to place a milliammeter in the anode circuit of the last valve. With adequate filament current and a known value of negative bias the usual family of static curves of the type of valve in use may be used to translate anode current into anode volts. As a refinement, allowance may be made for the voltage drop in the windings of the loud-speaker directly connected in the anode circuit, since the resistance of the instrument is known, as is the current passing through it.

It may be said that this method is likely to be unreliable owing to the fact that the performance of the valve is concerned in the reading. Experience shows, however, that modern valves are extremely regular, and a check is always available by the substitution of the valve by another having the same nominal characteristics.

There is, on the other hand, a very good point to be mentioned in favour of this arrangement, and that is that the milliammeter, if left in the anode circuit, serves as a distortion indicator. The pointer of the instrument should at all times be steady, whereas if the valve is being overloaded the instrument will waver in sympathy with the loud passages in the transmission, thus indicating that a reduction of input to the valve or better working conditions are desirable.

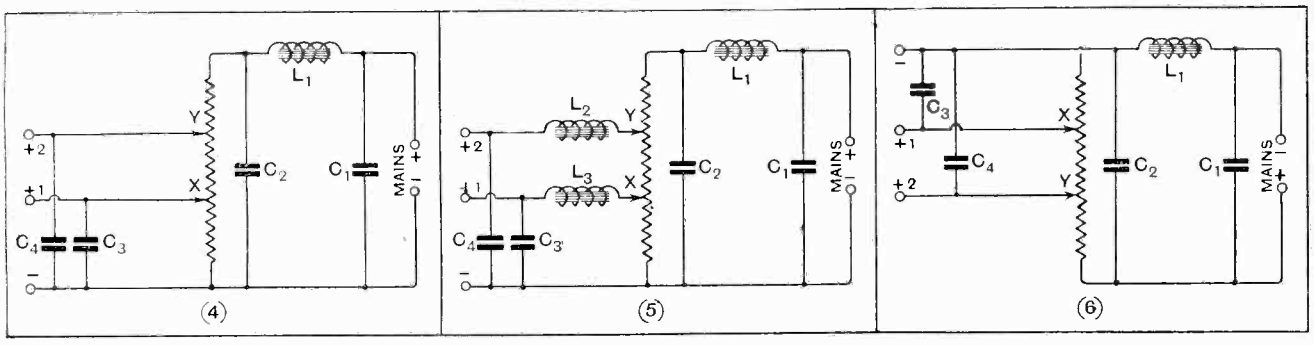
DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 72 (a).—A D.C. High-tension Battery Eliminator.

(Concluded from last week's issue.)

The present series of diagrams is intended to show progressively, and in an easily understandable manner, the various points to which special attention should be paid in the design of typical wireless instrumen's, and at the same time to assist the beginner in mastering the art of reading circuit diagrams. The simple H.T. eliminator shown below is intended to operate on direct current supplies of from 200–240 volts, and will give good results, except where there is a heavy "ripple" on the mains current.



An extra H.T. tapping is added at Y. This section is shunted by an additional condenser, C_4.

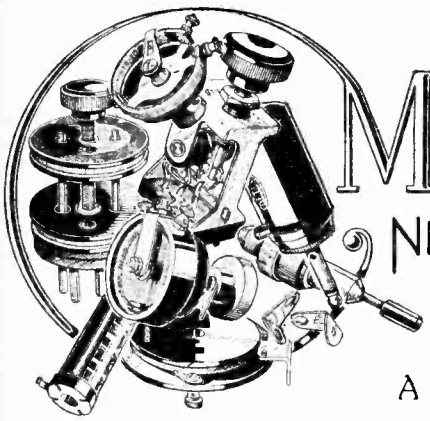
Extra smoothing chokes, L_2 and L_3, are inserted in each output lead.

When the positive main is earthed, the smoothing choke should be inserted in the "live" negative lead.

THE position for the second H.T. tapping is determined in the same manner as is the first, while the shunting condenser C_4 may have the same capacity as C_3. As the +2 terminal will probably supply current to the output valve, which generally requires both heavier current and greater voltage than the other, the tapping point Y will be nearer the positive end of the voltage-dividing resistance to compensate for the voltage drop.

The addition of extra chokes L_2 and L_3, as shown in (5), will only be necessary when the mains are "noisy," or possibly when the receiver employs an elaborate circuit; their inductances should be as high as is possible, compatible with sufficient current-carrying capacity and a suitably low ohmic resistance.

The circuit shown at (6) is suitable when the positive main lead is earthed. The arrangement as shown will result in a difference of potential between the "mains earth" and the positive tapping, while the connection of the output taps Y to the positive end of the resistor, with a corresponding movement of the negative connection, will avoid this; but there will still be a difference of potential if a second tapping is used. In cases where the positive main is earthed it is almost essential to use a coupled aerial circuit, as by doing so the filaments of the valves may be earthed only at one point. This coupled circuit is highly recommended for any receiver working from D.C. mains, whether positive or negative is earthed. If it is not adopted, a large condenser of high insulation resistance should be inserted in the earth lead from the set.



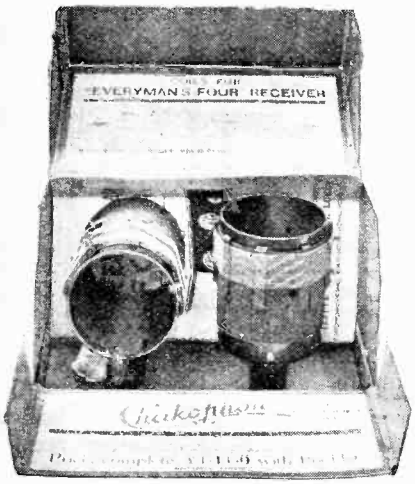
MANUFACTURERS' NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

CHAKOPHONE COILS.

The coils required for constructing *The Wireless World* "Everyman Four" receiver are being produced by manufacturers in increasing quantities. The Eagle Engineering Co., Ltd., Eagle Works, Warwick, are now making these coils, and an opportunity has been taken of testing them for the purpose of endorsing their performance.

Even to the manufacturer many errors are likely to occur in building these coils, such as failing to pick up all the strands of the Litzendraht wire, the use of inferior wire or formers, badly constructed spacers for the primary, and poor insulation between primary and secondary occurring under the terminal screws. All of these points were carefully examined, and, combined with a performance test, the Chakophone coils can be recommended for building the



Chakophone coils with constructional booklet for building "The Wireless World" Everyman Four receiver.

"Everyman Four" receiver. As well as being electrically correct, the coils are well finished, and, with the green silk-covered Litzendraht wire, are of particularly good appearance.

The coils are suitably packed for transit in a cardboard carton, which contains also *The Wireless World* handbook giving full constructional details.

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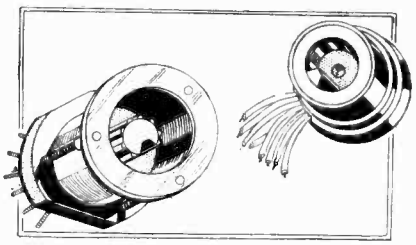
A MULTI-CONTACT PLUG CONNECTOR.

In the case of a receiving set employing several valves there are as a rule no fewer than six battery connections to be made. Owing to the trouble involved in providing all the necessary leads and connecting them up on to the terminals, with the danger, perhaps, of joining the H.T. battery to the L.T. terminals, many sets



New multi-way plug connector in which contact is made between the circle of bars and springs

are built with leads instead of battery terminals. A further improvement is to use a multi-way plug-connector, and a connector of original design has recently been produced by the London Instrument Co., Ltd., 51A, Bridge Street, Cambridge.

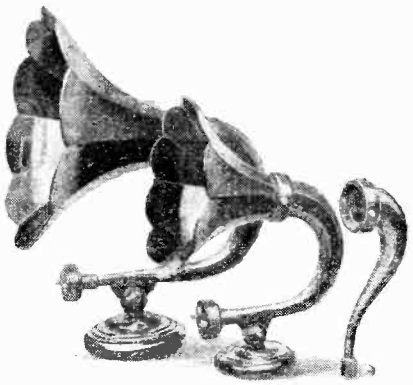
The connector makes provision for eight leads, the wires being joined to the plug and suitably labelled. Instead of using pin connectors, which are difficult to engage and render the withdrawal of the connector difficult, eight springs are employed, assembled round the inside face of an ebonite cylinder. These engage on eight bars secured to the walls of an ebonite rod. A particularly smooth action is obtained, with a liberal area of contact, making an entirely reliable electrical connection.

Brackets are provided for baseboard mounting, or, by means of bolts and screws, the connector can be secured to the panel. A key-way prevents the plug from being incorrectly inserted in the socket. The metal ring of the socket is nickel-plated, and the head of the plug is of polished ebonite, with the wires passing out at the side.

"ALL-WOOD" LOUD-SPEAKERS.

There are many listeners who prefer to use a loud-speaker fitted with a wooden flare, and a further development is to be found in the "All-Wood" loud-speakers and horns manufactured by Walker Bros., Ltd., St. Joseph's Works, Bramley, Guildford, in which the neck, as well as the flare, is built of wood. The aim is, of course, to reduce the resonances present in the metal type, and from the results obtained it is apparent that this has been achieved.

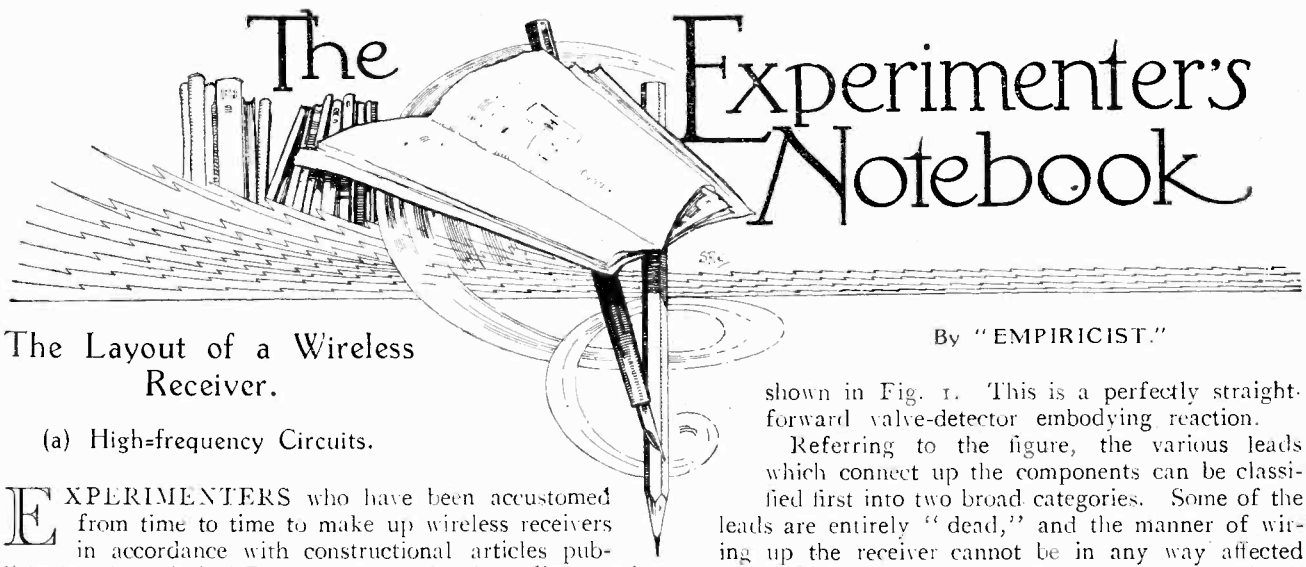
Apart from the acoustic merit of the "All-Wood" horn, these loud-speakers are cleverly constructed, being built up from thin pieces of wood to produce the required contour. Various models are available, including the upright swan neck and the curved "U," each type being available in several sizes. It is understood that the manufacturers enlisted the assistance of Messrs. S. G. Brown, Ltd., when developing the designs, and several of the bigger models are particularly suited for use with the Brown movement, while the Lissenola, T.M.C., Amplion, Nesper, and other units may be fitted.



Three specimen "All-wood" loud-speaker horns.

In view of the considerable work involved in the manufacture, and the particularly high-class finish, these horns are inexpensive, and, together with a high-grade movement, produce a reliable loud-speaker of pleasing appearance for a moderate cost.

The Experimenter's Notebook



The Layout of a Wireless Receiver.

(a) High-frequency Circuits.

By "EMPIRICIST."

EXPERIMENTERS who have been accustomed from time to time to make up wireless receivers in accordance with constructional articles published in the technical Press must very often have discovered for themselves by bitter experience the lamentable results that follow from comparatively slight variations in the layout and wiring. The fact is, of course, that in designing a receiver, especially one which embodies neutralised high-frequency circuits, all sorts of details have to be considered which are very difficult to deal with in constructional articles, as there is so much else which must be described. Readers of such articles, therefore, very seldom arrive at the "true inwardness" of the design, but have to take the result in faith, and, as often as not, pay the penalty for any attempted deviation from standard.

The present article is an attempt to lay down some general principles of design in which the writer personally believes, and most of which are matters of general experience. It is not to be contended that a receiver is wrong if they are not followed out, nor right if they are, but it can be said with certainty that they formulate a "safety first" policy and may lead to the avoidance of a considerable number of more or less well-known "snags."

It will be easier to consider this matter by taking first of all, as a particular case, a simple receiving circuit as shown in Fig. 1. This is a perfectly straightforward valve-detector embodying reaction.

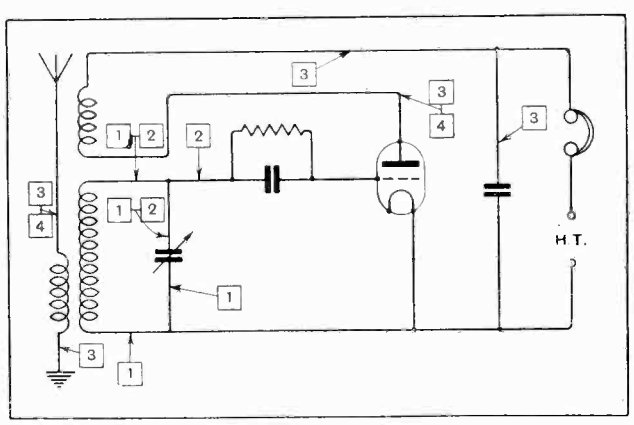


Fig 1.—Classification of leads in a high-frequency circuit. (1) H.F. current resonant leads; (2) H.F. potential resonant leads; (3) H.F. current non-resonant leads; (4) H.F. potential non-resonant leads.

Referring to the figure, the various leads which connect up the components can be classified first into two broad categories. Some of the leads are entirely "dead," and the manner of wiring up the receiver cannot be in any way affected by their disposition; other leads, however, are "live," by which we mean that they carry high-frequency currents or potentials, and in consequence are liable to affect neighbouring leads and circuits by electromagnetic or electrostatic induction.

In considering the general layout of this or any other receiver we therefore adopt as a first principle the necessity of taking care of the "live" leads and allowing the "dead" ones to look after themselves. Thus, for example, if it is possible, by running the filament supply round the set in any manner however awkward, to enable the high-frequency circuits to be wired up in a more satisfactory manner, we should naturally adopt this course.

Classification of Leads.

Considering further the question of "live" leads we may classify these according to whether they carry current or potential, or both. Actually, of course, the effects will be mixed up in all cases, but there are some leads in which the electrostatic effect is small enough to be negligible and the electromagnetic effect quite considerable, and *vice versa*. In other leads, both the electrostatic and electromagnetic effects are present in full measure.

We may make a further classification of both these types of lead according as to whether they are connected to a resonant or a non-resonant circuit, the necessity for such classification being due to the fact that the former require far more critical consideration in respect of the layout of receiver.

In Fig. 1 the leads marked [1] carry high-frequency current and are thus liable to set up an electromagnetic field, which interacts with other circuits; on the other hand, inasmuch as they are connected together to the filament of the valve, the only high-frequency voltage at any point on them will be that due to the volt drop in the short length of wire constituting the leads themselves. For the purposes of our classification we thus describe these as "current leads." Since they are also embodied in a resonant circuit, this fact must be borne in mind in classification, and we can thus describe them in an abbreviated form as "c.r." (current resonant) leads.

The Experimenter's Notebook.—

Reference [2] indicates a lead which carries practically no high-frequency current, inasmuch as it is connected to the "live end" of the resonant circuit it will radiate a strong electrostatic field. This may be described as a "potential lead," and since it is connected to a resonant circuit we may denote it as a "p.r." (potential resonant) lead.

The references [1, 2] which apply to two further leads indicate that the latter carry both current and potential; these may be denoted as "c.p.r." leads by analogy with the two former cases.

The leads connected to non-resonant circuits may be dealt with in a similar manner. Thus the leads [3] are c.n." (current non-resonant), and those designated [3, 4] are "c.p.n." (current potential non-resonant) leads. In the figure under consideration there is no p.n. lead, but from the foregoing such a classification is quite obvious.

In order to give further consideration to this classification and to consider its effects as regards the layout of a typical receiver, a three-stage neutrodyne is shown in Fig. 2, and the various designations as above described are marked against the respective leads. It will be noted in passing that there are two leads classified as p.n.: this is not strictly correct inasmuch as a small high-frequency current flows through the neutralising condensers, but the electromagnetic effect on this current under practical conditions is so small as to be negligible.

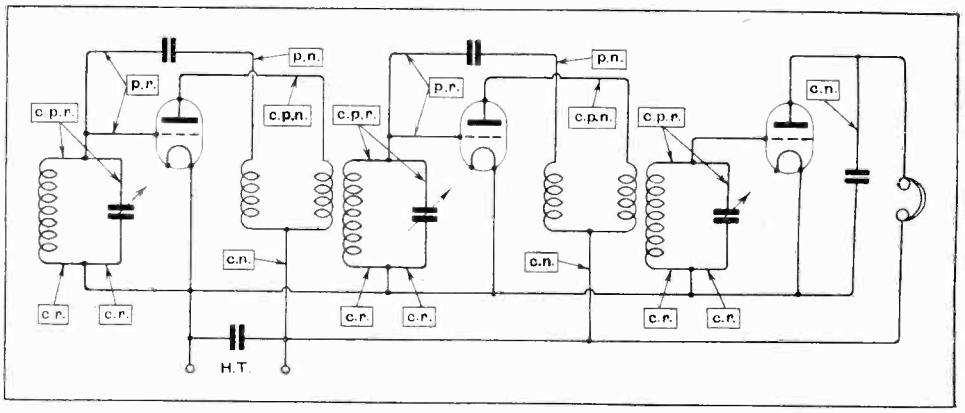


Fig. 2.—Three-stage neutralised H.F. amplifier. Current flowing in neutralising circuits is so small as to be negligible—leads are thus marked p.n.

We may now proceed to consider what should be done in laying out a set of this type, having regard to the above classification, and for this purpose we may first take the case of c.r. leads (including c.p.r.). These, as will be seen from the figure, constitute the interconnections between tuning coils and their condensers.

Wiring Resonant Circuits.

Very frequently the coils in a neutrodyne, such as that illustrated, are most carefully arranged so as not to be electromagnetically coupled to each other, but it is often found that if the connecting leads to the coils and condensers are traced out they constitute a loop of quite considerable area, and the presence of loops in each of the three circuits may give rise to interaction which will upset the stability of the instrument. We may thus lay down as a first maxim: "Arrange c.r. leads in each resonant circuit so that the area of the loop formed by them is the smallest possible."

In other words, "connect each condenser directly to the terminals of the tuning coil and keep the c.r. leads close to each other." The circuits to grid to filament respectively are then made by tapping these direct connections at any convenient point, and connecting them direct to their destination.

The consideration of p.r. leads (including c.p.r.) is more straightforward. Here we have to consider only the electrostatic field, which is set up by a piece of wire to which a high-frequency voltage is applied, and this field is controlled simply by the length and thickness of the wire concerned. Such leads must be kept as short as possible, and the disposition of the various components must be arranged with this end in view. It is amazing what can be done in this direction by merely careful thought, and it is equally so in respect of the greatly improved behaviour of a complicated set.

The thickness of p.r. leads in the average sets is also very often excessive, inasmuch as there is a kind of vicious circle, the increase of the length of such leads necessitating the use of thicker wire. This gives rise to a serious electrostatic field, with the possibility of induction effects with other parts of the circuit. It seems really quite unnecessary to go beyond No. 20 S.W.G. wire for interconnections of this kind if reasonable care is exercised in arranging the components.

The problem of c.p.r. leads in themselves is difficult inasmuch as they require careful treatment from both points of view, but there is no need to go to pedantic extremes in the matter of leads connecting a condenser to its coil, inasmuch as the stator of the condenser (which is normally connected to the live side) has a considerable area, and must necessarily have a tendency towards induction effects which is perhaps greater than any reasonable wiring could give.

In considering the non-resonant leads the same principles apply to a large extent with the exception that in this case correct spacing is not so critical. Trouble will arise when a c.n. lead, attached, say, to the plate of the detector valve, is led round in the neighbourhood of the first circuit of a set like that considered in Fig. 2, but there is no reason why this should be done, the obvious course being the by-passing of the high-frequency current by means of a condenser *direct to the filament*. If such a condenser is connected across the telephones or across the primary of a low-frequency transformer, it has a very great tendency to cause interaction with other c.n. circuits, and this is not entirely taken care of by the customary large condenser across the high-tension battery.

INTERNATIONAL ASPECTS OF BROADCASTING.

Important Functions of Broadcasting Neglected by the B.B.C.

By G. ROLLAND WILLANS.

ON April 1st and April 29th, 1925, the writer was given the opportunity of outlining his views on certain aspects of British broadcasting, and on the work of the International Broadcasting Bureau. At the time of writing these articles the eventual control and policy of what was then the British Broadcasting Company was assuming considerable importance, and it was then suggested that the future of broadcasting was the most important question of all, as it could be construed in the light of a national institution. Emphasis was laid in the first place on the necessity for providing adequate funds for the operation, maintenance, and, most important of all, the development of the broadcasting machine itself, and as in the course of time the writer has seen no reason to change his views he may perhaps be permitted to quote a paragraph of the article in question with a view to emphasising what appears to him to be the lamentable failure of British broadcasting as it is to-day.

The paragraph reads as follows:—

"The control of wider issues affecting broadcasting might well be considered as a national trust, and as such should appeal to the ablest speakers and doers of our own or any future generation. Apart from this the door should be left open to any form of private or public enterprise, which, under guarantees of a high standard of artistic and technical performance, would at the same time reduce the ultimate charge on the public to reasonable proportions."

Once more, as the Editor has recently pointed out in these columns, it has been left to our friends in Holland to blaze the trail of development for us. They have shown that through their intervention the programmes of the *British* Broadcasting Corporation, the Voice of England, can be flung to the most distant corners of the Empire, and have emphasised for us the true significance of broadcasting.

An Opportunity Missed.

To quote *The Evening News* of May 23rd: "The B.B.C., while welcoming the Dutch experiments, are taking no active part in them," and, to quote again, "It would be a wonderful thing if the Prime Minister's voice were successfully rebroadcast in Australia and South Africa." It would be wonderful, indeed, if British enterprise were responsible, but, with all due respect to the British Broadcasting Corporation and our friends in Holland, there is nothing wonderful, from a technical point of view, in the achievement itself, which is merely the ordinary and logical development of the art—a development which we in England have, as usual, been too slow to take advantage of. It may be economy, though probably parsimony is the better word, to allow others to take the initial step at their own expense, but the average listener, who if not to-day will very shortly be the average citizen, may well wonder why he is compelled to keep, feed and house a barkless dog.

It is not intended merely to criticise the efforts of the British Broadcasting Corporation in so far as these are directed towards providing education and amusement for the public at large, but also to emphasise that their duties are not merely parochial, and that their ultimate goal is not summed up in the announcement, "London will now take a little music."

A National Trust.

Again referring to the writer's previous comments on the subject, British broadcasting has now, in fact become something closely approximating to a national trust. Freed from commercial entanglements it is the more able to develop a policy directed towards the furthering of Imperial prestige and Imperial interests and to support and strengthen that vast concourse of men and women who year by year carry with them to the uttermost ends of the globe our national ideals. It would surely be better, now that our message can be accurately transmitted, to concentrate on widening the boundaries of transmission rather than to expend technical energy in the direction of making and demonstrating apparatus by which, in the opinion of the Corporation, this message can best be received—a point which can well be left to the manufacturer. As to the educational and amusement items, there is no reason to suppose that either as a company or as a corporation the broadcasting authorities can afford to neglect the specialists in these two different lines of activity. It is not pertinent to the issue to enquire why the average man is willing to pay more to be amused than to be educated, but it is certain that the specialist in the art of amusement is able to command a markedly higher figure, and is not nearly so likely to be impressed with the argument that it is an exceeding great privilege to be allowed to broadcast. The name of the pedagogue can never be said to be a household word to the same extent as is that of the organiser of prize fights, the producer of successful musical comedy shows, or films with an international reputation; and the ownership of a lecture hall or theatre of unlimited capacity does not necessarily imply the affinity to educate or amuse to a "full house" day in and day out.

In the particular article referred to the writer raised the following question: "Upon what will the future of broadcasting as a national institution depend?" and has endeavoured to answer this question by saying, "Utter confidence in those directly responsible for its development."

It can now safely be said that broadcasting has become an integral part of our national life, and that lack of

International Aspects of Broadcasting.—

vision, monopoly, or any other form of hindrance to its obvious and logical development will eventually be swept away by the tide of public opinion.

To quote again, this time from the writer's article of April 29th, 1925: "Owing no doubt to the basis upon which our own services are founded, we do not appear as yet to be sufficiently alive to the importance of broadcasting as a vehicle for all forms of propaganda. Certain Continental countries, on the other hand, are actively aware of this fact, and will undoubtedly endeavour to make use of the Bureau to further the commercial and other interests of their own national." It is interesting to note that, on the ordinary broadcast bands, German stations appear to be most frequently received during daylight hours and at night at excellent quality and volume, so much so that reception from other Continental stations is interfered with to a marked extent, not only by German main stations but also by their relays. It is childish to disregard the importance of broadcasting as a means of propaganda, and obvious that in our international broadcasting relationships we cannot afford to ignore the importance of holding our own and of being represented on international conferences of this order by individuals who are really capable of safeguarding our interests.

The progress of civilisation, with all that it implies, depends upon friendly intercourse between nations and individuals. Broadcasting, to be followed by television, having no regard for time or distance, can be of incalculable benefit to the human race, but in so far as we are human, in appreciating its possibilities, we must not as a nation allow ourselves to lose sight of its importance to our national existence.

NEWS FROM THE CLUBS.

Portable Transmitter at Mill Hill.

The new portable transmitter of the Golders Green and Hendon Radio Society was tried out with remarkable success during a recent field day at Mill Hill. The set consists of a Hartley oscillator embodying two L.S.5's in parallel, to which is coupled a resistance-capacity amplifier with the microphone across the grid and filament of a "high mu" valve; this valve is fed into a D.E.5 acting as a grid leak. The high tension is supplied from ten 60-volts "C.A.V." accumulators.

A working schedule had been arranged with the following stations on 45 metres: 5CD, Nottingham; 5TZ, Isle of Wight; 6FR, Birmingham; 6MU, Ireland; 2IT, Ireland; and 6NZ, Glasgow. Each of these stations sent an excellent report, though reception from 5CD, 5TZ and 2IT was bad owing to jamming. During the afternoon 2LO's programme was received and relayed to the Isle of Wight with great success.

Among the party were representatives of the Muswell Hill and District Radio Society.

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D.F. Field Day.

The next field day of the Golders Green and Hendon Radio Society will be held near Elstree on June 19th when some interesting D.F. tests will be carried out.

Hon. secretary: Lt.-Col. H. A. Scarlett, D.S.O., 357a, Finchley Road, N.W.3.

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Are H.F. Valves Worth While?

"What is the Use of H.F. Valves?" was the provocative title of a lecture given by Mr. J. W. Parkis, A.R.C.Sc., before the Croydon Wireless and Physical Society on May 16th. The lecturer referred to the two schools of thought on the subject, one of which contended that the sole requirement for reception was a sensitive detector followed by L.F. amplifiers, while the other school of thought maintained that H.F. valves were necessary for DX work. After summarising the position the lecturer suggested that while perhaps the use of H.F. valves as pure H.F. amplifiers was not altogether successful, yet the use of H.F. valves for selectivity was to be strongly recommended; the selectivity curve with H.F. amplifiers has comparatively straight sides and a flat top, whereas reaction gives a sharp peak to the curve. The lecture was followed by an animated discussion.

Visitors are warmly welcomed to the Society's meetings, particulars of which can be obtained from the hon. secretary, Mr. H. T. P. Gee, 51-52, Chancery Lane, London, W.C.2.

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The "Ideal" Receiver.

Mr. P. K. Turner (of Messrs. Graham-Amplion, Ltd.) gave an able lecture on the design of broadcast receivers when he addressed members of the Muswell Hill and District Radio Society on May 25th. The ideal to be sought for in wireless design, said the lecturer, was the production of a receiver which, when heard in an adjoining room, would give sound indistinguishable from the original. It was an advantage to obtain reception as loud as possible when seeking true reproduction, for when transmission comes in at half its original strength the ear does not receive it as such, and reproduction is not perfectly natural. It was desirable to have an output of at least ½ a watt.

Mr. Turner concluded with a detailed account of his own set, which had taken him several months to design and was intended to be the "last word." The set consists of a detector and three L.F. stages (two resistance and one transformer). Many questions were asked and the lecturer's opinion was sought on the respective merits of resistance, choke and transformer coupling. He replied that each system had its uses, though he objected to the latest high value resistance coupling.

Hon. secretary: Mr. G. S. Sessions, 20, Grasmere Road, N.10.

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Demonstrating Transformer Coupling.

What was described as "astoundingly fine reproduction" was obtained by means of a demonstration receiver operated by a representative of Messrs. Ferranti, Ltd., at a meeting of the Hounslow Wireless Society on May 24th. The lecturer dealt with the questions connected with low-frequency amplification when using iron-cored transformers. He clearly explained the desirability of using a transformer with a high primary inductance, especially in the anode circuit of a high impedance detector valve, and pointed out the consequent necessity of a low ratio and a considerable quantity of suitable iron in the magnetic circuit. The demonstration set incorporated a valve detector followed by two L.F. amplifying valves coupled by two A.F.3 type transformers. The volume obtainable was far too great and had to be controlled to keep within the grid swing of a super-power valve.

Hon. secretary: Mr. W. R. Collis, 7, Algar Road, Isleworth.

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R.C. Amplifier and the Gramophone.

The South Woodford and District Society has been studying resistance-capacity coupling. At the last meeting Mr. J. E. Nickless, 2KT, gave an interesting demonstration of the reproduction of gramophone records using a resistance-capacity amplifier with excellent results. This Society meets at Holy Trinity Parish Rooms on Monday evenings.

Hon. secretary: Mr. S. J. Turbyfield, 42, Alexandra Road, South Woodford, E.18.

FORTHCOMING EVENTS.

WEDNESDAY, JUNE 8th.

Muswell Hill and District Radio Society. At 8 p.m. At Tollington School, Tetherdown. Demonstration on "Electric Accumulators," by Mr. W. Schofield (of Messrs. Hart Accumulator Co., Ltd.).

Tottenham Wireless Society. At 8 p.m. At 10, Bruce Grove. Lecture by Mr. R. F. G. Holmes.

THURSDAY, JUNE 16th.

Golders Green and Hendon Radio Society. At 8 p.m. At the Club House, Willifield Way, N.W.11. Lecture: "Picture Broadcasting," by Mr. F. H. Haynes, Assistant Editor, "The Wireless World."

Broadcast Brevities

By Our Special Correspondent.

NEWS FROM ALL QUARTERS.

The Daventry Hush.

"Daventry Junior" shows no sign of swamping the ether. In fact, since those two furtive transmissions in May the station has been silent. Why this hustle?

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Failure?

If the first tests are to be regarded as full-blooded transmissions of the sort we shall hear under the regional scheme, the station might as well be written off as a failure. Many listeners within a hundred miles' radius have reported the signal strength to be no greater than that of an average main station.

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Warming Up?

However, as I hinted in these columns last week, there are reasons for supposing that an intentionally low power has hitherto been employed—somewhere in the neighbourhood of 10 kilowatts—with the idea, presumably, of "warming up" the apparatus.

Further tests are not likely to be made for a week or two.

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Response to the Referendum.

At the time of writing the B.B.C. has had no opportunity of arriving at the results of the referendum, but I understand that listeners have responded in their thousands, making the task of collation a particularly heavy one.

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2LO the Favourite.

A striking feature revealed by a preliminary glance through the stacks of postcards is the popularity of the London station. In one case, at least, a valve user residing 300 miles from London indicates 2LO as his favourite station.

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How Far is That Station?

Another point revealed by the referendum is the ignorance of some people regarding the geography of their native country. In estimating the distance to their pet station quite a number of listeners were nearly a hundred per cent. wrong. No wonder certain individuals are disappointed at the strength of their reception, and that others are correspondingly elated!

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The Transatlantic Short-wave Tests.

The 24-hour short-wave tests from WGY last week were a little disappointing, though they afforded a useful comparison between the respective merits of the 26.8-metre and 32.77-metre wavelengths at different periods of the day.

Comparing the Wavelengths.

Between 6 and 8 p.m. the transmission on 32 metres was inaudible, while that on 26 metres varied from fair to good. From 11.30 p.m. to 1.30 a.m., however, the tables were turned, the 32-metre signals being much stronger than the others—in fact, they were extremely good for the greater part of the time.

At 9.30 a.m. both transmissions were very good, but they soon faded, and neither was easily readable until just before 6 p.m., when the shorter wavelength signals rose to good audibility as the test concluded.

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A Useful Lesson.

While the results were erratic, the test provided one useful lesson, viz., that short-wave broadcasting of a reliable kind will probably be achieved by altering the wavelength at predetermined hours of the day to compensate for atmospheric vagaries.

This was abundantly demonstrated by the fact that both wavelengths enjoyed their good periods as well as their bad; no doubt if four wavelengths had been used good reception would have been possible throughout the greater part of the test.

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Some Licence Reflections.

Is the listening public growing as rapidly as it should? Judging from the licence figures issued for the first four months of this year, the pace is slackening. The following list is illuminating:—

1927.	No. of Licences.
January	2,227,256
February	2,235,000
March	2,253,845
April	2,283,028

The last number includes 6,501 free licences issued to the blind.

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Are We Near Saturation Point?

It will be seen that the average monthly increase is in the neighbourhood of 20,000. During the corresponding period of last year the monthly increase was over 50,000. Are we nearing saturation point?

There is no reason why we should be anywhere near it.

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That Five Million.

It is generally assumed that Great Britain contains about seven million families. The number of licences has not yet reached two and a half million, which would represent quite a small proportion of the total number of potential licencees.

FUTURE FEATURES

London.

JUNE 13TH.—Cornish Programme, relayed from Sennen Cove.

JUNE 15TH.—"My Programme," by L. du G., of *Punch*.

JUNE 16TH.—Tunbridge Wells Night.

JUNE 17TH.—"Philemon and Baucis," comic opera by Jules Barbier and Michael Carre.

JUNE 18TH.—"Four Quarters of an Hour" (a Pierrotic Phrenzy).

Birmingham.

JUNE 18TH.—Military Programme in Commemoration of Waterloo, 1815.

Bournemouth.

JUNE 15TH.—Songs and String Music by Modern British Composers.

JUNE 18TH.—The Saturday Medley (Instrumental and Vocal Programme).

Cardiff.

JUNE 16TH.—"The Banns of Marriage, by Charles Lee (a play).

Manchester.

JUNE 18TH.—"On With the Show," relayed from Blackpool.

Newcastle.

JUNE 14TH.—"A Racy Revue."

Glasgow.

JUNE 18TH.—"East, West, Hame's Best," a Staff Programme.

Aberdeen.

JUNE 13TH.—Shakespeare in Lighter Vein.

Belfast.

JUNE 15TH.—Original Programmes. No. 1: Reproduction of First Concert given by the Hallé Orchestra in 1858.

Five million licences would be nearing saturation point, and would allow for two million families of the type who either "don't believe in this 'ere wireless" or prefer to take their entertainment without paying for it.

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Broadcasting During the Eclipse.

During the eclipse on June 29th the B.B.C. will transmit a special series of signals from Daventry and London as follows:—

(*a*) Six dot seconds at 6, 6.15, 6.20, and 5.30 a.m.; (*b*) single seconds continuously from 6.22 a.m. to 6.26 a.m., missing each 29th and 59th second to mark half-minute periods. In addition a verbal announcement will be made every five seconds.

From Cambridge University.

The Cambridge University Musical Society will broadcast on June 10, when their performance of the "Sea Symphony" is to be relayed from the Guildhall, Cambridge, to 2LO and 5XX.

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B.B.C. and the Queen's Hall Concerts.

All lovers of music will rejoice at the announcement, which was officially given out by the B.B.C. on June 1st, that after a series of negotiations lasting for several months an agreement has been reached with Messrs. Chappell whereby the B.B.C. will give a series of Promenade Concerts at the Queen's Hall under the conductorship of Sir Henry Wood starting on Saturday, August 13th, and also 12 special symphony concerts during next season.

Thirty-seven Promenade Concerts will, therefore, be given, but not all of these will be broadcast, probably about two in each week.

The series of symphony concerts at the Queen's Hall will take the place of the National Concerts broadcast last season from the Albert Hall.

The removal of the ban on the microphone at the Queen's Hall will enable the B.B.C. to relay the speeches from public meetings and, when possible and desirable, to arrange for the broadcasting of other concerts that may be given there.

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Arnold Bennett's Night.

It is expected that Mr. Arnold Bennett will provide one of the "My Programme" series on June 22. Mr. Arnold Bennett has expressed very decided views on broadcasting, and it will therefore be interesting to note in what way he considers a broadcast programme should be made up.

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The Sound-range of Gunfire.

An interesting test will shortly be conducted by the Air Ministry with the co-operation of the B.B.C. to determine the range at which gunfire can be heard. Guns of different calibre will be fired at Shoeburyness, and before the firing of each gun the B.B.C. announcer at Daventry will count eight dot seconds. The gun will be fired exactly at the eighth second, and listeners in various parts of the country will be asked to note carefully the exact time between the firing of the gun and the hearing of the actual sound. This time may be considerable, as the rumble of the gun may be audible many miles away and it takes from eight to ten minutes for sound to travel 100 miles.

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Interference on 5XX.

Quite a number of listeners are reporting interference, chiefly of the spark variety, with the transmissions from Daventry. Just why a 1,600-metre transmission should suffer from ship interference is a little mystifying, unless it be that the few German ships using spark on 1,800 metres are the cause of the trouble.

Strangely enough, several of the complaints come from listeners in Germany and France.

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5XX Abroad.

This is a reminder that 5XX is still one of the most popular broadcasting stations in Western Europe, despite the claims of giants like Koenigswusterhauser, Langenberg, Hilversum, and others.

Daventry's transmissions are listened to nightly in Northern France, Belgium, Germany, and even Holland, though I imagine that the astute Dutchmen will soon forget Daventry in the excitement of building their short-wave sets to hear PC JJ.

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Always With Us.

Last week it was tremblingly suggested that oscillators were a dying race. The hope was based on the number of letters of complaint received at 2LO during April. O fatal optimism! Look at the figures for May:

1st week	...	...	187
2nd ,,	...	...	145
3rd ,,	...	...	158
4th ,,	...	...	175

Meanwhile two Post Office anti-oscillation vans are roaming the country, the B.B.C. is issuing anti-oscillation leaflets as fast as it can, and broadcasting has been in existence for over four years. And still the oscillator is in our midst.

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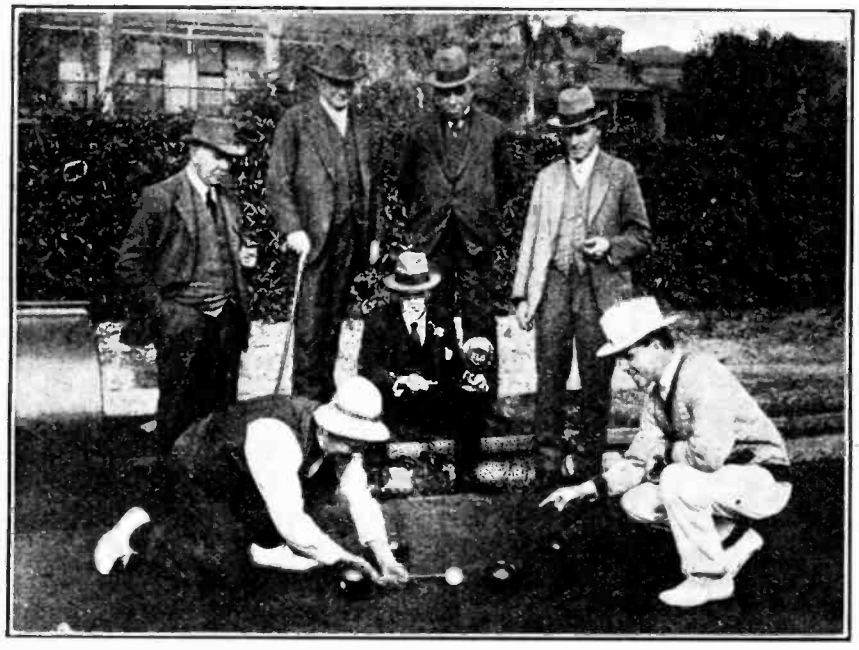
A German Conductor.

Herr Scherchen, who conducted one of the most successful of the B.B.C. national concerts at the Albert Hall last winter, is coming to the London studio on June 9 to conduct a light symphony concert in which the Wireless Symphony Orchestra will take part.



A POPULAR BROADCAST? Broadcasting a bowls match through the Melbourne station. Probably golf from 2LO would draw more listeners here.

"Saturday Night Revue."

The third instalment of Graham John's "Saturday Night Revue" will be given on June 18th. This is the third revue which Mr. Graham John has written and produced for the B.B.C. Among his successes have been the "Nine O'Clock Revue" and "Whirled into Happiness." He is also the author of the musical comedy "My Son John," now playing at the Shaftesbury Theatre.

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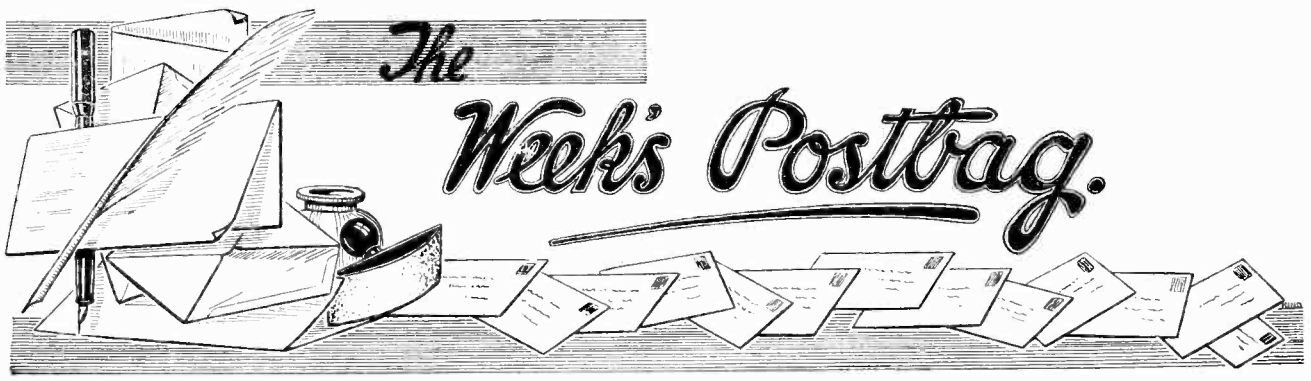
Straight from Cornwall.

"An Hour at a Cornish Inn" will form the subject of a broadcast from 2LO and 5XX on June 13. The programme will consist of a fishermen's sing-song, with touches of the Atlantic breakers and the "atmosphere" of Land's End thrown in. The inn from which the broadcast is to take place is situated near Sennen Cove, on the Cornish coast.



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

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

EMPIRE BROADCASTING.

Sir,—I have read with great interest the articles in your issues of April 27th and May 4th on Empire Broadcasting, and I certainly think it is time the Government woke up to the necessity of broadcasting programmes from the Old Country, not only for our colonies, but also for the benefit of Britons residing in foreign countries. By this I mean duplicating the success of the Philips station in transmitting a programme that can be picked up enjoyably in practically any part of the world.

Even before the advent of I'CJJ it was distinctly disheartening striving on a 7-valve receiver to pick up a B.B.C. station in the hope of hearing Big Ben chime midnight, only to be met with a roar of X's and Morse; and yet a few minutes later to change over to a simple 3-valve set and with the greatest of ease (and apparently any old aerial) tune in 2XAF—3,000 miles away, twice the distance of our nearest B.B.C. station—with a strength and clearness really astonishing. As for 5XX, the super power station, the less said the better. Now PCJJ comes in at "phones-on-the-table" strength in broad daylight using only 3 valves.

A census of the number of Britishers who, in the hope of hearing intelligible programmes from outside the 1,000-mile radius of any B.B.C. station, have spent money on costly receivers and then been disappointed, would be illuminating. There are quite a few on this little island.

Apart from the effect of broadcasting the Englishman's voice throughout the world, it is the duty of the Mother Country to provide programmes, and above all, news items, for her colonies and sons overseas. In how many different countries of the world have the American short-wave stations been heard?

Las Palmas, Canary Islands. M. V. BLAKE.
May 17th, 1927.

Sir,—Would you be good enough to intimate, through your admirable publication, to the brass-pounding fraternity the fact that they have no monopoly of the ether after the B.B.C. stations have closed down. Those of us who listen as regularly to 2XAF as we do to the local programme may be few and far between, but surely it is easy *not* to pitch exactly on 32.77 metres for the purpose of discussing counterpoises with some "ham" in the Antipodes. Zez Confrey was playing magnificently last night at WGY when some merchant started his "blibetty-blah, blibetty-blah" and spoiled reception for a solid half-hour. It often happens so.

Talking of "blah," when are the B.B.C. going to drop that hoary joke about low-wave work not being reliable and give the Colonies a chance of hearing the Mother Country. Broadcasting is impressive and fascinating as the square of the distance of the source of emission from the receiver. It is only fair to the people of this country that this medium of interchange of ideas should be opened up to them also by the establishment of similar stations overseas.

It should not be difficult (through the League of Nations, probably) to arrange a limitation of one short-wave high-power station in each country. There is no doubt whatever that people must think internationally if we are ever to have world peace, and a good start towards it is to get them *listening* internationally. Since listening to American broadcasting I have got an entirely different idea of the American mentality, and I am also beginning to understand the Germans and Spaniards. Listening to French stations has merely confirmed the opinion I had formed of France from personal experience. I am convinced that national mentality is laid bare in broadcasting programmes, and the wider the range of the programmes the sooner "foreigners" will become "fellow-citizens of the world."

The "DX-hounds" will, I am sure, when they realise that people actually listen to the other side of the world for other than test reasons, just consider before they switch on, and "keep off the grass." JOHN WILLINGS.

Handsworth, Birmingham.
May 25th, 1927.

B.B.C. TRANSMISSION OF PIANOFORTE MUSIC.

Sir,—Referring to Mr. Smyth's complaint of the poor reception of 2LO in the provinces, I should like to say that the same trouble is experienced here (six miles east of Ipswich), and that I believe I have definitely traced it to heterodyning by Leipzig. This interference varies in severity, and consists sometimes of a definite and steady heterodyne note, sometimes of 'nasal" distortion of speech and sometimes of sharp fading accompanied by snatches of horribly distorted speech or music from Leipzig followed by tolerable reception of 2LO for a few moments. A very slight adjustment of tuning will bring in Leipzig as large as life only equally distorted. These different types of distortion may be due to slight differences in my tuning from time to time, but I think the question of possible distortion in my own set can be ruled out, as I have three stages of neutralised H.F., detector and 2 L.F., and do not use any reaction for London. Outside interference is practically non-existent as I am well out in the country, while other stations of less power and greater distance come in quite undistorted. The set is reasonably selective and separates Cardiff from London easily.

It is a great shame that yet another station should be denied to us in this benighted spot. Defining a station worth listening to as one that will give full volume on a cone speaker practically every night with no fading whatever, no distortion, little or no interference from Morse or atmospherics, and all this without much reaction being needed; all we have here are Daventry and Hilversum, and in a lesser degree Radio Paris and Langenberg. Hilversum more often than not is badly jammed by Morse. London often provides a symphony concert or chamber music when Daventry is handing out rough stuff, and that is just when one would listen to London direct. I believe the B.B.C. have already protested to Leipzig once; it seems as if further action is needed. P. J. R. KING.

Woodbridge, Suffolk.
May 24th, 1927.

Readers' Problems

"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Litz Wire.

I should be glad if you would examine the enclosed sample of "Litz" wire. It appears to differ considerably from the stranded conductor which I have seen used in certain H.F. transformers, and I fancy its use may account for the poor results I am getting from my receiver. P. H. R.

We have, as requested, examined your sample of wire, and in our opinion it could not fairly be described as "Litz." It is made up from a number of strands (not a multiple of three) twisted together apparently at random, and we think it probable that it has a higher H.F. resistance than solid wire of equivalent cross-sectional area.

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An Economical Project.

I have often heard it stated that anode bend rectification is considerably less sensitive than the leaky grid type. I live 30 miles from Daventry, and am desirous of receiving this station at moderate loud-speaker volume with the least initial outlay and the smallest cost of upkeep. My friends tell me that I shall need a leaky grid detector with reaction followed by a transformer-coupled stage, and have thrown cold water on my idea of using an anode bend detector followed by a resistance-coupled stage with reaction. T. R. B.

We have no hesitation in saying that, provided you can erect a reasonably efficient aerial, your proposals are perfectly in order, and your friends' advice is nonsense. Furthermore, always provided your locality is not a bad one, and the aerial is reasonably good, you will have no need of reaction or H.F., but merely need to use a simple anode bend detector followed by one resistance-coupled stage such as was described with full constructional details in our October 27th issue last, under the title of "Economy Two." This will assure you of good volume coupled with very good quality. From the economy point of view, we advise 2-volt valves, one of the new high-magnification valves such as the Mullard P.M.1A. or Cossor 210 R.C., etc., being used as detector, and in the output stage a power valve such as the Marconi or Osram D.E.P. 215 or a similar 2-volt power valve by other makers.

Grid Bias for H.F. Valves.

I have constructed a receiver with two H.F. stages rather on the lines of the "Wireless World Five." The low-potential ends of the transformers are earthed to the screen through the frames of the tuning condensers, and thus the grid is working at zero, as the screen is also connected to L.T. negative. I now wish to add negative grid bias, but would prefer, if possible, to avoid the necessity of removing the condensers and fitting insulating bushes to their spindles. Can you make any suggestions? W. F.

The simplest way of making the proposed alteration would be to connect one or two dry cells directly between the grid of each valve and the tuned transformer. It is, however, bad practice to insert a mass of metal at the high potential end of the circuit, although in practice this arrangement may be permissible, as it is possible to obtain extremely small cells which are sold as replacement batteries for the so-called "fountain pen" flash lamps. Another method is shown in Fig. 1, and this is probably the sounder of the two. You will see that the necessary biassing cells are inserted in the low-potential end of the tuned circuit. If your H.F. transformers have secondaries of extremely low resistance it will be necessary to bridge each bias battery with a large condenser, as shown in the circuit diagram (C_1 and C_2). If, on the other hand, you are using transformers with secondaries of fairly high resistance, it is unlikely that the extra internal resistance of the dry cell will cause a noticeable reduction in amplification, but you should, of course, replace the cells fairly frequently.

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Keeping Out H.F. Currents.

I notice that in several recent issues you have shown resistances of about ¼ megohm connected directly in the grid circuit of the first L.F. amplifier, the idea being to prevent, or rather to restrict, the development of H.F. potential across the L.F. amplifier. I should be glad to know if this arrangement may be applied when an L.F. transformer couples the detector to the amplifier. C. H. D.

The stabilising resistance may be used in a transformer-coupled set, and it will certainly do no harm. It is doubtful, however, whether its inclusion is worth while, and in any case the difficulties of separating the H.F. and L.F. components are less pronounced with transformer coupling than when a resistance is used.

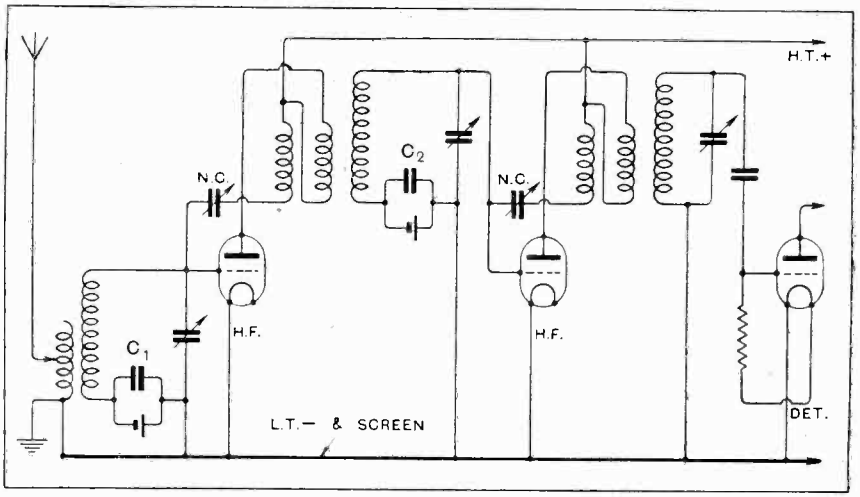

Fig. 1.—Grid bias connections in H.F. amplifier in which the tuning condensers are mounted on a metal panel.

An "All Wave" Alteration.

I have read with very great interest and appreciation your article describing the "All-Wave Four" receiver, and have decided to build it. I intend, however, to make two alterations, one of which you countenance in your article, that is, to use a transformer in place of the resistance coupling in the last L.F. stage. My second suggestion, which you do not mention in the article, is to use a choke filter output circuit. I should be glad if you would give me a revised diagram showing me the connections for making these alterations, and also the most suitable valves to use in the 2, 4 and 6 volt classes.

C. F. T.

Your proposed alterations to this receiver are perfectly sound in every way. The transformer which you should use should be of a good make having a high inductance primary (50 to 80 henries). In a case where a *reliable* manufacturer makes his transformers in more than one ratio, you should choose the lowest ratio which will be $2\frac{1}{2}:1$, or thereabouts. With regard to the output choke L_2, this need not have a greater value of inductance than 20 or 30 henries. There is no harm in using a higher inductance provided that the manufacturers specify that the iron core of the choke is so designed that it will cope with the heavy plate current of the output valve without magnetically saturating. Thus, the 32-henry choke made by Messrs. W. G. Pye, Ltd., is suitable in every way, although of slightly higher inductance than we have mentioned. The point is that, all other things being equal, higher inductance means that the choke will saturate at a much smaller value of plate current than would be the case if it were of a lower inductance.

Since we shall use a power valve in this last stage in any case, there is not the slightest object in using a high inductance. On the other hand, it must not always be assumed that because a choke has as low an inductance as 20 henries it will easily carry the plate current of a power valve, because a cheap 20-henry choke will not necessarily do this. With regard to the blocking condenser C_9, this should not be of less value than 2 mfd. if possible, and it is preferable, although by no means necessary, that two 2 mfd. condensers be used in parallel here (or, of course, one 4 mfd. condenser) in the interests of quality. There is not much object, however, in making this condenser of larger value than 4 mfd., although no harm will be done. Using the choke filter circuit, the connections of the loud-speaker with regard to its positive and negative terminals is immaterial, as no plate current will be passing through it.

It should be realised that, if desired, the single-wire extension system for using the loud-speaker at a remote distance from the receiver may be used here if desired. In this case one terminal of the loud-speaker will connect *via* the single extension wire to the terminal marked A in the diagram, the other terminal of the loud-speaker connecting to the remote earth. Terminal B in our diagram being then left blank. Having made this alteration the valve at V_3 will need to be changed, and one of about 20,000 to 30,000 ohms impedance and of as high a magnification factor as possible (provided a 30,000 ohms impedance is not exceeded) should be used. Suggested valves in the 2-volt class then are: V_1 Mullard P.M.1.H.F., Cossor 210H.F., or similar valves by other makers; V_2 Cossor R.C.210, Mullard P.M.1.A., or similar; V_3 Mullard P.M.1.H.F. or Cossor 210H.F.; V_4 can be Mullard P.M.2, Marconi or Osram D.E.P.215, or similar valves. Those who favour 6-volt valves can use for V_1 and V_3 Marconi or Osram D.E.5.B or Mullard P.M.5.X, Mullard P.M.5.B. for V_2, and for V_4 D.E.5.A or P.M.256, or, of course, similar types of valves by other manufacturers. Users of 4-volt valves have a similar range of valves at their disposal, such as in the Mullard series V_1 and V_3 P.M.3, V_2 P.M.3.A, V_4 P.M.4, or preferably P.M.254. Other valves are the Marconi D.E.L.410 for V_3. The D.E.H.410 should make an excellent detector with the D.E.P.410 as the output valve. It should not be forgotten that many readers prefer to use a 2-volt valve as anode bend detector, owing to the fact that usually a 2-volt valve makes a better anode detector than those of greater filament voltage. Thus, using 6-volt valves, we could use a 2-volt 0.1 ampere valve such as the Mullard P.M.1A as detector, but in this case it must not be forgotten that a resistor of at least 40 ohms value should be placed in series with R_3, and in the case of using a 4-volt accumulator the fixed resistor in series with R_3 must be at least 20 ohms. No harm will be done in exceeding these values slightly in order to obtain an instrument marketed as a stock resistance by a manufacturer, since we do not necessarily want full emission, and therefore need not have full filament voltage on the detector, owing to the high resistance in its anode circuit.

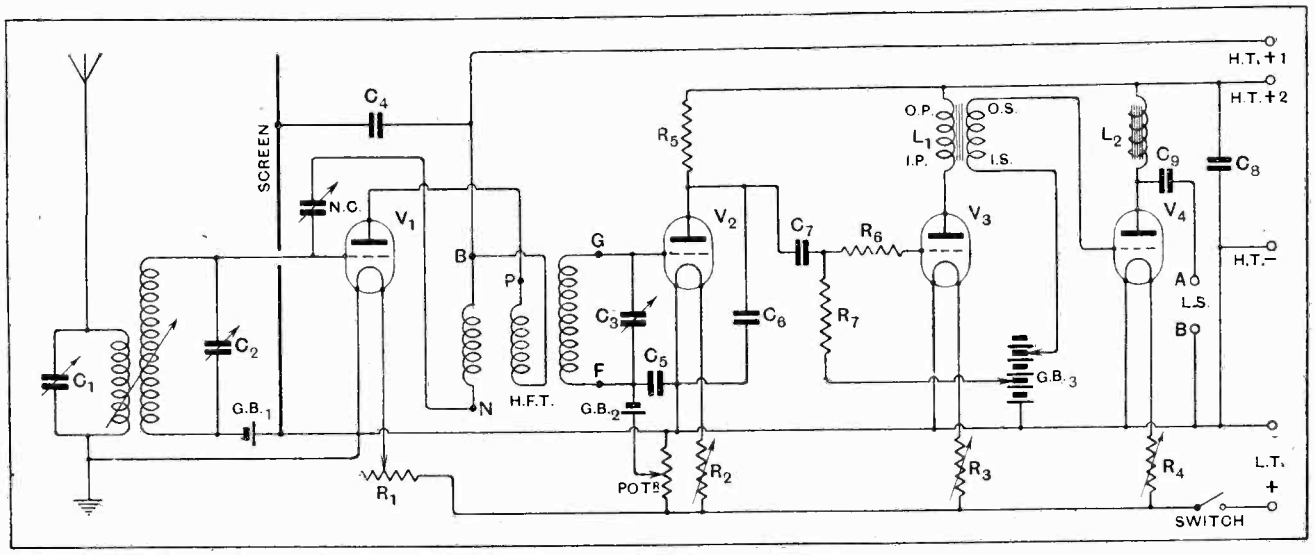

Fig. 2.—Modified "All-wave Four" circuit with transformer coupling for the second L.F. valve and choke filter output circuit.

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A Single Stage L.F. Amplifier.

Please tell me if the transformer-coupled L.F. amplifier designed for adding to the "Nucleus" receiver which was described in your issue of March 23rd, would be suitable for use in conjunction with a crystal set, and also if any modifications would be necessary.

C. L.

The L.F. unit to which you refer would be quite suitable for the required purpose and no modifications are necessary. It could, however, be improved slightly from the point of view of neatness if instead of fitting battery sockets on the face of the panel you were to mount a terminal

strip on the baseboard and pass out the connecting leads through a hole in the back of the cabinet.

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Problems of Aerial Coupling.

I have been carefully reading your article on the "All-Wave Four" receiver, and, in discussing the questions of "aperiodic" or fully tuned aerial coupling, it would seem that aperiodic aerial coupling is not of great use above 600 metres, whilst on the normal broadcast band both forms of coupling work very well. I am building a short wave receiver, however, and am desirous of knowing which system to use. The receiver will be for wavelengths below 200 metres. D. D.

It may be said that on short wavelengths aperiodic aerial coupling is the only system to use, and the shorter the wavelength the more does this rule hold good. On the normal broadcast band between 200 metres and 600 metres both systems of coupling will work very well, and there is not a great deal to choose between them. Possibly, on the lower part of the broadcast band, aperiodic aerial coupling would be the best to use, although, when approaching 600 metres, the fully tuned method would show a marked superiority. Either system may be used with good effect, however, for the broadcast band of wavelengths. Speaking generally, a fully tuned aerial should be used above 600 metres, and the longer the wavelength the more does this rule apply, so that a fully tuned aerial is the only thing to consider on very long wavelengths, just as on very short wavelengths aperiodic aerial coupling is the only thing to consider.

Many people working on a very long wave station may find that such a station may come in loudly with apparent aperiodic coupling, since there is no tuning condenser across the aerial tuning coil, but, in reality, it is probably not aperiodic aerial coupling at all which is being used, the actual facts being that, owing to broad tuning on long wavelengths, the aerial capacity and the self-capacity of the coil give the effect of a fully tuned aerial. Aperiodic aerial coupling can be made to work on long waves, but usually the primary winding must be designed for the aerial it is to be used upon, and the wavelength it is to receive.

Thus it was found, when first designing the "All-Wave Four," that an aperiodic aerial coil could be designed for Daventry when the set was used on a given aerial and maximum efficiency was obtained, but it was found also that using an aerial of different dimensions the number of primary turns no longer held good, or using the same aerial, the same number of primary turns no longer held good on Radio Paris, for instance, as he was of longer wavelength. Radio Paris was still receivable at good strength, but not anything like at maximum efficiency. On the other hand, as you know, aperiodic aerial coupling need not be changed over the normal broadcast band for different wavelength stations, nor need it be changed for aerials of different dimensions, provided always, of course, that all the aerials are of the average type, and not exceedingly long or exceedingly short, such, for instance, in the latter case, as a small indoor aerial. In the latter case it would be more efficient to connect the small indoor aerial direct to the top of the grid coil.

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Constructing a Home-made Cone Loud-speaker.

I possess a loud-speaker unit and understand that some time back you published an article on the construction of a cone loud-speaker using a unit similar to that in my possession. Unfortunately I have mislaid this issue, and should be obliged if you would give me the date of the publication in which this article appeared. R. P. S.

We think you refer to an article entitled "Loud-speaker for Home Construction," which appeared in our issue of November 10th, 1926. Excellent results were obtained from the loud-speaker described, and the quality of reproduction compared very favourably with that given by commercial types. The construction of a horn having good acoustic qualities would be outside the capabilities of the average home constructor, whereas the cone diaphragm presents little difficulty.

Eliminating 2LO.

I am situated three miles from the London Station, and wish to construct a receiver which will enable me to tune in some of the more distant broadcasting stations while London is working. I should be obliged if you would inform me which of the receivers recently described in your paper would most satisfactorily answer my requirements. W. E. P.

The best advice we can give is that you make up the "All-Wave Four" receiver described in our issue of April 27th last. Exhaustive tests have been carried out at varying distances from 2LO and at three miles it was possible to tune-in a station on 385 metres with no sign of interference from the London Station. An added advantage which this receiver possesses over those previously described lies in the use of interchangeable H.F. transformers, thus enabling the frequency valve to be employed for the reception of stations working on the longer wavelengths.

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A Misapprehension.

I have been reading with some interest the "Extracts from Readers' Logs" published in recent issues, and as they seem to be able to receive from practically any part of the world, I should like your advice as to where I could buy a suitable receiver to give equally good results. I am an absolute beginner and do not propose to construct my own set. R. W. S.

We think that you are mistaken regarding the signals heard by our readers. The published call-signs relate not to telephony stations, but, in the vast majority of cases, to short-wave amateur transmissions of Morse, for the reception of which, naturally, a knowledge of the code is essential, and, as you are a beginner, you probably have no experience of Morse signalling. If we are mistaken in this and you really do wish to receive Morse transmissions, we should be pleased to give you the addresses of one or two manufacturers of satisfactory short-wave sets.

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Long Waves and Short Aerials.

My three-valve receiver, a detector and two stages of low-frequency amplification, gives fair loud-speaker reception of the London Station 30 miles away, but although I am less than 100 miles from Daventry this station is indifferently received. My aerial is 35ft. high and 50ft. long, the down lead being taken from the centre of the horizontal portion. Can you make any suggestions that will enable improved reception of Daventry to be obtained without impairing the reception of the London station. J. S.

The poor reception of the Daventry Station is without doubt due to the type of aerial employed, and we think a definite improvement would result if an aerial of the inverted "L" type were erected. Actually the effective length of wire in use is only 60ft., this being the length of down lead plus half the length of the horizontal portion. If, now, you were to connect the down lead to one end instead of to the centre of the horizontal portion, a total length of 85ft. could be obtained, which would result in a longer fundamental wavelength. Under these conditions less "loading" of the aerial would be necessary to tune it to the Daventry Station's wavelength with a corresponding increase in signal strength. Also we should expect a slight improvement in the reception of the London Station.

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RECEIVER DESIGN.

THE design of receivers for broadcast reception in this country is, of course, governed to a very large extent by the policy of the B.B.C. and the distribution, wavelengths, and power of their stations. In the early days the wavelengths of the transmitting stations were confined to one band, and designers had a clean-cut line on which to develop their receivers. Then came the Daventry station, which complicated matters very much for the set manufacturers, who found that the public demand was for receivers capable of reception on both the short band and the Daventry wavelength.

The policy of the B.B.C. up till now has been to induce listeners to concentrate exclusively on their local station, with Daventry as an alternative, though as things have worked out Daventry has very seldom been an alternative programme to London. Now that the regional scheme seems likely to go through, having as its object the provision of alternative programmes from different stations, the set designer must, in many instances, turn his attention to modifying his existing models. Once the regional scheme is in operation the interest in receiving alternative stations will be extended, and this will require that receivers should be more selective than the average receiver of to-day, and in many cases it will be found expedient to add an H.F. stage where this is not already provided ; in fact, it seems likely that the H.F. stage will be necessary in order to be able to achieve the desired increase in selectivity. The reduction in the cost of valves will also, no doubt, result in a very large section of the public hitherto satisfied with a crystal receiver acquiring valve sets.

We have at the present time several commercial receivers which are admirably designed and will meet the alternative programme requirements, but these sets are in the minority and are very high priced. In carrying through our policy of reviewing commercial receivers of interest we deal in this issue with a set of American origin which is now being sold in this country under licence from the Marconi Company at a price which makes it a keen competitor of a large number of British sets, because it has the required selectivity and range to make it admirably suitable for the requirements of the regional scheme, and it has the further advantage that, viewed in the light of present equivalents, the price is right.

We would urge manufacturers here to get ready for the foreign competition which is bound to come about when, as a result of the introduction of the regional scheme in the autumn, the reception conditions of the British listener will compare so closely with those of America. Some drastic reductions in price and important modifications in the majority of what may be described as the standard broadcast receivers of to-day will have to come about, even at a cost of sacrificing appearance and many of the refinements characteristic of the British set, the requirements of range and selectivity with good quality must be met at the right price if the future of British sets is to be assured.

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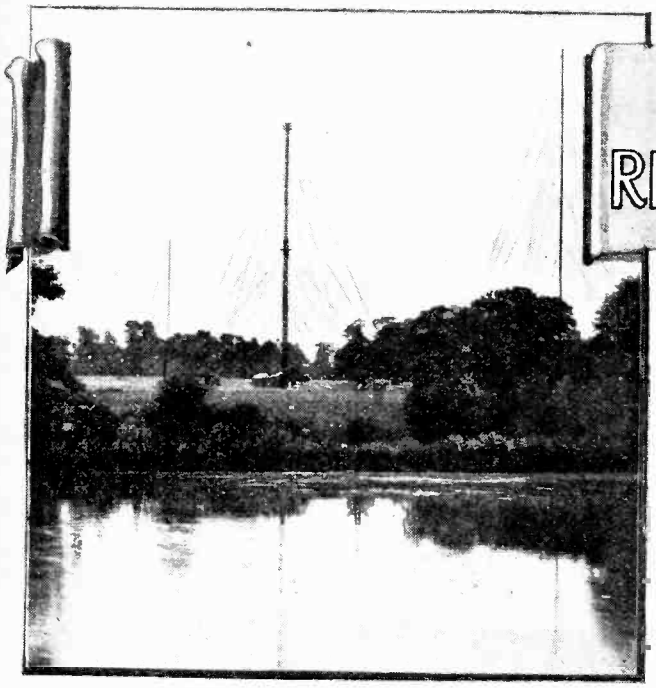


DITTON PARK RESEARCH STATION

Apparatus That Will Be Used During the Eclipse for Studying the Propagation of Waves and Atmospherics.

By J. F. HERD, A.M.I.E.E.

THE radio research station at Ditton Park is maintained by the Department of Scientific and Industrial Research, and the work is principally in connection with wave propagation and atmospherics.

The station is divided into two sections, one in each of two large fields on the estate of Ditton Park, near Slough, an historic site which is now the home of the Admiralty Compass Observatory. In one field the work done concerns problems of wave propagation—*i.e.*, absolute signal strength measurements, fundamental problems of direction-finding, including measurement of the electric and magnetic components of the arriving waves and their respective states of polarisation, night errors, and other factors due to the ionised upper layer of the atmosphere. The other section of the station is devoted to the study of atmospherics, and is possibly unique amongst wireless stations in its affection for what are mostly regarded as undesirable visitors.

Wave Propagation.

The characteristic feature of the "propagation" side of the station is the wide separation of the different buildings, which house the various measuring apparatus to prevent any form of interference between the sets. The need for such precautions will be realised when it is mentioned that four or five separate measurements are frequently being conducted simultaneously on the same signals for complete correlation of the various effects to be measured.

In one hut there is a direction-finder specially designed for measurements of the magnetic elements of the arriving wave. This instrument was described and illustrated in the issue for August 11th, 1926. The frame aerial is rotatable about both vertical and horizontal axes, and screened leads are carried in a brass tube to the apparatus, which is mounted in the tripod structure below the frame. The set is for work on the broadcast band and is used exclusively for making directional measurements on broadcasting stations.

A special hut has been constructed to house the direction-finder. The hut is supported on large porcelain insulators, and is electrostatically screened by wires passing over

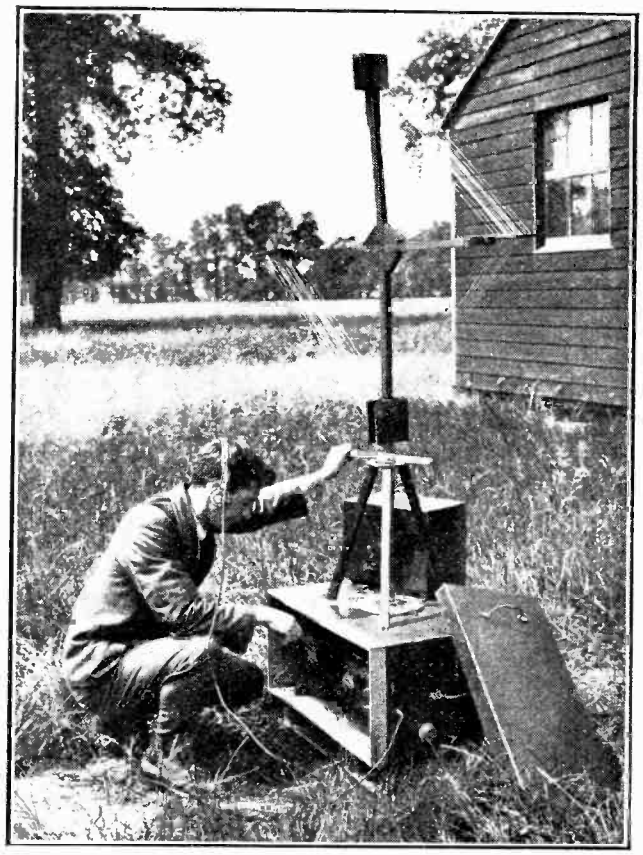


Fig. 1.—Portable direction-finder to be used during the eclipse for measurements on each side of the path of totality.

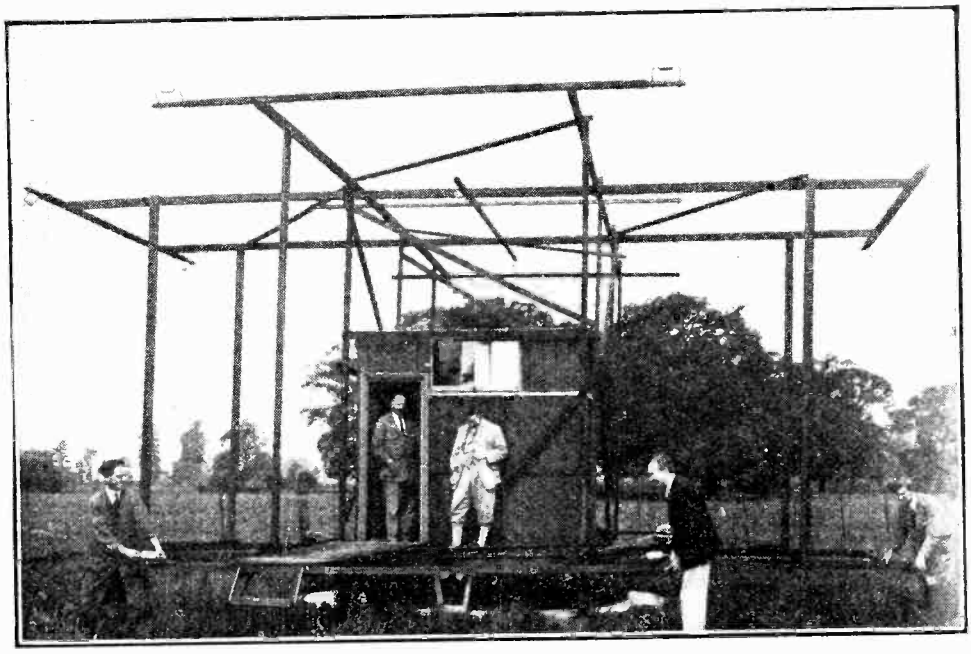


Fig. 2.—Testing the new wireless compass which makes use of the visual direction-finder.

small porcelain reel insulators mounted on an external framework.

In Fig. 1 is seen a portable direction-finding set mounted on the top of its screened amplifier. The front of the screen is shown open while the observer is making adjustments preparatory to directional measurements.

The direction-finding apparatus shown will be used for observations during the forthcoming eclipse, similar apparatus also being employed to make measurements in the region of totality.

A set for the measurement of long-wave signal strength is also available. Signal strength is measured by comparison with a known local input, the measurements being effected on a string (Einthoven) galvanometer. This set and similar apparatus at other places, operated by observers working in conjunction with Ditton Park, will also be in use for special observations during the eclipse.

Atmospheric Recorders.

On the "atmospherics" side of the station the notable external feature is the extensive aerial system. One system of large crossed loop aerials is employed for the visual direction-finder, while another large "T" aerial of about 1,600ft. total horizontal length is used for other purposes, including the study of atmospheric wave forms.

The main aerial system is shown in the title of this article. The central mast seen is about 200ft. high, of wooden lattice; the out-masts are about 155ft. high, of box construction, each being 600ft. from the centre mast. The two out-masts visible are respectively north and south. Similar masts, east and west, complete the crossed loops, while two other box masts support the outer ends of the "T" aerial. The main laboratory building is seen at the foot of the central mast.

The large crossed loops are used for the visual direction-finder, the directional indication being given on a cathode ray oscillograph. When no signal (or atmospheric) is being received nothing is visible but the normal green fluorescent spot on the screen of the tube. The arrival of a signal voltage opens out the spot into a line which makes the same angle with the vertical axis on the screen of the tube as the line of the transmitting station makes with the true north south line. The screen of the tube can thus be used as a direct-reading wireless compass. This holds good even with individual atmospherics lasting only a thousandth part of a second. In this case the indication is in the form of a momentary "streak" of fluorescence, giving the direction of the single atmospheric in the same manner as a signal.

Fig. 3.—Visual direction-finder. The observer is watching the fluorescent screen upon which the direction of the atmospheric is indicated by a line of green light.

Fig. 4.—Apparatus for recording atmospherics simultaneously on six different wavelengths. There are nine valves in each of the six receivers.

Fig. 2 shows a rotating hut which is being used for testing the performance of a similar apparatus working on smaller loops for the direct reading of the direction of wireless signals. The loop aerials are wound round the outer framework, on the grooved porcelain insulators shown. The hut can be rotated to any azimuth and the observer left inside to determine the direction of a signal, afterwards checking the accuracy of the bearing by the position of the hut as read on the large circular scale visible on the ground. The visual direction-finder in the interior of this hut is shown in operation in Fig. 3, where the observer is demonstrating the use of the fluorescent line to indicate the direction of a transmitting station.

The photograph of Fig. 4 shows apparatus recently developed for recording the atmospheric disturbance on each of six wavelengths. Six separate sets, each using nine valves, are used, the recording instrument being the double-thread recorder seen to the right of the picture. The The observers are calibrating the apparatus at the input and output ends respectively.

The atmospherics apparatus shown will be in use for special observations during the eclipse period, while a visual direction-finder and an atmospherics strength recorder will also be in operation at a point north of totality for comparison with Ditton Park results.

TRANSMITTERS' NOTES AND QUERIES.

Low-power Signals Heard in the Antipodes.

Since the preparation of the note on page 692 of our issue of June 1st, in which we recorded the report of reception in Tasmania of transmissions on a 6-watt input, we have received letters from other correspondents on a similar matter.

Mr. D. B. Fry (G 5UY), Mayfield, Sussex, has received a card from Mr. C. Harrison, of Bellerive, Tasmania, reporting the reception of his signals on April 22nd at 7.39 p.m., Tasmanian time, with an 0-v.-1 receiver. Mr. Fry was at that time using a hand generator giving an input of 9 watts.

Mr. F. N. Baskerville, on the other hand, reports having heard OZ 2AR—Mr. A. M. Rennie, 67, Campbell Street, Wanganui, New Zealand—last November on 34.5 metres when he was using only 2.5 watts input.

American Short-wave Tests.

A correspondent in Birmingham reports that during the short-wave broadcasting tests from 6 p.m. B.S.T. on Saturday, June 4th, to 6.12 p.m. on Sunday, June 5th, he was able to receive the programme from one or other of the stations during the whole 24 hours on a 2-valve set.

He states that during the time when it was daylight all across the Atlantic 2XAD on 22.07 metres was received much better than 2XAF on 33.77 metres, the latter being at times inaudible. During the hours of darkness all across the ocean 2XAF was much better and stronger than 2XAD, though both stations came through well.

When it was dark at the receiving end and light in America 2XAD was louder and more consistent than 2XAF, but when the conditions of light were reversed 2XAF was stronger, 2XAD being inaudible from 6 to 11.7 a.m. on Sunday morning. For 18 out of the 24 hours every word of speech was clearly heard from one station or the other.

General Notes.

Mr. G. G. Livesey (2BZT), Stourton Hall, Horncastle, Lincs, has been experimenting with a receiving aerial consisting of 60ft. horizontal wires arranged in "V" shape 9ft. above the earth, with which he has received U 2XAD at good loud-speaker strength on an 0-v.-2 Schnell receiver. 2XAD, which relays the WGY programme at 1.0, B.S.T., in the small hours of Monday morning, is, like 2XAF, crystal controlled.

A correspondent in China, writing on May 19th, asks if any reader can give him the power used by PCTT and PCPP, which he has picked up there at good strength on an 0-v.-0 receiver.

New Call-signs and Stations Identified.

2AZP L. Sanderson, 39, Bonham Rd., Brixton Hill, S.W.2.

2BQA A. Cawley, "Sunnybank," Church St., Frodsham, Nr. Warrington.

2BQH G. G. E. Bennett, 26, Blenheim Park Rd., Croydon.

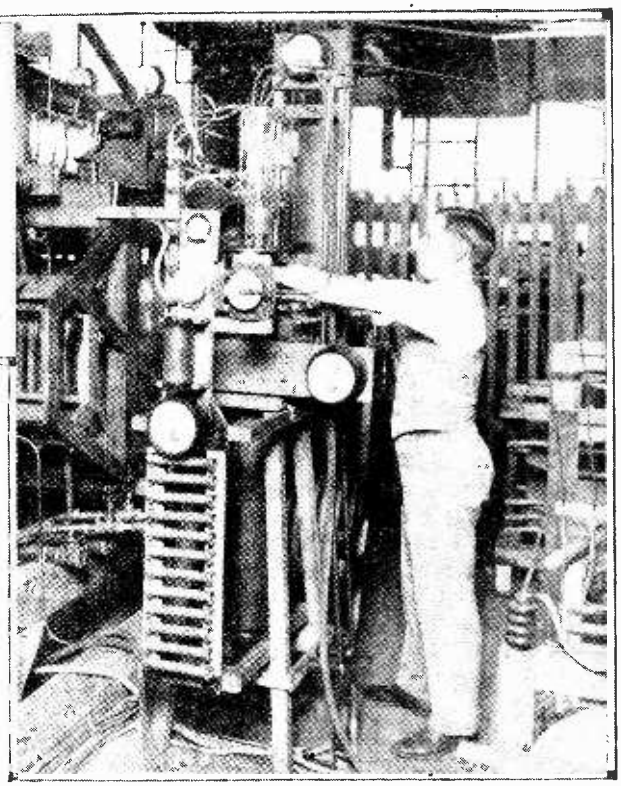
GW 18C W. H. Benson, 46, Dufferin Ave., Dublin. Transmits on 23 and 45 metres, usually between 1900 and 2300 G.M.T.

ED 7ZM G. Bramsley, Laboratory of Telegraphy and Telephony, Royal Technical College, Farimagsgade, Copenhagen. (Change of address.)

Q.R.A.'s Wanted.

G 5FO, G 6LP, NU 1XR, ZAX.

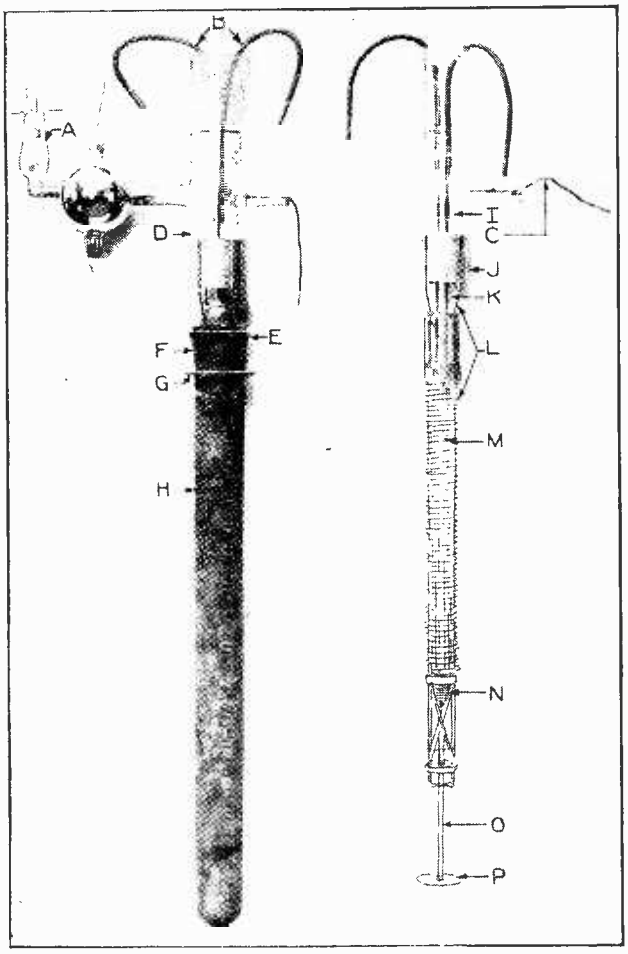
THE WORLD'S LARGEST VALVE



New 100 kW. Valve Used by WGY.

THE highest powered transmitting valve in the world is now being used by WGY, the General Electric Company's big broadcast transmitter at Schenectady, N.Y. The valve is one of the latest developments of that company's research laboratories, and is rated at 100 kW.

The utilisation of this valve, which takes the place of eight 20 kW. valves, marks the occasion of the first practical use of a valve of this size for broadcasting. Mounted in its water jacket, ready for use, the new valve stands 7½ft. high and weighs about 100 lb. The tungsten filament is 8ft. long and has a diameter almost equivalent to that of the lead of a pencil. It contains two ounces of tungsten, or about 750,000 times as much of this metal as an ordinary bright-emitter receiving valve.



Internal construction of the 100 kW. valve.

In order to keep the filament straight, several pounds tension is necessary, and this is obtained by means of a spring, N, which resembles an ordinary screen door hinge. To heat the filament 6.75 kW., or about 11 h.p., is required. This is equivalent to the power used to light one hundred and seventy 40-watt lamps. The leads carrying current to the filament are as large in diameter as a lead pencil, and the terminals used on these leads are similar to those common in switchboard construction.

In the development of the 100 kW. valve the engineers had to devise an entirely new structural design to provide the necessary strength and durability.

Details of Construction.

Outside its water jacket the valve stands five feet high, and, as can be seen in the photograph, two-thirds of this height consists of the copper envelope H, which is four inches in diameter. The envelope serves a double purpose, for it contains not only the elements of the tube, but is itself the anode or plate of the valve.

The upper third of the valve D is made of glass, through which the filament and grid leads make their insulated entrance. The glass bulb is 22in. long and 4in. in diameter, and it is sealed at E to the open end of the copper anode tube by a machine process, in such a way as

The World's Largest Valve.—

to make the junction F of glass and copper mechanically strong as well as vacuum tight under varying temperatures.

Two copper cables, B, of a size capable of carrying a current of several hundred amperes act as leads to the filament, and are connected to tungsten rods, K, which, in turn, pass through the pinch seal I to the ends of the filament. Three lengths of tungsten wire, M, each roughly 16in. long, connect to each of the filament leads, where they come through the pinch, thus forming six parallel filament spans. These pass within the grid and meet at a common point at the filament spring suspension in the lower end of the tube, which is held in position by a quartz insulator, O, and spacer disc, P.

The grid within the copper envelope is cylindrical, and has an overall length of 3ft. 5in. In design it is a spiral. The grid frame L is a most ingenious structure of molybdenum and tungsten and is clamped to the glass at J. Bracing such as is common in steel bridge construction, is used in the design to provide maximum strength with a minimum of metal.

Sufficient rigidity and strength are necessary in this construction to prevent short-circuiting due to swaying or sagging. A minimum of metal in the grid structure facilitates the exhausting of the valve and minimises the possibilities of "softening" at a later date due to the release, under working conditions, of occluded gas. The state of the vacuum is estimated during pumping by means of the ionisation gauge A, which is really an ordinary receiving valve to which meters are attached for measuring grid current.

The grid connection C inside the valve is brought out through a special arm part way up the high-tension glass bushing to a flexible outside grid terminal wire.

A uniform flow of water around the anode of the valve is necessary to prevent unequal heating, and for this purpose a new type of water jacket has been designed. This consists of an ordinary jacket with an inner flexible jacket secured to the flange G to direct the water past the anode.

The valve is now being operated as a plate-modulated power amplifier at WGY, where, due to the limitations of the circuit, the output is normally held at the comparatively low value of 50 kW. Engineers are thus securing valuable operating data on the new valve. A. D.

USING BURNT-OUT TRANSFORMERS.

Conditions Under which the Secondary Winding may be Used as a Choke.

ONE fairly frequently sees suggestions in the technical Press to the effect that the secondary of an intervalve transformer can be pressed into service as a choke after the primary winding has "burnt out." Provided that the limitations imposed by the fineness of the wire with which the secondary is wound, by the very large number of turns, and by the comparative smallness of the iron core are duly respected, such a transformer can be made of great use.

The fineness of the wire is a drawback chiefly insofar as it raises the D.C. resistance of the winding; the transformer secondary is therefore unsuitable where heavy currents have to be carried, on account of the large voltage-drop across it. As a smoothing choke in any type of battery eliminator, for example, it would be utterly out of place for this reason alone. Further, owing to the large number of turns, and the smallness of the core, the iron will become saturated if any attempt is made to pass a heavy current through it.

Choke Coupling.

This latter limitation must be borne in mind, too, if it is desired to use the transformer in a choke-coupled amplifier; if the valve that precedes it is of comparatively low impedance the plate current would almost certainly saturate the core, for, with the average secondary, one milliampere is about the maximum permissible current. Owing, however, to the very high inductance, which is usually well over 400 henries, there is no objection on the score of quality to using before it a valve of high impedance (say from 50,000 to 100,000 ohms), and the plate current will in this case be too small to cause trouble from saturation. Further, the high amplification factor of such valves enables considerable amplification per stage to be attained; as much, in fact, as can be had, *for the same quality*, with transformer coupling, using valves of lower impedance and amplification factor.

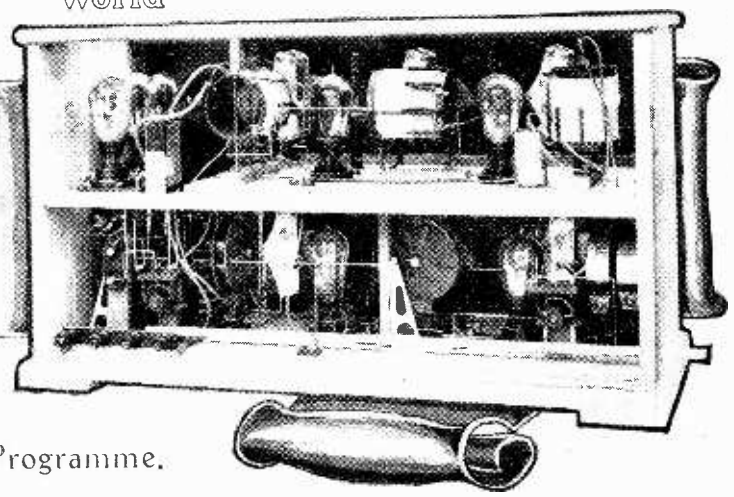
Used in this way, the burnt-out transformer need not be regarded in any way as a makeshift, for it will probably prove a better instrument for this purpose than the majority of commercial L.F. chokes, the inductance of which in many cases is deplorably low.

Avoiding Saturation.

The remaining purpose for which it is usual; in wireless practice, to employ a choke is as output choke where choke-condenser feed to the loud-speaker is employed. For this purpose the secondary, as it stands, is quite unsuitable, but in cases where the disadvantage of the D.C. resistance, with its accompanying voltage drop, is not serious, it may be converted into a tolerable makeshift by providing an air-gap in the core, which has the dual effect of reducing the inductance to a more suitable value and of preventing saturation of the core. The air-gap is introduced most easily by dismantling the core, and rebuilding it without allowing the stampings to overlap. Normally the T stampings are pushed in alternately from each end of the bobbin, but if an air-gap is required it is necessary to put them all in from the same end, and to bring all the U stampings round the bobbin from the other end, clamping them so that there is a small gap between the ends of the U and the cross-bar of the T.

It is hardly advisable to use a transformer converted in this way as output choke after a "super-power" valve, because the voltage drop is likely to be considerable in this case, owing to the large plate current; after a power valve of some 8,000 ohms impedance, however, it may prove very serviceable. A. L. M. S.

TWO-RANGE ALL STATION RECEIVER



A Three-unit Set Covering the Entire Broadcast Band with Switch Action for an Alternative Programme.

By A. J. BULL.

(Concluded from page 722 of previous issue.)

WITH the unit comprising the valve-detector and low-frequency stage completed and in operation on the local station, attention can be turned to the long- and short-wave high-frequency amplifiers.

Unit B.—The long-wave unit (Fig. 12) covering a wave-range of 600 to 2,000 metres is probably the most simple of the three to construct. With working drawings and component parts to hand, the unit can be assembled ready for wiring in about two hours. Care must be exercised, however, to ensure that the Utility switch is mounted on the baseboard in line with the one mounted on unit C, so that when, at a later stage of assembling, the rod connecting the switches is added, it shall operate smoothly. The ebonite panel (Fig. 13), after drilling, is attached to the baseboard by means of two angle brackets and a piece of wood ½in. square by 16in. long, fastened to the base immediately behind the panel and to which the panel is screwed.

The next step is to fit the three variable condensers, aerial and earth terminals, and filament rheostat to the panel, and the remaining components to the baseboard in positions indicated in the working drawing (Fig. 14). Upon completion of that work the Igranic coils Nos. 150 and 200 and the two Gambrell coils should be inserted tightly in their respective plugs and wiring commenced.

Begin the wiring with the filament circuits, which should be connected up with No. 22 tinned copper and Sistoflex (Fig. 17). Make other connections with No. 16 S.W.G., the leads being as short as possible. Where, for example, a 90-degree bend is needed, arrange it so. In short, make a good job of the wiring, and, as a result, when later the receiver is stabilised it will remain so indefinitely. The two input connections shown at *b* (Fig. 15) and the three output leads shown by the dotted lines to 4, 5, and 6, are made with 23/.007in. rubber-covered flexible wire soldered to their respective components mounted on the baseboard; they thus become an integral part of the unit. To the remaining ends of the input wires Clix plugs are attached, coloured red and black, representing aerial and earth respectively, and to the output wires tags are soldered.

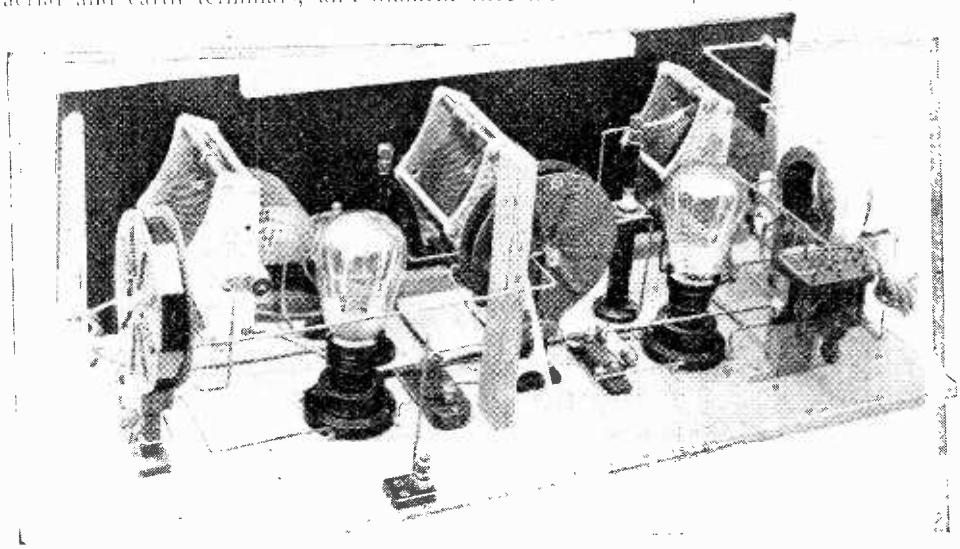


Fig. 12.—Unit B. The two-stage high-frequency amplifier, covering a waveband 600 to 2,000 metres.

Unit A.—Turning now to Fig. 16, it will be seen that unit A is in many respects similar to B and that the tuned anode coupling between the valves is substituted for H.F. transformers. These are similar to the H.F. inter-valve couplings adopted in *The Wireless World* Everyman Four receiver. As the principles underlying the design of H.F. transformers have so often been explained in the pages of this journal, the writer does not feel justified in introducing theoretical consideration of transformer design in this constructional article; he will therefore comment, in passing, that it is essential to the successful

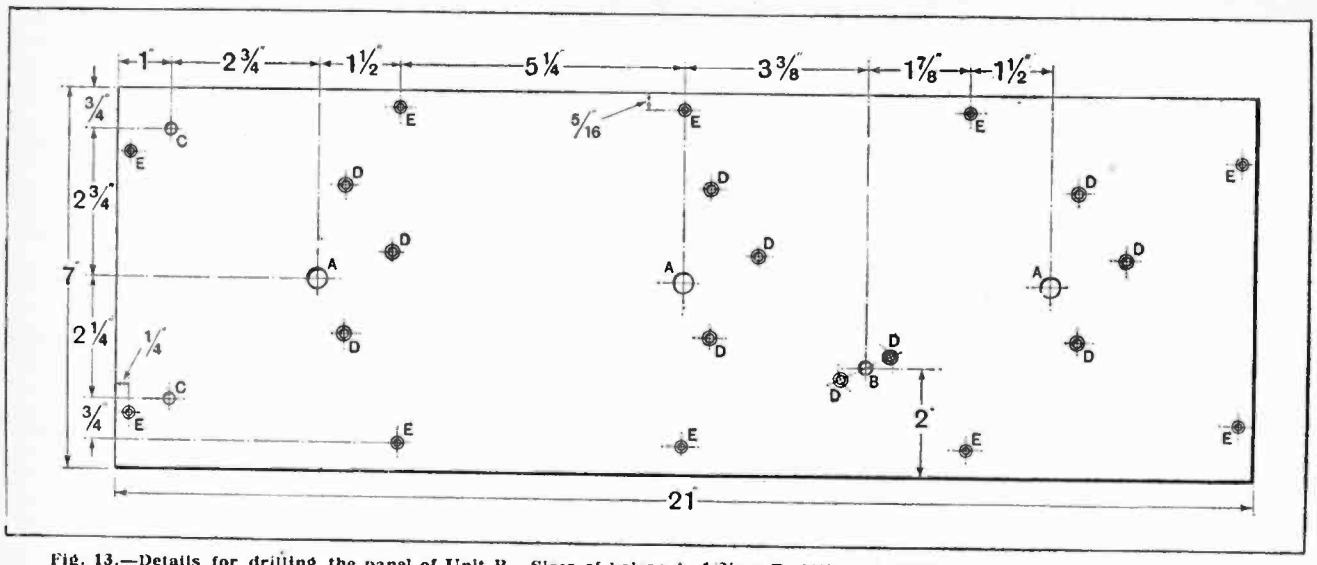


Fig. 13.—Details for drilling the panel of Unit B. Sizes of holes: A, 1/2in.; B, 1/4in.; C, 5/32in.; D, 5/32in. and countersunk for 4BA screws. E, 1/8in. and countersunk for No. 4 wood screws.

design of H.F. transformers to give good selectivity, to reduce to a minimum the electrostatic coupling between the windings. Consequently, the distance between the primary and secondary windings, the number of primary turns, spacing between turns, and diameter of wire employed, is of great importance. An examination of the coils designed for the "Everyman Four" will reveal that due consideration has been given to these points, and therefore, in view of the fact that the coils can be purchased ready made from most wireless factors, it is recommended that they be adopted in this unit.

If the coils are to be constructed minor modifications may be made to simplify mounting. The coils may be mounted rigidly by means of brass rods 5in. long threaded 4BA and passed through small holes in the cylindrical formers, as shown in Fig. 17; 4BA nuts are placed on either side of each rod, where they pass through the holes and grip the wall of the cylinder. In a similar manner the ends of the rods are secured to a baseboard measuring 5in. × 1in. × ⅜in.

Following the construction of the H.F. transformers, the ebonite panel should be drilled to receive the three variable condensers, filament rheostat, and Utility switch (Fig. 18). The dimensions of this panel and baseboard are identical with those of unit B, and the position of the components on the panel are the same. There are,

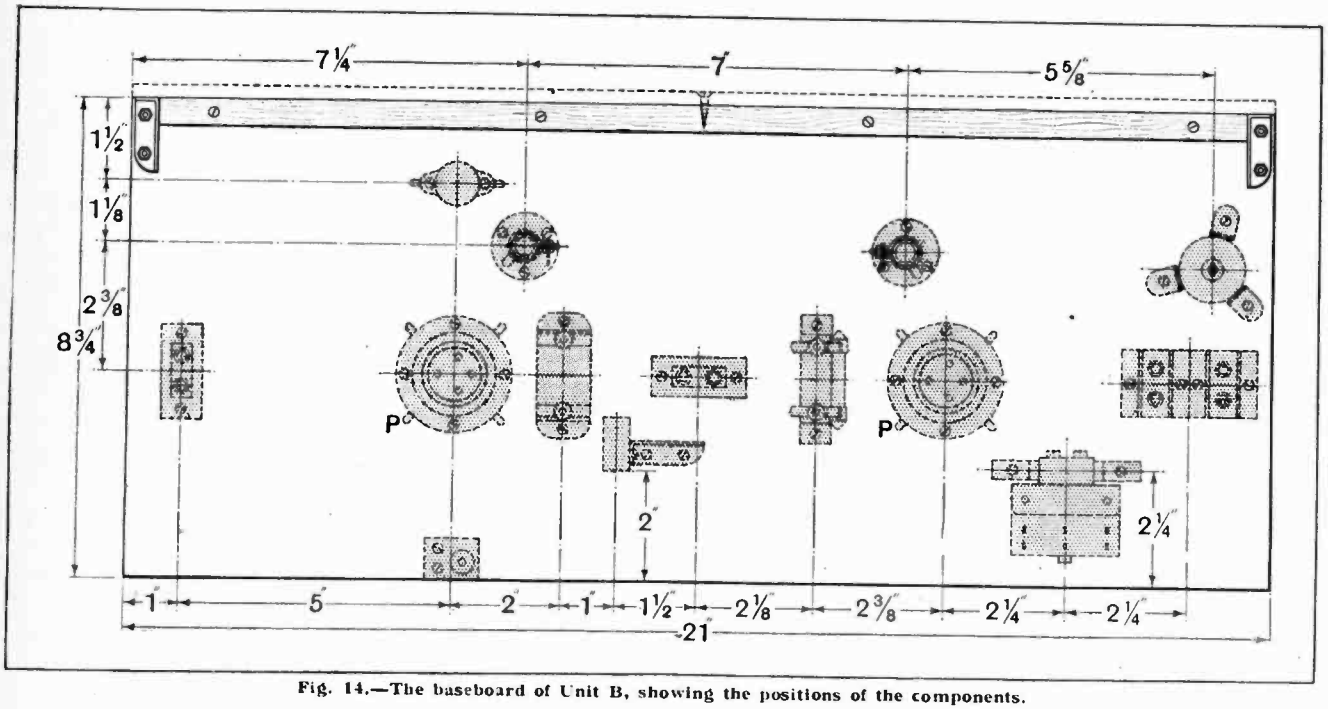


Fig. 14.—The baseboard of Unit B, showing the positions of the components.

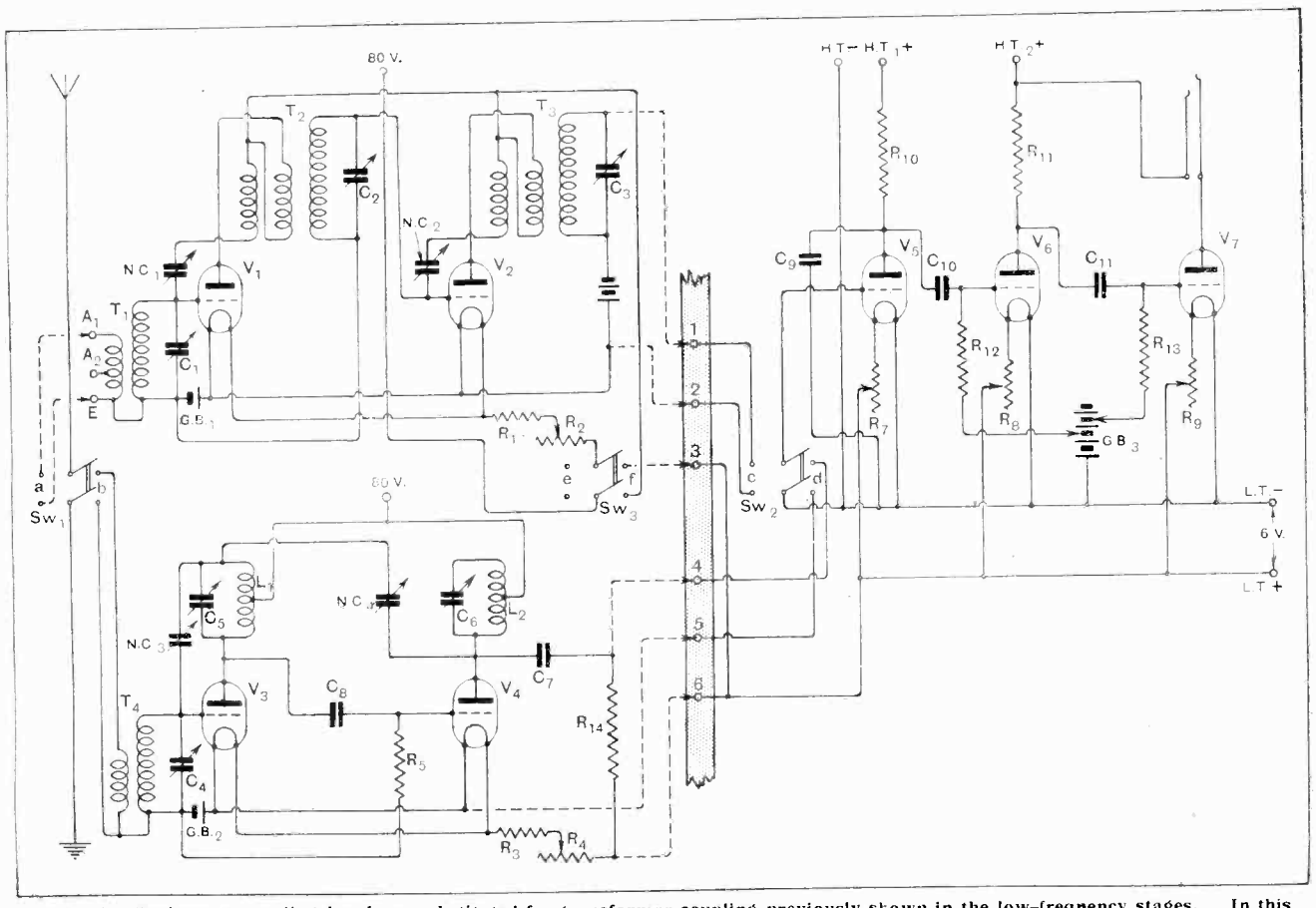


Fig. 15.—Resistance coupling has been substituted for transformer coupling previously shown in the low-frequency stages. In this instance the detector valve becomes an anode bend rectifier when connected to the short-wave H.F. amplifier. R_{10}, 150,000 ohms. R_{11}, 100,000 ohms; R_{12}, 0.5 megohms; R_{13}, 0.25 megohms; C_9, 0.0001 mfd. C_{10} and C_{11}, 0.1 mfd. (mica dielectric).

however, no A and E terminals. The panel is attached to the baseboard by angle brackets and wood strip in a similar manner to that of unit B.

The H.F. transformers and remaining components are now screwed to the baseboard in accordance with the particulars on the working drawing (Fig. 19), and wiring commenced and carried out on similar lines to the long-wave unit, using the practical wiring diagram (Fig. 20) as a guide. The three output connections (to be made to terminals No. 1, 2, and 3 of unit C, see Fig. 15) are made with 23/.007 rubber-covered wire soldered to their respective components, tags being provided for the other ends.

Testing.

The three units having been constructed and wiring checked with the diagrams, they should be placed on a convenient table in their normal working positions (but without cabinet) and with the Utility switches mounted on B and C linked together by means of the wooden rod.

An inspection of the receiver at this stage should reveal eight rubber-covered wires with free ends, six of which are fitted with tags and two with plugs coloured red and black respectively. Having connected the former

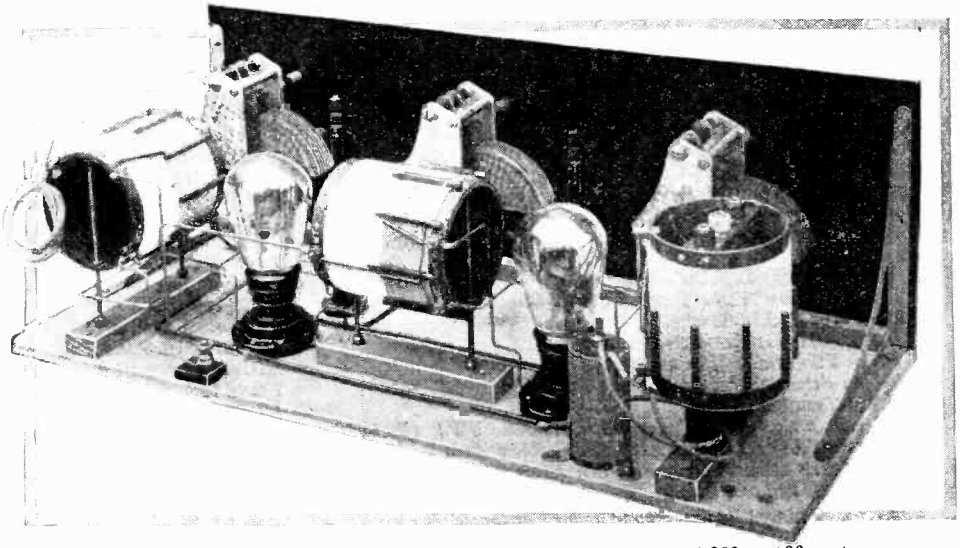


Fig. 16.—Unit A. Two-stage H.F. amplifier with a wave range of 200 to 600 metres.

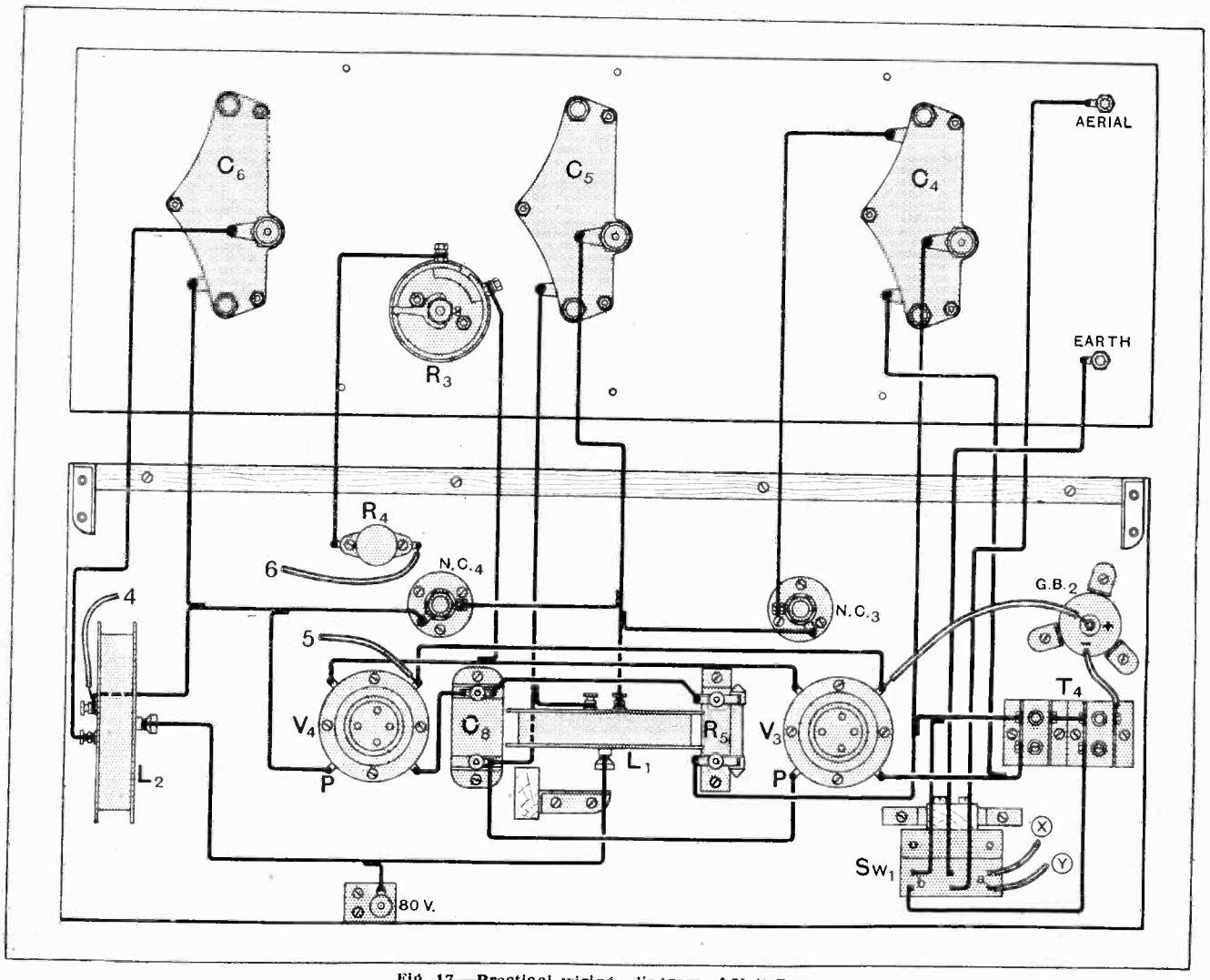


Fig. 17.—Practical wiring diagram of Unit B.

LIST OF PARTS.

UNIT A.

1 Baseboard of $\frac{5}{16}$ ply wood, 21in.×8¾in.
1 Ebonite panel, 21in.×7in.×¼in.
2 Variable condensers, 0.0003 mfd. (Igranic).
1 Variable condenser, 0.0005 mfd. (Igranic).
3 Slow motion dials (Igranic Indigraph. Cat. No. 2296/24).
2 Anti-microphonic Valve holders.
3 3½in.×3in. dia. Paxolin or ebonite tube. | *or 3 "Wireless World" coils (1 aerial coupler and 2 H.F. intervalve couplings).*
60 yards Litz wire 27/42.
4 pieces Ebonite rod, ⅛ dia. 1ft. long.
2 1ft. Lengths of brass rod threaded, 4BA.
30 4BA Nuts.
1 Utility switch, D.P.D.T. lever pattern (Wilkins & Wright, Ltd., Utility Works, Kenyon Street, Birmingham).
8 Lengths of 16 S.W.G. wire.
3 ft. 23/.007in. rubber covered wire.
1 4-ohm Filament resistor and mount (Burndept).
1 10-ohm Filament rheostat (Igranic Pacent).
1 H.T.+Terminal.
1 1.5 volt "Ever-Ready" dry cell, Cat. No. UW1 (Portable Electric Light Co., Ltd., 120, Shaftesbury Avenue, W.1).
3 Clix sockets coloured Red, Blue and Black respectively.
2 Clix plugs, Red and Black.
1 piece of Ebonite 2¾in.×1in.×¼in.
2 Neutrovernia condensers (Gambrell Bros., Ltd.)
1 pair 6in. Angle brackets.

UNIT B.

1 Baseboard of $\frac{5}{16}$in. ply wood 21in.×8¾in.
1 Ebonite panel, 21in.×7in.×¼in.
2 Anti-microphonic Valve holders.
2 Variable condensers, 0.001 mfd. (Igranic).
1 Variable condenser, 0.0005 mfd. (Igranic).
3 ordinary 4in. dials.
2 Gambrell E.1 centre tapped coils.
1 Igranic coil, No. 150.
1 Igranic coil, No. 200.
4 Coil sockets.
1 Terminal marked H.T.+.
1 Utility switch D.P.D.T., lever pattern.
1 Fixed condenser, 0.0002 mfd.
1 Grid leak, 2 megohm.
1 1.5-volt Dry cell, "Ever-Ready," Cat. No. UW1.
1 4-ohm Filament resistor and mount (Burndept).
1 10-ohm Filament rheostat (Igranic Pacent).
2 Neutrovernia condensers (Gambrell).
3 6in. Angle brackets.

Cabinet with hinged lid and removable back sections. (Carrington Manufacturing Co., Camco Works, Sanderstead Road, South Croydon.)

ERRATUM. C_9 referred to on page 718 of the previous issue should be 0.0001 mfd. and not 0.001 mfd. as given.

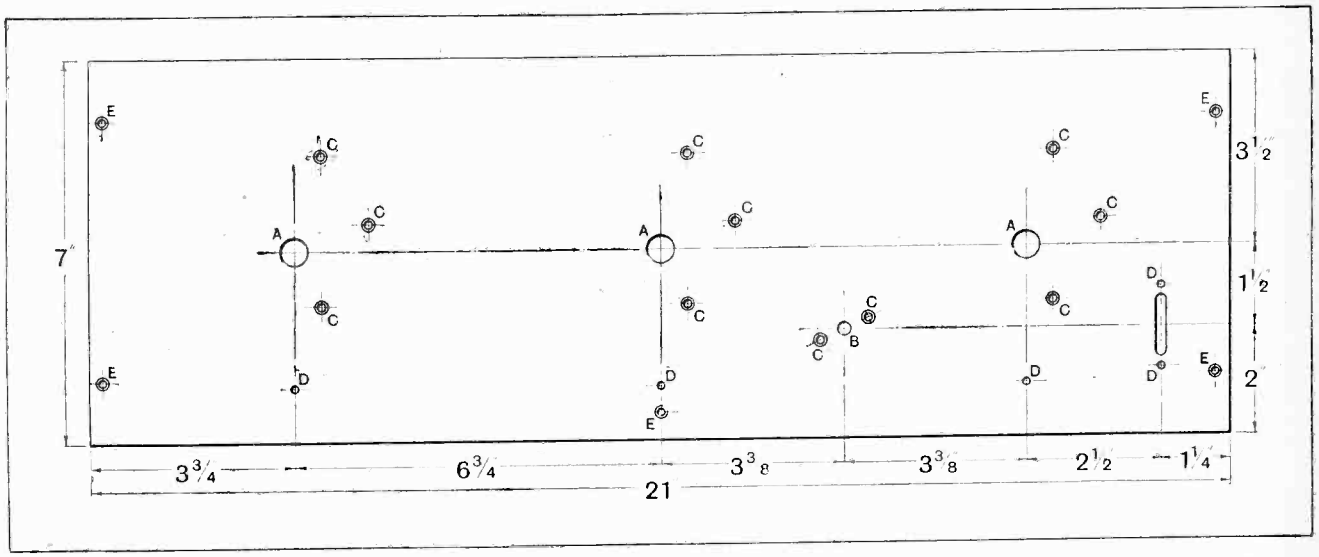


Fig. 18.—The panel of Unit A. Sizes of holes: A, 1/2in.; B, 1/4in.; C, 5/32in. and countersunk for 4BA screws. D, 1/8in.; E, 1/8in. and countersunk for No. 4 wood screws.

to the terminals 1 to 6 on unit C, and the latter to sockets similarly coloured and mounted on the aerial coil of unit A, the receiver is ready for test.

Proceed as follows:—

(1) Connect L.T. and H.T. supply to receiver.

(2) Insert loud-speaker or telephone plug in the jack of the second L.F. valve, and adjust all filament rheostats to the "on" position.

(3) Set wave-change switch to lower panel.

(4) By means of a voltmeter check voltage at each valve socket.

(5) Continue to check valve filament potentials with the wave-change switch set to upper panel.

(6) Make a further test with plug inserted in first L.F. stage.

(7) If the tests prove satisfactory, remove the top unit and insert in the lower unit two H.F. valves, and in unit C one H.F. in the detector stage, a "general purpose" valve in first L.F., and a "power" valve in second L.F. stage. Connect an aerial and earth to the receiver and with the telephones in first L.F. stage tune in Radiola Paris (1,750 metres), adjusting the neutralising condensers until positions are found where a movement either way (clockwise or anti-clockwise) produces evidence of oscillation. Now tune to a 600-metre station, and it may be found that a slight adjustment of one of

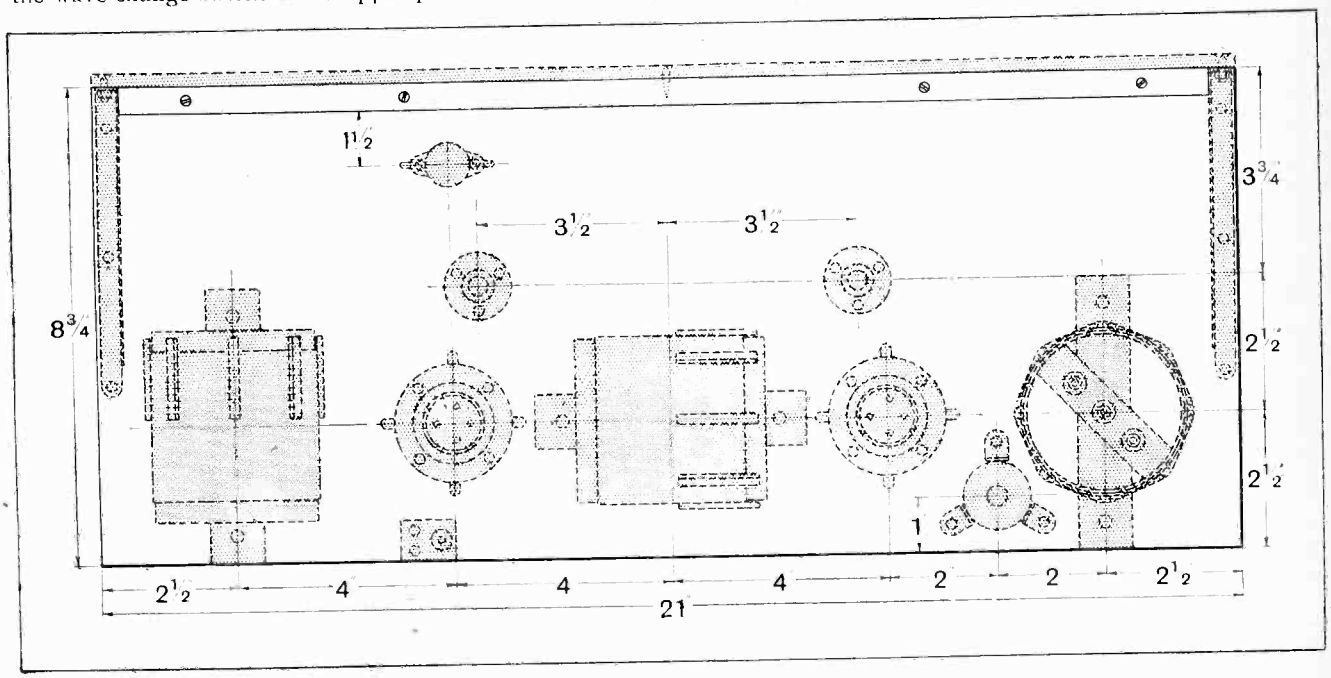


Fig. 19.—Layout of the components of Unit A.

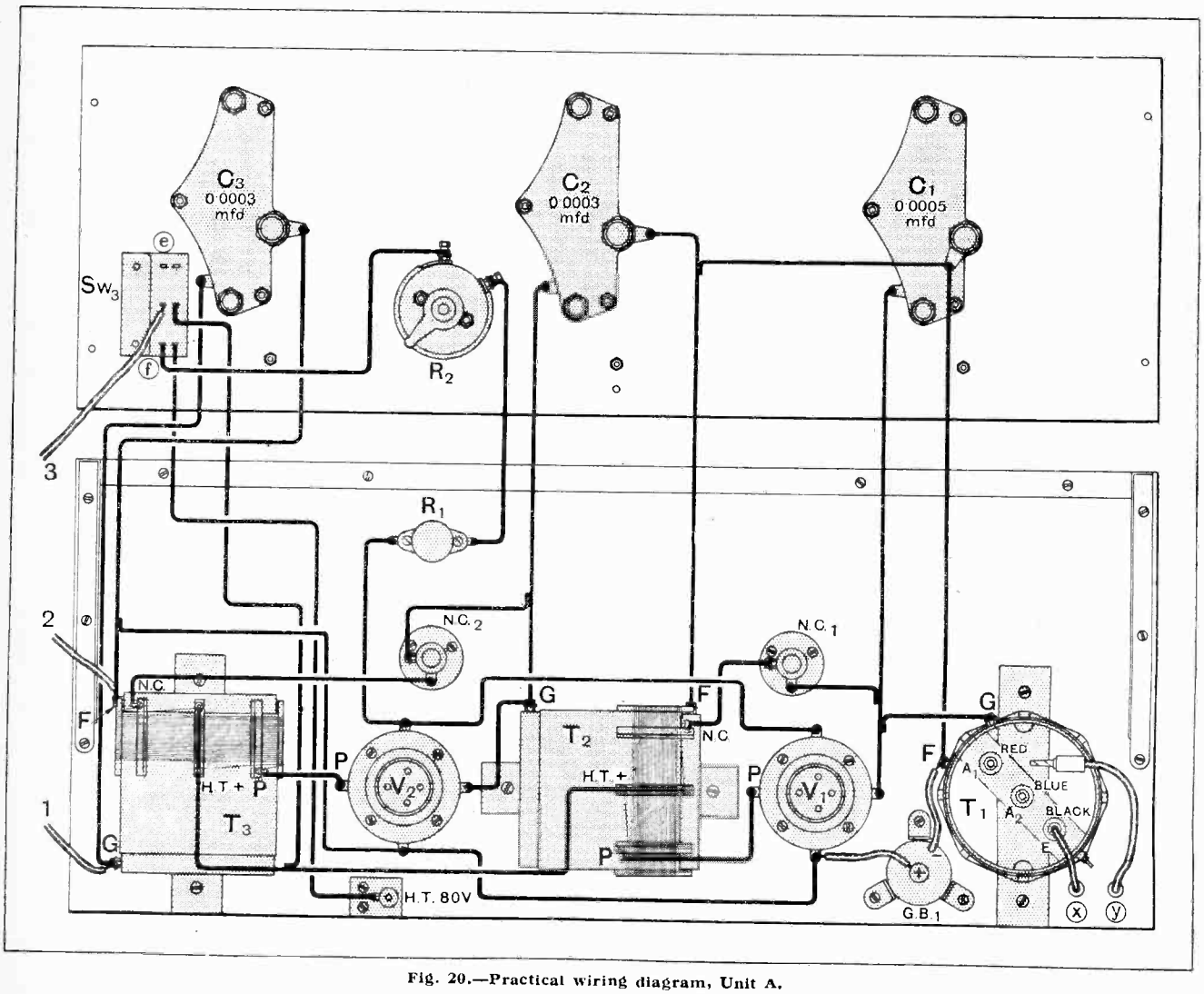


Fig. 20.—Practical wiring diagram, Unit A.

the neutralising condensers is necessary to obtain a balance. If that adjustment is carefully made it will be found that the unit is stable over the whole range of the tuning condenser.

It is advisable, when making these adjustments, to employ an aerial the height of which is only a few feet above ground, as the strength of the received signals are distressing to the ear.

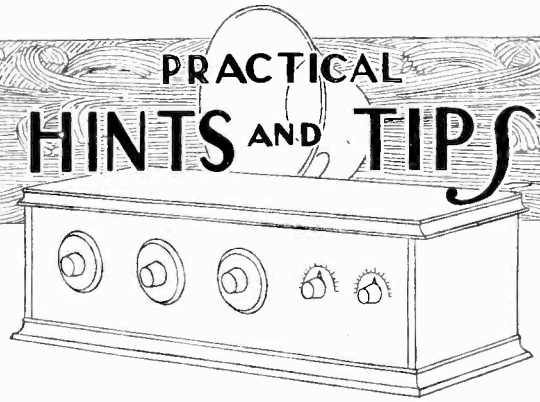
The short-wave panel should now be replaced complete with two H.F. valves and the effect of valve capacity neutralised. This can be accomplished by tuning in stations near limits of tuning condenser, say, 250 and 500 metres, and adjusting the neutralising condensers as just described. All that now remains is to fit the units in the cabinet and to calibrate the receiver from broadcast transmissions of known wavelength.

CURING "BOOM."

CERTAIN loud-speakers of the horn type, especially the earlier models, give a pronounced "booming" effect, which gives speech, more perhaps than music, the appearance of emanating from the bottom of a deep well. In some cases that have come under the writer's observation, this effect has been so marked that speech has been very nearly unintelligible.

Some improvement can generally be made to such instruments by connecting the two bobbins in parallel instead of in series, which tends to lessen the intensity of the low notes. Really, this is curing one fault by introducing another, and is, from the modern point of view, a thoroughly heretical proceeding; but, nevertheless, the resulting reproduction, though very far indeed from being perfect, is often more pleasing after this alteration has been made.

PRACTICAL HINTS AND TIPS



Aids to Better Reception.

Theoretical Diagrams Simplified.

VOLUME CONTROL.

WHEN dealing with a receiver primarily intended to give high-quality reproduction, the problem of controlling signal strength is not always quite such an easy one as might be imagined. Of course, it does not exist when the set depends for its sensitivity on the use of reaction, provided normal volume is small, but this method of increasing response is not operative in every case. It may sometimes be possible to reduce intensity by detuning; this is not quite so bad a plan as is often supposed, but is not altogether desirable under certain conditions and cannot be generally recommended.

Another method of obtaining reduced intensity is by dimming the filament of the high-frequency amplifying valve. This, in practice, is convenient, but has its limitations. It should be definitely stated that it is quite incorrect to dim the filaments of either detector or L.F. amplifying valves.

It is probable that the methods of volume control which depend on a reduction in the input to the L.F. amplifier are least open to criticism. Two alternative systems whereby this effect may be obtained in a resistance-coupled amplifier are shown in Fig. 1. The first (a) is particularly applicable when the normal values of coupling components are used, as tapped wire-wound resistors are readily obtainable. When the coupling condenser is joined to that end of the resistance which is connected to the anode, full volume will be produced; this will be reduced progressively as the tapping is moved towards the end joined to H.T. positive.

At (b) is shown a scheme of connections which is generally more convenient when a high ohmic resistance is inserted in the anode circuit. In this arrangement a suitable proportion of the total L.F. voltage available is taken from the grid leak. As resistances of this type are not generally available, it will be necessary to connect two or more single leaks (R_1, R_2, etc.), in series, totalling the resistance required. The L.F. amplifier grid is connected by means of a plug-and-socket arrangement or a switch to one or other of the junction points A, B, or C. Full volume is, of course, obtained when this connection is made to the point A, which resulfs in the inclusion of all the available resistance in the grid circuit.

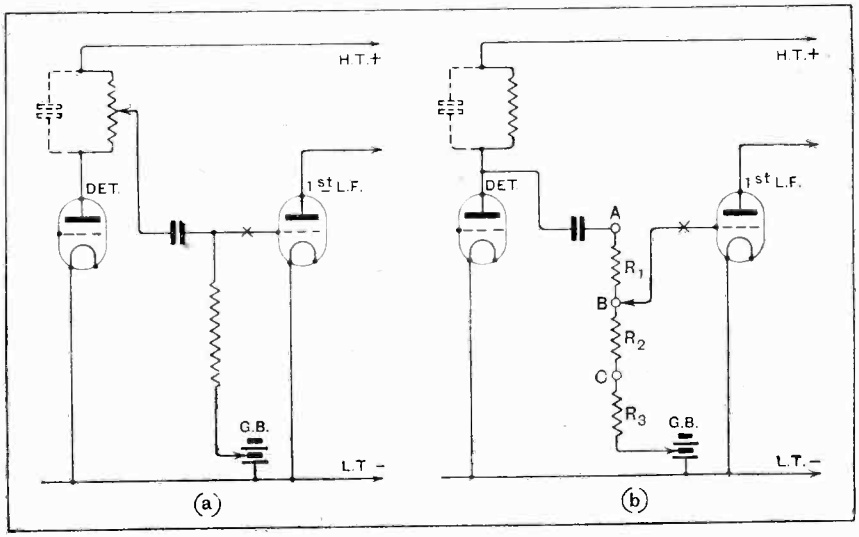


Fig. 1.—Alternative methods of volume control. The usual damping resistance may be inserted at the point marked X.

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VOLTMETERS.

THE normal purpose of a voltmeter is to read the electrical potential differences between two points, and in this capacity it is extremely useful to a wireless amateur.

All types of voltmeters except the electrostatic, which relies on the affinity of two electrodes at different potential, and the valve voltmeter, which relies on the change in anode current in a valve circuit following on the application of a potential to the grid, require current to give a deflection of the pointer.

The amount of current required to send the pointer to the highest reading on the instrument (known as full scale deflection) varies in different classes of instrument, and it may almost be said that the smaller this current, the better the instrument. A superfine meter costing six or seven pounds would possibly take only one-tenth of a milliampere, whereas a cheap pocket instrument might easily absorb one-tenth of an ampere, or one thousand times as much.

The range is given to an instrument by increasing its internal re-

sistance so that when a voltage applied to its terminals corresponds to the highest marked voltage on the scale, the current required to give full scale deflection is flowing.

It follows that since, with a given movement, the actual current required to give full scale deflection is always the same, the volts reading is dependent on the internal resistance, *e.g.*, of two instruments having the same pattern movements, but one scaled 0-12 volts and the other 0-6 volts, it will be found that the internal resistance of the former is twice that of the latter.

We have in this way a fair and useful way of comparing the relative merits of voltmeters—we say that the sensitivity of a certain meter is so many ohms per volt. The higher this figure (which is independent of actual scale reading) the better. With a cheap pocket meter the figure may be as low as 30, while 200 may be taken as a reasonable figure for a good all-round instrument.

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TRACING FAULTS.

IT is probably safe to say that it is an easier matter to locate the more serious faults, of the kind which give rise to a complete or almost complete failure to receive signals, than to find the small leakages and resistances which merely reduce the total H.F. amplification obtained from a receiver. Indeed, it is always difficult for the less experienced amateur to tell whether his instrument is or is not working as it should. He may be disappointed as to the strength of distant signals, but, realising that local receiving conditions play such an important part in determining the range of any set, and lacking a standard of comparison, he may assume that results are as good as can be expected, although actually there may be avoidable losses which should be eliminated.

Poor H.F. amplification is generally traceable to resistance in the tuned circuits, or to some form of damping which acts in more or less the same way as a resistance in the wrong place. The actual measurement of high-frequency resistance is a matter of considerable difficulty, requiring a fairly extensive laboratory equipment, but it is extremely easy for an amateur, even without any measuring apparatus, to obtain a very good idea if an apparent lack of sensitivity is due to the presence of excessive resistance or damping in the H.F. transformers or the circuits associated with them. The easiest way of carrying out the operation is deliberately to insert an artificial resistance in each circuit in turn, and then to notice if this addition results in an appreciable falling off in signal strength. If it does *not*, then it may be assumed that the circuit in question has already an excessive resistance, which must be removed before the best possible results can be obtained.

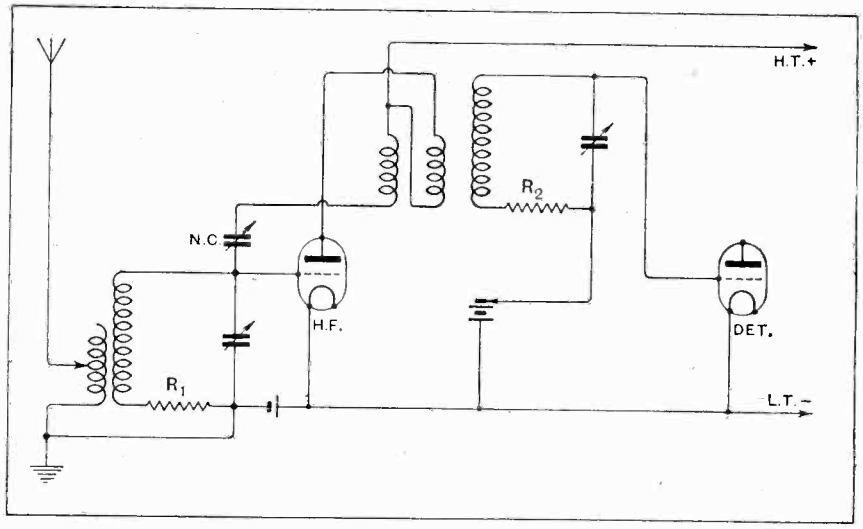

Fig. 2.—The insertion of artificial resistances as an aid to the location of damping in a receiver of the "Everyman Four" type.

This simple method of testing applies only, of course, to modern receivers using efficient coils, and particularly to sets on the lines of the popular "Everyman Four"; this may be taken as an example, to indicate the method of procedure. The essential H.F.-detector circuit is given in Fig. 2, which shows the position for the artificial resistors R_1 and R_2. These should be of some 3 to 5 ohms, and must be non-inductive; they can conveniently consist of a short, straight length (about 1½ in.) of No. 45 Eureka wire, which has a resistance of approximately 2¾ ohms per inch. This should be mounted on a narrow strip of ebonite, fitted with screws and nuts at each end, in order that it may be supported on the wiring of the receiver.

It is advisable to carry out the test when listening with 'phones to a distant station whose signals are weak, as under these conditions a comparatively small change in intensity is more easily appreciable. If the insertion of the artificial resistance in series with the aerial-grid transformer secondary results in a considerable decrease in strength it may be assumed with some confidence that this coil, with its condenser, etc., is in order. The resistor should accordingly be transferred to the intervalve transformer. If in this position its presence appears to make no difference in signal strength, it may justly be assumed that we have practically located the source of the trouble, which may be due to a completely or partially short-circuited turn on one of the windings, to broken strands in the Litz cable, or to an excessive H.F. resistance in the tuning condenser. It should be noted that none of these possible faults would be indicated by the ordinary tests.

If negative results are obtained, we have at least the satisfaction of knowing (assuming the valve itself to be in order) that in all probability our H.F. amplifier is working properly, and that this part of the receiver may safely be passed over in our further search. It should be emphasised that this test is applicable only to receivers with lightly-damped circuits.

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GRID BIAS PRECAUTIONS.

DUE to the fact that "super-power" valves are now coming into more general use, it may be permissible to repeat the advice, previously given in these columns, to the effect that the grid circuit of a low-imped-

ance valve, with probably a considerable voltage on its anode, should never be broken, even momentarily, while the filament is lighted. This means that, while adjusting grid bias voltage it is necessary to switch off the filament current before each alteration is made.

Neglect of this precaution will certainly result in the passing of a heavy anode current; while this in itself may not do much harm to the battery, provided it is of momentary duration only, it is possible that the valve may be damaged. Certain valves are found to be particularly susceptible to harm from excessive anode currents.

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HOW MANY TURNS?

THESE questions are continually confronting everybody who has occasion to wind tuning coils for himself. Without going into any of the formulæ for calculating the inductance of a coil from the thickness of the wire, diameter of the former, number of turns, etc., we can give a method of making an intelligent guess which usually brings us very nearly to the required result in the case of single-layer coils wound on ordinary cylindrical formers. In the first place most of us are not so much interested in the actual inductance of a coil as the wavelength to which it will tune with the condensers at our disposal. Now we usually have on hand some coil with which we are familiar and we know from experience to what wavelength this coil can be tuned when inserted in our set and the tuning condenser set to a certain mark. Such a coil may be used as a basis for the design of other coils to tune to other wavelengths. The wavelength to which a coil will tune in an ordinary receiver is very nearly proportional to the number of turns, other things remaining the same, provided that the length of the winding space is not greater than the diameter of the coil. Or, if the number of turns and gauge of wire are kept the same, the wavelength will be proportional to the diameter of the coil former. Thus, if our known coil tunes to 300 metres and has 40 turns on a 2½ in. former, and we want to make one which will tune to 900 metres we can do this either by winding the same number of turns of the same gauge of wire on a former of 7½ in., or use the same diameter of former as used in the original coil and wind it with 120 turns. In making coils to reach very different wavelengths it is often desirable to alter both the number of turns and the diameter. Perhaps we wish to tune down to 45 metres. If we have a coil which we know for certain to tune to 450 metres we are pretty sure that a coil half the diameter and having one-fifth of the number of turns will tune somewhere in the 45-metre region. This method of reckoning is admittedly rough, but is very useful when one is rather puzzled as to what size of coil to try.

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A CORRECTION

THE letters A and B on the two sketches showing H.F. Transformer construction appearing in these columns of last week's issue were inadvertently reversed; the correct method was shown at B, and not at A as stated.

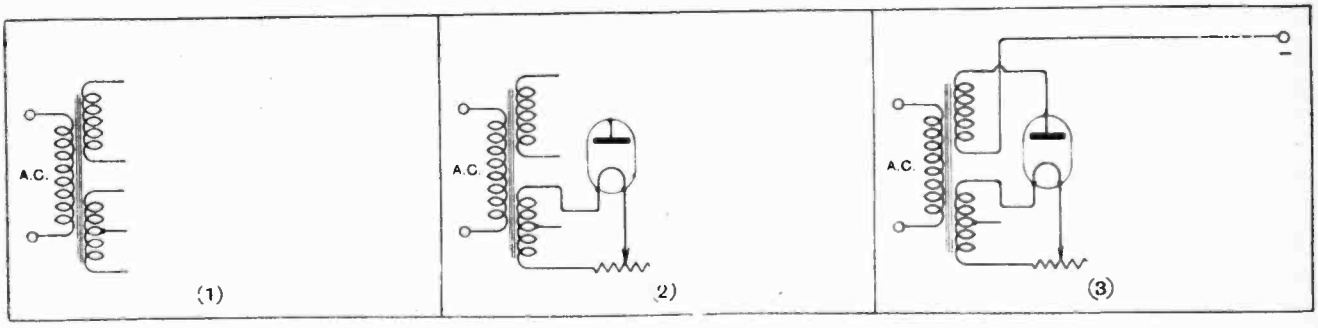
DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 73.—An A.C. High-tension Battery Eliminator.

(To be concluded in next week's issue.)

The present series of diagrams is intended to show progressively, and in an easily understandable manner, the various points to which special attention should be paid in the design of typical wireless instruments, and at the same time to assist the beginner in mastering the art of reading circuit diagrams. The eliminator shown below uses half-wave rectification and is probably the simplest pattern likely to give satisfactory results.



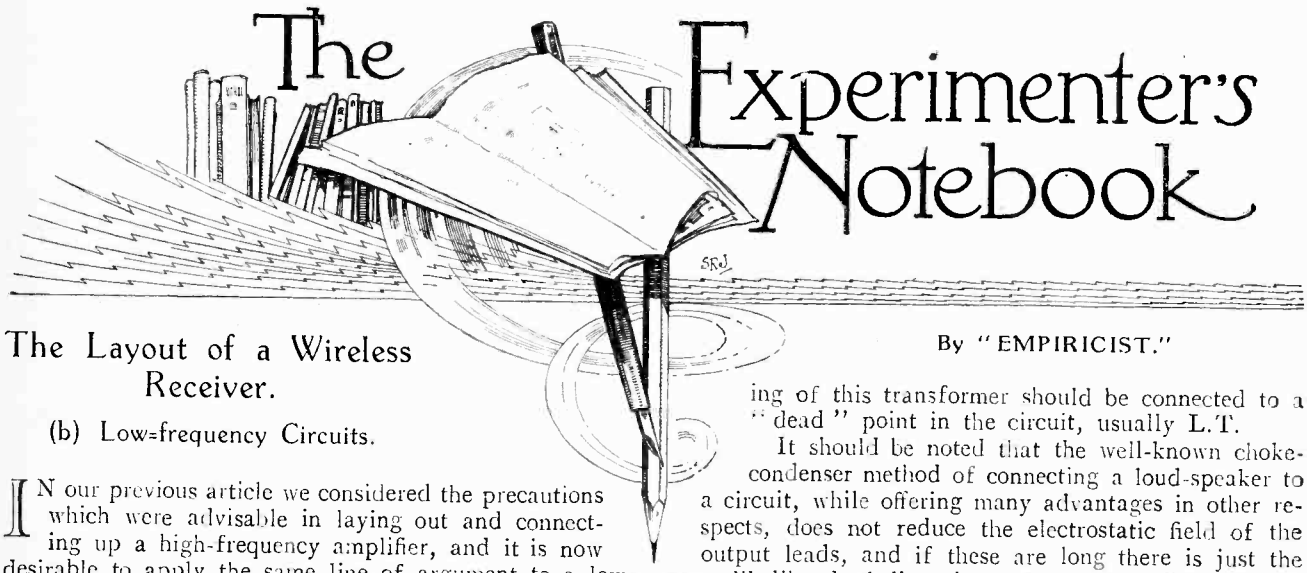
The double-secondary transformer, the primary of which is connected across the A.C. mains.

The low-voltage winding is connected across the rectifier filament, a controlling rheostat being interposed.

The plate circuit is completed through the high-voltage secondary winding to the negative output terminal.

THE transformer should be designed for working on mains of the voltage and periodicity of the supply (which will be shown on the meter). Its high-voltage winding should deliver about 120 volts; this, allowing for drop in the various series resistances, will give about 120 volts output. The filament-lighting winding must supply a voltage corresponding with the rating of the valve; if it exactly coincides it will be possible to eliminate the rheostat.

A number of suitable rectifying valves are available; amongst others are the DU.5, DU.10, U.4, S.P.41U. Where a small output is required, an ordinary bright-emitter receiving valve, such as the R.5V., with grid and plate connected together, will give good results.



The Layout of a Wireless Receiver.

(b) Low-frequency Circuits.

By "EMPIRICIST."

IN our previous article we considered the precautions which were advisable in laying out and connecting up a high-frequency amplifier, and it is now desirable to apply the same line of argument to a low-frequency layout.

The classification becomes more simple, inasmuch as the distinction between resonant and non-resonant circuits becomes somewhat meaningless. Admittedly, a transformer has inductance and self-capacity, but since there is no connecting up of condensers in any critical manner the same tendency towards interaction is not in general obtained. Furthermore, since the external wiring of transformers has a negligible electromagnetic field in comparison with that passing through the core, the precautionary measures outlined in high-frequency circuits become somewhat superfluous.

Troubles arising from potential leads remain, as before, a source of difficulty.

Grid Condenser and Leak Connections.

Foremost among these is the grid lead of the detector valve, when the "grid condenser and leak" method of rectification is employed. This lead is the first point in the circuit at which a low-frequency potential appears, and, owing to the impedance of the condenser, there is a very strong tendency for electrostatic pick-up at this point. This may take the form either of a tendency towards reaction, giving a resonance or even an actual oscillation on some audible frequency, or else a pick-up of induction from A.C. mains or other source of audio-frequency disturbance. It is of the first importance to connect the junction of grid condenser and leak to the grid terminal of the valve holder by the shortest possible lead. Not infrequently it is possible to connect both the condenser and grid-leak clip direct to the valve-holder terminal, and if this can be arranged it is very satisfactory.

Inasmuch as the grid condenser and leak must be in the circuit somewhere, however, it is essential that particular attention should be paid to the wiring of the rest of the amplifier. The worst trouble arises from the leads connecting the set to the loud-speaker, and it is frequently of advantage to employ a step-down transformer on the output of the set, so as to reduce the electrostatic field on the output leads. Some point on the secondary winding of this transformer should be connected to a "dead" point in the circuit, usually L.T.

It should be noted that the well-known choke-condenser method of connecting a loud-speaker to a circuit, while offering many advantages in other respects, does not reduce the electrostatic field of the output leads, and if these are long there is just the same likelihood of distortion and oscillation being set up in the receiver as in the case where no such coupling device is employed. The use of the choke-capacity unit is outside the scope of the present article, but it is hoped that it may be dealt with in another connection at a subsequent date.

Jacks and Switches.

Possibly the principal troubles that arise in low-frequency amplifiers are due to attempts at incorporating switches or jacks for cutting out a stage of amplification. This necessitates a considerable lengthening of "potential" leads, and the consequence is almost inevitably a distortion effect, if not actual oscillation when two stages are being employed. One is almost inclined, as regards stage switching, to take up the attitude of a well-known authority and say: "Don't do it!" Other means of controlling volume can be adopted, such as a variable high resistance or potentiometer across the secondary winding of one of the transformers. Even this device necessitates care in laying out, as it must be arranged so that the leads from it to the secondary of the corresponding transformer are short and not of unnecessary thickness.

The layout of the amplifier, apart from these considerations, is not a difficult matter, bearing in mind what is normally a necessity in respect of "potential" leads. Subject to a suitable arrangement of the components, the leads to grids and plates may be made very short, and the return leads may be taken in any desired manner to their appropriate terminal connections. The stability is sometimes improved, though not always, by earthing the shrouds of the transformers, and occasionally the sense of the transformer windings has a controlling influence upon performance.

It may be said, however, that a reversal of one of the transformer windings, except in the particular case of impedance in the H.T. circuit, is not a satisfactory cure for instability, and a set which is properly laid out should not work differently when the windings are reversed.

A word would appear to be necessary on the subject of resistance-capacity amplifiers, inasmuch as these have cer-

The Experimenter's Notebook.—

tain special features which it is desirable to consider. The principal trouble with these amplifiers is that radio-frequency currents get through them to a really alarming extent, and in consequence it is necessary either to employ rigorous means of filtering out such currents at the detector valve stage, or else to apply the same care to the leads of the amplifier as has been recommended for high-frequency circuits. The following out of the latter policy is made very easy by the extremely compact nature of the components used in these amplifiers, and it is probably due to this that in practice there is frequently no trouble experienced, at any rate on the shorter waves.

The use of a resistance-capacity amplifier in connection with the longer wavelengths, however, brings these troubles into increasing prominence as the wavelength is increased, though with simple radio-frequency circuits, embodying not more than one stage of high-frequency amplification, the effect of the radio-frequency passing through the resistance amplifier will be merely as if a certain amount of reaction of an accidental character had crept into the circuit, thereby necessitating a slight modification of the existing reaction adjustment.

A resistance amplifier which follows a supersonic receiver operating on a wavelength of about 6,000 metres almost invariably gives rise to serious trouble, and nothing but careful filtering out of the intermediate frequency is of any use.

NEWS FROM THE CLUBS.

Captain Round's Short-wave Set.

The President, Capt. H. J. Round, M.C., M.I.E.E., entertained members of the Muswell Hill and District Radio Society at his house on Wednesday, June 1st, when a very pleasant evening was spent. A super-heterodyne was installed in one room, while in another was a Rice-Kellogg loud-speaker and amplifier, an electrical gramophone, and a highly efficient short-wave set with two H.F. stages. This instrument was operated by Mr. Tremayne, and signals were received from North and South America, Australia, South Africa, and India—those from India emanating from the new beam station. At 9.30 Capt. P. P. Eckersley arrived to amuse the company with many songs and jests. Before the gathering broke up at midnight three honorary members were enrolled, viz., Mrs. H. J. Round, Capt. P. P. Eckersley, and Mr. Tremayne.

The Society is making excellent headway, but vacancies still exist for new members.

Hon. Secretary, Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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Q.R.P. Transmitters' Field Day.

Permits having been procured, the Q.R.P. Transmitters' Society met at 6LL's bungalow on the banks of the River Lea near Royden, Hertfordshire, for a field day on May 29th.

A base station using call 6LL was installed in the bungalow and used a "Hartley" circuit on the 180-metre band with grid modulation, the antenna being a T, 15ft. high and 25ft. long.

The portable station, conveyed by car and motor cycle, and using the call 6LB, was a choke control set for which 6TA was responsible. Input at both stations averaged 6 watts, H.T. being supplied in both cases by either a D.C. hand generator or two 120v. M-L anode converters in series.

Communication was maintained throughout the day between both stations, speech being exceptionally well received over distances up to ten miles. In one case speech from 6LB, the aerial of which was stretched *along the ground*, was received at 6LL, eight miles away, R4.

Later 5RD at twenty miles and 6JD at ten miles were worked from 6LL, speech being perfect according to 6JD. Also a letter from Epsom reported fine signals R5.

Among transmitters present were 6LL, 6TA, 2SC, 2AFL, and 5UP. Members voted it the best field day ever held, and another will be arranged soon.

Hon. Secretary, Mr. L. J. Fuller, 13, Seagry Road, Wanstead, Essex.

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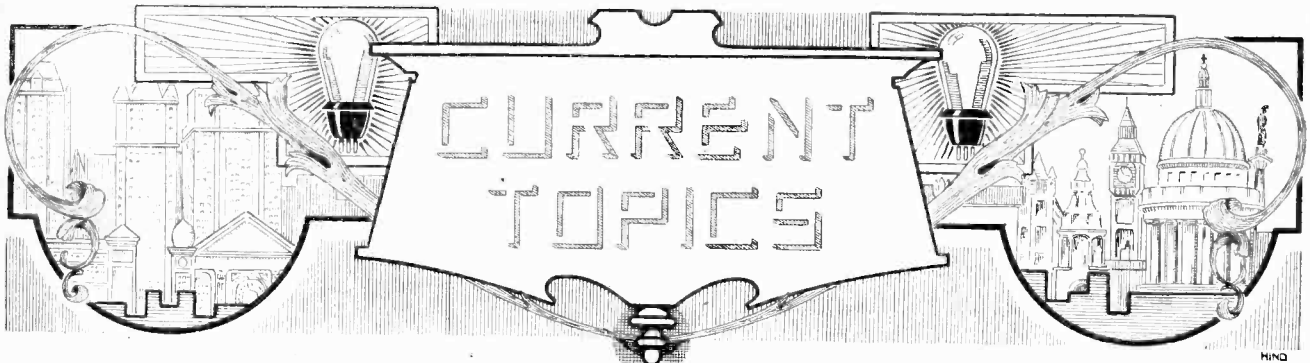
Finding a Hidden Station.

An ambitious "direction-finding" scheme has been arranged for Sunday next, June 19th, by the Golders Green and Hendon Radio Society. The object of the manœuvres will be to locate the club's transmitting station and to report on the effect of surrounding objects on signal strength. Ten parties will start off from predetermined points and each group will be equipped with a receiving set, frame aerial, magnetic compass, protractor, map, lunch, and a car.

Operations will begin at 12 noon, but a general stand-by will be observed for lunch between 1 and 2 p.m. Operations will cease at 3.30. Transmission will be on 150 metres, interrupted C.W., from station 5CT sending ten-second dashes for five minutes alternated by five-minute pauses.

During the day broadcast programmes will be picked up from Hilversum, Radio Paris, 2LO, and other stations, while teas and games have been arranged for the late afternoon. The arrangements are in the hands of the Hon. Secretary, Lt.-Col. H. A. Scarlett, D.S.O., 357a, Finchley Road, N.W.3.

AN IMPROMPTU TRANSMITTER. Portable station 6LB in action during a field day held recently by the Q.R.P. Transmitters' Society near Royden, Herts. Note a portion of the aerial which was stretched along the ground! Speech was heard R4 at a distance of 8 miles.



News of the Week in Brief Review.

NOT A NOISY INSTRUMENT.

"Wireless does not come under the description of a 'noisy instrument.'"—Clerk at the Willesden Police Court.

This is rather discouraging to owners of power amplifiers.

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DEVELOPMENTS AT CROYDON.

A new wireless station is shortly to be erected at Croydon Aerodrome to supersede the present installation. Messages will be received and despatched over a much larger area than is possible to-day.

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APPEAL THAT CARRIED.

In response to a broadcast appeal, a gift of five dollars for the church hostel has been received by the vicar of St. Martin-in-the-Fields from a listener in America.

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BRITISH ASSOCIATION MEETING.

The ninety-seventh annual meeting of the British Association for the Advancement of Science is to be held in Leeds from Wednesday, August 31st, to Wednesday, September 7th, 1927, inclusive.

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LIGHTHOUSE LISTENERS.

The installation of a broadcast receiver in the Inchcape lighthouse, near Arbroath, marks the completion of the *Daily News* Wireless for Lighthouses Fund. Lord Inchcape contributed £1,200.

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DISTANCE NO DIFFICULTY.

An inauguration ceremony conducted over a distance of two thousand miles took place in Paris recently, when officials in the French capital opened the new colonial wireless station at Brazzaville, in the French Congo.

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BROADCAST DESCRIPTION OF THE T.T.

An eye-witness account of the Senior T.T. motor cycle race in the Isle of Man will be S.B. to all stations on June 17th (the day of the race) at 9.20 p.m. from Liverpool. The commentator will be "Ixion," of our sister journal, *The Motor Cycle*. He will leave the island immediately after the race in order to reach the Liverpool studio in time to broadcast.

SHORT-WAVERS, PLEASE NOTE.

The Philips short-wave station PCJJ, at Eindhoven, will broadcast to-morrow evening (Thursday) from 5 to 8 o'clock (G.M.T.).

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WIRELESS SET FOR STORMS.

A ship's 2,000-watt wireless transmitter, specially designed to provide a stable wavelength adjustment independent of variations which might be caused by the rolling or pitching of the vessel, has been installed on the U.S. coastguard cutter *Northumberland*.

The equipment, produced by the General Electric Co. of America, embodies "dead front" panels, so that the operator is not exposed to dangerous voltages if thrown against the set during heavy seas.

LISTENERS IN JAPAN.

Approximately 300,000 people now hold receiving licences in Japan. Each set is licensed at 2s. per month.

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(HARD) LABOUR OF LOVE.

When Clifford Roberts was found guilty of stealing wireless parts to the value of £43 11s. 2d. at Wolverhampton last week, his defending counsel pleaded that it was simply a love of wireless that had made his client commit the offence.

The magistrates, who were unmoved by this tender appeal, sentenced Roberts to three months' hard labour.

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A TIME OF CHASTENING.

The present time is one of probation for the American broadcasting stations which have been allocated new wave-

RUNNING COMMENTARIES IN GERMANY. A scene at the aerodrome near Berlin during the wait for Messrs. Chamberlin and Levine, the Atlantic flyers. The commentators had the unenviable task of "filling time" with lengthy descriptions during the prolonged wait for news.

lengths by the Federal Radio Commission. The test period covers sixty days from 3 a.m. on June 1st.

Stations which satisfy the Commission that they are not causing interference will be granted a three-year licence.

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WIDE-AWAKE FARMERS.

On May 7th, according to the U.S. Department of Agriculture, 1,252,126 American farms were equipped with receivers for picking up market and weather reports.

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SWEATED LOUD-SPEAKERS.

The man who can never switch off is the subject of a trenchant article by John Wallace in the June *Radio Broadcast*, New York.

"When you open the door of his house for a friendly little call of an evening," says the writer, "you are immediately greeted by a resounding blare from a loud-speaker in the next room. And whether the order of the evening be bridge or poker, ping-pong or conversation, that infernal loud-speaker continues to vibrate viciously the evening through. It vibrates from string quartet to brass band, from election speech to bed-time story, from wheezy soprano to musical saw player, from stock market report to bee-keeping instruction, and back again—and all over again."

This type of listener is not uncommon in this country, but here, of course, we *pay* for the entertainment, and to miss any of it would be a pity.

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WIRELESS "LIGHTHOUSES" FOR ALL SHIPS?

Wireless beacons giving a service of protection to vessels which are not equipped with special D.F. apparatus is the latest project of the Board of Trade. Experiments with such a device are already in progress, and if they are successful a most important step forward will have been made in the interests of small ships and cargo boats which cannot carry elaborate apparatus.

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FIRE BRIGADE WIRELESS.

"Wireless Communications and the Fire Service" was the subject of a paper read by Fireman Tom Knowles, of Birmingham, at the conference of the Institution of Fire Engineers at Liverpool on June 2nd.

Since 1920, when successful experiments in wireless communication had been conducted between a fire engine and brigade headquarters in London over a distance of seven miles, interest in the matter had been spasmodic, said the lecturer, but several brigades had experimented on their own account. He was convinced that sooner or later wireless would be used to a very large extent to keep various units of a fire brigade in touch.

Chief Superintendent Wilson, of Rochdale, said his brigade had experimented with wireless and held transmitting and receiving licences. At a recent display one of the engines was fitted with wireless and communication was maintained with headquarters on the way to and from the ground and throughout the display—in fact, they actually received a call by wireless. They were convinced that wireless was a sound proposition for fire brigade purposes and could be easily worked.

FORTHCOMING EVENTS.

WEDNESDAY, JUNE 15th.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove. Competition for two-valve long-distance receivers.

Muswell Hill and District Radio Society. —At 8 p.m. At Tollington School, Tetherdown. Lecture and demonstration by Messrs. A. C. Cossor, Ltd.

THURSDAY, JUNE 16th.

Golders Green and Hendon Radio Society. —At 8 p.m. At the Club House, Willifield Way, N.W.11. Lecture: "Picture Broadcasting," by Mr. F. H. Haynes, Asst. Editor "The Wireless World."

SUNDAY, JUNE 19th.

Golders Green and Hendon Radio Society. —Field day.

WEDNESDAY, JUNE 22nd.

Radio Society of Great Britain.—Ordinary Meeting. At 6 p.m. (tea at 5.30). At the Institution of Electrical Engineers, Savoy Hill, W.C.2. Lecture: "Fading in Radio compared with other natural phenomena," by Mr. H. A. P. Littledale, F.R. Met. Soc.

NEW SYSTEM TRIED BY KDKA.

The engineers of the Westinghouse Electrical Co., in an endeavour to reduce as far as possible the interference and improve the efficiency of the well-known high-power station in Pittsburg, have developed a system of "frequency modulation" which, it is claimed, gives much sharper tuning and employs considerably

ROYALTY IN THE STUDIO. The Queen of the Netherlands photographed before the microphone of PCJJ, Eindhoven, while broadcasting to the Dutch colonies. With Her Majesty is H.R.H. Princess Juliana.

less power than "power modulation." Briefly, the new system of transmission, instead of varying the amplitude or strength of the signal, maintains an even constant strength of signal and varies the frequency by a very small amount, usually not more than .5 to .8 kilocycles. It is stated that during the few weeks of its use at KDKA the station tuned very sharply at near-by points, although radiating as much as 50 kilowatts energy. Observers at Michigan, New York, and Massachusetts have reported that the signal strength is even stronger than when the ordinary transmitting system was used. There has, at the same time, been a great saving in the number of valves required in transmission and the amount of power necessary. All modulator valves are eliminated, and this, in the case of KDKA, means 12 10-kilowatt water-cooled valves.

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STOCKTAKING IN AUSTRALIA.

The existing order of broadcasting in Australia may undergo striking changes at the hands of a Royal Commission which has been appointed to enquire into the position of wireless and broadcasting throughout the continent. All aspects of the subject will be considered, the most important questions relating to wireless and national defence, broadcasting and the Press, Government administration, experiment and research, besides patents and copyright.

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NEW AMERICAN PATENT AGREEMENT.

An important agreement has been entered into between the Crosley Radio Corporation of Cincinnati and the Radio Corporation of America, whereby the Crosley concern is licensed to use patents held by the R.C.A., General Electric Co., the American Telephone and Telegraph Co., and the Westinghouse Electric and Manufacturing Co. Henceforth the Crosley Corporation will be permitted to use 100 basic patents, with the exception of those covering the super-heterodyne and super-regeneration.

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THE SUPPLANTED SHEPHERD.

The weather forecasts of the Air Ministry which are broadcast daily have in many country districts supplanted that born weather prophet, the local shepherd. It is said that even he now gets his information from 5XX, but many of the oldest inhabitants of our villages still stoutly maintain that his old-fashioned forecasts were more accurate.

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A LECTURE ON FADING.

"Fading in Radio" is the title of a lecture which will be given by Mr. H. A. P. Littledale, F.R.Met.Soc., at the ordinary meeting of the Radio Society of Great Britain on Wednesday, June 22nd. The lecturer has discovered a definite type of periodicity in the fading of wireless signals which he finds only to exist in declination tables, earth-air potential tables, and in sunspot cycles. He will exhibit analyses of many of his records and a number of original charts made during a period of four years.

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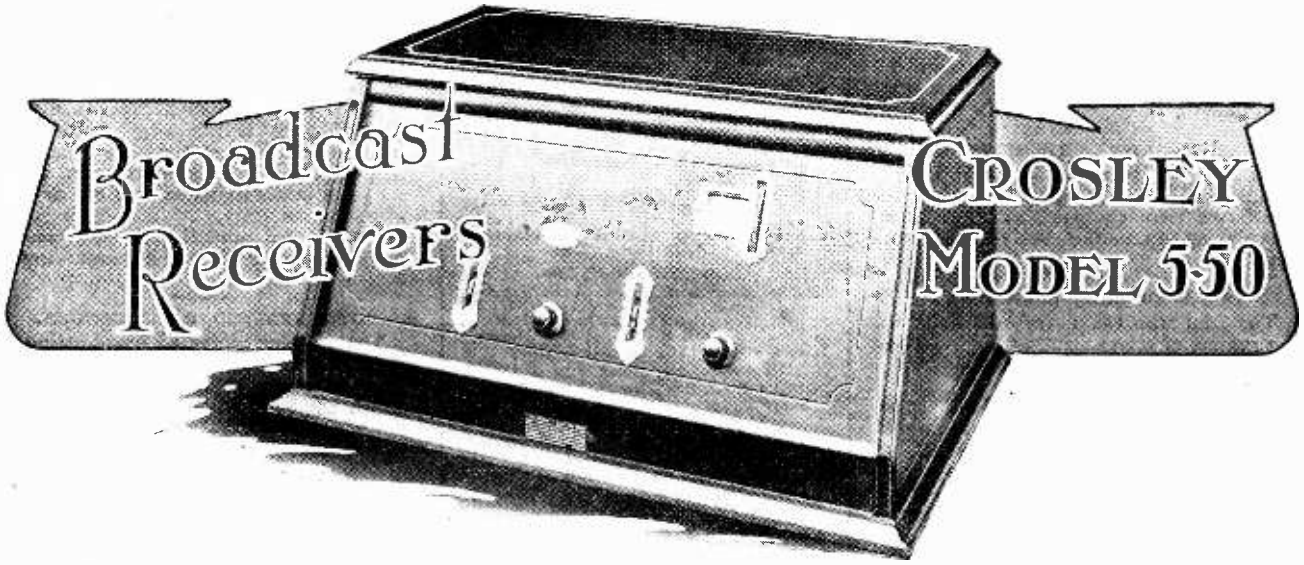
A CORRECTION.

In the valve data sheet which accompanied our issue of April 6th, it was stated in error that the A.C. resistance of the S.S.13 valve, a product of the Electron Co., Ltd., Triumph House, 189, Regent Street, London, W.1, was 4,000 ohms. The figure should read 74,000 ohms.

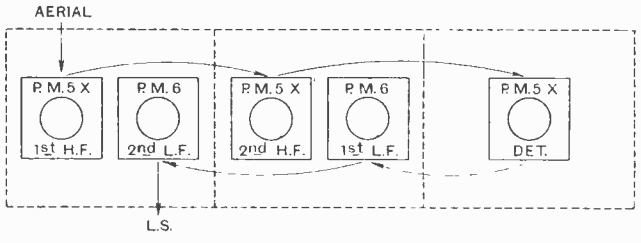


An Inexpensive Long-distance Receiver of American Origin.

THE Crosley 5-50 receiver is of American origin and is produced on mass production lines by The Crosley Radio Corporation of Cincinnati. This organisation has been at the forefront of the movement to provide "radio for the million," and may be said to have a unique experience of the requirements of the average broadcast listener.

American radio "fans" have an innate love of "getting distance," and a high degree of sensitivity is essential in any receiver which is to capture the popular imagination. At one time the single-valve reacting circuit or "Hooper" supplied this need, but of late it has fallen into disrepute, not only on account of the interference it causes, but because it does not possess sufficient selectivity to disentangle the maze of stations which has congested the American ether since the inception of broadcasting. High-frequency amplification before detection supplies the necessary sensitivity and selectivity, but multiplies the number of tuning controls, so that with two stages there are three tuning condensers which have to be operated simultaneously. To master the controls of such a set would require more time and effort than the average listener would be inclined to devote. Unified control of condensers is, therefore, a *sine qua non* of any popular receiver employing more than one high-frequency stage.

The Crosley set has been developed along these lines, and the use of *logarithmic* condensers has made the unified control a complete success. The two high-frequency stages are transformer coupled and are followed by a reacting detector valve. There is no fear of re-radiation, however, as the H.F. stages act as an effective filter between the detector and the aerial tuning circuit, and efficient screening prevents direct coupling between the two circuits.



Layout of H.F. and L.F. stages in the Crosley 5-50. Dotted lines indicate screened compartments.

Stability in the H.F. stages has been attained not by any of the fashionable neutrodyne balanced circuits, but by efficient screening and weak coupling between the primary and secondary windings of the H.F. transformers. With this system less than the optimum amplification per stage is obtained, but this is immaterial, since with two stages there is an ample margin of amplification above the requirements for average conditions. A far more important consequence of loose coupling in the H.F. transformers is the very considerable increase of selectivity which it gives, a quality which alone would justify this method of coupling apart from consideration of stability.

Fine Tuning.

Of course, with such highly selective circuits it is imperative that they should each be tuned exactly to the same wavelength, otherwise the overall selectivity of the set will not be so high as that of the circuits taken individually. To ensure exact tuning small variable compensating condensers are fitted to two out of the three circuits. So well, however, do the main logarithmic condensers function that the compensating condensers are superfluous for 75 per cent. of the stations received, and need only be brought into action when experiencing severe interference from a near-by station.

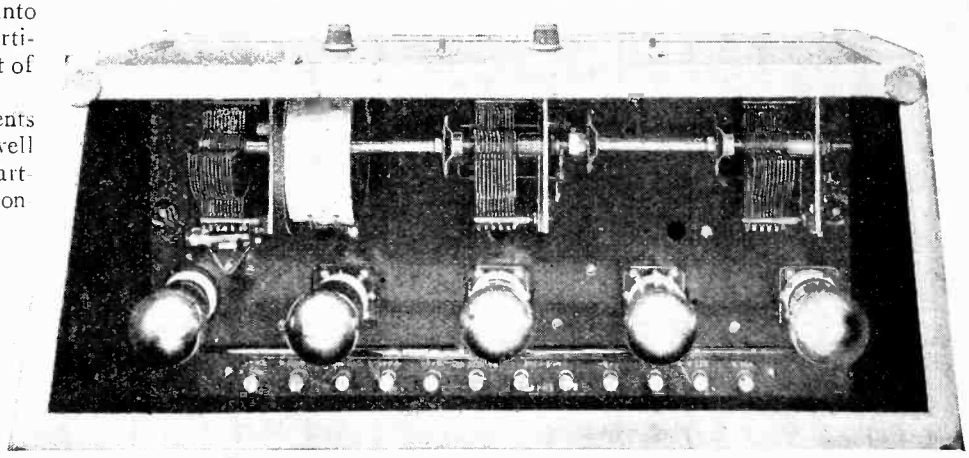
Two stages of audio-frequency amplification are incorporated to bring signals up to loud-speaker strength, and provision is made for the use of a power output valve in the last stage.

So much for the electrical circuit; let us now consider

Broadcast Receivers—Crosley Model 5-50.—the layout and constructional details. Here considerable ingenuity has been shown in combining convenience and efficiency with low cost of production. All the components are mounted on a metal "chassis" which can be withdrawn from the cabinet after removing the two small ebonite control knobs on the front panel.

The "chassis" consists of a metal box the top of which slopes downwards from the front panel and supports the tuning condensers and valve holders. The interior space below this panel is divided into three compartments by metal partitions running from back to front of the set.

The distribution of components in these compartments is well thought out. The first compartment, starting from the aerial, contains the 1st H.F. and 2nd L.F. stages; the second compartment, the 2nd H.F. and 1st L.F.; and the third the detector and reaction circuits. The introduction of L.F. transformers into the H.F. compartments in no way interferes with the functioning of the H.F. valves, and the extra spacing between partitions which results from the use of this method is a great advantage inasmuch as the H.F. transformers can be mounted farther away from the metal partitions.



Plan view of interior as seen from the rear of the set. Note the tuning drum with detachable paper scale.

If further evidence were required that the designers understood their business the method of wiring the set would suffice. All H.F. wires are direct and pass through clearance holes in the partitions, and battery and grid bias leads are collected in groups at the back of the set and tied together in the manner of telephone exchange wiring.

The valve-holders are arranged immediately over their respective components in the compartments below, with the result that H.F. and L.F. valves alternate as shown in the diagram. Mullard valves with special U.X. American bases are used throughout.

Unified Condenser Control.

The plan view of the interior shows the mounting of the logarithmic condensers, which are coupled through insulated flexible joints and operated by a large diameter drum. A knurled flange on this drum projects through a slot in the front panel, and a small square "window" with indicating pointer reveals a small portion of the paper scale upon which calibration particulars may be entered. The paper scales are detachable and may be renewed. There is very little friction in the system, and only a light touch is required to rotate the drum.

The same photograph also shows the ebonite terminal strip let into a recess at the back of the metal sub-panel. Here a minor criticism is possible. Since the metal panel is earthed a short-circuit will result if any of the H.T.+ wires are allowed to touch it when pushing the bared ends through the terminals from the back. The obvious remedy is to bare the wires only for a distance of $\frac{1}{4}$ to $\frac{3}{8}$ in.

The tuning controls are clearly visible in the photograph in the title of this article. The main tuning control is seen near the right-hand top corner of the panel. The compensating condensers are operated by levers working in two vertical slots lower down on the panel. They are tuned "acuminators" since their principal function is to sharpen tuning by bringing all circuits to the same wavelength. The small knob on the right-hand side operates the reaction coupling device, which consists of a small coil controlled by a quick-thread screw. It is known as the "Crescendon," since it is used to increase volume on distant stations. Incidentally, the judicious use of this control will greatly improve selectivity on wavelengths close to the local station. Finally, there is the left-hand ebonite knob, which controls the rheostat for the valve filaments.

The performance of the set is very convincing. Immediately after connecting up and without any manipulation of the "acuminators," stations were picked up at intervals of two or three degrees all round the dial. At least 30 stations were received at good loud-speaker strength in this way, but interference from 2LO (361 metres, $3\frac{3}{4}$ miles distant) was experienced on wavelengths between 325 and 410 metres. By careful adjustment of the "Crescendon" and "acuminators," however, the width of the interference band can be considerably reduced, and outside a radius of five miles Cardiff (353 metres) can be tuned in sufficiently clear of London to be enjoyable. Proof of this was established by a daylight test during one of the afternoon transmissions, when Cardiff's signals were rather weak.

Generally speaking, the quality of reproduction is not up to the standard of the best British sets, but by careful adjustment of the controls it can be made very pleasing. In our opinion the most striking feature of the set is the remarkable way in which distant stations fall in as the tuning drum is rotated; it is virtually a single-control set. European conditions in the ether now approximate to those in America, and the performance of this receiver is well suited to current requirements in this country.

The sole distributors are the Wholesale Wireless Co., 103, Farringdon Road, London, E.C.1, who carry out the final assembly of the parts. The set is licensed under Marconi patents, and the price, without valves or accessories, is £20, including royalties.

REGULAR BROADCAST TRANSMISSIONS.

List of Stations Likely to be Heard in England.

IN preparing the following list of broadcasting stations we have spared no pains to make it as complete and accurate as is possible under the ever-changing conditions.

In selecting the principal stations outside Europe we have chosen those in Canada and the United States which are most likely to be of interest to our readers, and have given a fairly comprehensive list of those in British possessions throughout the world.

Station.	*Call-sign.*	*Nominal Power (Kilowatts).*	*Present Wavelength (Metres).*
EUROPE.			
Konigswusterhausen	AFP	—	{4,000 / 2,900}
Eiffel Tower, Paris (Time-signals in code 0926 and 2226 G.M.T.).	FL	5	2,650
Berlin (Wolff's Bureau)	—	5	2,525
Montesanto, Portugal	CTV	1.5	2,450
Kovno, Lithuania	—	2	2,000
Scheveningen, Holland	—	2½	1,950
Koszice, (Kassa) Czecho-Slovakia.	—	—	1,870
Norddeich, Germany	—	—	1,800
Paris (Radio Paris)	CFR	3	1,750
Daventry, England (Time-signals 10.30 a.m., 6.30 p.m., 9.0 p.m.)	5XX	25	1,604.3
Moscow, Komitern, Russia	RDW & RA1	40	1,450
Nijni-Novgorod, Russia	RA13	1½	1,400
Karlsborg, Sweden	SAJ	5	1,365
Motala, Sweden	—	30	1,305
Irkutsk, Russia	—	—	1,300
Konigswusterhausen, Germany (relays Voxhaus)	AFT	8	1,250
Hjörring, Denmark (relay station)	—	—	1,225
Boden, Sweden (relays Stockholm)	SASE	1½	1,200
Luxemburg	—	½	1,200
Sorö, Denmark (relays Copenhagen)	—	1½	1,153.8
Ryvang, Denmark	—	½	1,150
Kallundborg, Denmark (projected)	—	7½	1,150
Warsaw, Poland	AXO	10	1,111
Kbely, Prague, Czecho-Slovakia	OKP	1	1,110
Viburg, Denmark (relay station)	—	1	1,110
Basle, Switzerland	—	¼	1,100
De Bilt, Holland	PCFF	1½	1,100
Hilversum, Holland	HDO	5	1,071
Veliky Ustjuk, Russia	RA16	1¼	1,010
Leningrad, Russia	RA42	10	1,000
Moscow (Central)	—	100	1,000
Odessa, Russia	RA40	1½	1,000
Ust-Syssolsk, Russia	REC	1¼	1,000
Tver, Russia	RA44	1½	965
Minsk, Russia	RA18	1¼	950
Voronesh, Russia	RA12	1¼	950
Leningrad, Russia	RA6	2	940
Homel, Russia	RA39	1¼	925
Tiflis, Russia	—	4	870
Artemosk, Russia (relays Moscow and Kharkov)	—	1¼	850
Lausanne, Switzerland	HB2	1½	850
Rostov-on-Don, Russia	RA14	1¼	820
Odense, Denmark (relay station)	—	1	810
Ivanovo Voznesensk, Russia	RA7	1	800
Sevastopol, Russia	RA9	1	800
Tashkent, Russia	RA27	4	800
Kiev, Russia	RA5	1	775
Baku, Russia	RA45	1¼	760
Geneva, Switzerland	HB1	1½	760
Bogorodsk, Russia	RA8	—	750
Ekaterinburg, Russia	RA15	¼	750
Ostersund, Sweden	—	1	720
Astrakhan, Russia	RA26	1	700
Novosibirsk, Russia	RA33	4	700
Saratoff, Russia	—	1	700
Moscow (Soviet Workers' Union).	RA4	½	675
Stavropol, Caucasus	RA20	1¼	655
Moscow, Popoff, Russia	MSK	2	650
Kharkov, Russia	RA43	4	640
Grenoble (Radio Club of Grenoble, France)	—	1½	588.2
Freiburg, Germany (relays Stuttgart)	—	½	577
Vienna (Radio Wien)	—	1½	577
Berlin (Magdeburger Platz)	—	2	566
Bloemendaal, Holland	—	—	566
Mikeli, St. Michel, Finland (relay station)	—	¼	566
Dniepropetrovsk, Russia	—	1	560
Hamar, Norway	—	¾	556
Budapest, Hungary	—	3	555.6
Sundsvall, Sweden	SASD	½	545.6
Munich, Germany	—	1½	535.7
Riga, Latvia	—	2	526.5
Vienna (Rosenhügel)	—	5	517.2
Krasnodar, Kuban, Russia	RA38	1	513
Brussels	SBR	1½	508.5
Porsgrund, Norway	—	¾	504
Palermo, Italy (projected)	ICP	2	500
Tromsö, Norway	—	—	500
Aberdeen	2BD	1½	500
Uppsala, Sweden (relays Stockholm)	—	¼	500
Valencia (Reine Victoria Hotel), Spain	EAJ14	½	500
Linköping, Sweden (relays Stockholm)	SMUW	¼	497.5
Zurich, Switzerland	HBZ	1	496
Bournemouth	6BM	1½	491.8
Berlin, Witzleben	—	4	483.9
Lyons (La Dona) (relays Ecole Superieure P.T.T.)	YN	1	478.1
Kharkov, Russia	RA24	4	475
Langenburg, Germany	—	25	468.8
Paris (Ecole Superieure)	FPTT	½	464
Barcelona (Radio Catalana)	EAJ13	1	462
Oslo, Norway	—	1½	461.5
Vladivostok, Russia	RA17	1½	456
Stockholm	SASA	1½	454.5
Rome	1RO	3	~~430~~ 446.9
Moscow (Trades Union)	RA2	2	450
Notodden, Norway (relays Oslo)	—	—	447.8
Rjukan, Norway (relays Oslo)	—	¼	443
Brum, Czecho-Slovakia	—	2½	441.2
Bilbao (Radio Club de Vizcaya), Spain	EAJ9	1	436
Fredrikstad, Norway (relays Oslo)	—	¾	434.8
Frankfort-on-Main	—	4	428.6
Cracow, Poland	—	1½	422
Moscow (Peredacha)	—	2	420
Bordeaux (Lafayette)	—	2	419.5
Bilbao (Radio Vizcaya)	EAJ11	2	418
Goteberg, Sweden	SASB	1	416.7
Berne, Switzerland	HBA	5	411

Station.	Call-sign.	Nominal Power (Kilowatts).	Present Wavelength (Metres).
EUROPE—*continued.*			
Glasgow	5SC	1½	405.4
Salamanca, Spain	EAJ22	½	402.5
Cadiz, Spain	EAJ3	½	400
Cork, Irish Free State	6CK	1½	400
Bremen, Germany (relays Hamburg)	—	1½	400
Falun, Sweden (relay station)	SMZK	1½	400
Mont de Marzan (Radio Club Landrais), France	—	½	400
Plymouth (relay station)	5PY	¼	400
Seville (Union Radio), Spain	EAJ17	1	400
Tammerfors, Finland (relays Helsingfors)	—	—	400
Hamburg	(Morse) HA	4	394.7
Madrid (Radio Espana)	EAJ2	3	393
Toulouse (Radio du Midi), France	—	2	389.6
Manchester	2ZY	1½	384.6
Stuttgart	—	4	379.7
Helsingfors, Finland	—	2	375
Madrid (Union Radio)	EAJ7	3	373
Bergen, Norway	—	1½	370.4
Leipzig, Germany	—	4	365.8
Nice	—	1	362
London	2LO	3	361.4
Graz, Austria (relays Vienna)	V (Morse).	½	357.1
Cardiff	5WA	1½	353
Paris, (Lucien Levy)	—	¼	350
Prague, Czecho Slovakia	—	5	348.9
San Sebastian, Spain	EAJ8	2	346
Barcelona (Radio Barcelona), Spain	EAJ1	1½	344.8
Seville, Spain	EAJ5	1	344.8
Paris, Petit Parisien	—	½	340.9
Copenhagen	—	2	337
Naples	INA	1½	333.3
Reykjavik, Iceland	—	½	333.3
Limoges, France (relay station)	—	¼	330
Konigsberg, Germany	—	4	329.7
Birmingham	5IT	1½	326.1
Malaga, Spain	EAJ25	1	325
Saragossa, Spain	EAJ23	1½	325
Milan	1MI	1½	322.6
Dublin	2RN	1½	319.1
Lahtis, Finland	—	—	318
Breslau, Germany	—	5	315.8
Newcastle	5NO	1½	312.5
Björneborg, Finland (relays Helsingfors)	—	—	311
Zagreb, Yugo-Slavia	—	1	310
Marseilles P.T.T.	—	½	309
Paris (Radio Vitus)	—	1	308
Belfast (3.0 p.m. onwards)	2BE	1½	306.1
Madrid (Radio Madrilena)	EAJ12	2	306
Nuremburg, Germany (relays Munich)	—	¾	303
Bratislava, Czecho-Slovakia	—	½	300
Tomsk, Siberia	RA21	¼	300
Cadiz (Radio Lehera)	EAJ10	1	297
Liverpool	6LV	2	297
Hanover, Germany (relays Hamburg)	—	¾	297
Jyväskylä, Finland (relays Helsingfors)	—	¼	297
Agen, France	—	¼	297
Varborg, Sweden (relays Stockholm)	SMSO	¼	297
Dresden, Germany (relays Leipzig)	—	¾	294.1
Hull (relay station)	6KH	¼	294.1
Dundee (relay station)	2DE	¼	294.1
Innsbruck, Austria (relays Vienna)	—	1	294.1
Stoke (relay station)	6ST	¼	294.1
Swansea (relay station)	5SX	¼	294.1
Uddevalla, Sweden (relays Stockholm)	SMZP	¼	294.1
Lyons (Radio Lyon), France	—	1½	291.3
Lille, France	—	½	287
Tallinn (Reval) Esthonia	—	2¼	285.7
Edinburgh (relay station)	2EH	¼	288.5
Dortmund, Germany (relays Münster)	—	¾	283
Cartagena, Spain	EAJ16	1	279
Caen (Radio Club of Caen), France (relay station)	—	1½	277.8
Leeds (relay station)	2LS	¼	277.8
Stavanger, Norway	—	¼	277.8
Trodhättan, Sweden (relay station)	SMXQ	¼	277.8
Jacobstad, Finland	—	—	275.2
Nottingham (relay station)	5NG	¼	275.2
Norrköping, Sweden (relay station)	SMVV	¼	275.2
Angers (Radio Anjou), France	—	½	275.2
Posen, Poland	—	1½	273
Sheffield (relay station)	6FL	¼	272.7
Danzig (relays Konigsberg)	—	1½	272.7
Genoa, Italy (Projected)	—	1½	272.7
Klagenfürt, Austria (relays Vienna)	—	1¼	272.7
Cassel, Germany (relays Frankfurt)	—	¾	272.7
Malmö, Sweden	SASC	½	260.9
Hangö, Finland (relay station)	—	¼	260
Toulouse P.T.T.	—	5	260
Linz, Austria (Projected)	—	—	254.2
Kiel, Germany (relays Hamburg).	—	¾	254.2
Pori, Finland	—	¼	254.2
Venice (Projected)	—	1½	254.2
Bradford (relay station)	2LS	¼	252.1
Kalmar, Sweden (relays Stockholm)	SMSN	¼	252.1
Montpellier, France	—	1	252.1
Stettin, Germany (relays Berlin)	—	½	252.1
Säffle, Sweden (relays Stockholm)	SMTS	½	252.1
Eskilstume, Sweden (relays Stockholm)	SMUC	¼	250
Gleiwitz, Germany (relays Breslau)	—	¾	250
Uleaborg, Finland (relays Helsingfors)	—	¼	250
Lemburg, Poland (projected)	—	1½	247.9
Trondhjem, Norway	—	—	243.9
Münster, Germany (relays Langenberg and Dortmund)	MS (Morse)	1½	241.9
Bordeaux (relays Paris, PTT)	—	½	238.1
Vilna, Poland (projected)	—	2	234.4
Boras, Sweden (relay station)	SMBY	¼	230.8
Juan-les-Pins, France	—	½	230
Helsingborg. Sweden (relays Stockholm)	SMYE	¼	229
Umea, Sweden (relays Stockholm)	SMSN	¼	229
Belgrade, Yugo Slavia	—	2	225.6
Leningrad, Russia	—	2	223.9
Strasbourg, France	—	¼	222.2
Karlstadt, Sweden (relays Stockholm)	SMXZ	¼	221
Orebro. Sweden (relays Stockholm)	SMTI	¼	218
Luxemburg	LOAA	¼	217.4
Halmstad, Sweden (relays Stockholm)	SMSB	¼	215.8
Viborg, Finland	—	¾	214.3
Kiev, Russia	RA5	2	211.3
Dijon, France	—	1	207.5
Gävle, Sweden (relays Stockholm)	SMXF	¼	204.1
Reims, France	—	½	204.1
Kristinehamm, Sweden (relays Stockholm)	SMTY	¼	202.7
Jönköping, Sweden (relays Stockholm)	SMZD	½	201.3
Karlskrona, Sweden (relays Stockholm)	SMSM	¼	196
Reziers, France	—	½	178
Eindhoven, Holland (Philips Lamp Works)	PCJJ	—	30.2

PRINCIPAL STATIONS IN DISTANT COUNTRIES.

Station.	Call-sign.	Nominal Power (Kilowatts).	Present Wavelength (Metres).
Canada.			
Calgary, Alberta (W. W. Grant, Ltd.)	CFCN	1½	434.5
Montreal, Quebec (Canadian National Railways)	CNRM	1	411
Montreal, Quebec (Canadian Marconi Co.)	CFCF	1½	410.7
Burketon Jct., Ontario (Canadian Broadcasting Corpn.)	CKCW	5	329.5
U.S.A.			
Des Moines, Iowa (Bankers Life Co.)	WHO	5	534.4
Chicago, Ill. (Westinghouse Electrical Co.)	KYW	2½	526
Hastings, Nebr. (National Broadcasting Co.)	KFKX	2	523
Omaha, Nebr. (Woodman of the World Insurance)	WOW	1	508.2
New York (National Broadcasting Co.)	WEAF	5	491.5
Portland, Oregon (Oregonian Publ. Co.)	KGW	1	491.5
Atlanta, Ga. (Atlanta Journal)	WSB	1	475.9
Washington, D.C. (Radio Corpn. of America)	WRC	1	468.5
Los Angeles, Calif. (E. C. Anthony)	KFI	5	468.5
Bound Brook, N.J. (National Broadcasting Co.)	WJZ	30	454.3
Pontiac, Mich. (Detroit Free Press)	WJR / WCX	5	440.9
Harrison, Ohio (Crossley Radio Corpn.)	WLW	5	428.3
San Francisco, Calif. (San Francisco Chronicle)	KPO	1	422.3
Chicago, Ill. (Radiophone Broadcasting Corpn.)	WHT	5	416.4
Minneapolis, Minn. (Washburn Crosby Co.)	WCCO	5	405.2
Cleveland, Ohio (Willard Storage Battery Co.)	WTAM	3½	399.8
Chicago, Ill. (Atlass Investment Co.)	WBBM	1	389.4
Oakland, Calif. (Edgewater Beach Hotel)	KGO	5	384.4
Schenectady, N.Y. (General Electric Co.)	WGY	30	379.5
Detroit, Mich. (Evening News Association)	WWJ	1	374.8
Chicago, Ill. (Edgewater Beach Hotel)	WEBH	2	365.6
Cincinnati, Ohio (U.S. Playing Card Co.)	WSAI	5	361.2
Devonport, Iowa (Palmer School of Chiropatic)	WOC	5	352.7
Seattle, Wash. (North West Radio Service Co.)	KJR	2½	348.6
Chicago, Ill. (Sears Roebuck Co.)	WLS	5	344.6
Zion, Ill. (W. G. Voliva)	WCBD	5	344.6
Springfield, Mass. (Westinghouse Co.)	WBZ	15	333.1
Denver, Colo. (General Electric Co.)	KOA	5	325.9
Richmond Hill, N.Y. (Atlantic Broadcasting Corpn.)	WABC	2½	325.9
Pittsburg, Pa. (Westinghouse Co.)	KIKA	30	315.6
Lincoln, Nebr. (Nebraska Buick Auto. Co.)	KFAB	2	309.1
Chicago, Ill. (Chicago Tribune)	WGN	15	305.9
San Antonio, Tex. (Southern Equipment Co.)	WOAI	2	302.8
St. Louis, Mo. (Voice of St. Louis)	KMOX	5	299.8
Baltimore, Md. (Consolidated Gas & Power Co.)	WBAL	3	285.5
Columbus, Ohio (American Insurance Union)	WAIU	5	282.8
Council Bluffs, Iowa (Mona Motor Oil Co.)	KOIL	1½	277.6
Batavia, Ill. (People's Pulpit Association)	WORD	5	275.1
Batavia, Ill. (Richmond Harris & Co.)	WTAS	3½	275.1
Atlantic City, N.J. (Municipality of Atlantic City)	WPG	2½	272.6
San Antonio, Tex. (Alamo Broadcasting Co.)	KTSA	2	265.3
Mount Prospect, Ill. (Zenith Radio Corpn.)	WJAZ	5	263
Fort Worth, Texas (Lone Star Broadcasting Co.)	KFQB	1	260.7
Spokane, Wash. (North West Radio Service)	KGA	2	260.7
Rossville, N.Y. (People's Pulpit Assn.)	WBBR	1	256.3
Chicago, Ill. (Trianon Inc.)	WOK	5	252
Portland, Oreg. (Western Broadcasting Co.)	KEX	2½	239.9
St. Louis, Mo. (Benson Broadcasting Co.)	KFVE	1	234.2
Minneapolis, Minn. (Radison Radio Corpn.)	WAMD	1	225.4
Pittsburg, Pa. (Westinghouse Co.)	KDKA	—	64
Schenectady, N.Y. (General Electric Co.)	2XAF	—	32.77
Schenectady, N.Y. (General Electric Co.)	2XAD	—	22
South Africa.			
Johannesburg (African Broadcasting Co.)	JB	½	450
Durban (Durban Town Council)	—	1½	400
Cape Town (African Broadcasting Association)	—	1½	375
Northern Africa.			
Tunis (Radio Carthage)	TNV	5	1,850
Algiers, PTT.	—	2	310
Morocco, Radio Casablanca (Radio Club de Maroc)	CNO	2½	305
India and Ceylon.			
Colombo, Ceylon	—	1½	800
Calcutta (Indian States & Eastern Agency)	5AF	—	425
Bombay (Bombay Residency Radio Club)	2FV	—	375
Rangoon, Burmah (Radio Club of Burmah)	2HZ	—	350
Australia and New Zealand.			
Perth, W. Australia (Westralian Farmers, Ltd.)	6WF	5	1,250
Sydney, N.S.W. (Farmers, Ltd.)	2FC	5	442
Auckland, N.Z. (Radio Broadcasting Co. of N.Z.)	1YA	—	420
Christchurch, N.Z. (Radio Broadcasting Co. of N.Z.)	3YA	—	400
Adelaide, S. Austr. (Central Broadcasting Ltd.)	5CL	5	395
Brisbane, Queensland (Queensland Radio Service)	4QG	5	385
Dunedin, N.Z. (Radio Broadcasting Co.)	4YA	—	380
Melbourne, Victoria (Broadcasting Co. of Australia)	3LO	5	371

SECRET RADIOTELEPHONY SYSTEMS.

The Side-band System as Used for Transatlantic Telephony.

By O. F. BROWN, M.A., B.Sc.

(Concluded from page 716, June 8th issue.)

THE practical difficulties referred to in the first part of this article are absent in the methods for secret telephony covered by the series of patents held by the Western Electric Co. (Standard Telephones and Cables, Ltd.). The arrangements proposed are based on the principle of "side-band" telephony already in use in the transatlantic service. As already stated, in this system this main carrier wave is suppressed and only one side band is transmitted. The principle of the apparatus used for this purpose is shown in Fig. 4. The apparatus consists of two balanced thermionic valves, V_1 and V_2.

A carrier wave of a suitable frequency, say 33,000 cycles, is developed by means of the valve generator and applied at the middle of the system, as shown. When the microphone M is not being spoken into, equal and opposite potentials will be applied to the grids G, and

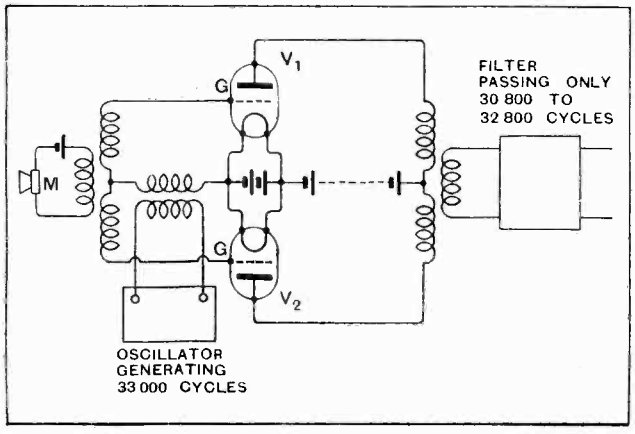


Fig. 4.—Schematic circuit of Western Electric side-band transmitter.

hence the currents and potentials in the two halves of the transformers connected to the plates of the valves will be balanced out. Thus the carrier frequency supplied by the oscillator will be suppressed. When the microphone is spoken into, however, the balance will be destroyed and the carrier frequency will be modulated by the voice frequencies ranging, as we have seen, from, say, 200 to 2,200 cycles, hence the balanced system will deliver to the secondary of the plate transformer the two side bands, one containing frequencies between 30,800 and 32,800 cycles, and the other frequencies between 33,200 and 35,200 cycles. These two bands are then passed through filter circuits, consisting of condensers and inductances, adjusted to pass only frequencies ranging from 30,800 to 32,800 cycles. The selected side band is then passed through a second pair of balanced valves supplied by an oscillator generating a frequency of, say, 88,500 cycles. The frequencies developed in the plate circuit are thereby further separated by filters passing frequencies between 55,700 and 57,700 cycles. These frequencies are then passed through a series of amplifying valves until the small power of a few watts developed in the first pair of balanced valves is amplified in stages up to a hundred or more kilowatts, which is the power applied to the aerial. In the example described, the band of frequencies emitted from the aerial is 55,700 to 57,700 cycles. To make the speech intelligible on the receiving station it is necessary to heterodyne this band by a frequency of 55,500 cycles. When this is done it is clear that frequencies included between 200 and 2,200 cycles, *i.e.*, frequencies corresponding to the voice frequencies, will be produced which can be detected in the usual way.

Speech Unintelligible in Ordinary Receivers.

It is clear that this system is secret to the extent that no intelligible speech can be received unless incoming waves are heterodyned with local oscillations of correct frequency. Nothing, for example, could be picked up by an ordinary broadcast receiver.

The object of the second modulation by the frequency 88,500 cycles is the further separation of the two side bands, so that the practical elimination of one side band is made easier. In what follows, therefore, it will be assumed that the second modulator is omitted.

The principle involved in the methods for securing greater secrecy now to be described depends on what is known as "inverted voice transmission." This means that the low notes in the speech band, or a portion of it, are turned into high notes, and *vice versa*. Obviously the voice will be completely distorted and the speech rendered unintelligible unless apparatus is provided in the receiver to re-invert the sounds transmitted.

It is not much use to invert the whole speech band because all that is necessary to re-invert it is to heterodyne the transmitted frequencies of the side band with one single frequency at the receiver. Thus, provided this local heterodyne frequency is correctly selected, there is no difference between the reception of a completely inverted voice and a non-inverted voice, and no gain in secrecy is achieved. To get over this difficulty the voice band is divided into three or four portions, the frequencies in one or more of which are inverted as desired. As a first example, let us suppose the speech band is divided into three portions comprising frequencies between 200 to 800 cycles, 800 to 1,500 cycles, and 1,500 to 2,200 cycles. To do this, all that is necessary is to apply the voice currents from the secondary of the transformer T_1 (see Fig. 5) in the microphone circuit to three filters F_1, F_2, F_3 designed to pass bands of 200 to 800, 800 to 1,500, 1,500 to 2,200 cycles respectively. The currents from these filters are applied to the centre of three balanced valve modulators M_1, M_2, M_3. In the input windings of the modulator M_1 is introduced, by means of the generator G_1, currents of frequency 1,000 cycles (*i.e.*, 200 plus 800 cycles). This current modulates the portion of the speech currents passed by F_1 so that at the output

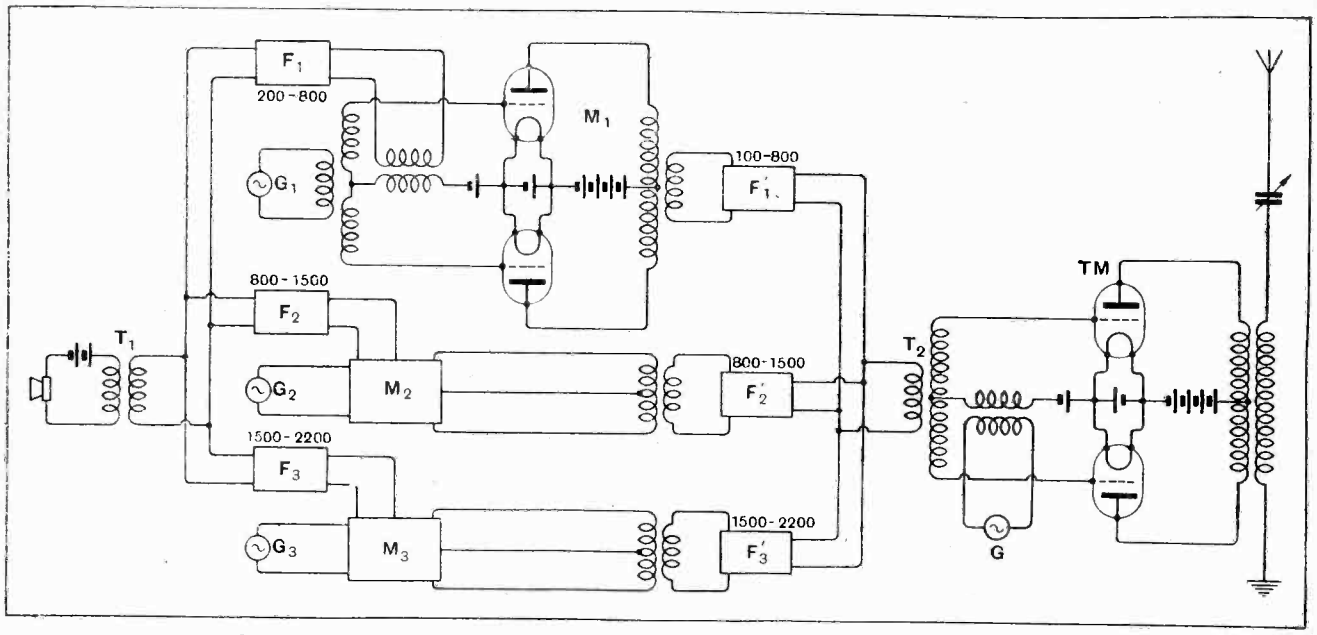


Fig. 5.—Filter circuits for dividing speech-frequency band in the Western Electric system.

end of the modulator two bands of frequencies are delivered, one 800 to 1,200, the other 1,200 to 1,800 cycles. The higher band is cut out by a second filter F_1' similar to the filter F_1, passing only frequencies between 200 and 800 cycles. After the currents leave F_1' it will be seen, however, that the frequency band has been inverted. A sound of frequency 200 comes out having a frequency 800, while a high note of 800 cycles comes out as a low note of 200 cycles.

In the same way the band 800 to 1,500 cycles is inverted by the modulator M_2, and the filter F_2' by modulation with a frequency of 2,300 cycles from G_2, and the band 1,500 to 2,200 is also inverted by modulation with a frequency of 3,700 cycles provided by G_3. The currents from the filters F_1', F_2', F_3' are re-combined together in the primary of the transformer T_2 and pass to the aerial through a balanced modulator TM in which is introduced, by the generator, the radio frequency oscillation at which it is desired that the transmission should take place. The apparatus between T_2 and the aerial would be of the type already described for ordinary side band telephony, but the additional filters and amplifiers are left out in the diagram for the sake of simplifying the drawing.

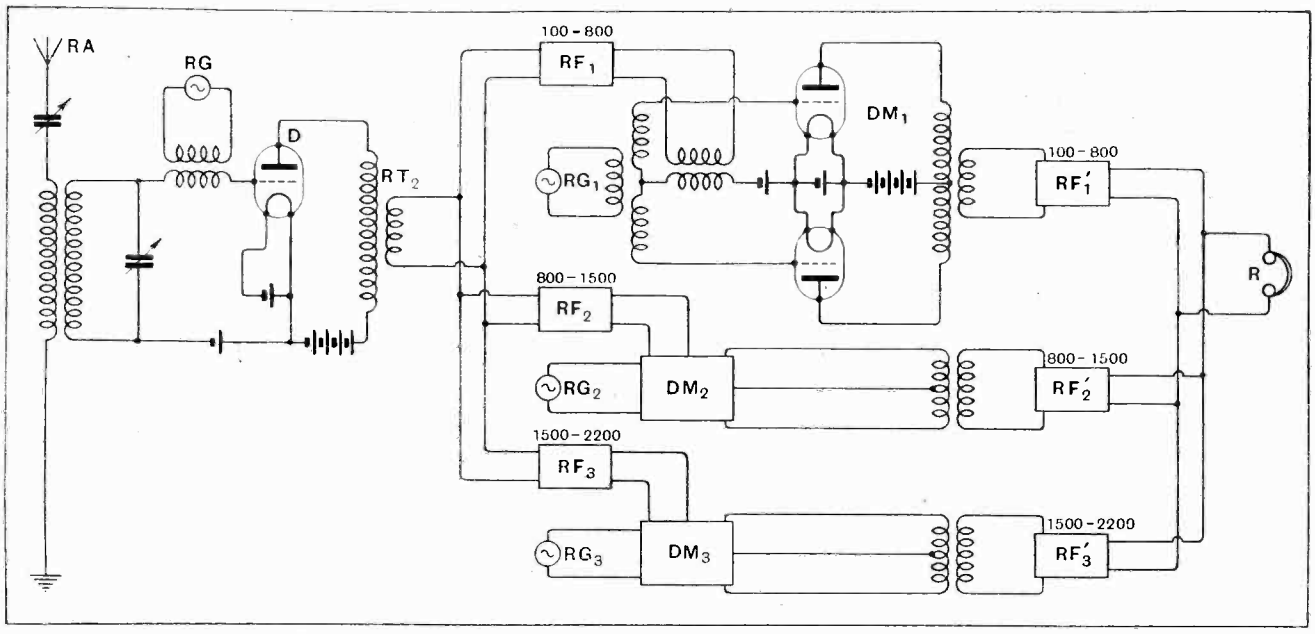


Fig. 6.—Receiving apparatus used in the Western Electric side-band system.

Secret Radiotelephony Systems.—

The diagram of the receiving apparatus is shown in Fig. 6. The radio-frequency carrier wave suppressed by the modulator TM in the transmitter is supplied from the local heterodyne RG, and by the usual detecting action of the valve D the low-frequency waves applied to the transformer RT_2 contain components similar to those impressed on the modulator TM at the transmitter. These components are passed through filters RF_1, RF_2, RF_3 and demodulators DM_1, DM_2, DM_3, etc., which are exactly similar to the corresponding apparatus in the transmitter. The output from the demodulators is applied to the receiving telephones R.

By switching out any of the modulators M_1, M_2, M_3 a portion of the band can, by arrangement with receiving station, be transmitted in an uninverted or normal condition. In this way, even if an intercepting station possessed a complete demodulator, reception could be rendered very difficult.

By employing the same principle a still greater degree of secrecy can be provided. If the speech frequency band is divided into, say, four parts, any one portion of the speech frequencies can be shifted into any other part of the speech band by introducing the correct frequency into a balanced modulator and using a suitable filter. With a system in which the speech band is divided in four parts it can be shown that 125 combinations of the four portions or sub-bands of the speech are possible which are incapable of yielding more than one of the sub-bands in its normal form in a simple heterodyne receiver, the others being present as unintelligible noise. It would be possible to change from one combination to another simply by switching arrangements. The changes would be capable of being introduced rapidly at prearranged intervals, and thereby a very high degree of secrecy could be provided. The number of possible combinations is worked out in detail in British Patent Specification 219,987, while the principle of the system is more fully described in British Patent Specification 218,282. It appears to the writer that the development of such methods of inversion of portions of the speech band before transmission on the lines described in these patents is most likely among the methods with which he is acquainted to lead to a satisfactory solution of the problem. In what has been written it has been assumed that the inversion methods were to be used with the side-band system of transmission. This system requires the use of a comparatively low radio frequency (*i.e.*, a long wavelength), otherwise the two side bands are so close together that the suppression of one band by filters becomes very difficult. There appears to be no reason, however, why the inversion apparatus should not be applied, if desired, to ordinary carrier-wave telephony on short waves.

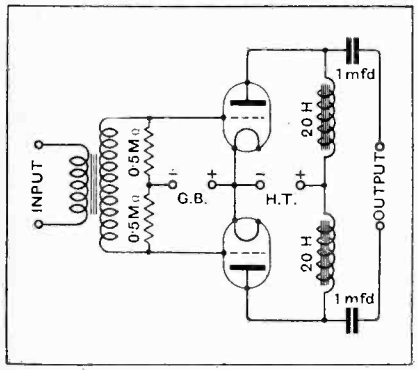
NOVELTIES FROM OUR READERS.

A Section Devoted to New Ideas and Practical Devices.

PUSH-PULL AMPLIFIER.

Experimenters who may wish to acquire experience with the push-pull system of L.F. amplification can do so without purchasing special transformers by following the accompanying circuit diagram.

An ordinary intervalve transformer is used in the input circuit, the electrical centre of the secondary winding being located externally by connecting two 0.5 megohm leaks across the secondary terminals. Grid bias is applied between the common filament connection and the centre point on this resistance.



Push-pull amplifier making use of standard components.

The output circuit operates on the "filter feed" principle, and consists of two chokes in series between the two anodes. The H.T. feed is connected to the centre point between the chokes and the output terminals are fed through two 1 mfd. condensers.

R. H. A.

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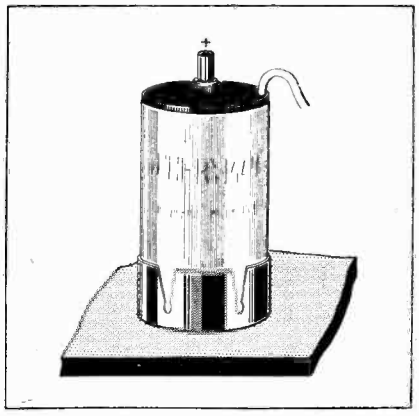
GRID BIAS MOUNTING.

A convenient mounting for the new cylindrical type of grid bias cell may be made from the lid of a metal shaving stick container. If the lid does not fit tightly on the end of the cell the edge of the metal should be first drilled and then V-shaped pieces cut as shown in the diagram and the projections pressed inwards to grip the sides of the cell. The finished holder is then screwed down to the baseboard.

E. T. W.



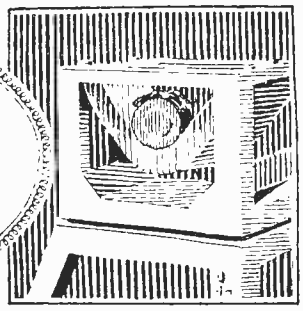
Shaving tin lid used as grid cell holder.

VALVES FOR IDEAS.

Readers are invited to submit brief details, with rough sketches, where necessary, of devices of experimental interest for inclusion in this section. A dull emitter receiving valve will be despatched to every reader whose idea is accepted for publication.

Letters should be addressed to the Editor, "Wireless World and Radio Review," Dorset House, Tudor St., London, E.C.4, and marked "Ideas."

Broadcast Brevities



Savoy Hill Topicalities: By Our Special Correspondent.

An Important Debut.—The Referendum.—Justifying the Regional Scheme.—B.B.C. and the Eclipse.—Giant German Station.—Stravinsky at 2LO.

Famous Conductor's Broadcast Debut.

Sir Henry Wood, whose engagement with the B.B.C. started on June 1st, may make his first appearance before the microphone at 2LO on June 30th. He is down to conduct the Wireless Symphony Orchestra in a Wagner programme, but there is a feeling that the first of the "Proms." on August 13th should be made the occasion of his broadcast debut, to give a more "spectacular" effect.

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Arnold Bennett's Night.

Owing to unforeseen circumstances the programme which was to have been provided by Mr. Arnold Bennett on June 22nd has been postponed.

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Valve *v.* Crystal.

The listening public has responded nobly to the B.B.C. appeal for information as to the most popular station, with the result that thousands of postcards still await checking at Savoy Hill. In the main the expectations of the engineers have been fulfilled, *i.e.*, the postcards show that the number of crystal sets is decreasing, 50 per cent. of the listening population now using valves.

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Regional Scheme Justified.

The main purpose of the referendum has been served, because the results show that the regional scheme, involving fewer stations and higher power, will be justified.

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A Long Wait?

So far so good. All that remains is to set the regional scheme into operation; but here we are gazing into the dim and (I fear) distant future.

The Daventry experimental station has yet to win its spurs, and even if it is transmitting regular programmes by the autumn, sites for the new stations will have to be found and similar experiments carried out before the present stations are superseded.

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Our Fortunate Grandchildren.

An optimistic prophet at Savoy Hill tells me that we may see the scheme in operation by the end of next year.

Anyway, there seems little doubt that our grandchildren will have alternative programmes, especially if they live to a good old age.

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Broadcasts From Wimbledon.

The Centre Court matches of the Wimbledon lawn tennis meeting will be broadcast on June 29th, from 4 to 5 p.m.; on June 30th, from 4 to 5.15 p.m.; on July 1st, from 4.45 to 5.15 p.m.; and on July 2nd., from 2.30 to 4.45 p.m. In addition descriptive comments will probably be transmitted between 6 and 6.30 p.m. on these days.

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Dominion Day in Westminster Abbey.

On Dominion Day (July 1st) the special morning service will be relayed from Westminster Abbey to 2LO and 5XX.

The R.A.F. Display.

Listeners who wish to hear the sounds of an aerial combat will have an opportunity of realising their desire on July 2nd, when a portion of the Royal Air Force display at Hendon Aerodrome will be broadcast.

The broadcast items will include the destruction of a kite balloon, an air fight, the rescue of a beleaguered British population from a barbarian town by means of aircraft, and the destruction of a fort and bridge. Quite a lot for one afternoon!

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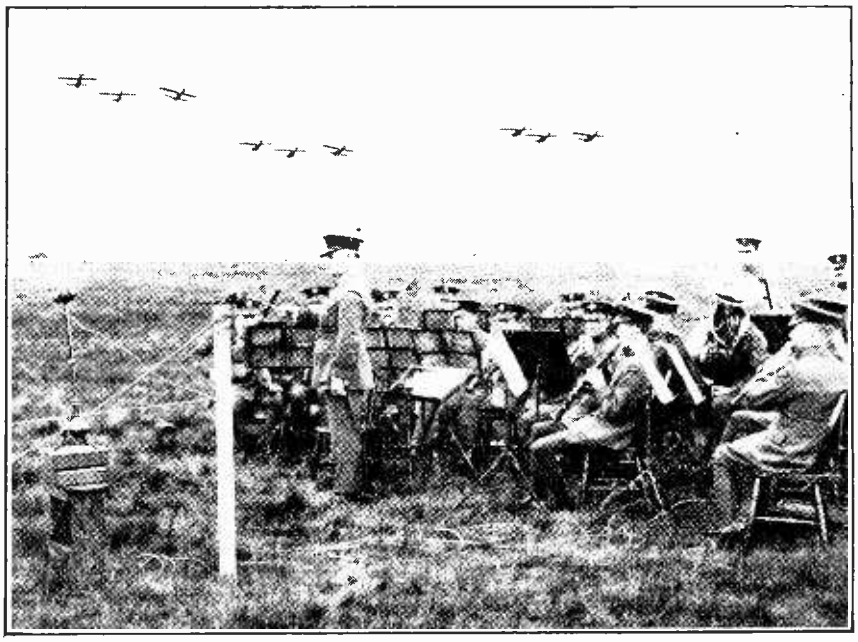
B.B.C. and the Eclipse.

The B.B.C. are to be commended for the very carefully arranged schedule of transmissions which has been prepared in connection with the eclipse on June 29th.



FLYING TO BROADCAST MUSIC. A rehearsal of a fascinating stunt to be given at the Royal Air Force display at Hendon on July 2nd, when a squadron of new planes will carry out aerial drill to "instructions" by music by the Royal Air Force Band.

Various time signals will be transmitted from London, Daventry, Birmingham, Manchester, and Newcastle, and the carrier waves of all except 5XX will be radiated continuously.

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Before and After.

The experiments are to be carried out on June 27th, 28th, 29th, 30th, and July 1st, so that listeners may have an ample opportunity of studying conditions before and after, as well as during, the eclipse. On each morning except June 29th a series of dot seconds will be broadcast, the sixth dot occurring precisely at every half-hour from 4.30 to 8.30. These signals will be sent out from London and Manchester at 4.30, 5, and 5.30 a.m. and from London only for the rest of the period.

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Continuous Carrier Waves.

On June 29th London and Manchester will transmit the dot seconds at 4.30, 5 and 5.30 a.m., and London and Daventry will give them at 6, 6.15 and 6.20. During the six minutes from 6.20 to 6.26 a.m. London and Daventry will broadcast single seconds continuously, missing the 29th and 59th seconds, while the announcer will call every fifth second throughout the period. London and Daventry will radiate dot seconds on the day of the eclipse at periods of half an hour between 6.30 and 8.30 a.m., while London and Manchester will also keep their carrier waves going continuously.

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Varying Wavelengths.

From the London station broadcast explanations will be given of the dot signals that are transmitted between 6 and 6.30 a.m. In each case the normal wavelength of the station will be used, except that on June 28th, 29th and 30th Birmingham and Newcastle, in transmitting their carrier waves continuously, will vary their wavelengths over a range of 10 metres, *i.e.*, 5 metres on either side of the normal.

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A German Giant.

A Berlin correspondent sends further details of the giant broadcasting station now being erected at Zeesen to supersede the present station at Königswusterhausen. From all accounts Zeesen will outpace Langenburg as well as Daventry.

The power of the new transmitter will be 35 kilowatts, *i.e.*, four times that of Königswusterhausen, and use will be made of Telefunken water-cooled transmitting valves rated at 20 kWs. such as are already used at Langenburg. The wavelength will remain at 1,250 metres, and, as in the case of Königswusterhausen, the modulation will be carried out at Berlin.

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A Move for Independence.

The principal reason for the removal and enlargement of the Königswusterhausen transmitter is that the station is intended to take foremost rank in the broadcasting of educational talks. Every afternoon from 3 o'clock onwards a varied selection of lectures will be given. It is felt that the present power of 8 kWs. is inadequate if a wide circle of listeners is to be appealed to, especially as the other commercial aerials at Königswusterhausen tend to absorb the transmissions from the broadcasting station.

FUTURE FEATURES.

London.

JUNE 19TH.—Programme of works by Stravinsky, conducted by the Composer.

JUNE 20TH.—Concert of New Compositions, and a Play.

JUNE 21ST. — "A Midsummer Night's Dream." (All Stations.)

JUNE 23RD.—Concert relayed from the Kingsway Hall.

JUNE 24TH.—"Carmen," Act 2, relayed from Covent Garden Opera House.

Cardiff.

JUNE 19TH.—Don Pedro and his Mexican Band and Watcyn Watcyns (baritone), relayed from Llandaff Fields Pavilion.

JUNE 22ND.—The Super Six in a Summer Revel.

JUNE 25TH.—A Neapolitan Night.

Manchester.

JUNE 19TH.—Special Evening Service relayed from Manchester Cathedral.

JUNE 20TH. — Vaudeville Programme.

JUNE 23RD.—"On With the Show of 1927," relayed from Blackpool.

JUNE 25TH.—"A Country Cottage," a Play by Patience Raymond.

Glasgow.

JUNE 19TH.—The Band of the Second Battalion, Argyll and Sutherland Highlanders.

JUNE 22ND.—A Highland Programme.

JUNE 23RD.—Symphony Concert.

Birmingham.

JUNE 20TH.—French Music and Plays.

JUNE 22ND.—Philip Ritte's Concert Party.

JUNE 24TH.—Chamber Music.

JUNE 25TH.—Military Band Programme.

Bournemouth.

JUNE 20TH.—Opera Comique: Vocal and Instrumental.

JUNE 24TH.—A Midsummer Day Concert.

Belfast.

JUNE 20TH.—Vocal and Orchestral Programme and Two Plays.

JUNE 23RD.—A Welsh Programme.

JUNE 24TH.—An Up-River Concert.

Newcastle.

JUNE 22ND.—The South Moor Colliery Band and the Prudhoe Gleemen.

JUNE 24TH.—British Composers, Instrumental Programme.

Aberdeen.

JUNE 23RD.—Scottish Programme.

Great things may be expected of the new station, which is situated rather more than a mile from the Königswusterhausen site.

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A Midsummer Fantasy.

A fantasy, "with music for a midsummer night," entitled "Pixie Led," by L. du G., of *Punch*, will be broadcast from 2LO on June 24th. Pixie songs have been specially composed by Kenneth A. Wright, who used to direct the Manchester station when it was first established by Metropolitan-Vickers.

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Stravinsky at 2LO.

A programme of works by the well-known composer Stravinsky, which he will conduct from 2LO on June 18th, will feature the first performance in England of his Concerto for Piano with accompaniment of wind instruments. For this item Stravinky will be the soloist, while the orchestra will be conducted by Edward Clark.

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About the Compère.

Is the *compère* idea being overdone? When this omniscient individual first came into favour he had at least the virtue of novelty. Now that the virtue has departed the question arises: Does the *compère* fill a *rôle* which could not be undertaken by the trained announcer?

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His Privileges.

Many listeners must be ready to answer the question in the negative.

In the majority of cases—there have been brilliant exceptions—the *compère* succeeds merely in bringing to the microphone an air of amateurism which the professional announcer has been trained to avoid.

The *compère* can be facetious without getting slapped; it matters not to him what high official of the B.B.C. may be listening. He may drop his voice or raise it without being cautioned by the engineers, and he can take liberties in the matter of free speech which are debarred the ordinary artist.

In a word, the *compère* enjoys all the privileges of the amateur who is not required to come up to professional standard. Who wants the *compère*?

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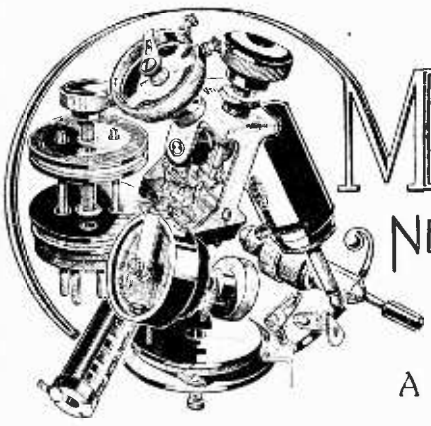
Ideal Length for a Talk.

Perhaps it affords no intense excitement to British listeners to know that Mr. D. Lawrence is broadcasting a series of talks on the American Government from the "Red Network" of stations of the American National Broadcasting Company. But it is interesting to note that each talk is limited to eight minutes' duration. Eight minutes seems an ideal length for a talk.

Some speakers can bore in less than one minute; others do not begin to bore after fifteen minutes. But eight minutes gives an average speaker time to bring out his main points without wrapping them in frills. It is the happy medium between long and short.



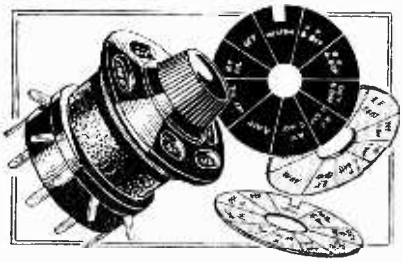
MANUFACTURERS' NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

WESTON METER SWITCH.

One sometimes hesitates before fitting a voltmeter to the panel of a receiving set when the instrument is arranged only to determine possibly the maximum battery potentials. A single voltmeter can, by means of a switch, be arranged to determine the voltages applied to the filaments and anodes of all the valves of a multi-valve receiver, as well as the grid biasing potentials. For determining L.T. and H.T. battery potentials, it is only necessary to have a single-pole multi-contact switch, which in turn connects the meter with the filament and H.T. valve connections, though it is necessary to introduce a series resistance when determining the anode voltages in order to read on the high-voltage scale of the meter.

The Weston Electrical Instrument Co., Ltd., 15, Great Saffron Hill, London, E.C.1, now supply for use with their Model 506 voltmeter a multi-contact switch in which is incorporated the series resistance for taking readings on the high-voltage scale. Being provided double-pole contacts, voltage readings can be taken on H.T., L.T., or grid biasing batteries, irrespective of whether the H.T.— is normally connected to the L.T.+ or L.T.—. The dial moves with a snap action, and the settings are shown on an



The Weston switch for determining all receiver voltages with a two-range voltmeter.

indicating card viewed through apertures in the dial. Several indicating cards are supplied to meet various requirements.

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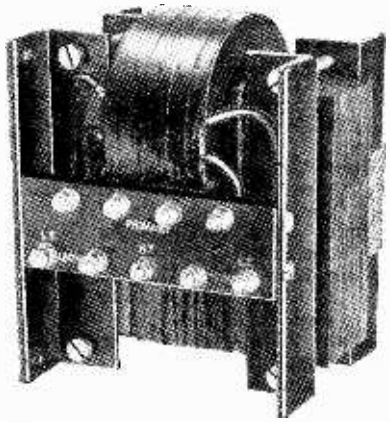
WILSON ELIMINATOR TRANSFORMER.

Wm. Hamilton Wilson, of 125-127, Red Lion Square, Surbiton, Surrey, has long been known as a manufacturer of power and special transformers for use in wireless transmission.

A new series of transformers has been produced for use in the construction of battery eliminators, the windings being suitable for supplying both filament heating and anode current to the rectifying valves. Although very moderate in price these transformers are of massive construction, and the general build at once reveals that experience in transformer design not always possessed by wireless manufacturers who have found it necessary to extend the scope of their products to include the manufacture of power transformers. The specimen transformer examined had a core cross-section of about 1¼in. square, and the frame, which had a single opening, measured about 3⅜in.×4½in. The windings were built up on a mica wrapping, and substantial angle pieces compressed the core stampings tightly together. By winding the primary as two sections with the ends brought out to four terminals the transformer was suitable for use on 100 to 125 volts, or 200 to 250 volts. The filament heating windings gave 7 volts at 1.5 amperes when connected to a 110 or 220 volt supply, and the step-up winding gave 120+120 volts at 50 milliamperes. These windings are suitable for operating most of the small rectifying valves requiring 6 volts or less, such as the Marconi or Osram "U.5" or two "U.4s," or the Burndept "U.695." In the case of the Mullard type DU.5 two valves may have their filaments connected in series for full wave rectification. Transformers are supplied with special windings to suit the Mullard DU.2 and DU.10 valves. On circuit the transformer is perfectly silent, and can be operated for many hours continuously without any apparent temperature rise. Other transformers are available with windings arranged to give L.T. 4 volts at 2.2 amperes with H.T. 120+120 at 50 milliamperes; 4 volts at 2.2 amperes with 180+180 volts at 50 milliamperes; 4 volts at 2.2 amperes with 200+240 volts at 50 milliamperes; 7 volts at 3 amperes with 200+200 volts at 80 milliamperes 7 volts at 7 amperes with 400+400 volts at 150 milliamperes, tappings being provided at 200+200 volts. In addition to this range, all suitable for use on various primary voltages and frequencies, there is another type giving 4 volts at 0.8 amperes for supplying heater current for Marconi and Osram valves of the K.L.I. type.



The new Hamilton Wilson battery eliminator transformer.

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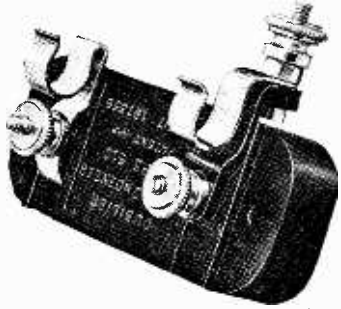
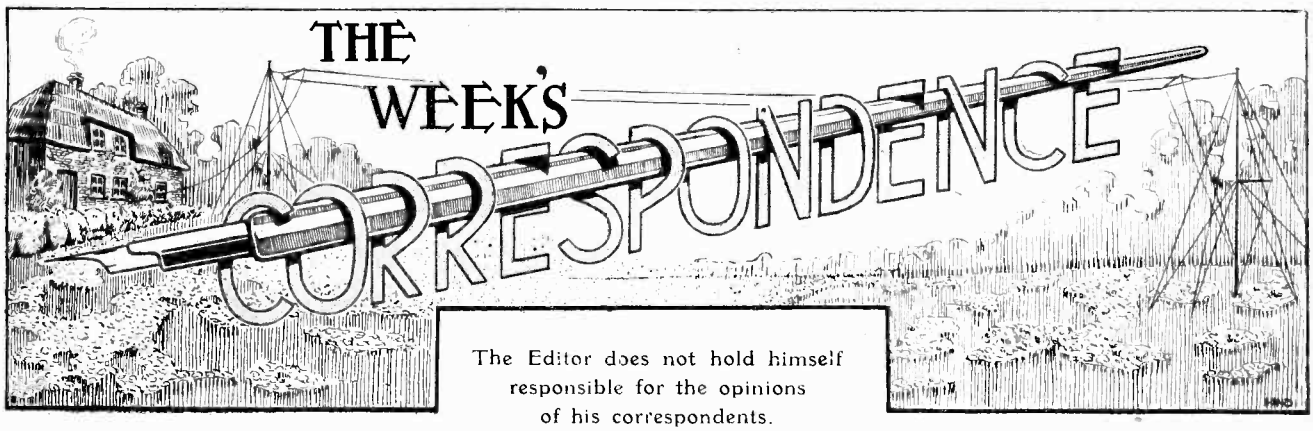
NEW DUBILIER DEVICE.

To make provision for connecting the grid leak either directly across the grid condenser or to return the connection to the filament, the Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, North Acton, London, W.3, has recently introduced a new form of mounting clip.



Dubilier clip mounting for use with grid condensers.

It is suitable for use with Dubilier condensers type 610 and 620, and consists of a small insulated extension piece carrying terminal and clip. It is supplied without extra charge with the condenser as well as being obtainable separately.



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

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

BROADCASTING AND THE PATENT POSITION.

Sir,—I have read with a great deal of surprise the letter in your issue of June 1st from the Marconi Co. with reference to broadcasting and the patent position.

It is just another example of the policy, or lack of policy, of the Marconi Co. that an explanation of its decisions should be made to a periodical only when attention is drawn to it, when surely that explanation should have been given in the first place to the parties mostly concerned, the actual licensees.

As a result of my refusal to accept a peremptory modification my licence has been determined by the Marconi Co. without the slightest possibility of negotiation or explanation. The licence which I hold entitled me, amongst others, to the use of patents Nos. 147147 and 159984, both of which are for multi-electrode valves giving several stages of amplification, and yet, to read the Marconi Co.'s statements, licensees were never meant to use these particular patents—what an anomalous position!

The facts of the case, I suggest, are as follow: The particular patents referred to above were put into the original licence as "make-weight," the Marconi Co. attaching little importance to them, but when multi-electrode valves are made a commercial product by another company the Marconi Co. see the possibility of cheap receivers being placed on the market, and accordingly set about to stop this at all cost.

The lot of a Marconi licensee is indeed a sad one, as he is bound hand and foot and has to pay all ways, as instance the following examples: If an amateur constructor applies to the Marconi Co. for a licence to cover a set he has built he is supplied with a licence on payment of 12s. 6d. per valve holder, a licence plate being thrown in free of charge; but the poor manufacturer licensee has to purchase the plates in addition to paying the outrageous royalty of 12s. 6d. per valve holder. This charge for licence plates, no doubt, is a paltry thing, but is another instance of grab.

A non-licensee may make and sell transformer-coupled amplifiers (as admitted by the Marconi Co.) without paying royalties, while another company (a licensee) can supply a single valve detector to go with such an amplifier, with the result that the user can purchase a three-valve set, paying only 12s. 6d. royalty; yet if the unfortunate licensee wishes to do the same thing he has to pay 37s. 6d. royalty.

The whole thing is manifestly absurd, yet the Marconi Co. cannot or will not see it, and it is high time that licensees banded themselves together to demand better and more equitable terms

"UNDER NOTICE."

June 2nd, 1927.

TELEVISION.

Sir,—In your issue of June 1st the statement is made that the recent demonstration of television by the American Telephone and Telegraph Co. was the first public demonstration of television.

May I draw your attention to the fact that Mr. Baird gave a public demonstration of television to over forty members of the Royal Institution on January 27th, 1926?

Professor Andrade, who witnessed a demonstration, states as follows in the *Encyclopædia Britannica* under "Television":—

"Mr. J. L. Baird, who has already succeeded in producing a crude but convincing representation of a moving object through the agency of Hertzian waves, and has so achieved a true 'vision by wireless.'

"In February, 1926, Mr. Baird had succeeded with quite crude apparatus, constructed on the lines laid down, in transmitting recognisable pictures of moving objects such as a living face.

"Synchronism is secured with the help of an alternating current generator mounted on the same shaft as the scanning disc. The slow alternations so produced are superimposed on the carrier wave which is used for conveying the variations of intensity which produce the picture. At the receiving end the synchronising wave is separated from the light modulations by a wave filter, and is then made to control the speed of the slit and the spiral disc."

Dr. Russell, Principal of Faraday House, states in *Nature* of July 3rd, 1926:—

"We saw the transmission by television of living human faces, the proper gradation of light and shade, and all movements of the head, of the lips and mouth, and of a cigarette and its smoke were faithfully portrayed on a screen in the theatre, the transmitter being in a room at the top of the building. Naturally, the results are far from perfect. The image cannot be compared with that produced by a good kinematograph film. The likeness, however, was unmistakable, and all the motions are reproduced with absolute fidelity. This is the first time we have seen real television, and, so far as we know, Mr. Baird is the first to have accomplished this marvellous feat."

A vast American organisation, employing about one thousand men to do this one demonstration, appear to have repeated Mr. Baird's early results, with the difference that they transmitted 200 miles, while Mr. Baird, at his first demonstration given nearly eighteen months before the American experiment, transmitted from one room to another. This, however, does not affect the point that television was first demonstrated in England.

The authorities of the Science Museum, South Kensington, after careful investigation, are exhibiting Mr. Baird's original apparatus, and describe it as follows:—

"*Original Television Apparatus*, made by J. L. Baird, Esq. *Lent by Messrs. Television, Ltd.*

"This is the transmitting portion of the original apparatus used by Mr. J. L. Baird in experiments which led him from the wireless transmission of outlines in 1925 to the achievement of true television nine months later, when, on January 27th, 1926, the transmission of living human faces, with light, shade and detail, was demonstrated before members of the Royal Institution, *this being the first demonstration of true television ever given.*

"The original apparatus here exhibited was used by Mr. Baird at a demonstration given at a London store in April, 1925, when the wireless transmission of outlines was shewn publicly for the first time. This apparatus was developed, troubles with the light-sensitive device were overcome, and an improved optical device was evolved with the result stated above."

With regard to the question of distance, it is noteworthy that Mr. Baird has recently demonstrated television between London and Glasgow, a distance of over 400 miles, employing for the purpose of the demonstration a staff of three operators.

Professor Taylor Jones, who holds the Chair of Natural Philosophy at Glasgow University, commenting on the test, said :—

"I think the images of those in London were remarkably clear. I recognised Mr. Baird immediately. The televisor has great possibilities, and it is a remarkable achievement that a face transmitted from London can be clearly seen in Glasgow, and its movements followed in detail."

In face of this evidence I think you will agree that the assertion made in your issue of June 1st that the American demonstration was the first is in error.

BAIRD TELEVISION DEVELOPMENT CO., LTD.
O. G. Hutchinson, Joint Managing Director.

London, W.C.2.
June 3rd, 1927.

THE STUDIO AT PCJJ. Mr. A. F. Philips broadcasting "to the world" from the Eindhoven station.

EMPIRE BROADCASTING.

Sir,—The letter over the signature of Mr. M. V. Blake, in the June 8th issue, makes out a strong case for the Empire broadcasting station which you have so consistently called for through the columns of your journal.

Here we have the case of a Britisher resident abroad who listens with comfort to an American and a Dutch station, but yet with a set employing more than twice as many valves fails to get satisfactory reception from a B.B.C. station. Is it merely apathy on our part, or is there some definite reason, not apparent to the layman, why broadcasting from England to the Colonies should not take place? The B.B.C. is, perhaps, only naturally rather timid to spend money on a station which it is really outside their province to maintain, unless a definite authority for that expenditure is forthcoming.

It would seem to me that the only way that this short-wave station can be brought into existence is by joint action from the Dominion Governments, with a request to the Mother Country to make the necessary arrangements. It seems hardly possible that if such a request were made collectively that the station could still be denied to the Empire. "EX-COLONIST."

South Norwood.
June 8th, 1927.

TRANSMITTERS.

Sir,—As a member of what your correspondent, Mr. John Willings, chooses to call "the brass-pounding fraternity," I write to take exception to the sarcastic tone of his letter published in your issue of June 8th, and also to suggest that he might be a little more courteous in his attitude towards the transmitting amateur as a community, even though he may, as I have no reason to doubt, have very good grounds for objecting to the inconsiderate attitude of certain transmitters who may be interfering with his reception of distant stations.

Mr. Willings also suggests that the "brass-pounding fraternity" might be told that they have no monopoly of the ether after the B.B.C. stations have closed down. As a whole, the transmitters would certainly not consider that they had a monopoly of the ether at *any* time, but if they are not to work after the B.B.C. stations have closed down, then, please, may we know when they should carry out their transmissions, because to work during broadcasting hours, although not prohibited in the terms of the transmitters' licences, is still regarded as "not done" amongst respectable transmitting amateurs? "PRE-WAR TRANSMITTER."

London,
June 9th, 1927.

RECEPTION OF PCJJ.

Sir,—I give below some details of the reception of PCJJ which may be of interest to readers. The receiver is a two-valve Bowyer-Lowe short-wave set.

Tuesday, May 10th, 1927 : Tuned in on closing remarks. Next transmission Thursday, 19.00/23.00 hours. Sig. strength R4-5. Steady wavelength (by Stn. wavemeter—29 metres).

Thursday, 12th : Tuned in at 19.15 hours. Held PCJJ till they closed down at about 23.00 hours. A few of the items from the programme are :—

(a) "Somebody Loves Me." Gramophone Record.
(b) "Nobody Knows What a Red-Headed Mummer (?) Can Do." "
(c) Selection from "Rose Marie." "
(d) Selection from "No No Nanette," including "I Want to Be Happy," etc. "

It was announced that there would be a special transmission at 18.40 till 20.40 hours on Saturday, 14th, to the Dutch East Indies and West Indies, when the Minister of Colonies would give a special address and the Philips' Band would play special Dutch selections. The announcer called the world mentioning among others British India and Calcutta. Sig. strength R4-5 intermittent fading. PCJJ announced wavelength as 30.2 metres.

Saturday 14th : Tuned in at 18.50 hours and held till 20.55 hours when PCJJ closed down. Music excellent. All announcements in Dutch but recognised the announcement "Philip Radio Laboritorium." Sig. strength R5. Fading in groups of 10 second intervals. A. T. DEWAR.
(A1 2KD.)

Rangoon, Burma.
May 16th, 1927.

INEFFICIENT OPERATION OF RECEIVERS.

Sir,—With reference to W. Carr's letter in the May 25th issue. This raises rather an interesting subject, namely, the percentage of sets in use which, through the lack of wireless knowledge of their owners are never extended to their full abilities. By which I mean, apart from technical values, such things as correct high tension to each valve, suitable grid bias, transformers applicable to the valves in use, and numerous other adjustments known to the experienced amateur, but of which the average listener fails to make use. A leaflet from manufacturers would help, but I think that this is where the numerous wireless societies could be of greater assistance, apart from their experimental work, to instruct the average listener in the intelligent operation of their receivers.

Croydon. H. W. HURLEY.
June 1st, 1927.

READERS' PROBLEMS

"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Super-regeneration.

I am very interested in circuits of the super-regenerative type, and understand there are two variants of this circuit upon the market, namely, the Armstrong and Flewelling circuits, and should be glad if you could give me the circuit diagram of these instruments and also information as to when they were first invented and what improvements have been made since. I understand that it is quite possible by means of one switch to convert these circuits from ordinary regeneration to super-regeneration as desired, and should like the necessary arrangements included in the diagram. M. D. D.

The two best known super-regenerative circuits are undoubtedly the Armstrong and the Flewelling, the former being the older circuit. There are, however, a large number of other types of circuit upon the market employing the super-regenerative principle which are mainly variations of the Armstrong and Flewelling circuits, although employing the same basic priaciples. Major Edwin H. Armstrong was not, however, the originator of the super-regenerative circuit, nor has he ever claimed to be so, and, indeed, in a paper read before the Institute of Radio Engineers on June 7th, 1922, which was published in the issue of *The Wireless World* dated November 18th, 1922, Major Armstrong acknowledges the work of Capt. John Bruce Bolitho, an Englishman who preceded him in the production of super-regenerative circuits (British Patent No. 156,330), and also acknowledges the work of another Englishman, Lawrence B. Turner (British Patent No. 130,408), who preceded Bolitho.

Many experimenters to-day use the Bolitho form of circuit, although it is very difficult to draw the dividing line between these circuits since Armstrong himself has produced more than one super-regenerative circuit, his original circuit using two valves, a rectifier, with a separate valve to produce the "quenching" oscillations. His best known circuit, and the one usually accepted, is that which we publish in Fig. 1 (a), where the valve acts both as a rectifier and as the producer of the "quenching oscillations." Referring to this figure, the frame aerial, of course, requires to be of such specifications that it will cover the band of wavelengths required when used in conjunction with C_1. The coil L_1 in series with the frame is necessary for the purpose of coupling the reaction coil L_2 to the grid circuit in order to produce ordinary regeneration. Alternatively, it is possible to use an outdoor aerial in the ordinary manner, but it is not advised as the circuit is a strong re-radiator.

We would point out that full constructional details of the Armstrong super-regenerative circuit have appeared from time to time in *The Wireless World*, such as October 21st, 1922, and, to come to more recent times, December 16th, 1925. In the latter receiver two valves are shown, but the final valve is merely an L.F. amplifier. It should be pointed out that many readers, owing to the loose use of the expression "super" or "Armstrong super," are apt to confuse the "Armstrong super-regenerative" circuit with the "Armstrong supersonic-heterodyne" circuit. The latter circuit, of course, is a very well-known and popular circuit, and is thoroughly reliable, but it cannot be said that any great progress has been made towards removing the stigma of lack of reliability from the latter circuit.

The Flewelling circuit, which was brought out by Mr. E. T. Flewelling, of New York, is of much greater simplicity in appearance, but even to this date no circuit employing the super-regenerative principle can be classed as a really stable and reliable circuit, and such circuits are suitable only for the experimenter. The original Flewelling circuit, which we show in Fig. 1 (b), did not make its appearance in the U.S.A. until the latter part of 1922, and in this country until the early part of 1923. The circuit was, as a matter of fact, published in the issue of *The Wireless World* for April 21st, 1923, a full constructional article being given

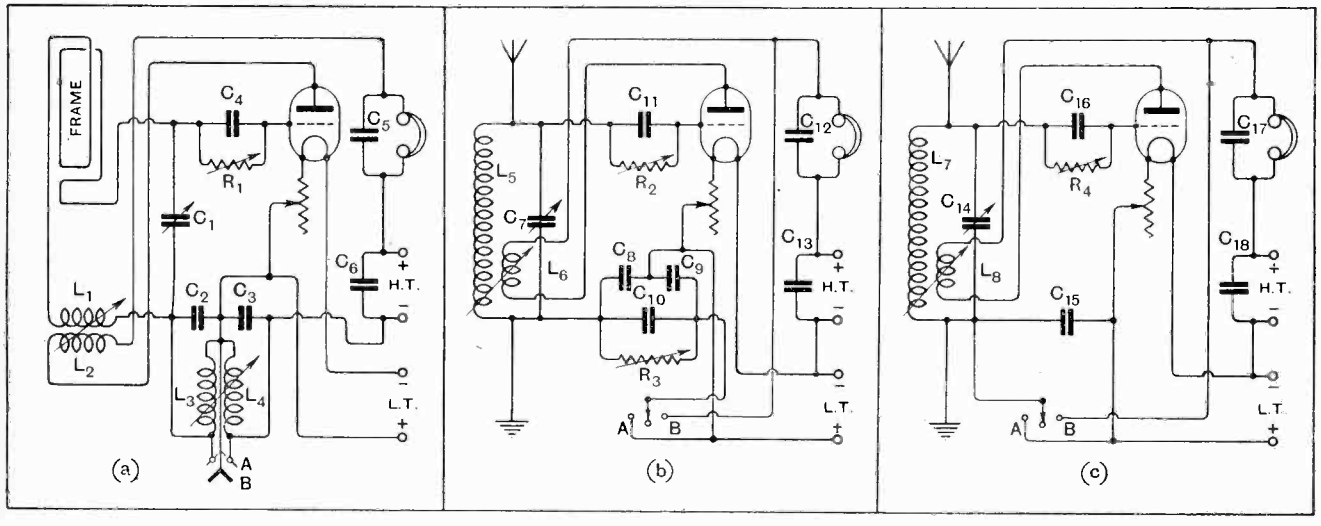


Fig. 1.—Three typical super-regenerative circuits.

in our issue of September 12th, 1923, the actual receiver published being, curiously enough, built as a portable receiver. Later, the Flewelling circuit was greatly simplified, and we illustrate this circuit in Fig. 1 (c).

With regard to your desired switching arrangement, we would inform you that in the case of the Armstrong circuit a double-pole switch will be necessary. A moment's glance at the figure will show you that the effect of this double-pole switch is merely to short-circuit the two quenching coils and their condensers; thus, with the switch at position A we have an ordinary regenerative set using a frame aerial; with the switch at B we have a super-regenerative set. In the case of the original Flewelling shown in Fig. 1 (b), only a single-pole switch is absolutely necessary. Positions A and B give us a regenerative or a super-regenerative receiver as desired.

It perhaps would be better, however, to include a double switch in order that R_1 may be short-circuited when using the receiver as an ordinary single valve set, since otherwise we must turn this to its position of minimum resistance in order to prevent it acting as an additional series grid leak. The simplified Flewelling shown in Fig. 1 (c) is really the only system in which a single-pole switch can be used for rapidly converting the receiver from regenerative to super-regenerative, A being a simple regenerative set, and B a super-regenerative, as in the case of the other circuits. It is claimed by experimenters that the simplified Flewelling circuit is much the easier to operate, although it is somewhat less sensitive than the Armstrong form of receiver, all other things being equal, and consequently we show it with a normal aerial and earth system, although a frame can be used with a series coil for the purpose of reaction if desired. Needless to say, L.F. amplification can be added in the normal manner by inserting the primary of an L.F. transformer in the place of the phones, but separate batteries are advised.

It cannot be too strongly urged that super-regenerative receivers of any description are not suitable for the ordinary listener or home constructor, and owing to their vagaries and difficulties in operation are really only suitable for the serious experimenter.

○○○○

Multiple Valves.

I have obtained two of the foreign multiple valves (the H.F. and detector-L.F. combinations), and have made them up into a receiver on the lines suggested by the makers. The set seems to be lacking in selectivity, and I should welcome any suggestions you could make on suitable methods for improving it in this respect.

R. S. S.

The circuit recommended for these multiple valves should certainly be moderately selective, and we can only think that you are using in your aerial-grid and intervalve couplings coils having a high H.F. resistance. You do not give details of your H.F. transformer, but we suggest you try one wound on the lines of that used in the "Everyman Four" receiver, but with the omission of the neutralising winding, which will be unnecessary in this case, as the sequence of tuned grid and plate circuits is broken by the interposition of the resistance-coupled stage included in the first valve. If this does not put matters right we suggest that you test carefully for high resistance connections and leakages, which may be giving rise to your present flatness of tuning.

○○○○

Protecting the H.T. Battery.

I always make a practice of disconnecting the batteries from my receiver after switching off each night, and notice when reconnecting the high tension leads that a spark is produced. Does this indicate poor insulation in the set?

W. R.

On the assumption that you are using the usual large by-pass condensers across each section of the H.T. supply we think that in all probability the spark is caused by the flow of charging current into these condensers, and if so the effect is quite normal. It may be added that if the insulation of the receiver is above suspicion (as it should be) there is no real need to disconnect the H.T. battery each night, as the flow of current from it should cease as soon as the valve filaments are extinguished.

○○○○

An Expensive Mistake.

I recently connected by accident a 4-volt accumulator to the L.T. terminals of my set with 2-volt valves in the sockets, and did not notice the error until the filaments had been alight for about ten minutes. All the filaments still glow, but results are very poor. I presume that they have been harmed by the excessive voltage applied to them?

T. R. R.

Yes, in all probability the emission of your valves has fallen off very considerably, due to the application of this excessive voltage for a comparatively long period. It may be, however, that some other fault has developed, and it would be worth while to test your valves with a milliammeter.

○○○○

Four-volt Economy.

I am attempting to build the three-valve portable set described in your May 11th issue, but, in the interests of economy, I am going to use 2-volt valves instead of 4-volt valves, as I invariably use 2-volt valves. Will you please tell me which valves in the 2-volt class will be suitable?

R. D.

We are afraid that you will be quite unable to obtain great economy in this case by the use of 2-volt valves instead of 4-volt valves. The filament wattage of the 4-volt valves was not quite half a watt, whilst the most economical valve in the 2-volt class consumes somewhat over half a watt, and so it is less economical to use it. It must be remembered that there are comparatively few four-electrode valves upon the market at present, although manufacturers will probably produce them with various characteristics in the 2-, 4-, and also in the 6-volt classes when such a demand arises. In the matter of economy, of course, we are only taking into consideration the question of L.T. supply, since economy in H.T. supply will depend upon the particular characteristics of the valve, irrespective of whether it is a 2-, 4-, or 6-volt valve.

○○○○

A Rising Resistance.

Some time ago I built a four-valve receiver, and, on connecting up, all was well. The receiver appeared to function normally, and excellent results were obtained. Gradually, however, the receiver seems to have developed a pronounced whistling noise of a rather low pitch. This pitch is constant, and does not appear to change, but, on the contrary, is growing louder. Can you tell me the cause of this trouble, and how to remedy it?

R. T.

It is not improbable that you are using H.T. batteries of a capacity inadequate to meet the needs of your set; the result is that more current is drawn from them than the makers had in view when designing them, and so gradually the battery resistance has been rising. It must be remembered that some portion of this battery at least will be common to the plate circuits of all four valves, even though a separate H.T. tapping be used on each valve. As the resistance of the battery rises, then, we shall have a resistance common to the plate circuits of all four valves, and this will act as a coupling between the valves, due to the fluctuating potentials set up across it by each valve, and a howling noise will be built up. As the battery grows older and the resistance greater, the noise will be increased in intensity.

Undoubtedly you could cure it for the time being by putting larger shunting condensers across the battery, but it is advised, if you are using small cell batteries, that you abandon them in favour of others of adequate capacity. You may argue that you are already using large cell batteries; if this is the case we should imagine that there exists in your amplifier magnetic or capacitative coupling, so that the amplifier is already unstable, and not very far from the point of L.F. oscillation. If this be so any little extra cause of instability, such as a slight rise in resistance in your H.T. battery, would be sufficient to cause the amplifier to howl, this slight extra resistance being, as it were, the last straw, and the amplifier consequently commences to oscillate. Of course, even the largest dry cell batteries have a certain internal resistance which rises as the battery grows older, although this rise does not occur so soon as in the case of the small cell batteries.

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POSSIBILITIES OF EMPIRE BROADCASTING PROVED.

IN the Correspondence columns of this issue we publish four letters under the heading of "Empire Broadcasting." Frankly, we must confess to having read these letters with a feeling of shame that England should have been left so far behind in the race for supremacy in world broadcasting. We were told the other day by the B.B.C. that it would be a long time, perhaps years, before we could have satisfactory broadcasting to the Empire from the Mother Country. Does this mean that we are going to sit down and watch whilst Holland, America, and other countries develop short-wave broadcasting in order that we may copy their methods when we have made quite sure that there is no element of uncertainty or experiment about the undertaking? Are we correct in looking upon short-wave world-broadcasting to-day as only in a very experimental stage? In the letters already referred to above, one correspondent, writing from Calcutta of Holland's re-broadcast of London, says: "I received the transmission almost word perfect. It was like being home again to hear the same old announcer's voice. Holland I listen to every night he works."

In another letter from a reader in England, Mr. H. Whittaker, we are given an account of how he received the wonderful broadcast in connection with Lindbergh's arrival in New York, which was relayed on short wave from 2XAD. Members of the staff of *The Wireless World* also listened in to this reception, and although at times a little fading did occur, yet with a two-valve receiver the speech never became unintelligible at any period throughout the transmission.

This broadcasting of Lindbergh's arrival was a truly national affair in America, and the psychological effect amongst American nationals must have been very great. The broadcast was probably the biggest ever organised in the United States. It continued for several hours, and microphones were placed in various parts of New York where the procession and celebrations could be described. Considering how excellent was the reception here, we cannot but feel that the B.B.C. missed a great opportunity in not re-broadcasting at least part of the 2XAD transmission. Can it be that, having made a public statement that they themselves regard broadcasting on short wave as only in an experimental stage and not possible of satisfactory achievement "perhaps for years," they hesitate to let the listening public hear for themselves the true state of development to which short-wave broadcasting has been brought?

In making our case for a short-wave station we are not expecting perfection at the outset, but a performance comparable with that of short-wave stations in other countries which have given, in our opinion, ample proof that short-wave broadcasting is no longer in the very experimental state that the B.B.C. would have us believe, but has reached a stage where the expenditure to establish such a station can be amply justified.

CONTENTS.

MAKING SYNTHETIC GALENA

Processes for the Preparation of Sensitive Crystal Detectors.

By G. H. TATHAM.

PRIOR to the days of broadcasting galena was very little used as a detector, and it is only in recent years that it has achieved such a widespread popularity. Practically every crystal used for broadcast reception is galena or one of its modifications, and in consequence it is now manufactured in considerable quantity. Natural galena, at one time fairly commonly used, has been replaced by a manufactured lead sulphide which in crystalline form is usually described as "synthetic galena," as it closely resembles in structure the natural product.

Although of a practical nature, this article describes for the first time the actual processes employed for the preparation of wireless detecting crystals.

The formulæ are of special importance. They have been developed from theories held by the author on the operation of crystal detectors, and will be found to produce particularly sensitive crystals when used in the manner described

By a series of experiments it was found that a pure synthetic galena could be produced by the fusion of powdered lead with sulphur, using only an ordinary gas-ring or Primus oil-stove and taking advantage of the considerable heat generated by the chemical combination of the lead and sulphur. A feature of the process is its simplicity, and interest attaches to the vivid display which takes place upon the chemical combination of the powdered lead with the amorphous sulphur. Several pounds of synthetic galena can be produced for a few shillings.

Materials Required.

An enamelled iron basin measuring about 4½in. in diameter by 5¾in. deep, together with an enamelled iron soup plate about 9in. in diameter, will be large enough for making some seven pounds of synthetic galena, the weight being that of the final fusion. Best enamelled ware is not required. A wooden paddle for stirring the plastic sulphur can be cut from a piece of dry wood, and should measure about one foot long by an inch wide and ¼in. in thickness.

Sulphur is usually purchased in the form of sticks known as roll sulphur, and the first step is to convert this to the amorphous form. The roll sulphur, which has a melting point of 112 deg. C., is first slowly melted in the enamelled iron basin with a gentle heat, taking care that it does not ignite. When entirely molten the temperature is slowly raised, the colour changes from yellow to a dark red, the viscosity rapidly increasing. This change takes place at 150 deg. C., and as the temperature is raised to 162 deg. C. the liquid becomes so thick that it can scarcely be poured, reaching a maximum viscosity at 180 deg. C. If the temperature is raised still higher the liquid becomes less viscous, although its dark colour still remains. The sulphur should be allowed to cool down soon after maximum viscosity has been reached, until it resumes a quite liquid state, when it should be poured off into the enamelled dish. When quite cold it can be crushed into small pieces, and by repeating this process twice again the sulphur can be reduced to a fine amorphous powder. The powdered lead required must be both pure and dry, and can be obtained from dealers in chemicals with a purity of 99.99 per cent.[1]

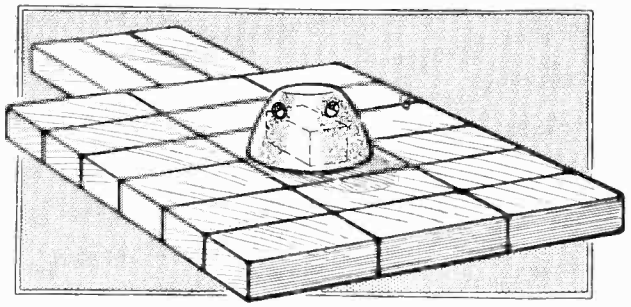

Fig. 1.—Layout of the bricks for the foundation of a small furnace. The construction of the fireclay cone for supporting a small crucible is shown. It is retained in position by a projecting brick.

According to the weight of the fusion required the enamelled iron basin should vary in size, and as a guide it may be mentioned that for a small fusion of about one pound a basin of the size of a teacup is most suitable, while for a fusion of 20 lb. the basin should measure about 7½in. in diameter by 4½in. deep, thus holding about two quarts.

A table is given showing the various combining weights of lead and sulphur to produce different weight fusions, and as the heat of combination is very considerable the

[1] Townson and Mercer, Ltd., 34, Camomile Street, London, E.C.3.

Making Synthetic Galena.—

height of the flame which will be produced is also stated.

Powdered Lead. lb.	oz.	Prepared Sulphur. lb.	oz.	Weight of Fusion. lb.	oz.	Approx. height of Flame.
1	0	0	3½	1	0	1 ft. 3 in.
3	9	0	9	3	8	3 ,,
6	0	1	0	7	0	6 ,,
12	1	1	15	14	0	10 ,,
15	3	2	3	18	0	16 ,,
17	9	2	7	20	0	18 ,,

Making 1 lb. of Galena.

The smallest quantity recommended is the one-pound fusion, requiring 1 lb. of lead and 3½ oz. of sulphur. After the sulphur has been prepared in the manner described it is again placed in the basin (which should have a capacity of about 6 to 8 oz.), preferably on a gas-ring, and the heat gently applied until the sulphur reaches the state where it is so thick that it will hardly pour. It is then removed from the flame, the gas turned off, and the powdered lead added quickly, stirring until thoroughly mixed. If a Primus oil-stove is being used owing to the need for working out of doors it is advisable to take the basin off the stove when mixing the lead with the sulphur as well as taking care to be ready to open the air valve directly fusion starts. It is inadvisable to attempt the fusion of more than about 3½ lb. from an oil-stove.

When thoroughly mixed it is replaced over the gas flame, which should well surround the bottom of the basin. After two or three minutes it will be observed that the sulphur is starting to combine with the powdered lead, and a flame which is bluish-white in colour first appears on the surface of the compound. The flame increases in height to about 15in., giving off a light grey smoke of lead oxide, the flame making a noise similar to a blow-lamp. The chemical combination of lead and sulphur raises the temperature to between 950 and 1,000 deg. C., and it will be seen that the basin becomes a bright cherry colour.

Directly the flame ceases a cover should be placed over the basin and the fusion allowed to cool down slowly. By gently tapping the basin when cold the synthetic galena can be easily removed. It is very important that the gas should be turned off directly the flame starts on the surface of the mixture, or otherwise the fused product will be found to contain innumerable small cavities. As a rule the enamelled basin cannot be used again for a fusion on account of the surface being destroyed. When a large fusion of 18 to 20 lb. is made any attempt at using the basin for a second charge will result in the metal being completely burnt away. A small quantity of synthetic galena prepared in the manner described will be found to be very rich in sensitive spots.

Making Larger Quantities.

When undertaking a large fusion of 18 to 20 lb. the surface of the liquid, which is at first quite even, after a while sends up small mounds, and from each a flame is ejected, and as the reaction continues the jets unite to form one large flame. The flame has good illumination power and colour, and is somewhat similar to the burning of a mixture of magnesium and zinc. The large fusion gives a good demonstration of the lead vapour being consumed by the oxygen of the atmosphere, and the chemical combination is so rapid that from the start to the completion of the reaction the time is only about 55 seconds.

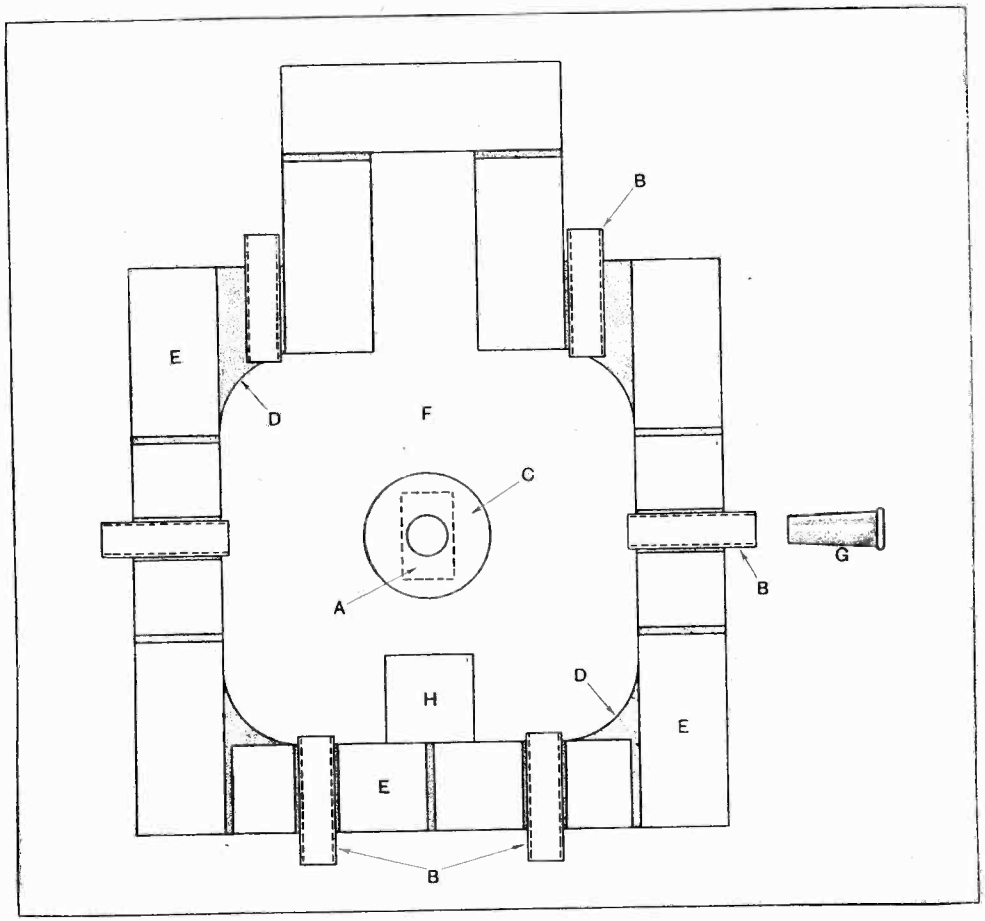

Fig. 2.—Section of first tier of furnace. A, brick supporting cone; B, air vent pipes; C, fireclay cone; D, fireclay filling; E, brickwork; F, floor of furnace shown in previous figure; G, filling stoppers; H, half brick for supporting the five movable bricks forming the door.

Making Synthetic Galena.—

In considering the most suitable quantity for one charge it may be mentioned that the larger the quantity of lead and sulphur the greater will be the temperature reached. The small enamelled basin becomes unsuitable for a 28 lb. charge unless the bottom is supported by a thin iron plate so as to avoid the basin being burnt through and the greater part of the galena being lost by burning away into the atmosphere. Uniform synthetic galena crystals can usually be obtained from a 14 lb. fusion. A 28 lb. fusion gave very large crystals, while a 40 lb. fuse proved to be the maximum that can be conveniently handled, inasmuch that the heat generated was so great that over 15 lb. of lead was burnt away. The temperature in this instance approaches 1,200° C. Although the synthetic galena as now prepared can be used for detection purposes, further treatment of the crystal is desirable, and the galena forms an excellent base for the production of wireless crystals.

Furnaces for Treating the Galena.

It is generally thought that for the further treatment of the crystal an electric furnace is necessary. As a matter of fact, there are several objections to the use of the electric furnace, principally that of heating too quickly, overheating and cooling down too rapidly. In certain types of furnace, however, these troubles have been eliminated, but the designs are elaborate and costly.

The process consists of further fusing the synthetic galena and introducing other substances to render the crystal more sensitive. As the principal difficulty is that of providing a suitable furnace for this purpose constructional details are given so that the experiments can be carried out by the experimenter in an economical manner. A temporary furnace may, of course, be fixed up in the kitchen stove, providing there is a good draught and a good coal is used. A small D-shaped muffle with a closed end supported by two pieces of brick so as to allow space for the fuel to gravitate under the muffle can be satisfactorily used with a small Battersea round crucible with lid such as size "A," which is 2⅝in. in height by 1⅝in. in diameter, or "B," 3in. in height and 1⅞in. in diameter. The D-shaped muffle should be used in a vertical position with the flat of the D facing the back of the stove and the fuel fed round the muffle.[2]

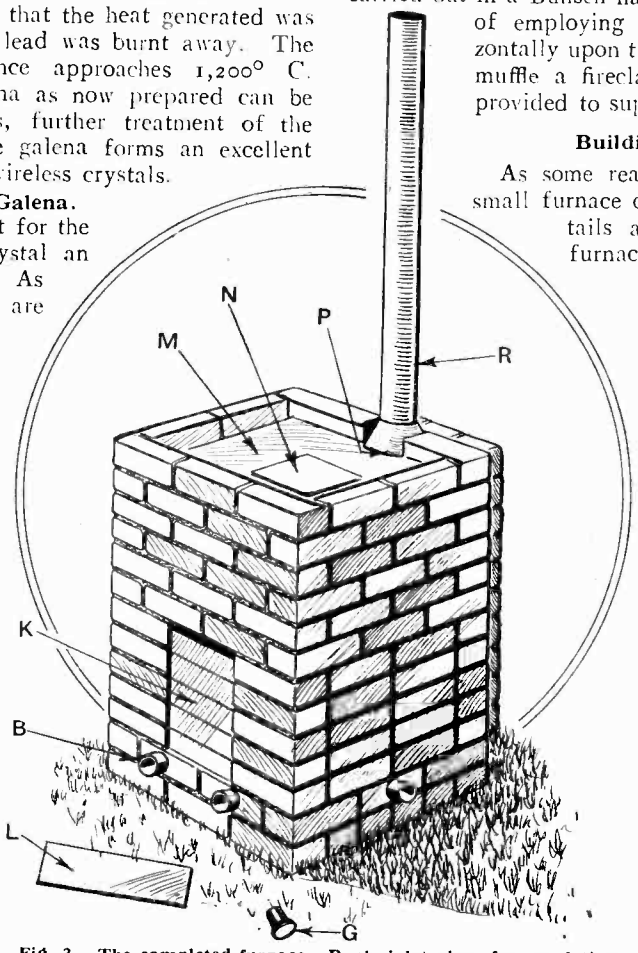

Fig. 3.—The completed furnace. B, air inlet pipes for regulating the fire with the use of the stoppers G. K, the five movable bricks forming the door to the furnace. L, Uralite sheet for sealing the door and kept in position by fireclay. M, Uralite cover plate. N, cover to fuel feed hole. P, semi-circular opening for chimney fixing. R, 6 ft. chimney of cast-iron pipe.

In use the charged crucible is brought to the desired temperature (deep orange, which is about 1,125° C.) and maintained at this temperature for a period of twenty to twenty-five minutes. The fire should be allowed to burn out before the crucible is removed. The D-shaped muffle may be used in a similar manner upon a smith's forge, being heated and timed as just described before allowing to cool. The crucible should be covered by pouring into the muffle dry powdered charcoal so as to prevent the crucible cooling too rapidly. With a small crucible, such as size "A" or "B," a smelt can be carried out in a Bunsen flame. A simple method consists of employing a D muffle supported horizontally upon two bricks. In the centre of the muffle a fireclay support about 1in. high is provided to support the crucible.

Building a Small Furnace.

As some readers may prefer to build the small furnace out-of-doors, constructional details are given of a portable assay furnace which has been used with considerable success for producing crystals. The following materials are required:—

150 common yellow bricks.

¾ cwt. fireclay.

A sheet of Uralite 18in. × 28in. × ⅜in.

6ft. of iron pipe to form the chimney.

Six pieces of iron gas-barrel each 6in. long × 1½in. diameter.

The materials are not expensive, and the furnace, if a muffle is included, may be used for other purposes. Constructional details are given in the accompanying diagrams, where the foundation is shown in detail. The bricks forming the foundation (Fig. 1) are laid flat and close together, and are not cemented in any way by the use of fireclay. In the centre the brick A (Fig. 2) is stood on end so as to protrude about 2in. above the level of the floor. If a muffle is to be used the projecting portion of the brick should be coated with paraffin wax.

Fireclay is prepared by working together one part with three parts of water, and should be as stiff as possible. A fireclay cone about 4in. in height and 6in. in diameter at the base and 2in. at the apex is built round the projecting brick. Two pieces of round wood ⅜in. in diameter are laid in the fireclay, and if coated with paraffin wax can be easily removed when the clay sets. It is for this purpose that the supporting brick is treated with wax, so as

[2] Reference should be made to the lists of chemical apparatus manufacturers for details of muffle and crucibles.

Making Synthetic Galena.—

to permit of the removal of the cone. The pieces of wood can, of course, be left in position, as they are soon burnt out, and the openings left assist in keeping the bottom of the crucible hot. The projecting brick, of course, keeps the cone in a firm position.

The six pieces of iron pipe are arranged in the first tier of brickwork as shown, and project about 1½in. outside the brickwork. The fireclay should be sifted before being mixed, and it is an advantage to soak the clay in water for two or three days before using it. By doing this the fireclay will give a more smooth finish, and to a certain extent prevent clinkers adhering to the walls. By means of fireclay stoppers the air supply can be regulated. All corners inside the furnace are rounded off with fireclay. Other constructional details can be seen in the accompanying illustration (Fig. 3).

By placing a brick in the back of the furnace a D-shaped muffle, size "J," can be introduced measuring 12in. long by 6in. wide by 4in. in height, and is capable of holding eight small crucibles. The best fuel is coke broken up into small pieces and used dry, or charcoal can be used. A pair of hand bellows will be useful to assist in lighting the furnace. The fuel is introduced through the feed hole in the top of the furnace. When the wood is well kindled replace the fireclay stoppers and introduce the coke, etc., moving the stoppers as necessary to regulate the air. When the coke is red-hot the crucible containing the charge may be placed in position on the cone either through the opening made by moving the loose bricks or with a pair of tongs through the fuel feed hole. The crucible should be well packed round with fuel and covered over to a height of 2in. or 3in. above the lid. By sliding the cover plate the ignition of the fuel can be checked, and if at any time one side is found to be turning dull attention should be given to the air regulating stopper or a few blasts may be given with the bellows through the air channel.

Crystal Formulæ.

The several formulæ given here for the production of synthetic crystals are all based upon the use of synthetic galena produced by the chemical combination already described. The galena should be broken up in an iron mortar, or it may be crushed to a powder[3] with a flat hammer upon an iron plate. The various dry chemicals should be well mixed together, and it is only by thoroughly mixing that the best results are obtained. In the formulæ the weight of sulphur given is for the amorphous variety powdered with pestle and mortar. Flowers of sulphur may be used in place of the amorphous sulphur, though it will be necessary to double the weights given. The proportions are given for a 7 lb. charge such as can be fused in a Morgan "G" size crucible, also for a small charge of 2 oz. such as can be contained in the No. 1 crucible and heated in the muffle.

When the charge is placed in the crucible it should be tamped down by gently tapping the sides and bottom of the crucible, and the lid should be luted on with a little moist fireclay. After a smelt it is most important that the crucible should be cooled as slowly as possible without disturbing the lid. The crucible may be left to cool in the furnace, and particularly is this desirable in the case of the 7 lb. charge. All the air inlets should be closed and the fire allowed to go out. If the crucible is removed while hot it should be placed as quickly as possible in an old iron pail half full of unslacked builders' lime and completely covered. The lid should not be removed until the crucible is perfectly cold.

FORMULA No. 1.

	7 lb. Charge. lb.	oz.	dr.	2 oz. Charge. oz.	drs.	gr.
Synthetic Lead Sulphide (PbS)	6	12	0	2	0	0
Silver Sulphide (Ag_2S)		1	3			9
Zinc Sulphide (ZnS)			8			2
Copper Sulphide (CuS)			10			2½
Mercury Sulphide (HgS)		1	0			4
Amorphous Sulphur			11			3

Temperature.—Deep Orange, about 1,125° C.
Time.—20 to 25 minutes.
Remarks.—When fractured should show very small crystals with bright faces. Use a soft catwhisker of gold or soft copper.

FORMULA No. 2.

	7 lb. Charge. lb.	oz.	dr.	2 oz. Charge. oz.	dr.	gr.
Synthetic Lead Sulphide (PbS)	6	12	0	2	0	0
Silver Sulphide (Ag_2S)		1	8			6
Copper Sulphide (CuS)			4			1
Mercury Sulphide (HgS)			10			2½
Nickel Oxide (NiO)			4			1
Cobalt Oxide (Co_3O_4)			8			2
Amorphous Sulphur			14			3½

Temperature.—Light Orange, about 1,150° C.
Time.—20 minutes.
Remarks.—When fractured small crystals incline to the cubic system. Use a catwhisker made of very fine soft iron which has been magnetised, or a nickel or silver catwhisker.

FORMULA No. 3.

	7 lb. Charge. lb.	oz.	dr.	2 oz. Charge. oz.	dr.	gr.
Synthetic Lead Sulphide (PbS)	6	11	8	2	0	0
Silver Sulphide (Ag_2S)		1	10			6½
Mercury Sulphide (HgS)		1	2			5
Uranium Black Oxide (U_2O_3)			12			3
Zinc Sulphide, Pure (ZnS)			8			2
Amorphous Sulphur			8			2

Temperature.—Bright Cherry Red, about 1,000° C.
Time.—20 minutes.
Remarks.—Crystal hard but very sensitive. Use with very fine wire catwhisker, three or four strands bunched together, of copper or silver. A light contact only is required.

FORMULA No. 4.

	7 lb. Charge. lb.	oz.	dr.	2 oz. Charge. oz.	dr.	gr.
Synthetic Lead Sulphide (PbS)	6	10	11	2	0	0
Silver Sulphide (Ag_2S)		1	4			5
Mercury Sulphide (HgS)		1	8			6
Zinc Sulphide (ZnS)			8			2
Lanthanum Oxide (La_2O_3)			4			1
Yttrium Oxide (Y_2O_3)			4			1
Praseodymium Oxide (Pr_2O_3)			2			0½
Amorphous Sulphur			8			2

Temperature.—Bright Cherry Red, about 1,000° C.
Time.—20 minutes.
Remarks.—Thoroughly mix the yttrium and praseodymium oxides before introducing the other compounds. Catwhisker of soft silver or gold.

[3] Powdered to pass through a 60-mesh sieve.

Making Synthetic Galena.—

FORMULA No. 5.

	7 lb. Charge. lb.	oz.	dr.	2 oz. Charge. oz.	dr.	gr.
Synthetic Lead Sulphide (PbS)	6	10	0	2	0	0
Silver Sulphide (Ag_2S)		1	10			6½
Mercury Sulphide (HgS)		1	4			5
Black Uranium Oxide (U_2O_5)		1	8			6
Thorium Dioxide (ThO_2)			8			2
Zinc Sulphide (ZnS)			8			2
Amorphous Sulphur			10			2½

Temperature.—Deep Orange, about 1,125° C.
Time.—20 to 25 minutes.
Remarks.—Thoroughly mix the silver sulphide with the uranium black oxide. Mix the thorium dioxide with the mercury sulphide and then grind altogether in a mortar. Catwhisker of fine tinsel copper, gold plated.

FORMULA No. 6.

	7 lb. Charge. lb.	oz.	dr.	2 oz. Charge. oz.	dr.	gr.
Synthetic Lead Sulphide (PbS)	6	10	3	2	0	0
Silver Sulphide (Ag_2S)		1	8			6
Mercury Sulphide (HgS)		1	6			5½
A: Thorium Dioxide (ThO_2)			5			1¼
A: Tellurium "Metal Crystals" (Tl_2O_3)			4			1
A: Uranium Black Oxide (U_2O_5)			9			2¼
A: Zinc Sulphide, Pure (ZnS)			6			1½
B: Lanthanum Oxide (LaO)			5			1¼
B: Yttrium (Y_2O_3)			5			1¼
B: Praseodymium Oxide (Pr_2O_3)			3			1
Amorphous Sulphur			10			3

Temperature.—Cherry Red, about 900° C.
Time.—30 minutes.
Remarks.—Thoroughly mix A and B separately. Place 8 drachms of mercury sulphide in bottom of the crucible for a 7 lb. charge. 3 grains extra for a 2 oz. charge. Catwhisker of four or five soft flexible strands of copper tinsel or fine silver wire.

FORMULA No. 7.

	7 lb. Charge. lb.	oz.	dr.	2 oz. Charge. oz.	dr.	gr.
Synthetic Lead Sulphide (PbS)	6	10	4	2	0	0
Silver Sulphide (Ag_2S)		2	0			8
Mercury Sulphide (HgS)		1	8			6
Cobalt Sulphide (CoS)			4			1
Nickel Sulphide (NiS)			8			2
Selenium Sulphide (Se_2S)			4			1
Zirconium Oxide (ZrO_2)			10			2½
Amorphous Sulphur			10			2½

Temperature.—Cherry Red, about 900° C.
Time.—45 minutes.
Remarks.—Place 8 drachms of the mercury sulphide in the bottom of the crucible. Mix the cobalt sulphide, nickel sulphide and selenium sulphide together, then add the mercury sulphide, followed by the zirconium oxide and blend altogether. Catwhisker, silver or fine gold.

FORMULA No. 8.

	7 lb. Charge. lb.	oz.	dr.	2 oz. Charge. oz.	dr.	gr.
A: Synthetic Lead Sulphide (PbS)	6	10	6	2	0	0
A: Silver Sulphide (Ag_2S)		1	15			8
A: Mercury Sulphide (HgS)		1	3			6
B: Uranium Black Oxide (U_2O_5)			8			2
B: Thorium Dioxide (ThO_2)			6			1½
B: Lanthanum Oxide (La_2O_3)			4			1
B: Yttrium Oxide (Y_2O_3)			4			1
B: Praseodymium Oxide (Pr_2O_3)			2			0½
C—Amorphous Sulphur		1	0			4

Temperature.—Cherry Red, about 900° C.
Time.—35 minutes.
Remarks.—Place 8 drachms of the mercury sulphide in bottom of the crucible. Well mix A and B separately, then mix A, B and C together. The praseodymium acts as an exciter of the phosphorescence of lanthanum and yttrium. Catwhisker of fine soft flex or copper tinsel, silver wire very fine, three or four strands.

New Marconiphone Catalogue.

An attractive art catalogue has recently been issued by the Marconiphone Co., Ltd., 210-212, Tottenham Court Road, London, W.1, covering in 72 pages the complete range of "Marconiphone" wireless apparatus. Among the noteworthy items in these pages must be mentioned the KLI transformer and power choke, the new potential divider and new "Marconiphone" valve switch. The catalogue incorporates a useful list of Marconi valves with prices and operating data.

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Burndept Portable Five.

On page 660 of our issue of May 25th the price of the Burndept Portable Five receiver was erroneously given as £30. The correct price of this instrument is 30 guineas.

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From America.

From Messrs. Claude Lyons, 76, Old Hall Street, Liverpool, sole concessionaires for Great Britain for General Radio Instruments of Cambridge, Mass., U.S.A., we have received numbers 10 and 11 of the *General Radio Experimenter*, a monthly publication, copies of which, we understand, can be forwarded to any reader making application to Messrs. Claude Lyons.

In dealing with the productions of the General Radio Factory this little periodical contains much useful information on recent technical developments in the United States. An interesting piece of apparatus dealt with is the type 388 Vacuum Tube Reactivator, an instrument for testing and restoring thoriated valves. The two methods of achieving this end, *viz.*, "flashing" and "cooking," are described.

TRADE NOTES.

HOW VALVES ARE MADE. At the recent opening of Whiteley's wireless department a successful demonstration was given of the manufacture of Osram valves stage by stage. The photograph shows how skilfully the exhibit was arranged in a comparatively small space.

H.T. FROM THE MAINS.

Some Notes on Mains Units and their Application to Receivers.

By H. L. KIRKE.

MUCH has been written on the subject of mains units for supplying H.T. and L.T. to broadcast receivers. There are many types on the market at the moment; some good, some poor. It is the purpose of this article to point out some of the pitfalls in the design of such apparatus. The article will be confined chiefly to apparatus for obtaining H.T supply.

One of the great advantages of obtaining H.T. from mains—in particular A.C. mains—is that fairly high voltages are obtainable by this method with little extra expense. The advantage of high H.T. voltage is that good volume is obtainable with freedom from distortion. That is to say, the valves—in particular the output stage—may be operated on the linear portion of their characteristics, even when using sufficiently high grid negative bias to prevent grid current with very loud signals. Despite this great advantage of the mains unit there are very few giving outputs greater than about 120 volts at 10-15 milliamps. One wonders why. Is it that the importance of high H.T. for good volume with good quality is forgotten, or is it that mains units have been designed simply to replace dry H.T. batteries where 120 volts was considered to be quite a high voltage.

Broadcasting loses much of its charm if the volume is insufficient, even if the quality is good. For reasonable volume in a medium-sized room at least 30 milliamps at about 200 volts is required; while really loud results require at least 50 milliamps at about 300 volts.

The Receiver.

The next point to be considered is for what type of receiver the unit is to be designed, and in turn for what loud-speaker the receiver has been designed. For instance, if the loud-speaker reproduced frequencies only down to 200 or 250 cycles, as some do, there is no object in designing a receiver which is efficient down to, say, 50 cycles or even 20 cycles. As will be seen later the type of loud-speaker and its method of connection to the receiver, as well as the receiver itself, all affect the design of the H.T. supply unit.

It frequently happens that when a mains unit is connected up to an ordinary receiver and loud-speaker only an unpleasant noise results. This noise is often referred to as "squeggering," or "motor-biking." This is due to low-frequency reaction introduced by the smoothing system of the H.T. unit, causing the whole L.F. portion of the receiver to oscillate at some low (audio) frequency which depends upon the constants of the whole circuit.

Fig. 1 shows the essential connections of a simple 3-valve receiver, consisting of a detector and two resistance-capacity-coupled L.F. amplifying stages, together with the connection of a normal H.T. mains unit.

A system containing condensers and inductance, such as shown in the smoothing system in Fig. 1, has an impedance which varies with frequency both in amplitude and phase. The circuit acts at frequencies above the resonant frequency as a condenser, at some frequencies below the resonant frequency as an inductance, and at the resonant frequency as a high resistance. Slightly above the resonant frequency the circuit acts as a high resistance in series with a small condenser, while slightly below the resonant frequency it acts as a high resistance and large inductance in series. In fact, it acts in a manner similar to a simple tuned anode circuit, except that it is less sharply tuned, due to the high resistance of the choke and the damping effect of the rectifier valves.

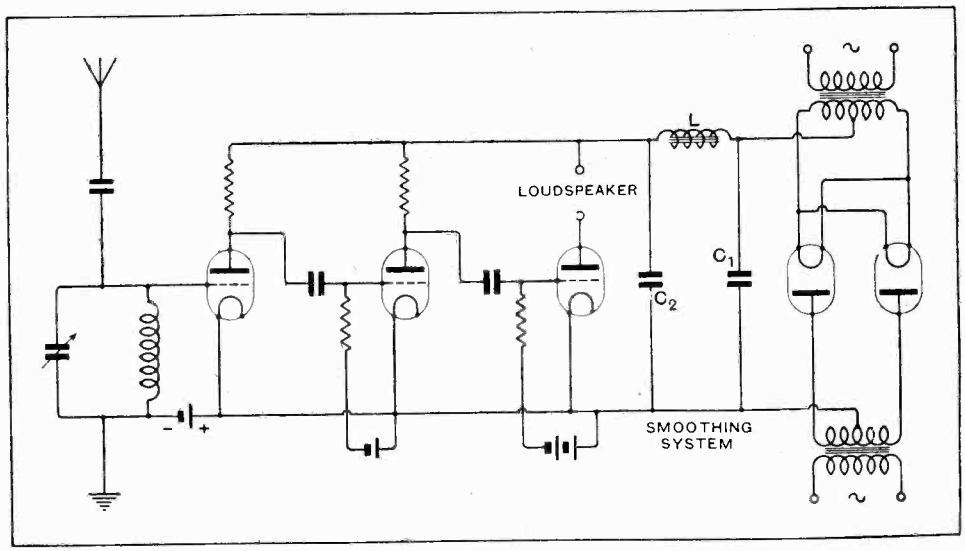


Fig. 1.—Simple 3-valve receiver with H.T. unit working from A.C. mains.

The natural frequency for such a circuit will be

$$f = \frac{1}{2\pi\sqrt{L\left(\frac{C_1C_2}{C_1 - C_2}\right)}}.$$

Neglect the resistance of the choke and the damping effect of the rectifying valves, and consider what happens when an alternating E.M.F. is passed through the receiving circuits. The action of the receiver under normal circumstances is well known and need not be described here.

Consider, therefore, that the E.M.F. has arrived at

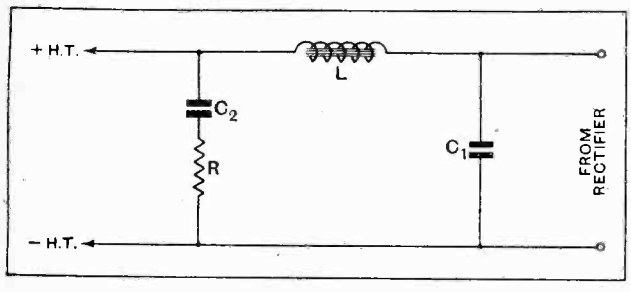
H.T. from the Mains.—

the grid of the last valve; the changes of grid potential will cause changes of anode current The magnitude and phase of the changes will depend upon (a) the valve internal resistance, (b) the impedance normally in the output circuit, such as the loud-speaker, L.F. choke, etc., and (c) the impedance of the smoothing system.

There will be a certain back E.M.F. across the smoothing system due to the alternating current through it; the magnitude of this back E.M.F. will be I Z where I is the current and Z the impedance of smoothing system.

There is, therefore, instead of a steady high-tension supply, one which is modulated or varying at the frequency of the magnified impulses in the receiver. This varying H.T. supply causes the anode current in the first valve to vary in magnitude. Part of the variation will occur across the anode resistance and the remainder across the valve Any changes of potential at the anode of the first valve will be applied through the intervalve condenser to the grid of the next valve, and will be magnified by the remainder of the system, adding to or subtracting from the original impulse according to the phase angle. If the secondary impulse happens to be as large as the original impulse would have been had there been no secondary impulse, and of the same phase, the whole system can oscillate at that frequency. It frequently does.

How can this be prevented? There are various methods; one frequently adopted is to reduce the value of the intervalve condenser, so reducing the magnification of the amplifier at low frequencies until the amplification is sufficiently low to prevent oscillation. This method is cowardly and robs a resistance-capacity amplifier of one of its most important features, *i.e.*, its ability to amplify (if properly designed) very low frequencies equally with the high. A second method is to reduce the value of grid leak or increase the value of anode resistance in the first interstage circuit, the latter method being usually more effective. The effect is to alter the ratio of P.D. across the valve to that across the anode resistance, so reducing the value of P D. applied to the second grid.



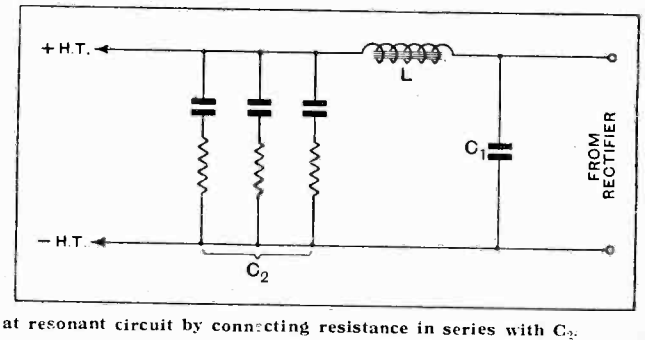


Fig. 2 and Fig. 3.—Reducing impedance of smoothing circuit at resonant circuit by connecting resistance in series with C_2.

The more scientific method is to alter the smoothing system by increasing C_2, C_1 and/or L until its impedance is so low that there is very little back E.M.F. across it.

The effective capacity of the system at frequencies well above the natural or resonant frequency will be very nearly the capacity of C_2. At frequencies just above the resonant frequency the effect of the remainder of the circuit (*i.e.*, C_1 and L) will be to decrease the effective capacity of the system. Increasing C_2 will therefore decrease the impedance at frequencies above the resonant frequency and also tend to reduce the impedance at the resonant frequency. Increasing C_2, C_1 and/or L will decrease the resonant frequency and so lower the impedance at what was the resonant frequency.

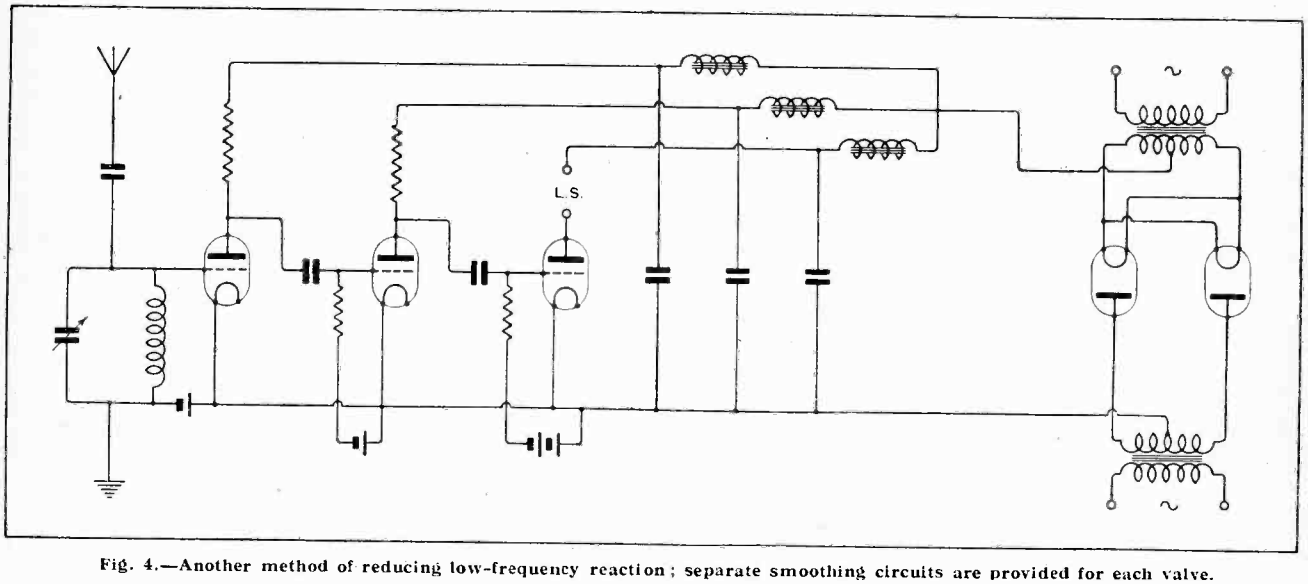


Fig. 4.—Another method of reducing low-frequency reaction; separate smoothing circuits are provided for each valve.

H.T. from the Mains.—

It is frequently found that, however much C_2, C_1 and L are increased (within practical limits), the receiver still continues to oscillate, but at a lower frequency, this is particularly true of a good resistance-capacity amplifier. This is because the impedance of the smoothing system is always high round about the resonant frequency, the increase of C_2, C_1 and L causing a lowering of the resonant frequency.

The impedance at the resonant frequency can be reduced by inserting resistance in series with C_2 or by dividing C_2 into several parallel paths and connecting various values of resistance in the various condensers, as shown in Figs. 2 and 3.

The decrease in impedance at the resonant frequency is usually at the expense of an increase of impedance at higher frequencies. It is possible, however, to make a compromise.

A further method of tackling the problem is to use separate smoothing systems for the various valves. This is not so expensive as it may seem. High resistance is of very little consequence in the smoothing circuits for the resistance-capacity valve, as the current is

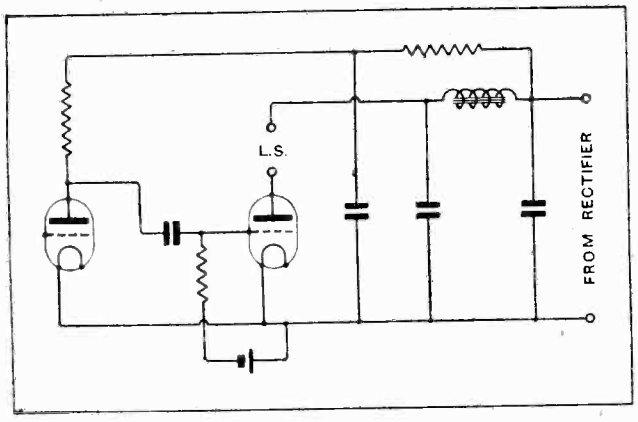


Fig. 5.—Resistance-capacity smoothing system for use when a reduction in H.T. voltage is required.

so small. Very high inductance chokes can therefore be used with smaller condensers. The circuit is shown in Fig. 4. It is not, however, always necessary to use separate smoothing for each stage. Where the H.T. to a particular valve can be considerably less than the maximum H.T. a resistance-capacity smoothing system may be used. This is shown in Fig. 5.

Some smoothing systems consist of more than one section, *i.e.*, three or more condensers and two or more chokes, as in Fig. 6. While the smoothing for a given total capacity and inductance may be greater than for a single circuit, as shown in Fig. 1, the circuit has more than one natural frequency, and the natural frequency will be higher due to the reduction in inductance and capacity per stage. This means that for given values of intervalve condenser, anode resistance and grid leak, etc., the circuit is more liable to self-oscillate with a multi-stage filter, due to the increased impedance and higher resonant frequencies.

Reference was made in the beginning of this article to the method of connection of the loud-speaker to the receiver and its bearing on the working of the receiver with a mains unit. The effect is as follows:—The amount of reaction is proportional to the alternating current from the last valve which flows through the smoothing system for a given grid voltage. This current depends, as stated above, upon the internal resistance

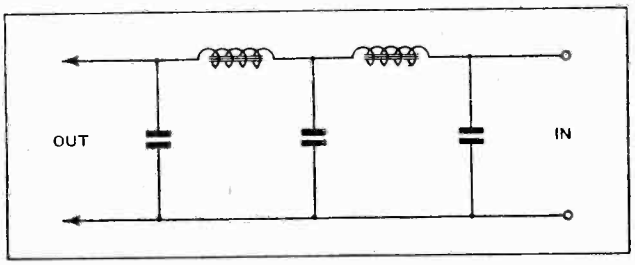


Fig. 6.—Multiple-circuit smoothing system.

of the valve, the loud-speaker impedance, and the smoothing system impedance. Therefore, if we increase the loud-speaker impedance we shall reduce this reaction effect. This method, however, is not efficient, as there is an optimum loud-speaker impedance for maximum efficiency.

A method of connection commonly known as parallel or choke feeding may be employed. This is efficient as far as the set and loud-speaker is concerned, and has the effect of reducing the reaction effect considerably. The connections are shown in Figs. 7 and 8; Fig. 7 showing how the circuit may be used when the loud-speaker impedance is correct for the valve; Fig. 8 where a transformer must be used to change the effective impedance of the loud-speaker to suit the valve. It is important that the loud-speaker or transformer should be connected as shown and not between the blocking condenser and + H.T., as is frequently done.

In both these cases the current which actuates the loud-speaker flows through the blocking condenser and loud-speaker to earth, while only a small portion of the current flows through the choke, smoothing system, etc. This latter current may be made as small as desired by increasing the inductance of the choke. The maximum value of inductance of the choke is limited by its resistance, which if too high will considerably reduce the H.T. at the anode of the last valve and thus reduce efficiency.

The value of condenser C_3 depends upon three points, viz., the impedance of the loud-speaker or output circuit, the valve internal impedance, and the lowest frequency it is desired to reproduce. As a rough guide 2 mfds. per 6,000 ohms is about right, the increase of capacity being proportional to the decrease in valve internal resistance.

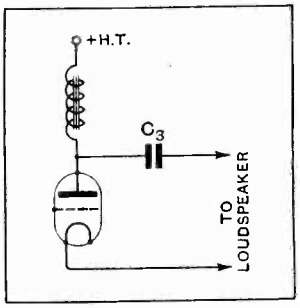


Fig. 7.—Choke-capacity output circuit for use when the loud-speaker impedance is suited to the valve.

It is generally found that with a good receiver the values of smoothing condenser and inductance required to prevent self-oscillation at audio-frequency are usually sufficient to provide good smoothing.

H.T. from the Mains.—

It is sometimes found in such systems that, however much smoothing is used, a certain amount of hum remains. This residual hum may be due to causes other than lack of smoothing. One of these causes is rather peculiar.

Referring to Fig 1 it will be seen that there is a path for a high-frequency alternating current from the earth terminal of the set to – H.T. and thence *via* condenser C_1. the rectifying valves, the capacity between windings of the power transformer to the mains, and *via* the capacity of the mains to earth. If the earth lead is not very short or the earth not good, the earth terminal will not be actually at earth potential, *i.e.*, there will be a difference of potential between the earth terminal and earth proper; this difference of potential will cause a current to flow through the above-mentioned path to earth. This path is intermittent, as rectifying valves are only conductive during part of the L.F. cycle; therefore, H.F.

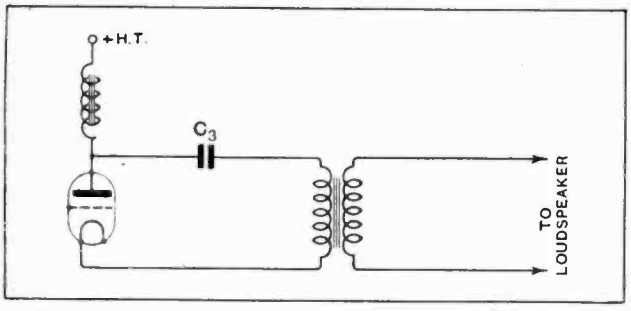


Fig. 8.—Combined choke-capacity and transformer output circuit for use with low-impedance loud-speakers.

current can only flow during this portion of the L.F. cycle, with the result that the current is intermittent. We thus have part of the carrier current in the aerial going to earth *via* the earth lead, and part *via* a circuit which is intermittently conductive. This results in the aerial current being modulated at the frequency or double the frequency of the supply, according as to whether single- or double-wave rectification is used.

This effect may be reduced to a negligible amount by inserting H.F. chokes in the rectifier system as shown in Fig. 9.

Effect of Various Types of Inter-stage Coupling.

So far we have considered merely the simple case of resistance-capacity coupled receivers. While most of the remarks above regarding the design of mains units apply when various types of receivers are used, the type of receiver has considerable bearing upon its working with a mains unit.

It is well known that a high-magnification L.F. amplifier will not work with a high-resistance H.T. battery. The same applies to mains units; a mains unit can be considered as a high-resistance battery shunted by a condenser, except at its resonant frequency. If, for instance, choke-capacity coupling is used, we have the circuit in Fig. 10. It is well known that the impedance of a choke is proportional to frequency. For the sake of simplicity in Fig. 10 consider that the grid leak resistance R is high compared with the resistance of the valve V_1.

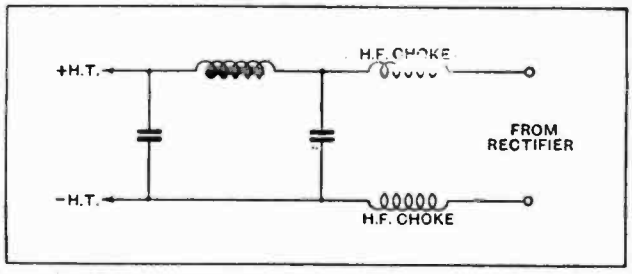


Fig. 9.—Chokes inserted in supply leads to keep H.F. off the rectifying valves.

If we apply an alternating E.M.F. across *a*, *b*, Fig. 10, a current will flow through L_2 and V_1. At very low frequencies the impedance of the choke will be negligible, and therefore the main P.D. will be applied in effect across *c* and *a*, there being no drop of potential across the choke L_2. In the circuit considered in Fig. 1 there was a considerable drop of A.C. voltage in the anode resistance, thereby reducing the voltage across the first valve, as it is this voltage that is magnified and causes reaction. It will be seen that the circuit shown in Fig. 10 will be more liable to oscillate than the circuit in Fig. 1.

The above is not strictly true, but illustrates the general principle that choke coupling is more liable to give trouble than resistance coupling. Here again, however, it is possible to use a separate smoothing system for the first valve. With transformer coupling the case is again different in that the reaction effect of a receiver depends upon the P.D. developed across the primary of the first transformer and the frequency characteristic of the remainder of the amplifier. The amount of reaction in the amplifier will decrease as the resistance of the first valve is increased, as this increase of resistance will decrease

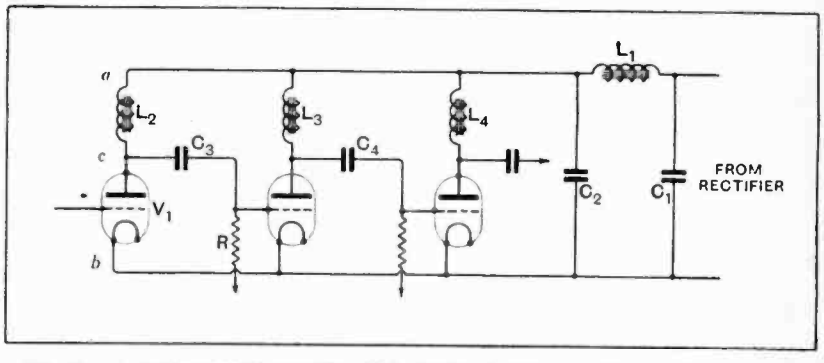


Fig. 10.—A choke-coupled amplifier with single-circuit smoothing system is more subject to L.F. reaction than a resistance-capacity amplifier operating under the same conditions.

the alternating current through the primary of the transformer, due to the back E.M.F. across the smoothing system.

The reversal of the transformer connections will reverse the phase of the reaction, and may in some cases stop

H.T. from the Mains.—

the oscillation; but what generally happens is that the frequency of the oscillation changes to one which suits the new arrangement.

In general, however, with the high voltages obtainable from mains units, very little advantage can be gained by using transformer coupling, as reasonably high magnification consistent with good frequency characteristics can be obtained from resistance or choke-capacity coupling.

A point which must be borne in mind in direct-coupled amplifiers such as resistance or choke coupling (particularly the former) is that the phase of the reaction effect changes 180 degrees for each valve. It is, therefore, possible that, by adding a stage of magnification, the reaction may be reduced. This is only true when the phase angle of the smoothing system does not change with frequency, and is nearly zero.

In practice, however, the phase angle at frequencies above resonance is nearly − 90°. The angle of reaction will vary, therefore, between − 90° and + 90° nearly, unless the smoothing circuit is designed so that the phase angle is nearly zero for all frequencies that matter. Most of the above remarks apply (in particular the use of H.F. chokes) to smoothing systems for D.C. mains H.T.

SOLAR ECLIPSE TESTS.

Short-wave Transmissions by the Radio Society of Great Britain.

IT is thought that many experimenters would like to participate in the tests which have been organised by the R.S.G.B. This Society is confining its attention to the shorter wavelengths, and arrangements have been made for stations using wavelengths as indicated to transmit signals on June 27th, 28th, 29th, 30th, and July 1st, commencing each day at 5.40 a.m. B.S.T., and closing down at 6.40 a.m. B.S.T.

G5YG (Glasgow)	100 metres;	steady unmodulated carrier wave.
G2NM (Surrey)	90 metres;	ditto
G2WJ (Palmers Green, N.)	46 metres;	C. W. Morse code words.
G6WW (Leicester).....	44 metres;	ditto
G2OD (Gerrard's Cross) ...	32 metres;	ditto
G6IZ (Aberdeen)	23 metres;	ditto

The following scheme has been devised in order to ensure that all stations receive a certain amount of attention from listeners and others interested. A map which shows your nearest town or village is obtained, and then upon a piece of tracing paper or tissue paper a circle divided into six equal segments is drawn as shown in the sketch. It will be noted that each segment forms an angle of 60°, which can be marked out from a protractor or by means of a pair of compasses. The drawing is now placed over the map so that the line ZZ intersects Borth (Cardigan Bay) and Birmingham and so that the point A comes immediately over Birmingham. From the following table the station to observe is selected :—

Sector No.	Station Wavelength.	Sector No.	Station Wavelength.
S1	23 or 90	N1	23 or 90
S2	44 or 100	N2	44 or 100
S3	46 or 32	N3	46 or 32

Will any R.S.G.B. members who have received the "T. and R. Bulletin" kindly note that the wavelengths of sectors S_3 and N_3 have been altered as shown above.

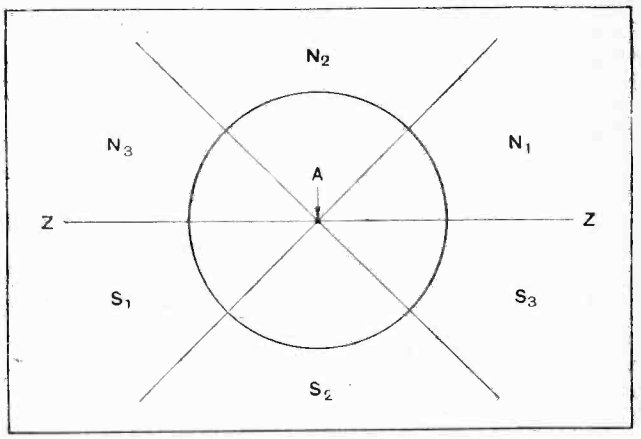
Members of the general public taking part in the tests should insert at the head of the report their sector number, county, town and street, and house number in that order from top to bottom, and the report is best prepared on a sheet of paper squared in tenths. Any phenomena occurring during the tests should be noted as nearly as possible to the nearest five seconds, and in this connection the time signals being transmitted by the B.B.C. will be of great assistance in correcting timepieces.

Following the transmission of the station call signs for five minutes the Morse signals should be noted, and if there is any doubt a blank should be indicated.

Abbreviations have been prepared for use on the log sheets, and these are as follow :—

S.—Statics.
S.E.S.—Statics extra strong.
F.—Fading.
I.S.—Increase in signal strength.
G.I.S.—Great increase in signal strength.
S.G.—Great interference by statics.
D.—Distortion.
S.I.—Interference by other stations (here also state call of interfering station if possible.)

All reports and log sheets should be forwarded to the Hon. Organiser, Solar Eclipse Tests, Radio Society of Great Britain, 53, Victoria Street, London, S.W.1, after the tests, and any deductions or theories formed as a result of the observations will in due course be communicated to the technical Press by the Society. Readers should note that any information apart from that specified above should be sent on separate sheets of paper, and not included in the daily log sheet of the receiving station.



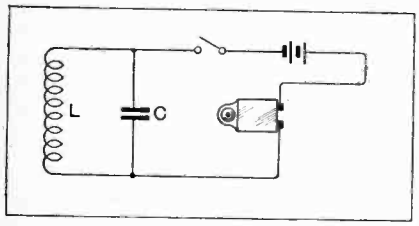
This diagram should be redrawn on tracing paper and used according to instructions to indicate the stations to be observed.

READERS' NOVELTIES

A Section Devoted to New Ideas and Practical Devices.

BELL CIRCUIT.

When the loud-speaker is working on full volume on the local station difficulty may be experienced in hearing the electric house-bell. Sometimes when the bell wiring runs parallel to loud-speaker leads the electrical disturbance due to the bell may be heard in the loud-speaker. Extending this idea one can make certain of always hearing the bell in the loud-speaker by connecting in the bell wiring a circuit LC tuned to the wavelength of the local station. When energised by the bell, this circuit will radiate in the same manner as a buzzer wavemeter and will effect the aerial circuit of the receiver so that the vibration of the bell will be reproduced in the loud-speaker. The



Tuned circuit for making house-bell audible in loud-speaker.

tuned circuit may be introduced at any point in the circuit, preferably near the receiving room or aerial lead-in. H. J. S.

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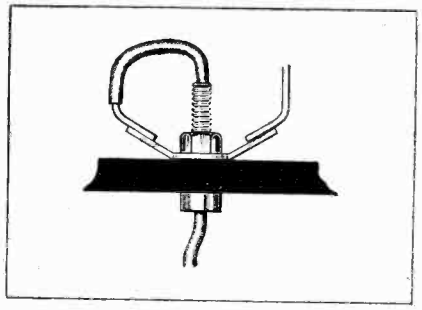
BATTERY LEADS.

A convenient method of anchoring battery leads when it is desired to dispense with terminal panels is shown in the diagram. "Clix" or similar sockets are fitted to the panel or the back of the cabinet. Both the battery leads and the internal connections to the set are soldered to tags at the back of the socket, while the battery lead itself is brought out through the socket. The mouth of



A neat method of terminating battery leads.

the socket is usually bevelled or rounded which prevents fraying of the insulation. F. P.

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NEUTRALISING "THE WIRELESS WORLD FIVE."

The trouble of taking off the back of the copper screen, disconnecting the H.T. leads and resoldering when neutralising this receiver may be obviated by including two flash-lamp adaptors and bulbs in the H.T. leads to the set.

When the set has been tuned to the local station the bulb in the first high-frequency transformer lead is unscrewed, thus breaking the H.T. current, and the neutralising condenser adjusted until the signals from the local station are at a minimum. The bulb is then replaced and the process repeated for the second H.F. stage.

In addition to providing a convenient method of breaking the H.T. circuits the bulbs also act as a protective fuse and may be fitted with advantage to the detector and L.F. valves. For convenience the adaptors should be mounted outside the screen, but in all cases they should be connected in circuit on the battery side of the Mansbridge by-pass condensers. A. R.

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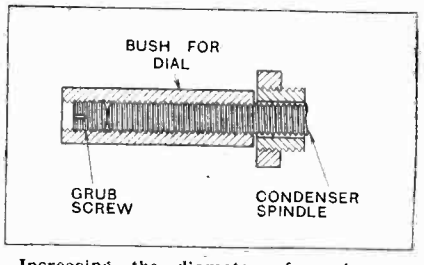
CONDENSER SPINDLE.

The sectional drawing shows an excellent method of increasing the diameter of obsolete condenser spindles for use with modern slow-motion dials. Most of these old condensers were provided with spindles



Increasing the diameter of condenser spindle to fit modern slow-motion dials.

consisting of a length of 2B.A. rod, whereas plain ¼in. spindles are standard on modern condensers.

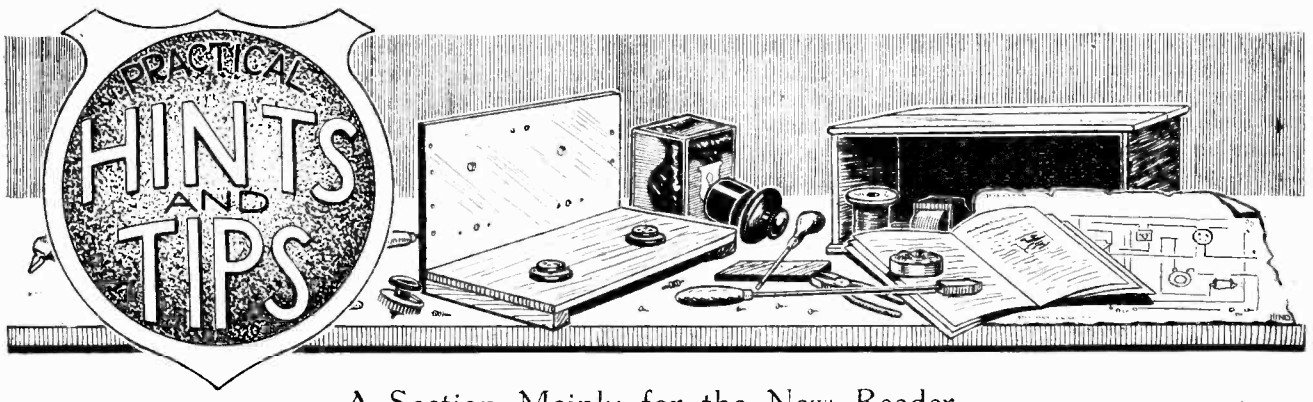
A length of ¼in. brass rod is drilled throughout its length, preferably in the lathe, and tapped 2B.A. To fix this bush on the spindle use is made of a small internal grub screw driven down inside the bush on to the head of the condenser spindle.

F. J. W. T.

VALVES FOR IDEAS.

Readers are invited to submit brief details, with rough sketches, where necessary, of devices of experimental interest for inclusion in this section. A dull emitter receiving valve will be despatched to every reader whose idea is accepted for publication.

Letters should be addressed to the Editor, "Wireless World and Radio Review," Dorset House, Tudor St., London, E.C.4, and marked "Ideas."



A Section Mainly for the New Reader.

ARTIFICIAL RESISTANCE.

IT may not be generally realised that the method of testing the effectiveness of an H.F. transformer by the insertion of an artificial resistance, as advocated in these notes in last week's issue, may be applied to the "Everyman-Four" receiver without the necessity for altering any connections. A consideration of the circuit diagram will show that a loading coil socket is inserted in series with the tuned H.F. transformer secondary. If the coil is replaced by a plug, the terminals of which are joined together by a loop of fine resistance wire, the conditions necessary for a test will be realised when the short-circuiting switch, primarily intended for the long-wave changeover, is "opened."

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EXPERIMENTAL SET CONSTRUCTION.

THE majority of wireless components are intended to be permanently mounted on a panel or baseboard, and it is always a matter of some little difficulty to arrange them conveniently when connecting up a temporary receiver, either for experimental purposes or for testing some new circuit. Variable condensers are probably responsible for the greater part of the trouble; even if a rigid support is devised, noises are likely to develop in a few days' time, due to the accumulation of dust between the vanes.

Those who undertake the construction of receivers in the manner under discussion will find that it is an excellent plan to mount two or three spare variable condensers in stout wooden boxes, fitted with an ebonite front panel and terminals. These containers will serve not only to prevent damage to the instruments themselves but will also act as a support for the other components, which may be mounted on the top, or even on the back, and sometimes on one or both of the sides. When the circuit calls for two or more condensers the boxes may be placed side by side, a baseboard of suitable size being screwed to their upper surfaces. This gives solidity to the whole arrangement, and the edge of the board serves as a point of attachment for terminal strips and small pieces of ebonite carrying such components as filament rheostats, etc. If necessary, the baseboard may be of such a size that it overhangs the condenser boxes both at the back and sides, thus giving ample space for the mounting of a large number of components.

If all the parts are secured to the removable base it is possible to detach it without disturbing the wiring, except, of course, that joined to the condensers, and to use the latter for other purposes, reverting to the original circuit at short notice.

The use of screening, which is so necessary in many modern H.F. amplifying circuits, is not precluded, as metal sheets may be introduced between containers. It has been found when connecting up receivers of this kind that it is most convenient to screw each container (with perhaps an inch or so of spacing between adjacent ones) to a wooden strip running along the back. The H.F. valve holder, together with its coupling device, is then mounted on the top of the associated tuning condenser.

The boxes may conveniently measure about 5in. by 5in. by 6in. in depth, and should be made of wood at least ⅜in. or, better, ½in. in thickness. These dimensions represent the minimum size recommended. There is no real reason why the boxes should not be larger, and indeed a slight increase is sometimes necessary to give a clearance for the vanes of certain S.L.F. condensers, which generally occupy a good deal of space when the condenser is in the middle of its scale.

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A SOLDERING TIP.

WHEN soldered joints are made in a wireless set with everything *in situ* it is often difficult to prevent the flux becoming spluttered on to the panel or surrounding components. Killed spirits may be the worst offender in this respect, but even the so-called non-corrosive fluxes are apt to wander into places where it is undesirable. Even if this does not give rise to noisy operation in the finished set it looks very bad. A cleaner way of doing the job is to tin each component separately at the points where the soldered connections are to be made before the final assembly is carried out. All traces of superfluous flux are cleaned off and the components assembled in their various positions. A touch with a clean soldering iron then serves to sweat the various joints together effectively. This procedure has the advantage that one can use one's favourite flux and hold each component in the most convenient position to ensure thorough tinning, instead of having to do the most critical part of the soldering in awkward positions amongst the components of an assembled set.

VALVE INSULATION.

WHEN searching for the leakages which are often responsible for poor H.F. amplification and flat tuning, the possibility of faulty insulation in the valves themselves should not be overlooked, and it is advisable to test (by means of phones and a dry battery, if no more exact method is available) between plate and filament, grid and filament, and grid and plate.

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A LOCAL STATION RECEIVER.

IT has been suggested from time to time in this journal that the simple arrangement of an anode rectifying detector valve followed by a single resistance-coupled low-frequency amplifier makes a perfectly adequate receiver for loud-speaker reception up to distances of five or even ten miles from a main station. It is essential, however, that the detector valve should be of the "high-magnification" type, and, moreover, that a considerable high-frequency voltage should be applied to its grid. Even in the immediate vicinity of a transmitter, this latter condition may not obtain unless the aerial-earth system is moderately effective.

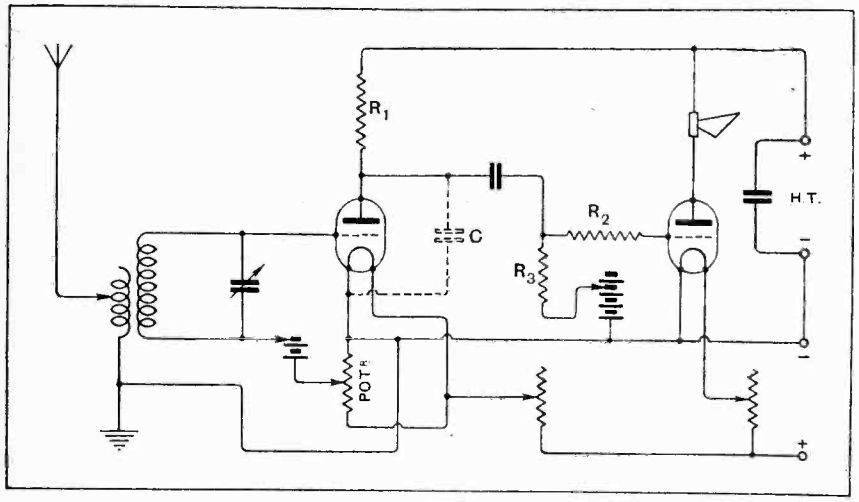

Fig. 2.—A detector-L.F. combination with resistance capacity coupling and "untuned" aerial-grid transformer.

A simple receiver of this description has so many advantages that a hint as to possible methods of improving its sensitivity and range may be of interest. It is generally recommended that, to avoid complications, a direct-coupled aerial circuit should be used, and a set on these lines was described with constructional details in *The Wireless World* for October 27th, 1926. It should be pointed out, however, that the average aerial, particularly of the kind which, of necessity, is generally erected in a town, has a very considerable H.F. resistance, and that the easiest way of compensating for the reduction in signal strength caused by this resistance is to fit an "untuned" aerial coupler. It is no exaggeration to say that under certain conditions the apparent loudness of signals will be almost doubled by this change, while in the great majority of cases a very appreciable gain will result. The circuit diagram of a complete receiver of this type is given in Fig. 2.

This is one of the cases where the good effects of a highly efficient coil will be felt, and it is recommended that an aerial-grid transformer of the design included in the "Everyman Four" receiver (and in several others recently described in this journal) should be used. The anode resistance R_1 and the grid leak R_3 will have conventional values suitable for the comparatively high impedance of the valve with which the former will be associated, while a damping resistance R_2 of about 0.25 megohm, may be inserted as shown. An anode by-pass condenser, generally of not more than 0.0001 mfd. capacity, is as a rule desirable; it should be connected as shown in dotted lines.

As a refinement, a grid potentiometer may be provided; many of the modern valves require for best detection a more accurate adjustment of voltage than that provided by a tapped bias battery. In point of fact, the majority of them operate best at, very roughly, two volts negative. This means that two dry cells should be used, the excess negative voltage being offset by moving the potentiometer slider towards the positive end of the winding.

Finally, it should be pointed out that the substitution of a coupled aerial circuit for a direct connection is *least* likely to result in an appreciable gain when the aerial is excessively short.

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SWITCHING OFF THE H.T.

PROVIDED that the insulation of a receiver is as good as it should be, there is no real need to disconnect or switch off the high-tension battery when "closing down." As soon as the filaments of the valves become cold, the current flow from this battery will cease entirely, unless there is leakage across its terminals.

In spite of this, however, there may be cases where it is desirable, as a safety measure, to arrange for complete disconnection of the high-tension battery, and the most certain way of doing so is provided by the insertion of a switch in each positive lead. Alternatively, a single-pole switch may be inserted in the lead joining H.T. − to L.T. −, although it should be realised that this plan will not preclude the possibility of short-circuiting sections of the battery between any alternative tappings which may be connected up.

It is sometimes recommended that a multi-pole switch should be fitted in order to switch off both batteries, but if this arrangement is adopted the switch should, strictly speaking, be of special construction, its contacts being arranged in such a way that the H.T. circuits are completed *before* the filaments are lighted, and broken *after* they are extinguished. In other words, the anode circuits should not be interrupted while the filaments are glowing.

From the foregoing it will be seen that the switching on or off of the high-tension battery is not altogether a simple matter, and probably the best advice to the average wireless user is that this battery should be permanently in circuit, being disconnected only when the receiver is to be out of use for a prolonged period.

THE CHOICE OF A CIRCUIT.

ALTHOUGH the construction of a receiver, including a single stage of high-frequency amplification, does not present any very great difficulty, due largely to the fact that the windings of up-to-date transformers are arranged so that a "balance" may easily be obtained, the less experienced amateur should be warned that a "two-H.F." set is a much more ambitious project, and that the chances of complete success are remote unless a good tested design is followed implicitly.

It is certain that an efficient single stage will give more satisfaction than two stages which are not working properly, and, moreover, under good receiving conditions, it is probable that one high-frequency amplifier (always provided that it is effective) will give sufficient magnification of any signal to which it is worth while listening. This does not apply, however, when local receiving conditions are bad—perhaps due to the use of a poor aerial-earth system—or when high selectivity is necessary to eliminate a powerful near-by transmitter.

It may be added that there are comparatively rare occasions when a set of almost unlimited sensitivity may be used with advantage from the point of view of long-range reception, even under the almost ideal conditions which sometimes obtain in country districts. Such circumstances are likely to arise when the waveband on which it is desired to receive happens to be particularly free of interference and "mush" and when atmospherics are absent. This is because the ratio of signal strength—even when amplified enormously—to extraneous noises will be good.

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ELECTROLYTIC RECTIFIERS.

THOSE who work with aluminium electrolytic rectifiers for H.T. supply are often troubled with excessive corrosion of the aluminium electrodes at the point where they enter the solution. This may be avoided by making the aluminium electrodes of round rod and fitting them with a tight sleeving of rubber tubing where they enter the solution. This rubber tubing should extend at least an inch above and below the surface of the solution. When rubber tubing is thus used it is not practical to use a layer of oil as is sometimes suggested, as oil ruins rubber after a short time.

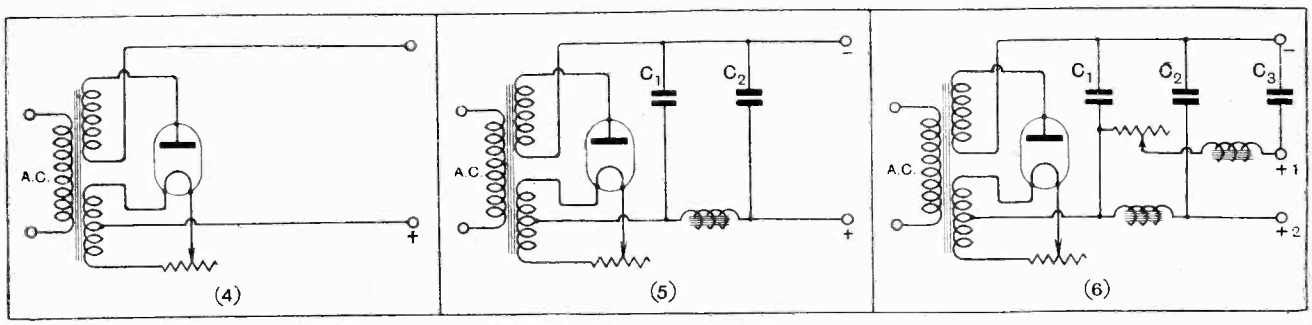
DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 73 (a).—An A.C. High-tension Battery Eliminator.

(Concluded from last week's issue.)

The present series of diagrams is intended to show progressively, and in an easily understandable manner, the various points to which special attention should be paid in the design of typical wireless instruments, and at the same time to assist the beginner in mastering the art of reading circuit diagrams. The eliminator shown below uses half-wave rectification, and is probably the simplest arrangement likely to give satisfactory results.



The positive output connection is taken from the centre tap of the filament-lighting winding.

A smoothing choke is inserted in the positive output lead, and two large "reservoir" condensers are added.

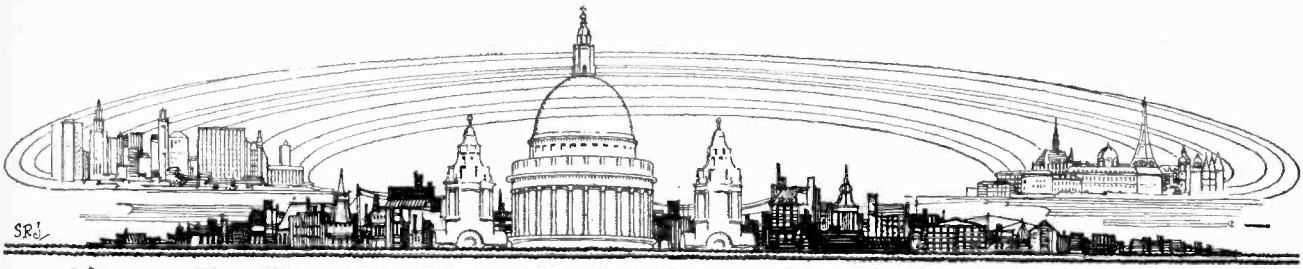
A lower voltage (+1) output is obtained by inserting a series resistance and another smoothing system.

THE smoothing choke in the high-voltage output lead should have an inductance of at least 30 henries—preferably more—and an ample current-carrying capacity. This latter will depend entirely on the consumption of the set. Two chokes may be connected in series if necessary, and it should be remembered that they should have a reasonably low D.C. resistance.

It is hardly possible for the smoothing condensers to be too large, but, in the interests of economy, a capacity of as little as 2 mfds. may be tried for C_1, C_2 and C_3 should be of 4 or 5 mfds.

The choke in series with the low-voltage output terminal (+1) should be of high inductance. This terminal will presumably feed the valves consuming only a small current, so a fairly large D.C. resistance and a low saturation current value are permissible. An inductance value of 100 henries is suggested.

The series resistance should have a current-carrying capacity of two or three milliamperes and a maximum value of about 100,000 ohms. A wire-wound resistor with some five or ten tappings is suitable. It is impossible to give an even approximate idea of the actual proportion of the total resistance required in circuit for a given voltage without knowing the current which will be consumed. The tapping point is best determined by trial and error.



CURRENT TOPICS

Events of the Week in Brief Review.

SCHOOL WIRELESS.

Over 3,000 schools now receive the B.B.C. lectures from London and Daventry. Of these schools 372 came on the register during the last term.

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IN FRANCE, TOO!

Wireless amateurs in the south-west of France are complaining bitterly of interference to broadcast transmissions by the Government high-power station at Croix-d'Hins, near Bordeaux.

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EXIT THE S.A. PIRATE?

In South Africa, which recently appeared to hold the world's record in the matter of wireless "pirates," the number of licensees is increasing. According to the latest census, licences are held by 13,093 people.

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SIGNALS AND THE ECLIPSE.

A specially designed log sheet for registering signals received during the eclipse on June 29th has been issued by the Radio Association. Copies are obtainable from the hon. secretary, Mr. S. Landman, M.A., 22 and 23, Laurence Pountney Lane, London, E.C.4.

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TRACKING A MOBILE TRANSMITTER.

A direction-finding test with the object of plotting the route taken by a mobile transmitter is to be carried out on Sunday next, June 26th, by the Leeds Radio Society in conjunction with the Sheffield Society. The experiments will be conducted within a radius of ten miles from Penistone.

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NATIONAL BROADCASTING IN BELGIUM.

A national broadcasting company, State-owned to the extent of 60 per cent. of its capital, is the latest proposal in connection with Belgian broadcasting. The scheme provides for a board consisting of eleven members, the chairman and five other members to be appointed by the Minister of Posts and Telegraphs and the remainder to be appointed by general meeting.

The company would be granted authority to continue for ten years with the right of extension for another five years.

WIRELESS GEOGRAPHY.

"This station is in Moscow, now a part of Poland . . . it manages to get across in good volume."—*Northern Echo.*

And it seems to have taken Moscow with it!

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RADIO SOCIETY OF GREAT BRITAIN.

"Fading in Radio" is the title of a lecture to be delivered by Mr. H. A. P. Littledale, F.R.Met.Soc., at this evening's (Wednesday) meeting of the Radio Society of Great Britain at the Institution of Electrical Engineers, Savoy Place, W.C.2. This meeting will be the last of the present session.

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"ALL WELSH" STATION.

A resolution asking for the erection of an "all Welsh" broadcasting station was passed at the conference of the National Union of Welsh Societies held recently at Oswestry.

TELEVISION IN FRANCE.

France has come into line with other nations by duly producing her inventor of television. He is M. Valensi, chief engineer of the French Post Office. M. Valensi makes use of the cathode ray in his experiments.

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NEW MARCONI OFFICE.

A new Marconi telegram office has been opened at 3, Charterhouse Street, London, E.C.1.

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NEWS FROM ABERDEEN.

Official figures show that an increasing number of receiving licences are being taken out in Aberdeen. This proves that wireless is not an expensive hobby.

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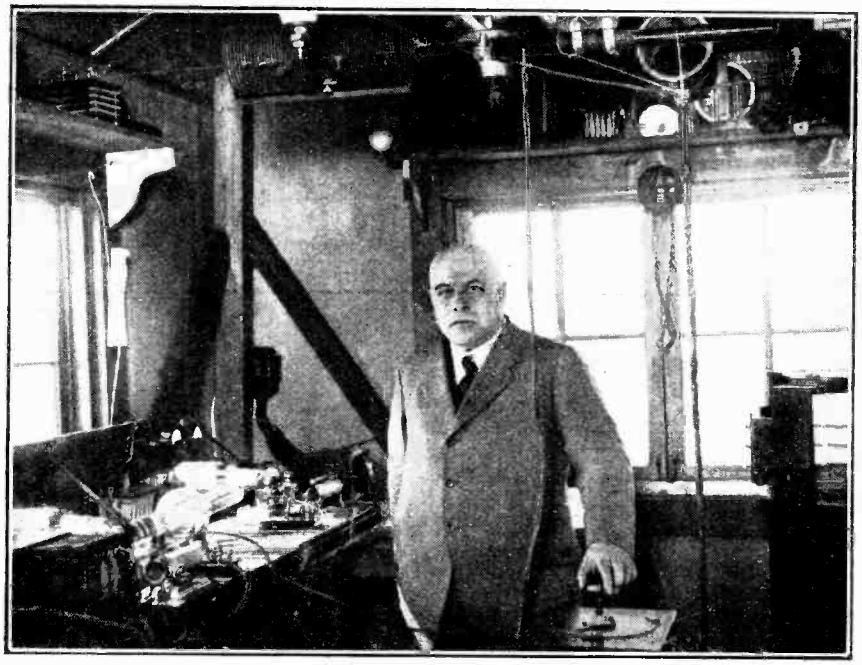
RADIO AND THE AURORA BOREALIS.

The influence exerted on wireless reception by the aurora borealis has formed the subject of researches by the director



AIRCRAFT RADIO BEACON INAUGURATED. Dr. G. Burgess, of the U.S. Bureau of Standards, with the wireless beacon which has been erected at College Park, Maryland, for the guidance of civil aircraft. This installation is the first of 40 to be erected at 200-mile intervals on the American civil airways.

of the Goodhaon wireless station, in Greenland. He states that tests over a prolonged period have not revealed any increase or diminution in signal strength which could be attributed to the "northern lights."

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WHEN "BIG BEN" ERRS.

Those who rely on the broadcasting of "Big Ben" for the correct setting of their household clocks may be interested to learn that certain discrepancies in the performances of the famous timepiece have been noticed by the Astronomer Royal. In his report covering the year ended May 10th, 1927, the Astronomer Royal reports that "Big Ben" was more than three seconds fast on nine days, between two and three seconds fast on 122 days, between one and two seconds fast on 164 days, and less than one second fast on two days. For a time the clock was kept purposely about two seconds fast, as its chimes were used as a warning for the Greenwich broadcast time signal.

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ECLIPSE SIGNALS ON THE CONTINENT.

No opportunity is being lost on the Continent to experiment during the eclipse on Wednesday next, June 29th. At the time of going to press we learn that the following stations will send test transmissions :—

Paris.—École Supérieure. W.L. 458 metres. Transmits from 6.15—6.35 a.m.

Madrid.—Union Radio (EAJ7). W.L. 373 metres. 6.10-6.35 a.m. : Dashes indicating wavelength.

Barcelona.—(EAJ1). 344 metres. 6 a.m. : Concert, "Serenata Española" (Albeniz), 3 minutes' duration; "Mallorca" (Albeniz), 4 minutes' duration; "Rondalla Aragonesas" (Granados), 5 minutes' duration; "La Gran Via," selection (Chueca-Valverde), 10 minutes' duration; "Jota," from "Dolores" (Bruton), 8 minutes' duration. 6.30 : English talk. 7 : Close down.

Madrid.—San Sebastian (EAJ8). 297 metres. 6.10-6.35 a.m. : Dashes indicating wavelength.

Berlin.—1,250 metres, 577 metres, 484 metres, and 215 metres. 6-9 a.m. : Musical and gramophone programme.

Pittsburgh.—(KDKA). 309 and 62 metres. 4.35 a.m. : Revue from the Grand Theatre, Pittsburgh.

Schenectady, N.Y.—(WGY). 379.5 metres. Programme relayed by 2XAF on 32.77 metres. 3.30-4.30 a.m. : "Radio Cavalcade."

The times mentioned are B.S.T.

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EIFFEL TOWER SIGNALS DURING ECLIPSE.

Special transmissions will be made by the Eiffel Tower station in Paris under the direction of the Bureau Internationale de l'Heure. Using the well-known call sign FL, the Eiffel Tower will transmit on 2,650 metres, spark or interrupted C.W. The following is the schedule of transmissions, the times being B.S.T. :—

5.30 a.m. to 5.35 a.m.—306 rhythmic time signals.

6.30 a.m. to 6.35 a.m.—306 rhythmic time signals.

7.30 a.m. to 7.31 a.m.—61 rhythmic time signals.

Special transmissions of a similar nature will also be made on the previous two days, June 27th and 28th, at 6.30 a.m. and 7 a.m. (B.S.T.).

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LOOKING AHEAD.

Commenting on the progress likely to be made in wireless picture transmission, Mr. David Sarnoff, of the Radio Corporation of America, suggests that at some time in the future "newspapers" will be printed at home, each household being equipped with a photo-radioscope.

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WHAT THE COLONIES SAY.

Colonial wireless papers, without exception, are enthusiastic over the reception of short-wave programmes from PCJJ, Eindhoven.

The South African *Wireless Weekly* writes :—"We would heartily welcome an efficient short-wave station in England. . . . We can only once again express the hope that soon something will be done in England, which at the moment seems to be the only important country without a short-wave station."

Describing the reception of PCJJ in Australia, *Western Wireless* writes :—"The strength and clarity of the reproduction, though only gramophone records, was remarkable."

What a pity it is that the B.B.C. "has not been convinced that any of the proposals so far made are likely to be productive of that degree of efficiency which would justify the expenditure involved."

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WIRELESS AT THE R.A.F. DISPLAY.

The R.A.F. display at Hendon on Saturday, July 2nd, will furnish abundant interest to wireless enthusiasts.

The most novel event will be the aerial drill to music, briefly referred to in our issue of June 15th. For obvious reasons the pilots would be unable to hear music from the ground in the ordinary way. The music will therefore be broadcast. A microphone slung over the band position will pick up the music, whence it will be transferred by means of a land line to a central control room containing powerful amplifying apparatus. There it will be amplified and broadcast from 24 loud-speakers erected so as to serve all public enclosures. At the same time a land line will carry the music to a radio telephony transmitting station, whence it will be transmitted to the air. Spectators will, therefore, be able to follow changes of manœuvre consequent upon changes of tune. In addition, as tunes change, the squadron leader in the air will give the words of command involved by changes of formation to his squadron by radio-telephony. His transmission will be received by receiving stations situated at remote points of the aerodrome and the signals transferred by land lines to the control room, where they will be amplified and broadcast to the spectators by means of the loud-speaker system.

The installation of input and output circuits for wireless stations and the loud-speaker system involves the laying of some twenty miles of buried cable.

TRANSMITTERS' NOTES AND QUERIES.

Transmitters in I.F.S.

Amateur transmitters in the Irish Free State are taking an active part among those engaged in experimental research on this side of the Atlantic. There are now seventeen stations licensed and most of these can be heard working nearly every evening on about 45 metres. Reports will be greatly appreciated.

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Also in Jamaica.

On the other hand, we understand that NJ 2PZ, the station operated by Mr. J. F. Grinan, Kingston, is the only one licensed in Jamaica and that other calls purporting to originate from that island should be regarded with suspicion.

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American Short-wave Tests.

The second 24-hour test, on June 4th to 5th, when the General Electric Company's stations 2XAF and 2XAD were transmitting continuously, has aroused considerable interest.

Among the reports received is one from Messrs. Stratton and Co., Ltd., of Birmingham, who send us a copy of the actual log of signals taken with a two-valve receiver from 1815 B.S.T. on Saturday to 1812 B.S.T. on Sunday. Some trouble was experienced from atmospherics from about 2200 to midnight on Saturday and during Sunday afternoon. These appeared to affect 2XAF on 33.77 metres more than 2XAD on 22.02 metres. The results generally were consistent with expectations, with the exception that for a period of five minutes between 4.40 and 4.50 the signals came in with unusual strength and clearness. During the hours of daylight the carrier wave from both stations kept strong, but became very sharp and the tuning critical.

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As these stations are now attracting considerable attention, it may be convenient to remind our readers that NU 2XAF transmits the Tuesday, Thursday, and Saturday evening programme of WGY on 32.77 metres, and NU 2XAD the evening programme on Sunday, Monday, Wednesday, and Friday on 22.02 metres every week. In addition, 2XAD transmits the special programme from WGY every Tuesday from 4.0 to 5.0 p.m. Eastern American Time (10.0 to 11.0 p.m. B.S.T.), and at 6.45 p.m. E.S.T. each Saturday (12.45 a.m., Sunday, B.S.T.); the complete schedule for the ensuing week is transmitted by ICW (Morse) from 2XAD and by telephony from 2XAF.

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We understand that reports received at Schenectady from Europe and South America indicate that the shorter wave, 22.02 metres, is more effective when it is daylight at either the transmitting or receiving end, but that when the whole area covered is in darkness the longer wavelength proves better.

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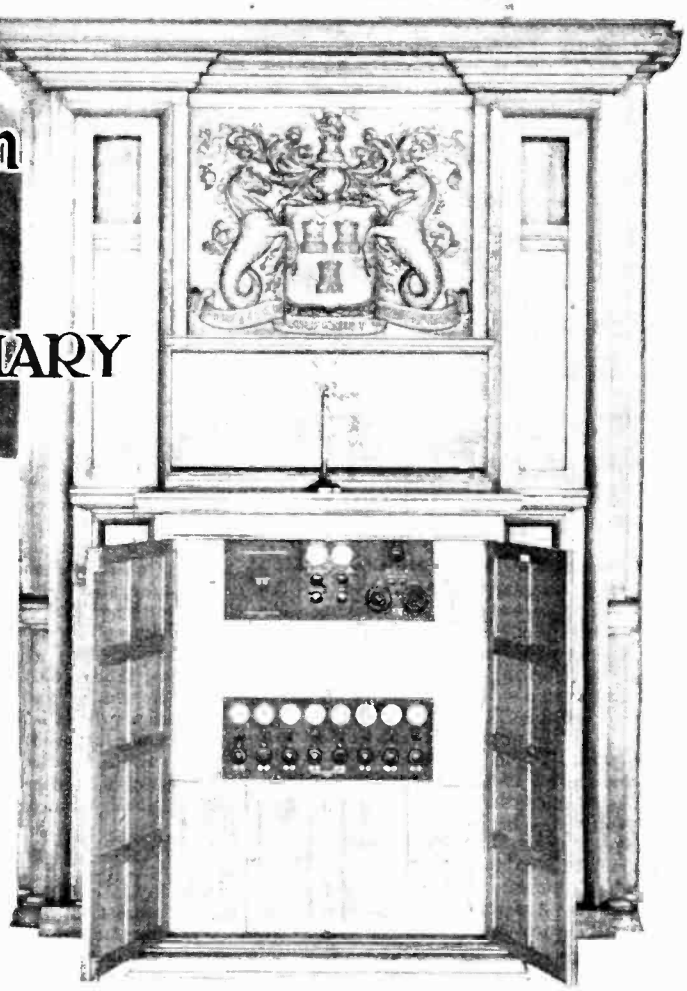
QRAs Wanted.

HZA 1, EN ODK, ER 5AA, EI 1DR, EAR 59, NT 8AF, EA MM.

Wireless Installation at the Newcastle Infirmary



Receiving Equipment for 250 Phones, with Semi-automatic Battery Maintenance.

By LEONARD A. SAYCE, M.Sc., Ph.D.

CRITICISM of university "rags" is frequent and not always undeserved, but never had students a better excuse for their high spirits than that which made them turn Newcastle upside down in February last year. It all began in the Union Refectory at a lunch-time conversation concerning wireless in hospitals. Why should the Newcastle Royal Victoria Infirmary be behind the London hospitals, and why should not the students of the two Newcastle colleges of the University of Durham organise an Appeal? Surely Newcastle was wealthy enough to equip its own infirmary! (These were days before the Coal Stoppage!) And so a committee got to work to put into practice their slogan "Radio for the Royal!" This slogan, by the way, was the outcome of a competition, the prize for which was two tickets for a college dance.

How the Funds were Collected.

Twelve hundred pounds was the estimated requirement, and, inexperienced as were the students in the annual charity "rags" which are so successfully carried out in Glasgow and Manchester, it appeared a difficult enough task. An "Appeal Week" was set aside, and Newcastle was prepared for this special effort by means of circulars and Press notices. The activities of the week, which were to culminate in a "rag" on the Saturday, included a broadcast appeal, a daily procession in the main streets of Newcastle of students wearing sandwich-boards and heralded by a drum-and-pipe band, an appeal by means of printed slips to patrons of city restaurants, the exhibition of special lantern slides in local kinematograph theatres, a collection in the workshops and factories of the district, and the placing of collecting-boxes in many of the shops.

Thus the people of Newcastle were well acquainted with the students' objects when the rag took place at the end of the week. Women students in academic dress were "on duty" with collecting-boxes in all the principal streets of the city throughout the day, whilst the men students, in fancy costumes which were anything but academic, held a mock coronation of "King Radio," after which they dispersed to empty the pockets of the Novocastrians. How successful they were may be judged from the fact that they collected over nine hundred pounds in this one day's effort, bringing the total for the whole Appeal to over sixteen hundred pounds. It fell to the lot of the present writer to design the installation and supervise its erection, and with the ample funds available the task has been a pleasant one.

In the library of Newcastle Infirmary, a large room beautifully panelled in unpolished oak, was a handsome fireplace which had never been used as such, for the room was centrally heated by hot-water pipes. So the fireplace became the home of the radio installation, and the illustration in the title of this article shows how complete has been the transformation. The radio panel,

Wireless Installation at the Newcastle Infirmary.—

at the right-hand side of the upper ebonite panel, is a straightforward two-valve set employing high-frequency and detector valves. The aerial circuit is loose-coupled to the grid circuit of the high-frequency valve, which, in turn, is coupled to the detector input by the well-known "tuned anode" method. The circuit is shown in detail in Fig. 1. Stability rather than efficiency is required, so the grid circuit of the first valve is stabilised by means of a "damping resistance" of high value, as shown.

The microphone amplifier panel at the left-hand side of the upper ebonite panel contains a one-valve amplifier fed from microphones situated either in the Infirmary chapel or the library itself. The circuit of this panel is shown in Fig. 2. These microphones are as used in the Marconiphone Public Address system, and are so simple and effective that a brief description may be of interest. Experience has shown that a carbon granule

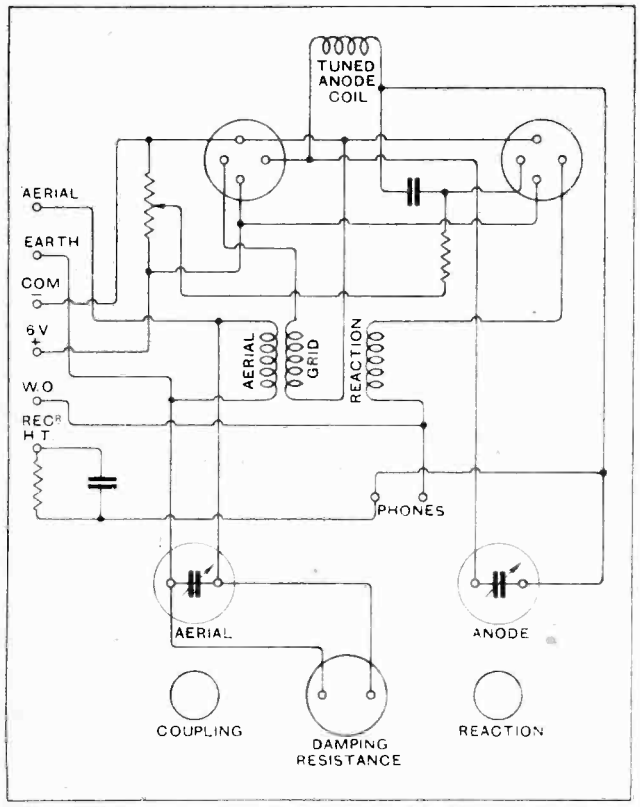


Fig. 1.—Circuit diagram of receiver unit.

microphone of the ordinary type can be made suitable for the faithful transmission of speech and music by two important modifications: (1) by damping the diaphragm very heavily, and (2) by the use of very fine granules. Both these objects are fulfilled by the microphone in question in the manner shown in Fig. 3.

The body of the microphone consists of a piece of steel tube, A, of 2in. external diameter and $1\frac{1}{4}$in. internal diameter and $\frac{5}{8}$in. long. At one end of this a thin gilt diaphragm, B, is securely stretched by means of the ring, C, and the nuts, D. To the other end of the tube is fixed a steel disc, E, and the little box so formed is filled with "Sorbo" rubber soaked in oil. A metal cup, F, $\frac{13}{16}$in. in diameter, lined with carbon and half full of very fine carbon granules, is held near to the diaphragm by means of the insulated steel bar, G, and a ring of soft felt, H, prevents the leakage of granules and further assists in damping the diaphragm. The sound-waves are thus received only by a small annulus. In spite of its small dimensions this microphone is most responsive. It requires only one stage of amplification to deliver normal "phone strength," and it is remarkable

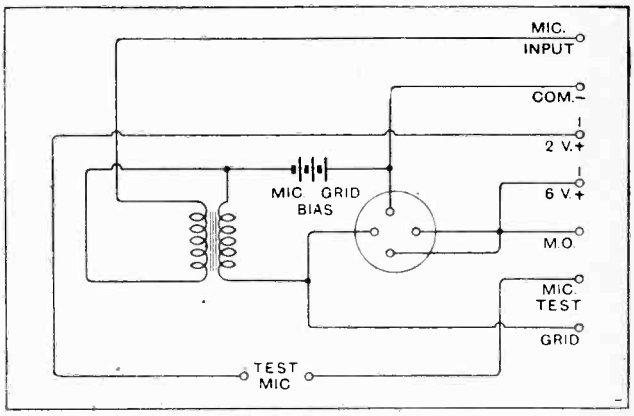


Fig. 2.—Circuit of microphone amplifier panel.

for its excellent pick-up. It is shown in its shock-absorbing mount standing on the top of the instrument cabinet.

The Main Amplifier.

The output either of the radio panel or of the microphone panel is taken *via* the "control panel" situated between them to the lower amplifying panel. This is the main amplifier, and it provides two transformer-coupled stages of low-frequency amplification, the first by one D.E.5 valve and the second by eight D.E.5A valves, whose grids and filaments are all in parallel. Each of these "second-stage" valves can deal comfortably with at least 250 pairs of 4,000-ohm telephones connected in parallel and fed from its output through a step-down transformer. Each of these valves is provided with a milliammeter in its anode circuit as a check on distortion and grid bias. It is controlled by an "on and off" switch and a variable graphite resistance across the secondary of its output transformer to act as a "volume control." There is also a pair of telephone plugs across each output circuit, so that an operator "tuning in" may

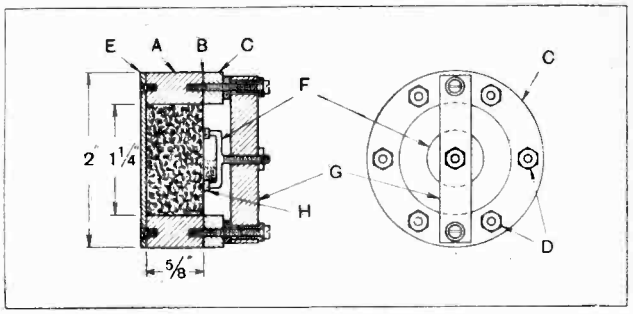


Fig. 3.—Section of carbon granule microphone.

Wireless Installation at the Newcastle Infirmary.—

hear exactly what is going to the wards. The circuit diagram of this amplifier—Fig. 4—has been simplified by the inclusion of only one of the second-stage valves and its associated meter, switch, etc.

The control panel, already mentioned, can be recognised in the title photograph by its two volt-meters for checking H.T. and filament voltages. Its circuit is shown in Fig. 5. Below the voltmeter dials are two switches, one on the right marked "Radio-Microphone," for connecting the amplifier input to the output of radio set or microphone respectively. The other switch, on the left, is for switching the microphone amplifier input to any one of the three microphones. Below these two switches again are two variable resistances acting as "volume controls" to the outputs of microphone amplifier and radio set respectively.

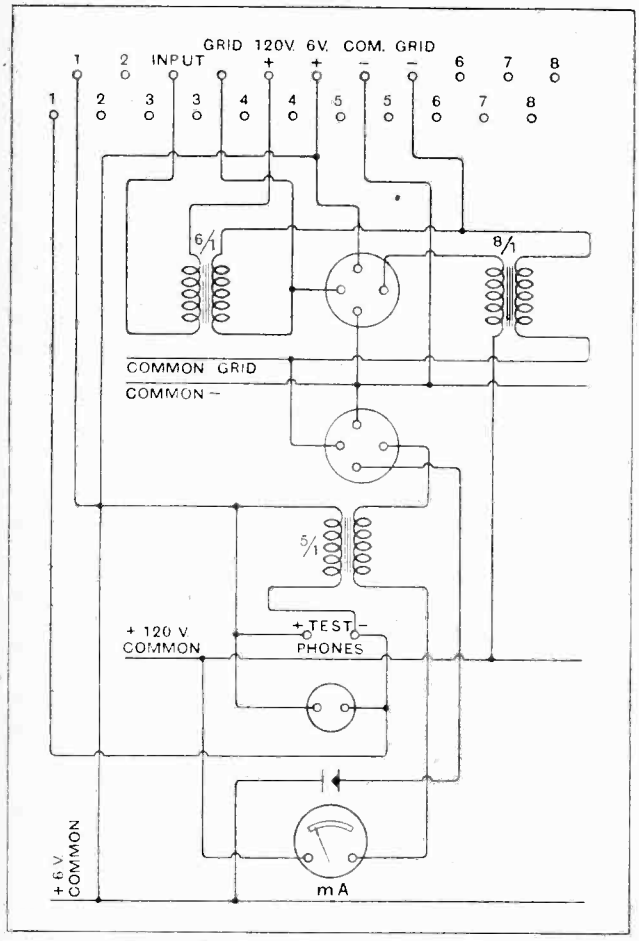


Fig. 4.—Circuit diagram of main amplifier.

The cabinet containing all the above gear is supported on concealed castors, and when pulled out of its normal position discloses the original "fireplace." This is now a veritable telephone exchange, for all the input, output, and battery wiring is concealed in this space, and even the aerial lead-in comes down the chimney! Thus to external appearance, at least, the installation is truly "wireless."

The many miles of lead-covered wire needed to distribute the output of the amplifier to the bedsides of the patients run, as far as possible, upon the external walls of the buildings. Nothing of the installation is to be seen inside the wards but the telephones themselves and a neat bakelite fitting upon every alternate window-frame. Each ward is provided with a two-way switch which, when in the "off" position, puts a "dummy load" upon the

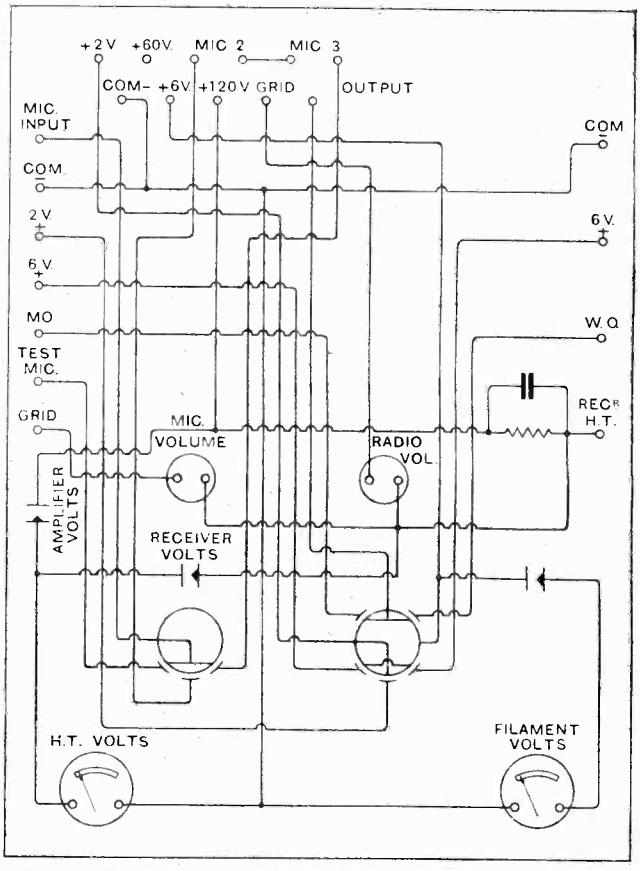


Fig. 5.—Control panel connections for checking volume and H.T. and L.T. voltages.

amplifier equal to that of the telephones themselves. In this way the signal strength in the other wards on the same circuit is left unaffected.

The telephones were selected with great care, for previous experience of hospital installations had shown the writer that the roughest and most inconsiderate treatment must be expected in such institutions. The following requirements were therefore laid down as essential :—

1. They must have no external nuts.
2. They must have no adjusting screws or external screws of any kind that could be loosened without the aid of a screwdriver.
3. The head-bands must have no leather or fabric coverings (for hygienic reasons).
4. The ear-caps must be able to withstand frequent falls upon the hard floors.
5. The flexible connecting cords must be provided with "tension tags" to relieve the electrical connections from all mechanical stress.

Wireless Installation at the Newcastle Infirmary.—

6. The stirrups, swivels, and headbands must be very robust and not be likely to work loose.

These conditions, necessary as they undoubtedly were for the installation under discussion, were satisfied by scarcely any of the many types of headphones upon the market. In fact, manufacturers have been slow to develop telephones really suitable for use in public institutions. They do not seem to realise the amount of misuse which must be borne by their productions at the hands of people who have not themselves paid for them! Nor do

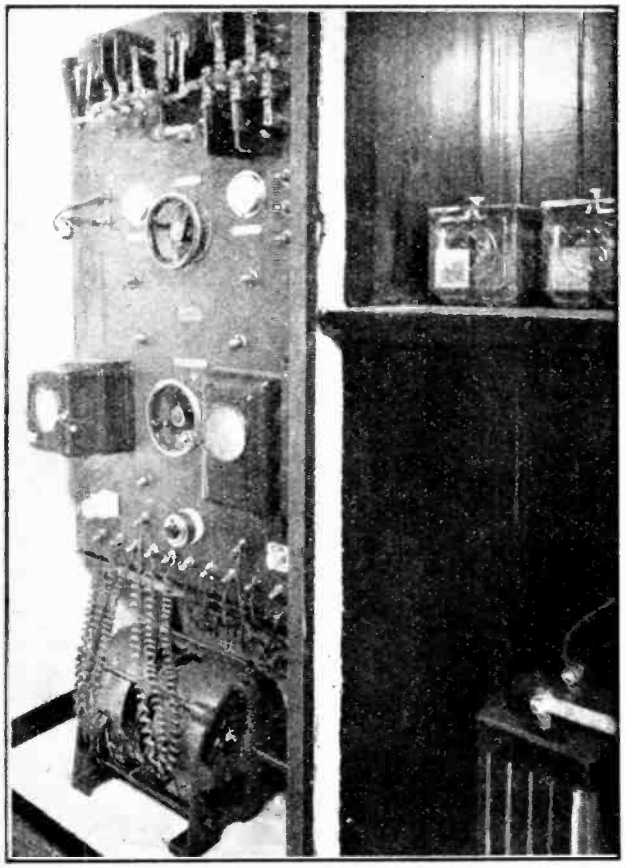


Fig. 6.—Switchboard of automatic battery-charging plant.

they realise that 90 per cent. of the maintenance charges of a hospital installation is in telephone repairs. The makers of the "Claritone" headphones, however, have in the opinion of the writer, come nearest to the ideal, and their telephones have been used throughout the installation.

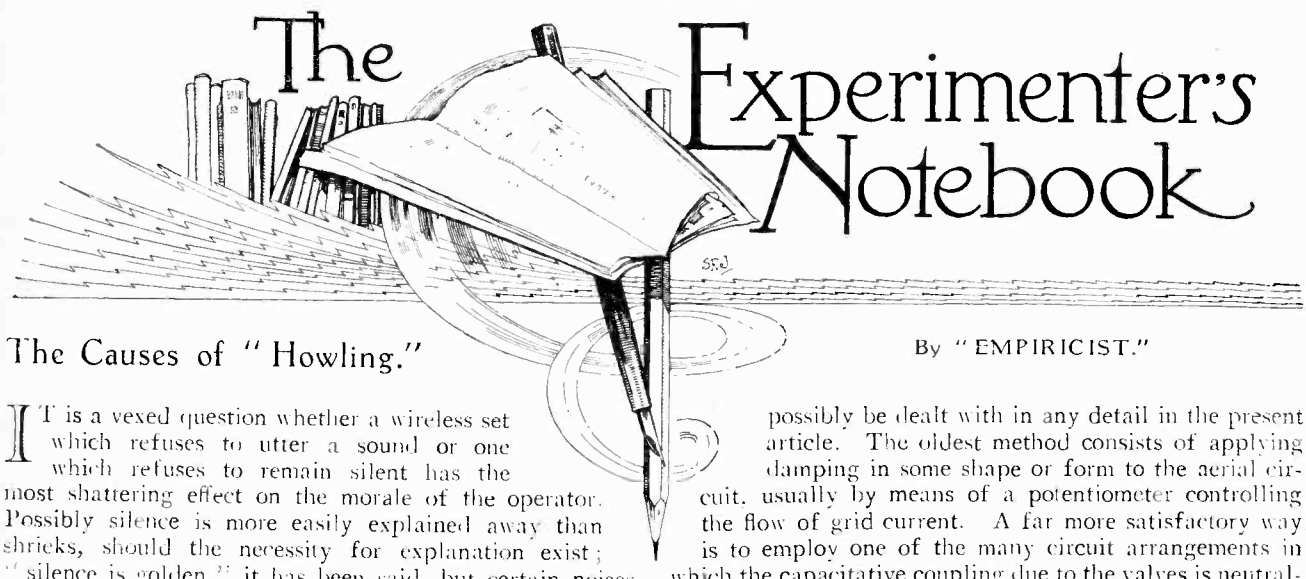
A further requirement of a hospital installation is that it should require a minimum of skilled attention, for it must be remembered that to many hundreds of people it is their only relief from monotony and suffering, and reliability must have first consideration. For this reason the Newcastle Infirmary installation has been made entirely automatic, and, except for the use of the microphone and the occasional "topping up" of the batteries, the only attention it requires is the winding of a clock once a month. High and low tension current is supplied by 120-volt and 6-volt accumulators respectively. At a given time each day these are connected to the instruments by means of a time-switch and contactor. At the end of the day's programme the time-switch again operates and the instruments are switched off. In falling to the "off" position the discharge contactor starts up a motor generator which commences to recharge both high and low tension batteries. But during the discharge period the filament current was taken through an ampere-hour meter, commencing at zero. The charging current also passes through this meter, but in the reverse direction. Thus, when the meter has got back to zero, a contact is made inside the meter, the "charge" contactor is released, and the motor-generator switched off. If this were all, the batteries would receive exactly the same amount of energy as they supplied on discharge, and, seeing that their efficiency is not 100 per cent., they would run down in the course of time. The meter contacts are so arranged, however, that a small overcharge is given automatically.

Battery-charging Plant.

The batteries and their charging and control equipment are contained in a large cupboard in the basement of the infirmary immediately under the instruments which they operate. The cupboard is divided into two compartments by a vertical partition. The right-hand compartment contains the batteries and is painted with anti-sulphuric enamel and provided with ventilation holes. The left-hand compartment contains the charging and switching gear, which was made to order by Messrs. Igranic Co., of Bedford. The two contactors are at the top of the slate panel. Beneath them are centre-zero charge-discharge meters for the two batteries, lower still are the special meter and the time-switch, whilst the motor-generator is screwed to the floor. The two wheel-like controls in the middle of the panel are for the purpose of controlling the respective charging rates of the two batteries.

The foregoing description of this installation has been given in the hope that it may be of some assistance to those who may be responsible for future hospital installations. The benefits of "wireless" for invalids is so great that radio facilities will soon be regarded as an essential part of the equipment of a hospital.

In conclusion, I should like to pay tribute to the excellent workmanship of Messrs. Marconiphone Co., Ltd., who were the contractors to the installation.



The Experimenter's Notebook

The Causes of "Howling."

By "EMPIRICIST."

IT is a vexed question whether a wireless set which refuses to utter a sound or one which refuses to remain silent has the most shattering effect on the morale of the operator. Possibly silence is more easily explained away than shrieks, should the necessity for explanation exist; "silence is golden," it has been said, but certain noises produced by receivers can only be described as brazen.

In considering the causes of "howling," which is the purpose of the present article, we must give careful thought to the different kinds of oscillation which can be produced; these are many and various, and are all too frequently confused with each other.

Let us take first the most generally familiar case, namely, that of a pure continuous wave oscillation on the wavelength to which the receiver is tuned. This is, of course, the most anti-social form of oscillation, and one which is very rightly condemned in all quarters, inasmuch as it affects not only the user of the receiver, but also his neighbours for a considerable distance. A receiver in a state of oscillation will give no evidence of its condition unless it is tuned in to a wavelength closely corresponding to that of a signal, when the characteristic heterodyne note will be heard over a certain range of the tuning condenser. A number of points on the dial will give such notes corresponding to various broadcasting stations, but in general no audible effect will be produced except by the aid of external signals.

Uncontrollable Reaction.

The causes of oscillation of this kind depend on the type of circuit which is being employed. If a valve detector without a high-frequency stage is used, there should, of course, not be the slightest difficulty in controlling oscillation, though on occasions a highly efficient valve used in conjunction with too large a reaction coil may be impossible to stabilise. The golden rule is always to use the smallest value of reaction coil that will give the desired effect; such a course not only makes the set absolutely certain as regards oscillation, but also largely negatives the necessity for retuning the receiver after an adjustment of the reaction coil.

In the case of circuits embodying stages of high-frequency amplification we are on more difficult ground. Sets of this type have a general tendency towards oscillation when the aerial and high-frequency circuits are brought into tune with each other. The cures for self-oscillation of this kind are many in number and cannot possibly be dealt with in any detail in the present article. The oldest method consists of applying damping in some shape or form to the aerial circuit, usually by means of a potentiometer controlling the flow of grid current. A far more satisfactory way is to employ one of the many circuit arrangements in which the capacitative coupling due to the valves is neutralised. More recently again we have the various methods developed in America for stabilising receivers, of which the Loftin-White circuit is a good example.

If one of the above methods of controlling oscillation is embodied in the receiver there is still plenty of opportunity for snags in carrying it out. Only two tips can be given here: first, look after the high-frequency component of current flowing in the detector valve circuit and see that it is led in the right direction, *e.g.*, by a by-pass condenser from plate to filament; and, secondly, do not forget the by-pass condenser across H.T. batteries. Apart from these considerations, the factors dealt with in a previous article on the layout of the set should be borne in mind.

A second form of "howling," which is essentially due to the high-frequency circuits, is fairly often met with.

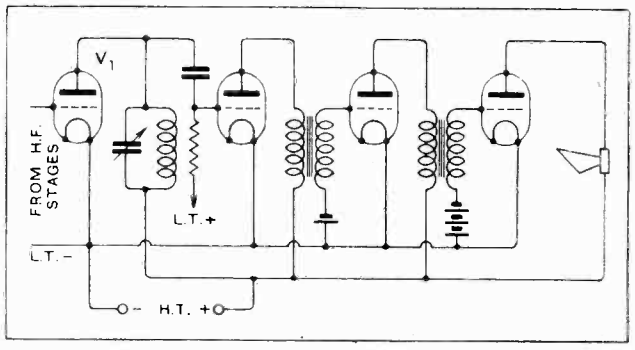


Fig. 1.—Howling was experienced in a circuit of this type and still persisted when the H.F. valve V_1 was switched off.

The symptom in this case consists of a squeaky note, the pitch of which is constant over a fairly considerable range of the tuning condensers, or, when there is more than one high-frequency circuit, on bringing the latter into tune with one another. The effect is traceable to the high-frequency circuit by short-circuiting any tuning condenser; if the howl stops under these circumstances it must be due to high-frequency effects.

Two main causes of this form of howling are well

The Experimenter's Notebook.—

known; first, the excessive use of reaction (or a state of excessive accidental regeneration) when one of the circuits has a grid condenser and leak; and, secondly, the modulation of the high-frequency currents by oscillations produced in the low-frequency amplifier.

Howls of the first type are simply due to excessive instability and yield to the treatment outlined for the first class of oscillation. Howls of the second type open up larger questions. In reflex circuits they are very commonly encountered, and are not infrequently due to the use of a valve for double magnification purposes which has an insufficiently straight characteristic. Another cause of this trouble is interaction between the high-frequency and low-frequency circuits through the medium of the H.T. battery or through a leakage path of some kind to the receiver.

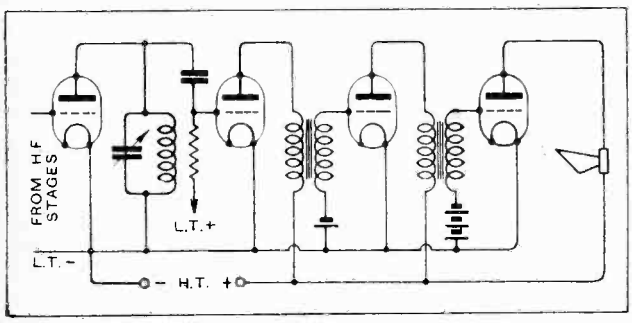


Fig. 2.—By connecting the tuned anode circuit to L.T.—with the H.F. valve switched off the howling produced in the circuit in Fig. 1 was cured.

The third class of oscillation with which it is proposed to deal is that which consists of a persistent note, which does not alter in pitch when the high-frequency circuits are adjusted, and which persists when the tuning condensers are shorted out. This is due to low-frequency regeneration pure and simple, the most common form of which originates from a grid lead of excessive length connected to the detector valve.

Any unnecessary length of lead or complication in the wiring of the low-frequency circuits is apt to lead to trouble of this kind, and it is well worth while, in laying out the low-frequency amplifier, to pay careful attention to the points raised in a previous article. There is, however, a totally distinct cause of audio-frequency oscillation which must not be forgotten, namely, that due to impedance in the H.T. battery, which gives rise to a transfer of voltage from the output to some point in the input of the receiver.

A good test in order to check whether the trouble is due to the latter cause is to take a condenser bank of considerable size, say, 4 to 6 mfds., and apply it across the various H.T. tappings in turn. The oscillation may not be cured by this means, but a change in its frequency will infallibly indicate that the trouble is due to impedance of some kind in the H.T. battery.

The writer came across a most unexpected trouble of this kind in the case of a set which had a stage of tuned-anode amplification followed by two L.F. stages. The set howled persistently with the circuits in their normal state, but when the return path of the tuned anode was connected to L.T.—, instead of to its normal H.T. tapping, the howl at once ceased. The H.F. valve, it should be mentioned, was removed for both of these tests, so that the circuits were essentially as in Figs. 1 and 2 respectively.

The trouble was thus traceable to the transfer of the alternating voltage set up in the H.T. battery back on to the grid of the detector valve, and in this particular case it was cured by a choke-capacity output unit connected as in Fig. 3, the bulk of the alternating current being diverted through the loud-speaker to the filament, and thereby not giving rise to any appreciable alternating voltage in the H.T. battery. However, it is worth noting that this defect exists in a tuned-anode circuit, and it is as well to consider the great advantage in this respect offered by a high-frequency transformer.

It may be mentioned, in passing, that by-pass condensers across the high-tension are of amazingly little use in curing a howl of this character when there is a serious resistance in the H.T. battery. The choke-capacity output device seems to offer a far more fundamental and satisfactory way of safeguarding a receiver in this respect.

"Motor-biking."

A fourth class of oscillation which may be considered for the sake of completeness as a howl consists of a pulsating effect not unlike the sound of a motor bicycle. The writer, in fact, fell into the habit of talking about this effect as "motor-biking" as long ago as 1923, and it is of interest to note that the term "motor-boating" is now in common use in American radio journals to describe the same symptoms.

The trouble is always due to H.T. battery impedance, and was first encountered when using a resistance shunted by a condenser in the H.T. circuit of an amplifier to produce "automatic" grid bias. A reversal of one of the L.F. transformers in the amplifier cured the trouble

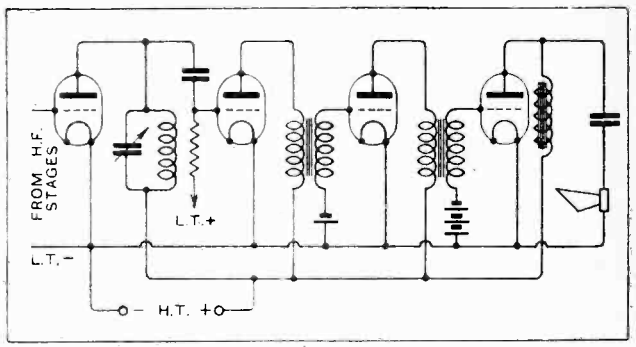


Fig. 3.—Howling may frequently be cured by the use of a choke-capacity output circuit as the choke prevents the flow of A.C. from the last valve through the H.T. battery.

at the expense of a certain amount of audio-frequency distortion, and ultimately grid bias batteries were resorted to as being safer.

"Motor-biking" is also extensively found in amplifiers that are supplied from mains units, but as this is the subject of an article by Mr. H. L. Kirke appearing in this issue it would be superfluous to go further into the matter.

The Experimenter's Notebook.—

The last form of howling that has to be considered is that due to the impact of sound waves on one of the valves of the receiver. The nature of the howl is usually quite apparent from the outset, inasmuch as it builds up very slowly from a faint noise to a considerable volume, can be made to vary in intensity, and may even be completely extinguished by moving the loud-speaker about the room or pointing it in different directions.

The cure for howling of this type is the employment of a proper shock-absorbing mounting for the detector valve of the set, and maybe for other valves as well. The valve which is giving the trouble can usually be identified by the loud noise produced on tapping it with the finger.

A curious case of microphonic howling is sometimes experienced in the case of receivers, *e.g.*, of the super-sonic type, which give a great deal of high-frequency amplification. In this case a howl clearly microphonic in character is sometimes produced on tuning-in a very strong carrier wave. As a rule, such howling only occurs when the station is being received at such strength as to cause serious saturation of the detector valve, so that when the volume is reduced to manageable proportions the effect disappears. The use of a shock-absorbing valve-holder is, however, indicated in such cases, particularly on the first detector of a supersonic receiver.

NEWS FROM THE CLUBS.

FORTHCOMING EVENTS.

WEDNESDAY, JUNE 22nd.

Radio Society of Great Britain.—Ordinary Meeting. At 6 p.m. (tea at 5.30). At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Fading in Radio compared with other Natural Phenomena," by Mr. H. A. P. Littledale, F.R.Met.Soc.

North Middlesex Wireless Club.—Lecture: "Electrolytic Rectifiers," by Mr. A. J. Simpson.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove. Lecture: "Work on Short Waves," by Mr. S. V. Smith.

SUNDAY, JUNE 26th.

Tottenham Wireless Society.—Field Day.

TUESDAY, JUNE 28th.

Thornton Heath Radio Society.—At 8 p.m. At St. Paul's Hall, Norfolk Road. Demonstration for Beginners, by Mr. Welstead.

Making the Most of Summer.

The present summer is proving a "bumper" season for field days and other outdoor activities. No doubt favourable weather conditions are partly responsible; at the same time there are undoubted indications that the clubs are recognising the value of maintaining enthusiasm among members during the misnamed "slack" season by means of well-organised field days.

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Portables in the Field.

In view of the programme of direction finding to be carried out on the field day of the North Middlesex Wireless Club next month, the last meeting of the club was partly devoted to the examination of a 4-electrode valve portable set, constructed by Mr. W. Gartland. The complete receiver (2-valve) weighed only 12 lb., and was contained in an ordinary attaché case with socket for 'phone plugs and tuning control on the outside. The removal of the 'phone plug automatically cut off the L.T. battery.

It is hoped to have a number of portable direction finders in the field on July 9th.

A large receiver which was not giving the results expected of it was exhibited by Mr. G. L. F. Martin, and in the search to discover the trouble members obtained more information than would have been gleaned if the set had been working perfectly. While the selectivity of the instrument was beyond reproach, it was found that the L.F. side was inefficient, distortion and overloading being noticeable. After careful experiment and adjustment the set functioned satisfactorily.

Hon. Secretary: Mr. H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

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Advice on Accumulators.

A large number of accumulators and components was on view at the last meeting of the Muswell Hill and District Radio Society on June 8th, when Mr. W. Schofield (of Messrs. Hart Accumulator Co., Ltd.) lectured on "Electric Accumulators." Many valuable hints were given on the choice of an accumulator and especially its maintenance, while special interest was shown in the construction of accumulators, including those of the type used on submarines.

Hon. Secretary: Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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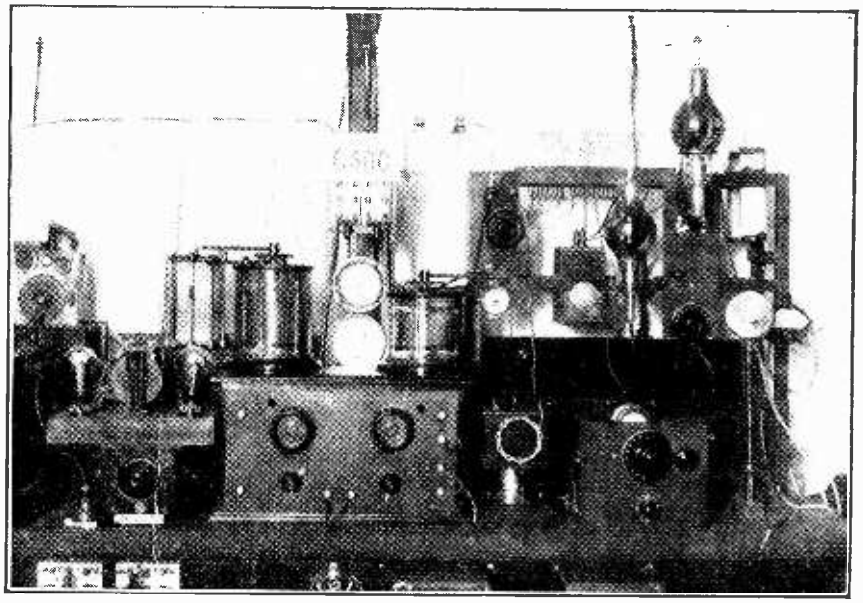
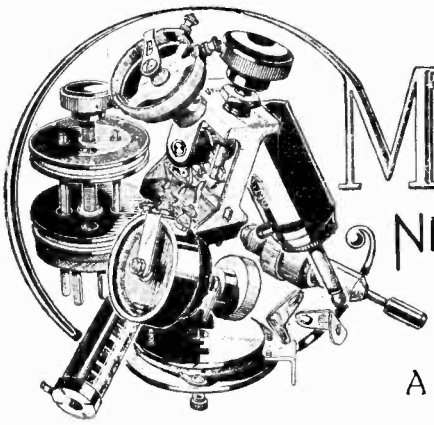
An Active Society.

The Thornton Heath Radio Society, which holds its meetings every Tuesday evening throughout the year at 8 o'clock at St. Paul's Hall, Norfolk Road, Thornton Heath, has arranged a number of summer events of special interest. A demonstration by Mr. Atkinson of the various kinds of valves on the club's set on June 28th will be followed on July 12th by a demonstration for beginners in the efficient use of grid bias and reaction. Features of the society's meetings are the elementary evenings and open discussion nights. The society has an energetic experimental section, and every endeavour is made to cater for all radio enthusiasts. Enquiries as to membership are cordially invited by the Hon. Secretary, Mr. C. H. Piper, 77, Torridge Road, Thornton Heath, Surrey.



G. 5DC, owned and operated by Mr. W. T. Aked at Victoria Road, Thornton-le-Fylde. The transmitter has a tuned grid circuit with grid modulation. Telephony tests from this station have been heard in Brazil.

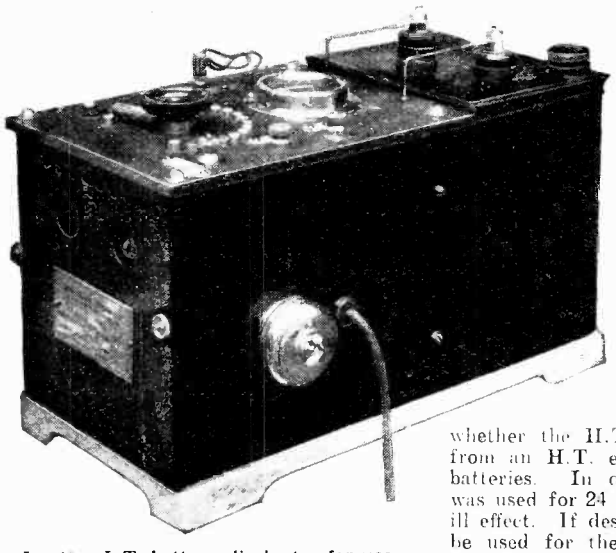


MANUFACTURERS' NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

AN L.T. ELIMINATOR FOR A.C. MAINS.

Hitherto it has been a perfectly simple matter to purchase or build a reliable H.T. battery eliminator for A.C. mains which, when connected to almost any receiver, has proved a more than satisfactory substitute for any type of battery, but it has not been possible to do the same in the case of the L.T. battery, and resort has had to be had either to the use of special valves or to a trickle charge.



Longton L.T. battery eliminator for use on A.C. supply.

Messrs. Longton, Ltd., of Guildford, Surrey, have now made it possible, however, to dispense entirely with the use of the L.T. battery if A.C. mains are available and no special valves or circuit arrangements are called for. The device consists essentially of a transformer which, in conjunction with an arc rectifying valve, produces a rectified current which is more than adequate to supply the L.T. current for a large multi-valve set using modern dull-emitter valves of the 0.1 amp. type and a 0.25 amp. super-power valve in the output stage. This rectified current is passed through a smoothing circuit, the leading feature of which is a large-capacity electrolytic condenser. It is necessary only to dissolve the salts supplied by the manufacturers in warm water and to pour this into the condenser to render the eliminator ready for use. The instrument requires no other attention than the "topping up" of the electrolyte with water at prolonged intervals to compensate for evaporation. The rectifying valve has a normal life of 1,000 hours and is renewable at a cost of 12s. 6d.

The eliminator is suitable for use with either 2, 4 or 6 volt valves, and has been tested by us with various types of set, perfectly satisfactory results having been obtained, the background being quite silent in every case, irrespective of whether the H.T. supply was delivered from an H.T. eliminator or from H.T. batteries. In one case the instrument was used for 24 hours constantly without ill effect. If desired the instrument may be used for the charging of L.T. batteries, and was satisfactorily tested for this purpose. The charging rate of a 6-volt battery is about 1.2 amperes or a 2-volt battery 1.5 amperes.

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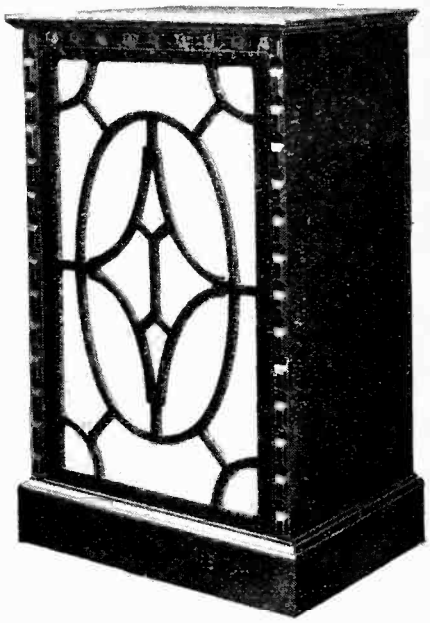
LOUD-SPEAKER CABINET.

Many amateurs prefer to construct a loud-speaker by fitting a loud-speaker movement to a horn either of home construction or one of the special papier-mâché types for which they may have a preference. Loud-speakers constructed in this way, although being sensitive and producing good results, are usually of somewhat ugly appearance.

Messrs. W. and T. Lock, 15, St. Peter's Terrace, Bath, well known as manufacturers of wireless cabinets, have recently introduced a cabinet containing a loud-speaker horn so that a good loud-speaker is produced merely by fitting a movement. As a cabinet type loud-speaker this new production is unlike other commercial models, as the loud-speaker stands vertically instead of being turned to produce a horizontal cabinet, which is the common practice.

The specimen examined was built throughout of mahogany, and measured 16 in. high × 10 in. wide × 7 in. deep, and enclosed a properly supported papier-mâché horn. The grill was of particularly open design, and had a pale blue covering resembling silk.

The cabinet is a specimen of high-grade work, is well finished, and can be recommended where a loud-speaker is required to harmonise with other furnishings. It might be mentioned that many of the cabinet loud-speakers at present on the market are fitted with an enclosed horn, as this form of loud-speaker is usually more sensitive than the diaphragm type and is suitable for operation on small input.



The new loud-speaker cabinet of W. & T. Lock. It is fitted with an enclosed papier-mâché loud-speaker horn.

Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

A Running Commentary Triumph.—Keston's Lost Opportunity.—Sir Henry Wood's Debut.—Oscillation: A New Move.—De Groot Again?

Best Commentary of the Year.

The best running commentary I have yet listened to came over the Atlantic on Monday of last week in the afternoon and evening, when 2XAD, on 22.02 metres, broadcast the arrival of Colonel Lindbergh in New York.

If only the B.B.C. had been listening!

(Keston, by the way, might have attempted to relay this truly remarkable broadcast.)

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Many "Points."

No effort had been spared to give the American listener a complete bird's-eye view of the progress of Lindbergh's car from the time he landed until arriving in Central Park to receive the official welcome from the Governor of New York State. Indeed, it is doubtful whether a bird could have seen as much in the time, for the description came through from a dozen or more "points," the microphones being changed over with a swiftness which was almost bewildering.

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Lindbergh's "Business Suit."

At about 8 p.m. (B.S.T.) the announcer was heard describing the scene at the War Memorial, with its "Eternal Flame," where Lindbergh placed a wreath. "Colonel Lindbergh is wearing his business suit," said the announcer, leaving the listener to conjecture what type of garment that might be. Then the listener heard the impressions of an announcer on the 27th floor of the Metropolitan Building as the procession passed and proceeded by the new building of the National Broadcasting Company up Fifth Avenue. It was also stated that the crowd lining the street was twenty-five deep, that the streets were impassable, and that showers of confetti and streamers were falling from all the surrounding buildings.

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In Central Park.

Governor Smith's speech of congratulation on the platform in Central Park was heard clearly, but unfortunately the same can hardly be said of Lindbergh's reply, which came through badly. This may have been due to fading or to the fact that the microphone was badly placed.

During the address of welcome the excited comments of the crowd could often be distinguished.

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Keston's Lost Opportunity.

The broadcast was a memorable one. It raised this question: Were the B.B.C. engineers listening?

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Query.

Who was the wireless official who decided to appraise the qualities of the female staff at Savoy Hill in terms of "Millivamps"?

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A Delysia Item.

Miss Alice Delysia is to broadcast from 2LO on July 1.

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To-night's Programme.

A "Musical Man-in-the-Street" will provide the items for another of the "My Programmes" series to be broadcast from 2LO this evening (Wednesday). It takes the place of the "My Programme" which it was expected Mr. Arnold Bennett would arrange for this date.

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Saturday's Variety.

A variety programme will be given on Saturday next by Sydney Fairbrother (Cockney humour), Barney O'Reilly (Irish ballads), Harold Harvey (syncopated songs with guitar and ukulele accompaniment), Ann Penn (impersonations), and Charles Heslop and Cyril Smith (entertainers).

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Safety First.

The adoption by the British Broadcasting Corporation of kilocycles instead of wavelengths elicits a timely warning from "Vigilant."

"Remember," he says—"remember the therm!"—"Beachcomber," *The Daily Express.*

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Sir Henry Wood.

It has now been decided, as hinted in *The Wireless World* last week, that Sir Henry Wood's broadcast debut will be postponed until August 13th, when he will conduct the first of the "Proms." This will be a much more auspicious beginning than if the famous musician opened his broadcasting career by conducting the Wagner programme on June 30th in the studio.

FUTURE FEATURES.

London.

JUNE 26TH.—Military Band Programme. Service S.B. from Liverpool.

JUNE 27TH.—Murray Ashford's Concert Party, relayed from Felixstowe.

JUNE 28TH.—"The Belle of New York," a musical comedy by Hugh Morton.

JUNE 29TH.—Harrow Speech Day. Variety Programme and Chamber Music.

JULY 1ST.—Dominion Day Programme.

JULY 2ND.—Military Band and Variety Programme.

Birmingham.

JUNE 26TH.—Light Symphony Concert.

JULY 2ND.—Popular Orchestral and Vocal Programme.

Bournemouth.

JUNE 27TH.—Instrumental and Vocal Programme.

JULY 1ST.—Concert of Modern British Composers.

Cardiff.

JULY 2ND.—Orchestral Programme relayed from Weston-super Mare.

Manchester.

JUNE 27TH.—Spanish Sonatas and Songs.

JUNE 29TH.—"Eclipse," a topical sketch by J. L. Hodson.

Newcastle.

JUNE 27TH.—Choral Singing and 'Cello Solos.

JULY 1ST.—Orchestral Concert relayed from Whitby, and a play.

Glasgow.

JUNE 26TH.—Instrumental and Vocal Concert.

Aberdeen.

JUNE 27TH.—Variety Programme and two plays.

Belfast.

JUNE 27TH.—Military Band Programme and a play.

JUNE 29TH.—Orchestral Programme. "Black Out," a Telescopic Review.

Curbing the Conductor.

It is fortunate that most conductors in the studio are unaware of the restrictions that surround them. Most conductors imagine that the music goes out from 2LO's aerial just as played. Sometimes it does. But if the conductor has an idea concerning the rendering of a piece differing from that of the composer, the odds are that the composer's idea will be more faithfully represented in the music broadcast.

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Controlling by the Score.

This is one of the mysteries of "control," the department at 2LO which is now presided over by the erstwhile B.B.C. Director of Music, Mr. Stanton Jeffries.

The official in charge of control during a symphony concert is furnished with a copy of the score. It is by this that he is mainly guided in the task of adjusting for volume. Consequently, a conductor who seeks for extravagant effects "not in the score" may waste his fragrance on the desert air, and his purple passages will get no farther than the purple passages of Savoy Hill.

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Control Room "Tyranny."

Whether the control room should exert this "tyranny" over the studio is a serious question.

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Where Danger Lies.

No artist will give a piece of music precisely the same interpretation on two different occasions. And it is precisely this spontaneity of approach and treatment (within limits) which makes a performer an artist rather than a machine.

The control room idea of following the score rather than the conductor has its dangers.

New Pill for the Oscillator.

Tormented by a local oscillator, a friend of mine recently wrote to the B.B.C. for comfort and consolation. In reply he received a questionnaire which the Corporation has prepared with the object of getting at the facts systematically, and with a minimum of irrelevant detail. These interrogatory forms, which contain five important questions, are to be issued to all listeners who send in complaints of oscillation.

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The Questionnaire.

The questions are as follow:—

1. Is your set a valve or crystal?
2. Does the distortion take the form of (a) howling, (b) sudden variation in signal strength, or (c) complete cessation of signals?

If (a) state if the howling is continuous for periods of ten minutes at a time or longer. If (b) is the variation or cessation continuous for several days at all times when you attempt to listen?

3. Is your set in perfect order?
4. Are there any particular times or days of the week or types of programme during which the interference is more noticeable?
5. Could you in confidence name any person who, in your opinion, is likely to be causing the disturbance.

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Let's Hope So.

The above should save much futile correspondence; whether it will lead to the detection of offenders is another matter.

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De Groot Again?

Statements have recently been made to the effect that Mr. de Groot had been approached by the B.B.C. with the object of regaining his services. I understand that the statements are untrue.

In the case of de Groot, as in the case of other celebrities who have engaged in "hotel broadcasts," the B.B.C. negotiates only with the hotel proprietors, not with the individual artists. In the case of de Groot the question of his return to the microphone has been raised by the Piccadilly Hotel, and although nothing has materialised, there is a strong probability that the famous Dutch conductor and his orchestra may broadcast again.

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Russian Exiles in Chiswick.

A programme by Russian exiles is to be relayed from their English home at Chiswick on Saturday next, June 25. Besides M. Vladimir Polunin, the scene painter to the Diaghileff Russian ballet, who has taken a leading part in organising the show, those who will assist in the programme are Mme. Edezi, Mme. Marie Rabinek, M. Nicholi Rabinek, M. Ivan Ivanich Barnett, Mme. Rabinovitch, Mme. Ustinov, Mme. Duska Benois, M. Carlo Norway, W. H. Stanton, and M. Strachovsky. The *compères* will be A. P. Herbert and L. de G. Sieveking, who will make their announcements in English.

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Kilocycles.

The decision of the B.B.C. to talk in kilocycles instead of wavelengths provokes the comment which so often hovered on the lips of Victorian maidens: "Oh, George, this is so sudden!"

If the decision had been taken last autumn, when the British public was in the mood to grasp the Geneva scheme, with its dependence upon kilocycle calculations, it would have been more comprehensible.

Coming at the present moment, the decision tempts one to think that an effort is being made to keep our minds occupied on any matter other than short-wave Empire broadcasting.

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The British Stations.

The following is a list of the British stations with their wavelengths and kilocycle equivalents:—

Station.	*Wavelength.*	*Kilocycles.*
Daventry	1,604.3	187
Aberdeen	500.0	600
Bournemouth	491.8	610
Glasgow	405.4	740
Plymouth	400.0	750
Manchester	384.6	780
London	361.4	830
Cardiff	353.0	850
Birmingham	326.1	920
Newcastle	312.5	960
Belfast	306.1	980
Liverpool	297.0	1,010
Hull	294.1	1,020
Stoke	294.1	1,020
Swansea	294.1	1,020
Dundee	294.1	1,020
Edinburgh	288.5	1,040
Leeds	277.8	1,080
Nottingham	275.2	1,090
Sheffield	272.7	1,100
Bradford	252.1	1,190

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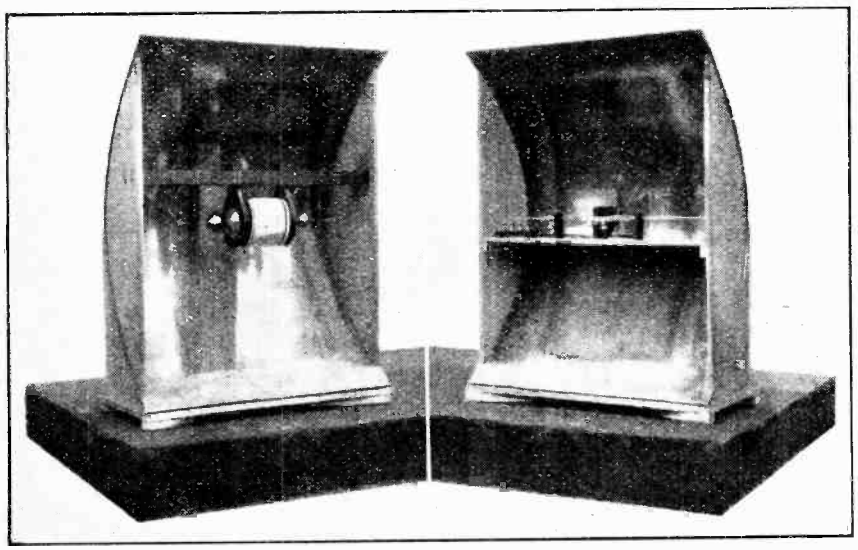
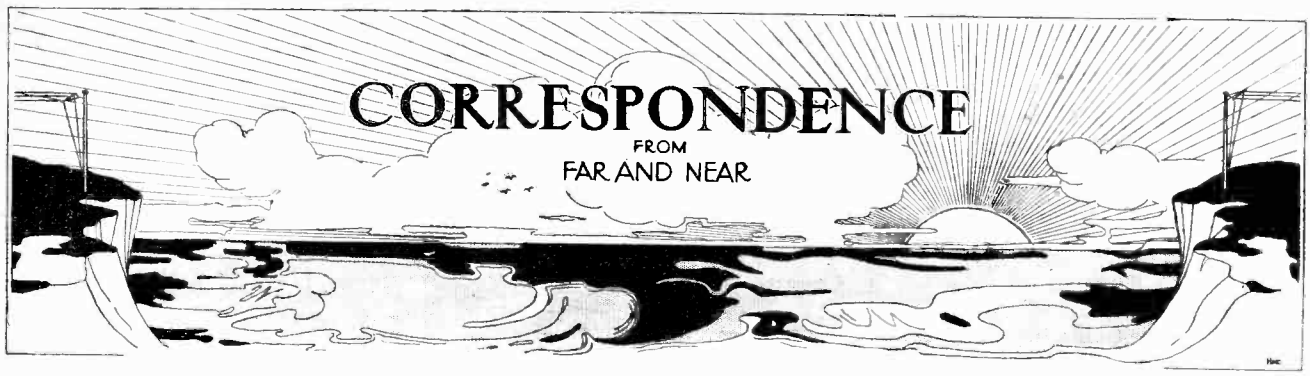
A Yodelling Programme.

Yodel songs have an attraction of their own, especially when sung by a native of Switzerland. On July 7th Marthe Hugentobler, the Swiss yodeller, will broadcast from the Dundee station, in a recital of old Swiss yodel airs.



LONG BEFORE BROADCASTING. The early days of wireless are being recalled by the Volta Centenary Exhibition now being held at Como. The two exhibits seen in the photo are replicas of Marconi's first experimental apparatus using parabolic reflectors for the transmission and reception of wireless telegraphy. That on the left is the transmitter. The replicas stand side by side with a modern "beam" transmitters!



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

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

EMPIRE BROADCASTING.

Sir,—May I take advantage of your offer to write you in regard to Empire broadcasting? Doubtless you have heard of the Holland station's (PCJJ) recent success. London was re-broadcast last Friday night, and I received the transmission almost word perfect; it was like being home again to hear the same old announcer's voice. Mine is a three-valve home-constructed set, and I use an aerial of only 30ft. Holland I listen to every night he works, but the six hours' difference in time makes many fans prefer to stay in bed rather than turn out at 1 or 2 a.m.

If by your efforts a short-wave station should be erected at home, I hope you will put this matter forward. The best time for them to broadcast, in my humble opinion, would be from midday, so that it would be received here in the evening, 6 p.m., our time, and a wavelength of 30 metres should be used, this being most free from static.

There is an enormous interest in India. I know of hundreds of keen fans; many spend hours listening to Morse, there being little else to listen to. Think what it will mean to many lonely souls, miles from anywhere, if they can only hear a few words from home. The stuff is here in the shops, everything of the latest to be had, but what is the use of building or buying sets if there is nothing to listen for? This is the usual cry. Think what it will mean to the trade at home if we had enough encouragement to build sets. The millions of folk here who would buy sets like hot cakes if England would only wake up to these facts.

Calcutta, May 26th, 1927. M. S. HALES (T. E. Bevan and Co., Ltd.).

Sir,—You will be interested to hear that PCJJ continues to be received very well here on his 30.2 metre wavelength. On May 20th, with characteristic enterprise, the Philips Company carried out a relay of Daventry through this station, thus demonstrating in a convincing manner the possibility of Empire broadcasting. Practically the whole of this transmission was listened to here, and although the strength was wonderful the quality was open to criticism. There was a definite cut-off of the higher audio-frequencies, for the sibilants were missing from a man's voice, and a woman speaking or singing was very difficult to follow. As this fault was not noticed in speech actually from Holland, but only in that relayed from Daventry, it would appear that the fault was in the amplifier between the Daventry receiver and the PCJJ transmitter, and not due to any effect caused by the use of such a wavelength for telephony. No doubt our Dutch benefactors will have remedied this defect before very long.

I wish you all success in your endeavours to create an interest at home in broadcasting to the Dominions. I should like to add that the suggestion that the beam services may be utilised for sending programmes to the Dominions and Colonies for retransmission on the normal broadcasting wavelengths would be only a half-measure. In this country at least the range of broadcast stations is very limited for most of the year because of the prevalence of atmospherics. In any case such relays from home would of necessity be infrequent, as they would interfere with the working of the proposed beam telephone services. What is wanted is a regular programme on a wavelength in the 26-35 metre band, which (if of the same power as PCJJ) would not be interfered with by anything short of a local thunderstorm. E. J. H. MOPPETT.

Roorkee, U.P., India, May 25th, 1927.

Sir,—In your issue of May 4th you ask for opinions from overseas readers regarding short-wave Empire transmission.

The London programme which has recently been received in India *via* Holland has been the subject of enthusiastic notices in the Press out here, and I am convinced that if a regular short-wave transmission could be instituted it would be a source of great delight to us exiles.

I believe I am right in saying that short waves travel as well, if not better, by day than by night, and also that they are not nearly so liable to interference from atmospherics.

At present out here to listen in to Europe one has to wait till about midnight, and, except during the cold weather months the appalling atmospherics which prevail render reception practically impossible. Both these disadvantages would be done away with by short-wave transmission.

As far as the residents of this station are concerned we would be very grateful for anything you could do to bring about this transmission.

MAJOR G. W. P. MONEY.

Almora, U.P., India, May 24th, 1927.

Sir,—As I am writing this letter I am listening to what, in my opinion, is an excellent argument in favour of England having a short wave station. It is a transmission relayed by 2XAD on 22.02 metres from WMYC of Lindbergh's reception in New York, with a continuous running commentary by announcers in various parts of the city.

The transmission was first picked up at 6.50 p.m. B.S.T., when the announcer was heard to say that about 50,000 people were massed in Broadway alone. At about 7 p.m., a band in the parade was heard, and at 7.5 p.m. Lindbergh arrived seated on the hood of his car. The cheers and clapping were clearly heard. We were then switched over to the City Hall, where fragments of various speeches were heard. At about 7.45 p.m. Lindbergh left the Hall amidst frantic cheering. Next announcements were heard from the 25th floor of the Municipal Buildings. After this a big fade took place, lasting till about 8.15 p.m. Since then signal strength has increased until now, 8.45 p.m., every word can be heard. I have just heard that Lindbergh has put a huge wreath on some memorial in, I think, Fifth Avenue.

Two or three more announcers in various streets have been heard. The description of the vast crowds and the double lines of police and soldiers provides intensely interesting padding to the rest of the account.

America is letting the world listen to the way she greets her heroes, why cannot we do the same?

Although reception is far from perfect, yet it is good enough to have kept me, with the earphones glued to my ears for two hours, intensely interested.

I could tell you a great deal more of what I am hearing, but I think I have told enough to make you realise how interesting this reception is.

Now, at 9.10 p.m., I am able to get the transmission through a loud-speaker. H. WHITTAKER.

Illingworth.

June 13th, 1927.

VALVE NOMENCLATURE.

Sir,—The Radio Manufacturers' Association of America have formed a Vacuum Tube Committee to consider attempts to standardise valve nomenclature. They have approached three radio engineers in this country who have been closely associated with valve development with a view to co-operation in this matter.

As one of those approached, I am requesting the hospitality of your columns to invite from valve manufacturers, radio societies and members of the public suggestions towards the solution of the problem of classifying in a convenient manner the different types of valves used to-day. Any suggestions sent to me will be forwarded to the committee in the United States.

How far it is practicable to classify the large number of British valves it is difficult to say. The fact remains, however, that nearly all types convey no information whatever regarding the filament voltage, filament current and voltage amplification factor or impedance. The nearest approach to satisfactory nomenclature is that applied to Burndept valves, but obviously more can be done to indicate the vital factors relating to voltage amplification and impedance.

The problem is a difficult one, and perhaps a satisfactory solution would be too complicated for general use by the public. The question, however, deserves full investigation, and, in my private capacity, I shall be only too happy to forward any British suggestions to an American industry which has honoured us by an invitation to co-operate with them.

JOHN SCOTT-TAGGART.

2, Melbourne Place, Aldwych, London, W.C.2.

TELEVISION.

Sir,—Your Editorial of June 1st on Television surprised me considerably. Surely you have seen the Press of the country during the past two years and have read that a British inventor has given not one but many successful public demonstrations of television?

However, we will let that pass, and instead I would refer you to a book written by your contributor, Mr. A. Dinsdale, entitled "Television," published in 1926, and purchasable on almost any bookstall.

In it, having referred to the various systems of television, he says of Baird, on page 49: "Baird was not discouraged. In the obscurity of his attic laboratory he worked on—money was becoming scarce: results had to be achieved—and achieved they were.

"On *January 27th*, 1926, a strange gathering thronged the stairs leading to the little attic laboratory in Frith Street. Baird *had at last achieved television.*" The italics are mine.

The paragraph refers to a demonstration given to over 40 members of the Royal Institution, and further down it is stated, "Living human faces were transmitted between two rooms by television. . . . As one of the members said (of the Royal Institution), 'He has got it. Development is now purely a matter of L.S.D.'"

A footnote to this part of the book refers to accounts in *The Electrician* of June 28th, 1926, and *Nature* of July 3rd, 1926.

This, I think leaves little doubt as to who was really first to demonstrate television successfully and in public.

I am inclined to think that you, like other Englishmen in the past, are ignoring the sterling and basic work of your countrymen and lauding the efforts of foreigners who have copied and exploited British discoveries. It happened with aniline dyes and again with wireless, in which the key discoveries of, I think it was Hughes, were discountenanced by members of the Royal Institution, who told him his discoveries could be explained by existing electrical and natural laws. They were, but nevertheless he had discovered wireless.

There is one point about your description of the A.T. and T. Company's demonstration that needs explanation. What did they do with their thousand men? I cannot conceive how they employed them all unless, as one illustration suggests, two or three looked on while one man worked. Perhaps they used them as a sort of chorus to come in at appropriate moments and sing "Who invented television? We invented television, the great A.T. and T Company." Of course, the figure may have been quoted to give a false idea of the difficulty of working television, particularly as the A.T. and T. Co. have carefully copied some of Baird's patents and have not acknowledged the use of them.

Baird's demonstrations never required more than two people—one to act as "subject"—unless, of course, you include the commissionaire at the door, the lift man, the power station hands, the people who made the various pieces of apparatus he uses, and so on. Then, of course, you can produce as imposing a total as the regiment that the A.T. and T. Company wasted its money on.

Reading between the lines, it rather looks as though the A.T. and T. Company were fishing to get the key invention to television by trying to make it appear impossible or at least very costly. Colour is given to this idea by the fact that a British company was floated some weeks ago for the purpose of putting television apparatus on the market and starting television broadcasting. W. C. FOX.

London, N.W.11. June 8th, 1927.

Sir,—Following your Editorial comment in the issue of June 1st on the first successful demonstration of television, one reads with interest the observations made by the Baird Television Development Company in your issue of June 15th. As the statements made might be convincing in support of the priority as well as the success of the Baird system, might I suggest that a demonstration of the Baird apparatus should be given before the Radio Society of Great Britain which could be fully reported on in the pages of *The Wireless World*? As a wireless enthusiast who is distressed by the sensational statements which appear in the daily Press on scientific matters and on wireless in particular, I feel that you were right in your comment. The importance of the matter now demands a well authenticated demonstration, not before non-technical newspaper men or general or journalistic scientists, but before those who have kept a keen watch on television progress—the wireless amateurs.

One has not forgotten, of course, the paper read before the Radio Society of Great Britain on the Baird system, but among those who have studied the problem of television this paper was far from complete and was subsequently commented on by M. Mihaly in the pages of *Experimental Wireless*, and many amateurs still await with interest a reply to the points raised. The paper was not accompanied by a demonstration, although Mr. Baird has frequently stated through the daily Press and illustrations have appeared in publicity pamphlets indicating that the apparatus is of simple construction and can even be used in conjunction with our broadcasting service for the home reception of moving pictures.

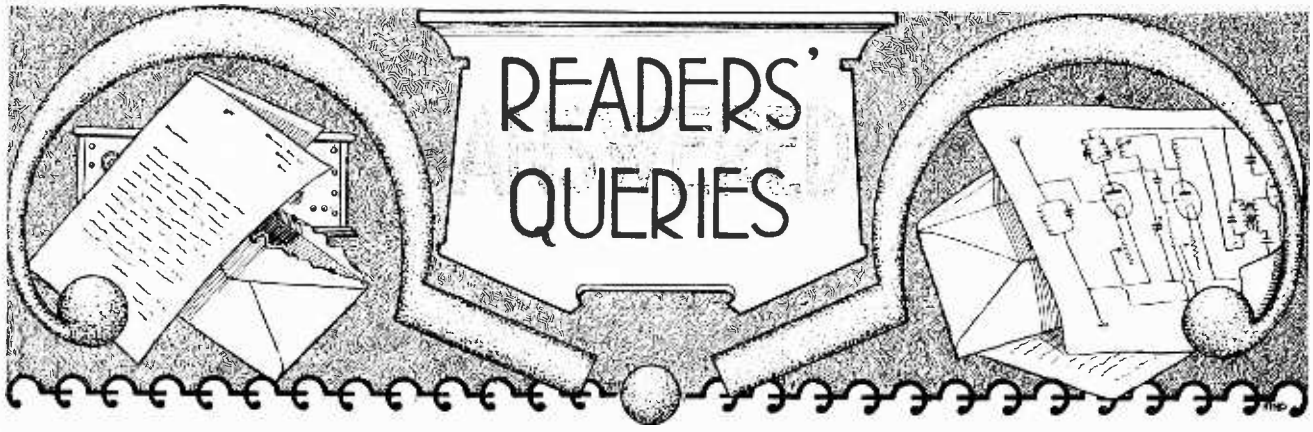
In spite of the progress which Mr. Baird has undoubtedly achieved, the wild statements which he has permitted to appear in the daily Press leaves considerable doubt in the mind of the enthusiast as to the merit of the apparatus with which Mr. Baird claims the distinction of having given the first successful demonstration of television. A. J. DIXON

Ponders End, Middlesex. June 15th, 1927. (G6PD).

TELEVISION—A SUGGESTION.

Sir,—May I make a suggestion for what it is worth? Television will probably never be an accomplished everyday fact until the problem of synchronisation has been solved. I suggest that a great wireless station should be set up to transmit, on a specially reserved wavelength, a signal at equal intervals of time, like a great clock ticking across the world. The signal sent out could be of any desired frequency, and, by its use, not only television apparatus, but also clocks, could be synchronised throughout the world. The station would be supported by users of the service. G. CHAPMAN.

Hockley, Essex. June 8th, 1927



"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Transformer Ratios.

I have two L.F. transformers, one of which has a 5 : 1 ratio and one a 3 : 1 ratio, and I intend to incorporate these in a four-valve receiver. Which ratio should be used in the first stage? V. T.

From the point of view of ratio alone it is quite immaterial which instrument is used in the first stage. We presume from your letter that you are building a four-valve set with one H.F., detector, and two L.F. stages, and are going to make use of valves of about 20,000 to 30,000 ohm impedance in the first three positions, with a good power valve of about 3,000 or 4,000 ohms impedance in the output stage. If this is the case, of course, both transformers should have a high-inductance primary which (owing to difficulties of manufacturing a high-ratio instrument with a high-inductance primary) means that the transformer will have a ratio not exceeding 3 or 3.5 : 1. If you could state the primary inductance of your instruments, we can help you better, but as it is we do not suppose that your 5 : 1 instrument has a high-inductance primary. Possibly, the 3 : 1 instrument has a much higher primary inductance, although we have had cases brought to our notice of transformers of 3 : 1 and 5 : 1 ratio respectively having the same primary inductance, the smaller ratio being obtained by the rather useless procedure of pulling off a number of the secondary turns. In such cases, of course, it is immaterial which transformer comes first, but, acting on the assumption that your 3 : 1 instrument has a higher inductance primary than the 5 : 1 ratio, we should suggest the lower ratio in the first stage, whilst you might try the higher ratio one in the last stage, using, however, a valve of lower impedance, say 7,000 to 10,000 ohms impedance in front of it. This should give satisfactory results if your transformer is by a good maker, but if otherwise there is considerable risk of it saturating under the normal plate current of a 7,000 ohm valve

Uncontrollable Oscillation.

I have a four-valve receiver (H.F.-Det.-2 L.F.) of which the circuit diagram is given on the attached sheet. This set worked quite satisfactorily with bright-emitter valves, but since I have changed over to dull emitters it has been almost impossible to prevent oscillation, which is produced when a station is tuned in. I had gathered from various remarks in your journal that the new valves are in every way an improvement over the old ones, and must admit that I am disappointed. Can you make any suggestion? A. D. L.

The circuit you are using (of which the H.F. detector portion is reproduced in Fig. 1) includes no stabilising device, and we are not surprised to hear that uncontrollable oscillation is produced when a modern H.F. valve of higher efficiency is substituted for the bright emitter. There

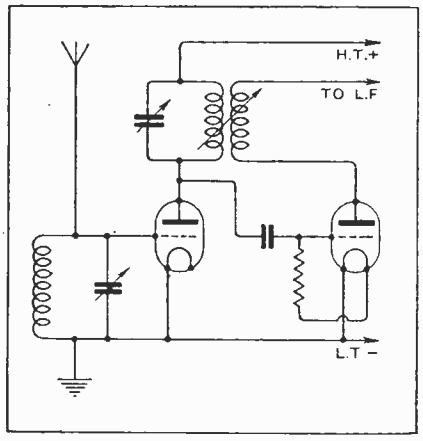


Fig. 1.—Circuit of H.F. and detector valves in the receiver referred to by "A. D. L."

is normally a good deal of coupling between plate and grid circuits, oscillation being checked only by the load of the direct-coupled aerial: this is evidently insufficient when a better valve is used.

We strongly recommend you to rebuild to a more up-to-date circuit, but if you do not care to do so it might be worth while to try the effect of short-circuiting the reaction coil holder and/or altering the relative positions of grid and anode coils. The application of a positive grid bias to the H.F. valve by means of a potentiometer would certainly stabilise the set, but this is only a palliative, and a bad one at that.

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Background Noise.

I understand that it is possible to have what is known as a "noisy" valve in one's set. Can you please explain this?—T. L. V.

In the average loud-speaker set there is always a certain unavoidable background of noise, although in a properly constructed set this is negligible. In some cases, however, the noise is excessive, and it may be found that it is not traceable to any defect in the set itself but is due to one of the valves. Modern valves are of a very high standard, and do not usually suffer from this defect, although one may still occasionally come across a specimen which has accidentally slipped through the exhaustive tests carried out by manufacturers without this defect being detected.

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Logarithmic Condensers.

I am building the "All-Wave Four" receiver. I have, however, several variable condensers of the new logarithmic type, and should like to enquire whether I can use these in the receiver or whether it is necessary to purchase the S.L.F. type as used by the authors? N. P.

It would be quite in order for you to use these condensers in the receiver in question, and thus save yourself the expense of buying the ones used. We would point out that an additional saving of expenditure can be made by using a plain dial on the aerial condenser, since the tuning of the aerial is naturally comparatively flat, and an expensive slow-motion movement would be rather superfluous.

Neutralising Unnecessary.

I wish to modernise my receiver, the circuit diagram of which is attached, by substituting the present H.F. coupling by either a neutralised tuned anode or transformer. Do you think that the change would be worth while? K. St. J. F.

We think it would be a mistake to go to the trouble of putting in a neutralised coupling unless at the same time you change your aerial tuning circuit, which at present is direct-coupled with a parallel tuning condenser. As you do not complain of lack of stability, we expect that the H.F. valve is stabilised by the aerial load, and there would be no advantage gained by neutralising as suggested, although it is possible that a more efficient H.F. transformer would improve sensitivity.

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Indoors or Outdoors?

I have built a four-valve receiver, using one H.F. stage, and am making use of the high-efficiency aerial-grid and intervalve H.F. transformers developed by THE WIRELESS WORLD. *Results have been excellent in every way on the normal aerial, but the results on an indoor aerial do not satisfy me. I have* 15 *turns in the aerial coil, with a tapping at the 8th turn, but on connecting the indoor aerial to either of these terminals results are poor. I should mention that the aerial consists only of a length of flex slung across the room.* J. C. B. R.

The trouble which you are experiencing will probably disappear entirely if you connect your small indoor aerial direct to the top of the grid coil of the H.F. valve instead of to terminals A_1 and A_2, which should be used only in conjunction with an outdoor aerial or a very large indoor aerial; you will then, of course, be using a direct coupled aerial circuit with the indoor aerial, but owing to the smallness of the indoor aerial you should not lose in efficiency.

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A Mystery Unmasked.

In my receiver I have separate switches for switching off either the H.T. or L.T., my source of H.T. being accumulators. I find that when I switch off the H.T. the programme carries on for a short period without any H.T. supply whatever, and then does not cease abruptly, but gradually fades away. What is the cause of this strange phenomenon? C. E. T. R.

The behaviour of your equipment is perfectly normal, and it is caused by the presence of the large condensers across the various tappings of your H.T. battery. When the set is in use, of course, these condensers are all the time fully charged. On breaking the H.T. supply, the condensers commence to discharge themselves, of course, and so supply the valves in the set until their charge is exhausted. The larger these condensers are the greater time will they take to discharge, and by using very large condensers indeed one could arrange for the programme to carry on for quite an appreciable time without any apparent source of H.T.

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Three-valve Receiver.

I propose to construct a three-valve receiver capable of giving good loud-speaker reproduction from the local station and possessing sufficient sensitivity to enable a number of the more distant stations to be received. It is desired to use the receivers for the reception of long-wavelength stations such as Daventry and Radio Paris. Can you recommend a circuit which would answer my requirements? J. M.

A three-valve receiver consisting of one H.F. amplifier, a detector valve and one transformer-coupled L.F. stage would be most suitable in your case. If you construct a receiver on the lines indicated in Fig. 2 you will have an excellent three-valve set capable of efficient performance on both the medium and the long wavelengths. This is a modification of the "All-Wave Four" receiver in which interchangeable aerial coils and H.F. transformers are employed, and accordingly this portion of the receiver will be identical with that of the "All-Wave Four," constructional details of which were published in the April 27th issue. A modification is recommended to the detector valve circuit and the resistance-capacity coupling has been replaced by an L.F. transformer. It will be necessary to have a transformer with a high primary impedance owing to the retention of anode bend rectification, and the Ferranti A.F.3 would be a suitable component to employ. In view of these modifications, the valves recommended for use in the "All-Wave Four" will not be the most suitable and we accordingly recommend the following. The H.F. valve will remain as formerly, namely, one having an A.C. resistance between 20,000 and 50,000 ohms, but the detector valve must be one of a much lower internal resistance. We do not recommend a valve of higher A.C. resistance than 20,000 ohms, and a Cossor 610 H.F. or Mullard P.M.5X would be a typical example of the type specified. One low-frequency valve only is shown, and we must accordingly have a power valve in this position, such as a Mullard P.M.256 or one with similar characteristics.

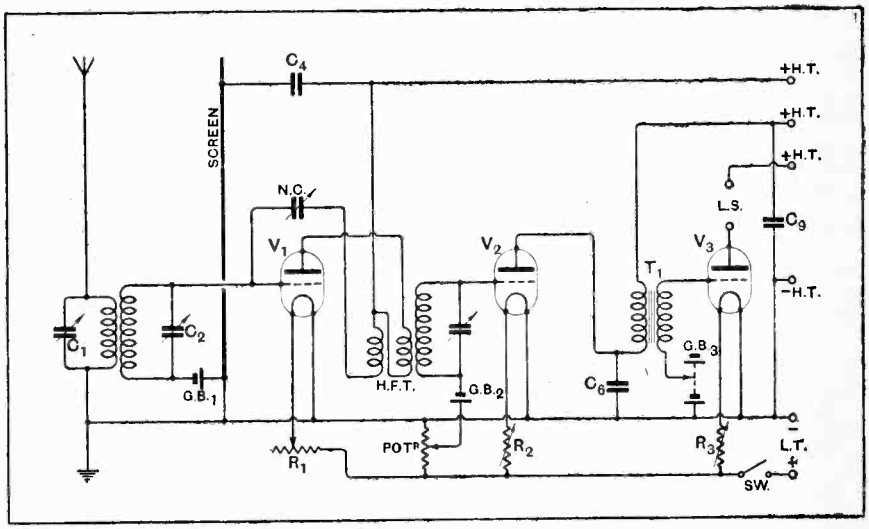

Fig. 2.—Three-valve circuit for long- and short-wave reception.

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When Jacks are Undesirable.

I am constructing the "All-Wave Four," but wish to insert jacks in order to use the H.F. and detector only, or to use one or two L.F. valves after the H.F. and detector valves as required, and shall be glad if you will give me an amended diagram to embody this. J. M.

We should be doing you a definite disservice to recommend you such an arrangement, for many reasons. In the first place, we would point out that both L.F. stages are of the resistance coupling type employing high anode resistances, and the stray capacities associated with the jacks would very effectively reduce the efficiency of the L.F. amplifier, quite apart from the instability which would probably be caused. Another point is that, in any case, the high resistances are in the anode circuits of very high impedance valves, and if jacking were arranged to substitute phones or loud-speaker for the high resistances terrible quality would be obtained, owing to the fact that the valve used is of very high impedance, and, consequently, we should lose all our low notes. It would be useless also to attempt to use the telephones in series with either of these resistances, owing to the very small percentage of volts dropped across the telephones as compared with the volts dropped across resistance and telephones combined. In other words, nearly all our volts would be dropped across the resistance, leaving practically nothing for the telephones.

Wiring the "Everyman Four."

In the "Everyman Four" booklet it is stated that three earth wires are connected to the screen, but I can only see two in the practical wiring plan. As I am in difficulties with the connecting up of this receiver I should appreciate elucidation on this point.
S. M. F.

We consider that this matter is fairly clear from both practical and theoretical diagrams. The positive side of the grid-bias battery is earthed to one point on the screen, while the earth terminal is joined to another. Both these wires connect to that side of the screen next to the aerial-grid transformer. A third lead coming from one side of the by-pass condenser C_6 and also originally from L.T.−, joins to the other side of the screw to which the last-mentioned connection is made.

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Valve Filaments in Series.

I have constructed a two-valve portable receiver, and, to economise in current consumption, have wired the filaments in series in accordance with suggestions I have seen from time to time in your journal. Both the valves are rated at 1.8 volts, 0.1 amp., but they are of different manufacture. Perhaps this accounts for the fact that the set seems to be absolutely "dead," and I can hear no signals whatsoever. V. M.

The fact that your valves are of different make does not account for your failure. When connecting filaments in series all that one need concern oneself with is current, at the same time bearing in mind the fact that the total voltage applied must equal the sum of that at which individual valves are rated. Your valves will require a total of 3.6 volts across their filaments and will, of course, consume 0.1 amp. As you are probably using a dry battery of 4½ volts we suggest that you include a filament rheostat of 10 ohms maximum.

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No Switching.

Please give me a circuit diagram showing how one of the L.F. stages in the "All-Wave Four" receiver may be switched out by means of a jack. This is to enable me to listen to the local station without the necessity of using all four valves. C. C. R.

We think that it would be a great mistake to recommend you to insert a jack for this purpose, as in our opinion this form of switching (or, indeed, any other) should be used only with the greatest care in any amplifier employing high ohmic resistances in the anode and grid circuits. For local station work it would certainly be better and much simpler to switch out the H.F. valve, and to partially deneutralise. Under these conditions you should obtain adequate volume and the current consumption of the whole set will be less than that of many 2-valve receivers, because both detector and first stage L.F. amplifier consume very little current from the batteries.

Simplicity or Selectivity.

I should be obliged by your criticism of the enclose circuit diagram. The receiver gives very fair results, but is not at all selective, and it is in this direction that the suggestions for improvement would be appreciated.
W. T. A.

Your circuit diagram shows a tapped aerial tuner directly coupled to a detector valve followed by two stages of L.F. amplification. Now this tuning arrangement has many advantages from the point of view of simplicity and quick change of wavelength, but it must be lacking selectivity, as judged by modern standards. and we are afraid that very little can be done to improve it, short of entirely remodelling the receiver. Our only suggestion is that you should try the effect of connecting a fixed condenser of from 0.0001 to 0.0002 mfd. (the best value is only to be found by test and may be somewhat larger than that indicated on the long wavelengths) in series with the aerial. When selectivity is required you will adjust the tappings on your aerial coil so that the tuning condenser across it is set at a fairly high value.

The Cure for Overloading.

I think that your suggestion (made in a previous reply) as to the cause of my trouble with distortion must be correct, as I find that the needle of a milliammeter inserted in the anode circuit of the last valve fluctuates violently when signals are being received; thus I take it that this valve is being overloaded. How can I remedy it? H. W.

We are afraid that there are only two courses open to you. The first is that you substitute in your output position a valve with a greater voltage-handling capacity, and also with a suitably increased grid bias voltage, or else you must satisfy yourself with the weaker signals obtainable by reducing signal strength to the point where distortion is no longer produced.

A "Reflex" Difficulty.

I am using a "Roberts Reflex Neutrodyne" receiver, and find that with the detector valve switched off it is possible to hear signals from the local station at almost loud-speaker strength, and should be interested to know how this can happen, as it alone could function as a dual amplifier. G. S.

It would appear probable that your reflex valve is over biassed and, indeed, the only way it can give signals without the detector is by acting as a bottom bend rectifier. It is quite feasible that on a very large input you should obtain loud signals with the arrangement, but as you suggest the valve cannot be operating as a reflex amplifier.

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Gas or Water?

I have the choice of two alternative earth connections, the gas pipe or the water pipe. No doubt the latter would prove the more efficient owing to the superior conductivity of water. In my case, however, the gas pipe takes the shorter path to earth, and I am undecided which to use. Could you please advise me on this point?
T. H.

Under no conditions should a gas pipe be used as an earth connection for a wireless receiver. Any length of wire, such as an aerial, is likely to accumulate an electric charge, this being more probable during the summer months. Strong "atmospherics" might quite possibly charge an aerial sufficiently to cause minute sparks to occur at any joints in the system. Should these sparks take place at a leaky joint in a gas pipe unpleasant results are likely to be encountered, and we therefore strongly discourage its use as an earth lead.

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Leaky Insulators.

I am using a crystal receiver in a large manufacturing centre, and during the last six months my reception of the local station has become progressively weaker. The receiver has remained unaltered, and although various crystals have been purchased no improvement results. I should be obliged if you could suggest a possible explanation. A. P. S.

The atmosphere in your district is no doubt heavily laden with soot and other impurities given off from factory chimneys. These impurities will be deposited on aerial insulators, and owing to the presence of carbon in soot will result in surface leakage. In time the surface resistance of the insulators will be lowered and serious losses will occur. An increasing percentage of the aerial energy will be by-passed to earth, this being accompanied by a decrease in the strength of broadcast signals.

We suggest you take down the aerial, remove any deposit from the insulators, and before re-erection connect three or four of the bobbins in series, thus minimising the possibility of this trouble recurring.

The Wireless World AND RADIO REVIEW

(15th Year of Publication)

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THE EMPIRE STATION DELAY—A REMEDY.

As this issue is chiefly concerned with matters of short wave interest, including articles giving designs for a 45-metre transmitter and a short wave receiver, it is only natural that our thoughts should turn once more to the question of Empire Broadcasting and the need for a British short wave station.

Letters continue to arrive from overseas impressing upon us the urgent demand for Empire broadcasting, and unless Britain intends to turn a deaf ear to the supplications of those who people our distant units of Empire it is imperative that we should act quickly. Our main concern is that a station should be established without any unnecessary delay; it is a worthy object, in the way of which the Government—including the Post Office authorities—would place no obstacle. Writtle, the first broadcast transmitter of a regular character in this country, and the forerunner of the established transmissions of the British Broadcasting Company, was an undertaking of private enterprise conducted by the Marconi Company, the authority for which was obtained from the Post Office by the Radio Society of Great Britain.

The British Broadcasting Corporation has given as its excuse for not proceeding earlier with a short wave broadcasting station that it is not justified in spending public money on experimental work unless a satisfactory result from that work is already in view. The preliminary work of an experimental kind before the first B.B.C. stations were established was undertaken by the big wireless companies, and when a long wave station was decided upon it was first established and all experiments conducted in connection with it at the Marconi Company's works at Chelmsford.

The Solution.

We sympathise with the attitude of the B.B.C. that it is not justified in incurring heavy expenditure on experimental work, but such experimental work, we believe, would readily be incurred by one of the commercial companies if the station, when established in going order and after having passed specified tests, could be handed over to the British Broadcasting Corporation at an agreed price, just as in the case of the beam stations the Post Office gave to the Marconi Company the contract for their establishment at an agreed figure and the Post Office was not committed to take over the stations and pay for them until they had passed the required tests.

We do not expect the B.B.C. to have at its disposal the same facilities as a commercial wireless company for the building of a short wave broadcasting station at short notice, but this work could undoubtedly be done on their behalf, and our suggestion is that the B.B.C. should invite tenders for a station such as is required and place a contract with one of the commercial companies. There would then be no excuse for delay and the B.B.C. could stipulate a time within which the station was to be ready to be taken over by them. The matter is urgent and we see no reason or excuse for delay.

CONTENTS.

EMPIRE BROADCAST RECEPTION

A Receiver for Wavelengths from 20 to 70 Metres.

By H F. SMITH

NOW that the efforts of *The Wireless World* seem likely to be rewarded in the not-too-distant future by the inauguration of a British short-wave broadcasting service, amateurs both at home and in the overseas Dominions and Colonies are turning their attention to this specialised branch of the wireless art. The interest of the former is aroused not so much because they themselves expect to gain any great benefit from the British station, but because the fact has been emphasised as never before that short-wave transmissions have an extraordinary range, considered in terms of power input, and because, if the wavelength is suitably chosen, these ranges are attained when daylight exists over the greater part, or even over the whole, of the signal path. Under these latter conditions good signals are not infrequently received from across the Atlantic. Gone are the days when it was necessary to "sit up for America" into the early hours of the morning. One of the greatest charms of reception on the ultra-short waves is that the necessary apparatus is neither elaborate nor expensive; indeed, the complex and so-called "powerful" multi-valve set seldom seems to put up a performance sufficiently good to justify its initial cost.

Interesting as the subject may be for the amateur in the British Isles, we must not lose sight of the fact that the proposed transmissions are primarily intended for the benefit of those of our own race living at great distances from the Mother Country, and that our own interest in the matter is purely a subsidiary one. The description of an Empire broadcast receiver may possibly appear to be premature, but even now there are signals to which it is worth while listening, and many will wish to gain experience of this form of reception.

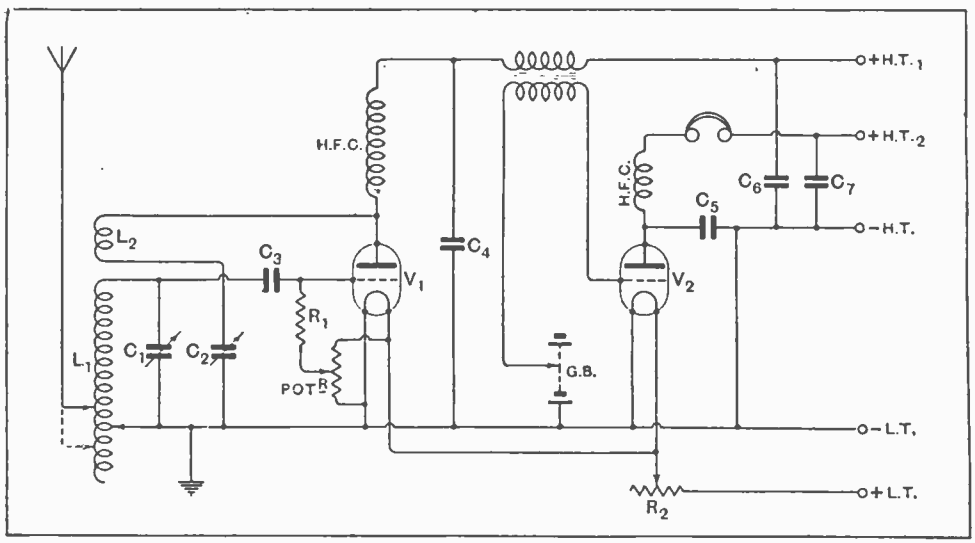


Fig. 1.—The circuit diagram. C_1, C_2, C_4, 0.0002 mfd.; C_3, 0.0001 mfd.; C_5, 0.001 mfd.; C_6, C_7, 2 mfds.; L_1, aerial-grid coil; L_2, reaction coil; R_1, 5 megohms.

This is neither the time nor place to enlarge on the subject of Empire broadcasting, but it may be permissible to make a few observations as to the results which can be obtained at the present state of development. In the first place, it should be emphatically stated that the user of a short-wave receiver must not expect to receive consistently signals from a transmitter—perhaps thousands of miles away—which will be comparable

Empire Broadcast Reception.—

with those from a local station. This statement should be unnecessary, but it is observed that some enthusiasts are apt to think that the system is a complete solution of the problem of long-distance work. It is not; signals suffer from most of the disabilities of those on the normal wavelengths, with the addition of a peculiar trouble of their own, known as high-speed fading, but in spite of this they are received with some reliability at greater distances than by any other system, excepting the beam, which for obvious reasons is of limited interest to the amateur.

Daylight Range.

At the present time of year, under summer conditions, when atmospherics are at their worst and when daylight covers the greater part of the path across the Atlantic, the chances of receiving intelligible signals from either of the two American stations on 32.77 or 22.02 metres at any given time during their periods of transmission are distinctly in favour of the listener. This statement is made as a result of careful observations under what may be described as average conditions, and gives a fair idea of what may be expected. There are, of course, times when signals fail altogether, and others when fading or atmospherics render reception impossible. It is a fact, however, that atmospherics are generally less troublesome on the short waves, and this is particularly true in tropical climates. Even in this country, incredible as it may seem, there are occasions when the signal-strength to atmospherics ratio is better on American short-wave transmissions than on those of a broadcasting station 50 or 100 miles away.

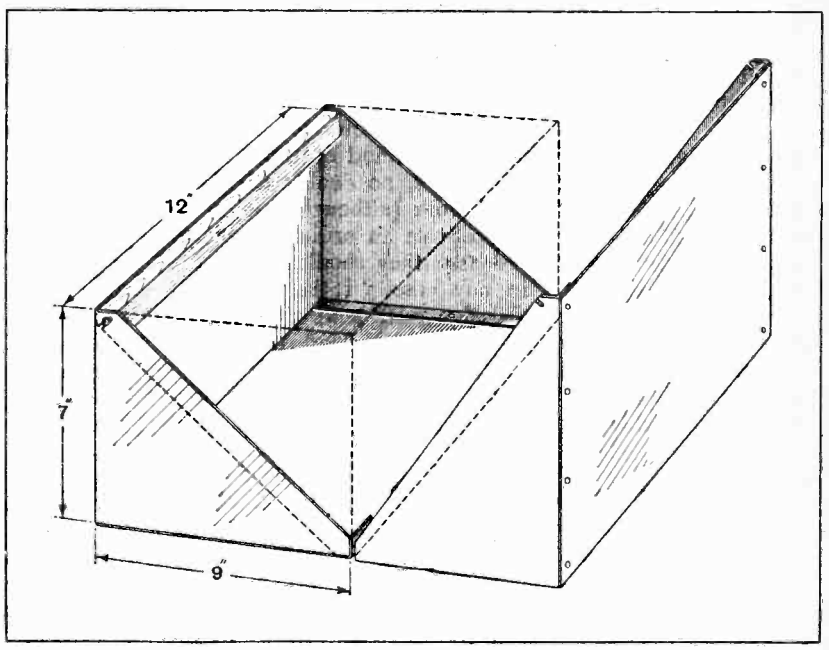


Fig. 2.—The containing case, with lid open.

As has been suggested above, there is no need for elaborate apparatus, and a detector-L.F. combination, of the type which it is proposed to describe, is the most generally favoured receiver. As pure high-frequency amplification is almost out of the question at present, we have to depend on the use of reaction; provided that really critical control of this invaluable aid to sensitivity is obtained, and hand-capacity effects are minimised, the problem of design is practically solved. The first requirement is met by introducing capacity-controlled regeneration with a well-proportioned reaction coil, together with a careful choice of H.F. choke, grid leak, and condenser values, and the provision of a detector grid voltage adjustment. The second is assured by arranging for the spindles of the variable condensers to be at earth potential, by fitting an H.F. choke in the phone leads, and by thoroughly screening the apparatus. The circuit is conventional, as will be seen from Fig. 1; it comprises the usual grid detecting valve, followed by a transformer-coupled low-frequency amplifier. An additional by-pass condenser, C_4, is added, in effect, to that already included in the transformer, in order to dispose of H.F. currents in the anode circuit; this addition to the transformer would hardly be permissible in a receiver designed for the normal broadcast wavelengths, but it is legitimate in this case.

The complete screening mentioned

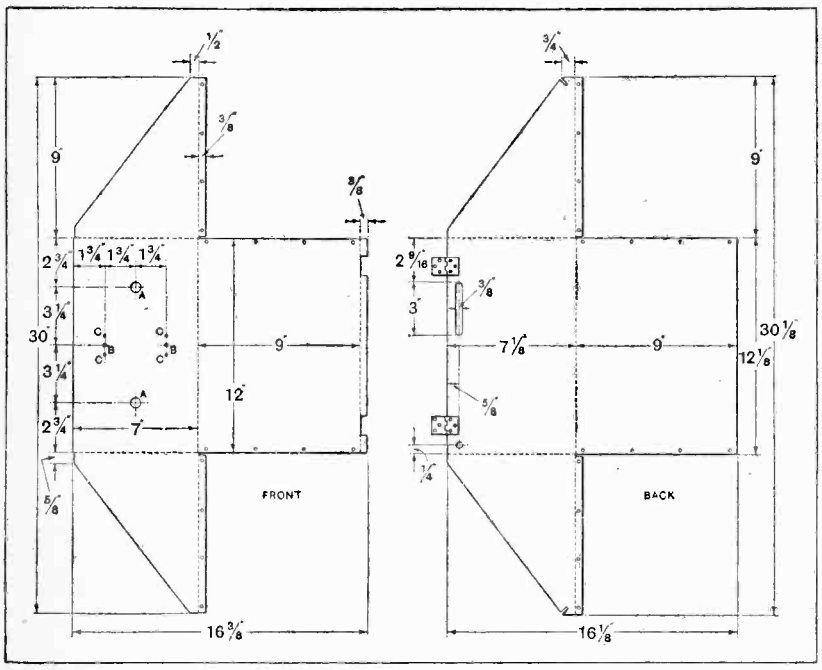


Fig 3.—Constructional details of the front and back sections of the metal case. Positions for the panel holes are shown. A, 9/16in.; B, 3/8in.; C, 5/32in.

Empire Broadcast Reception.—

above is obtained by mounting all the apparatus in a containing case made of sheet aluminium; No. 16 gauge was actually used, although it is probable that No. 18 would be heavy enough for ordinary requirements. It is not essential, however, that this method of construction should be followed; many readers, no doubt, will hesitate to embark on sheet-metal work (although it is by no means difficult), and may substitute an ordinary wooden cabinet, but it is suggested that they should retain the aluminium front panel in any case. It seems likely, however, that short-wave design will tend towards the use of these metal containers, which lend themselves particularly well to the construction of a set intended for tropical climates. Thus, in all probability, boxes similar to that illustrated will become available commercially.

Constructing the All-metal Case.

The case is made in two similar parts, which are hinged together, the construction being shown in Figs. 2 and 3. The latter shows the exact dimensions to which the sheets forming each section should be cut before bending at the dotted lines. The seams are riveted together, small brass pins being used as rivets. To avoid the need for another bend (which would give sufficient rigidity) a stout wooden batten measuring $\frac{5}{8}$in. × $\frac{7}{8}$in. in cross-section is screwed to the rear upper edge of the front panel. Two screws, the projecting heads of which engage with slots in the lid, thus forming a catch, are passed into the ends of the batten. Another slot, of the dimensions shown in Fig. 3, is cut to receive the connecting leads, and a hole, which is preferably bushed with ebonite, is drilled to take the phone cords. A wooden base, $\frac{3}{8}$in. thick, and of the full internal dimensions of the case, is secured to it by wood screws passing through the bottom, which is raised on four small rubber buttons (sold by ironmongers as "cupboard

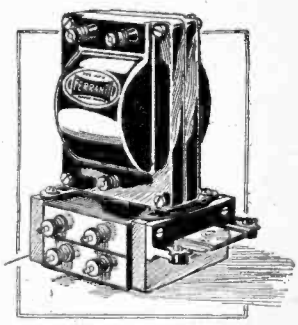
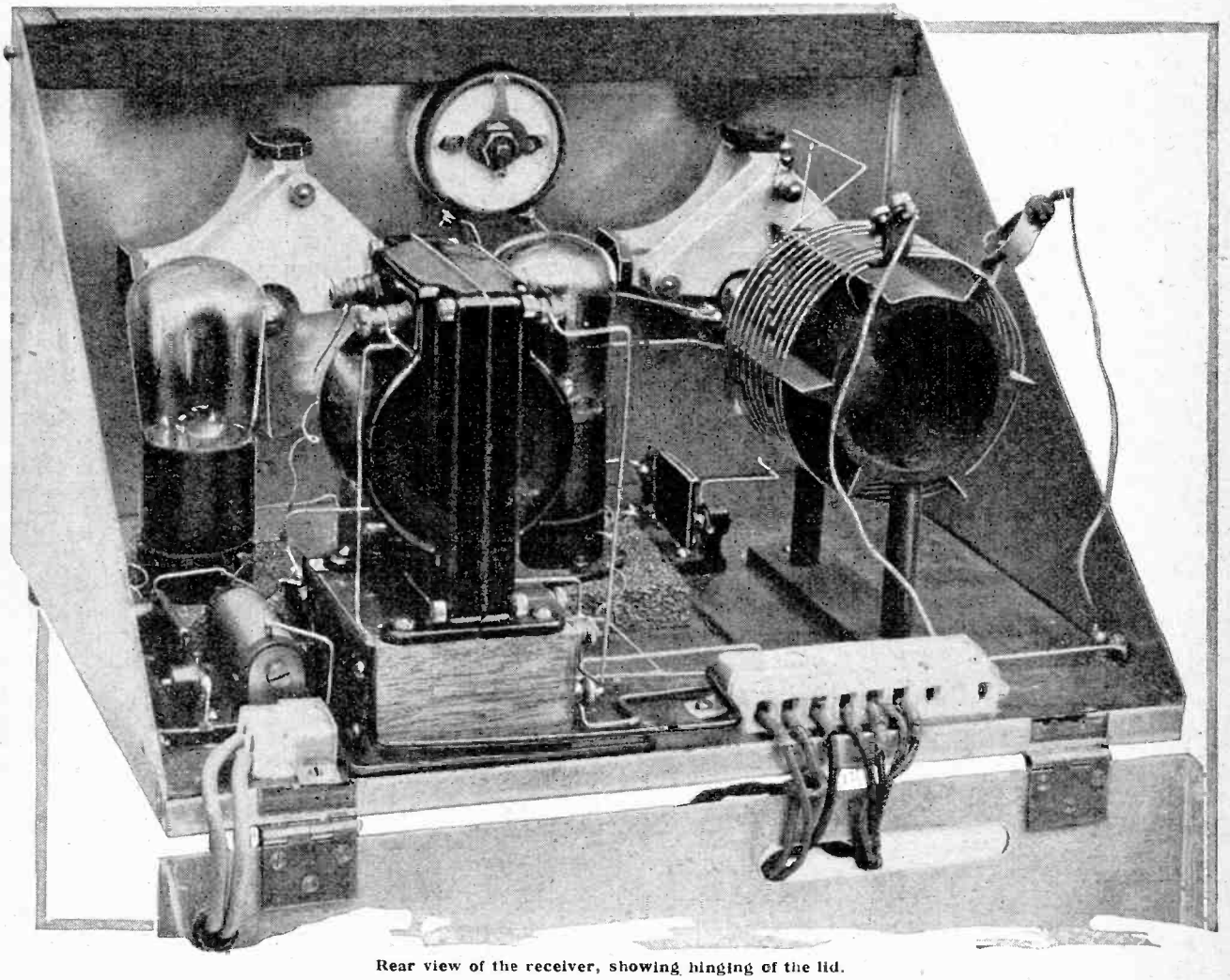


Fig. 4.—Mounting for the L.F. transformer, reservoir condensers, and by-pass condenser C_4.



Rear view of the receiver, showing hinging of the lid.

Empire Broadcast Reception.— stops "). Those who have had no previous experience of work of this kind and who doubt their own capabilities are recommended as a preliminary to make a full-size model case of cardboard.

The aerial-grid coil L_1 consists of nine turns of No. 18 tinned copper wire, which are wound with $\frac{3}{16}$in. spacing between the centres on a ribbed former 3in. long by 3in. in diameter. The reaction coil L_2, having 5 turns of No. 30 D.S.C., is wound in the same direction, with adjacent turns touching, and is spaced $\frac{3}{8}$in. from that end of L_1 which connects to the grid condenser. The ends of this winding are secured to soldering tags screwed to the ribs, while those of the heavy wire coil are passed through holes in the body of the former, which is raised on two ebonite pillars $1\frac{7}{8}$in. in length; these are attached to an ebonite base.

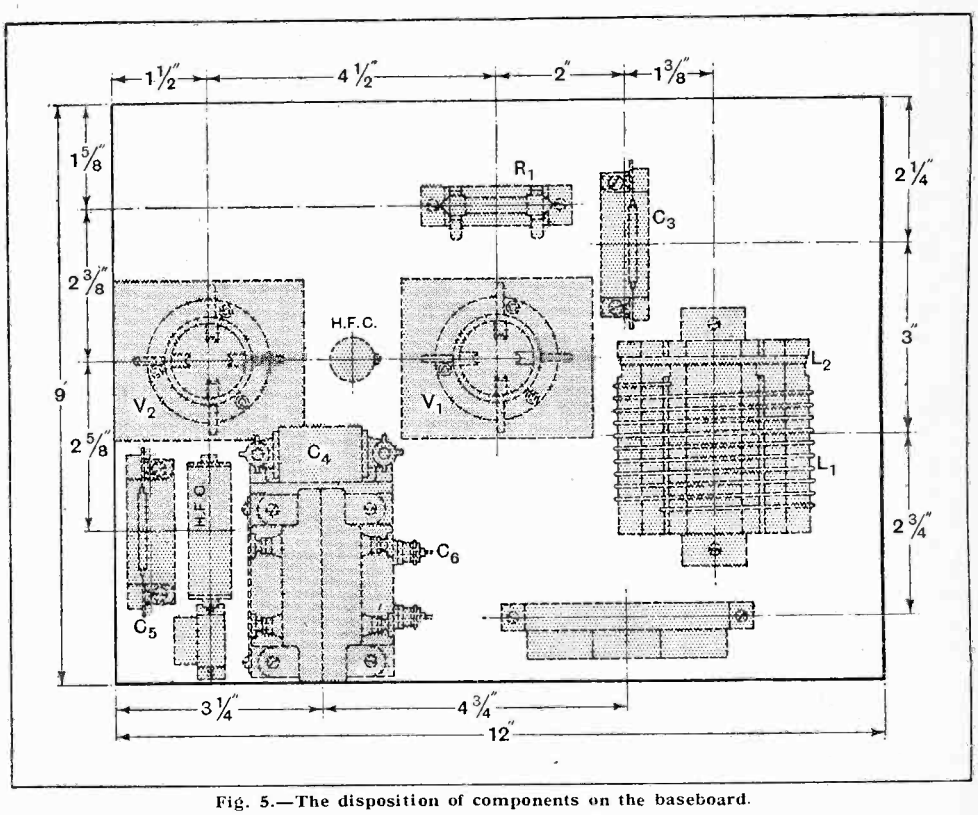


Fig. 5.—The disposition of components on the baseboard.

The H.F. choke in the anode circuit of the detector valve is wound on an ebonite rod $\frac{3}{4}$in. in diameter and 3in. long, which is mounted vertically, being secured in position by a screw passing through the bottom of the case. Its winding is a single-layer solenoid of No. 42 D.S.C. wire, with turns touching, and a length of $1\frac{3}{8}$in. The choke in series with the phones is of similar construction, except that the former is 2in. in length and is mounted horizontally on two brass brackets. The ends of the windings of each of these coils are soldered to the heads of small brass screws inserted in the formers; these serve also as points of attachment for the leads to the external circuit.

To economise in space, the L.F. transformer is raised on two small wooden strips, the 2 mfd. by-pass condensers C_6 and C_7 being mounted underneath it, while C_4 is attached to the side, as shown in Fig. 4. Porcelain connectors are used in place of the more conventional terminal strip, and they are secured to the baseboard as shown by aluminium strips, drilled so that access may be had to the heads of the inner screws. Both in this matter and in the mounting of the valve holders, which in the receiver, as illustrated, are supported on shock-absorbing sponge rubber bases, the constructor may follow his own ideas.

If a rheostat and potentiometer of different construction are substituted for those specified, it may be necessary to bush the panel, as it is essential that the spindle should be insulated. With the particular type shown

LIST OF PARTS.

2 Variable condensers, 0.0002 mfd., with slow-motion dials (Utility).
1 Filament rheostat, 6 ohms (Igranic Pacent).
1 Potentiometer (Igranic Pacent).
1 L.F. transformer (Ferranti A.F.3).
1 Fixed condenser 0.0001 (with base), (Igranic Freshman).
1 Fixed condenser, 0.0002 (with base) (Igranic Freshman).
1 Fixed condenser, 0.001 (Igranic Freshman).
2 Fixed condensers, 2 mfds. (T. C. C.).
2 Valve holders (Excelsior Motor Co.).
1 Grid leak, 5 megohm (Dubilier).
1 Porcelain base (A. F. Bulgin & Co.).
1 Ribbed ebonite former, 3in. (Becol).
2 Spring clips (Baltic).
3 Three-way porcelain connectors.
1 Two-way porcelain connector.
Sheet aluminium, ebonite rod, wire, screws, etc.

Approximate cost £5 0 0.

In the "List of Parts" included in the descriptions of THE WIRELESS WORLD receivers are detailed the components actually used by the designer and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

Empire Broadcast Reception.—

this is prevented by drilling a central hole with an ample clearance, and also by enlarging that in the indicator disc. As an additional precaution, a thin tube of insulating material may be slipped over the spindles.

The remaining points regarding assembly and wiring will be sufficiently clear from the various diagrams. Particular note should be made of the fact that the rotors of both condensers and one end of the potentiometer winding are in metallic connection with the case; this contact is obtained automatically by making use of the one-hole fitting on the former components, but it should be pointed out that the large brass washer supplied with the make of condenser shown should not be removed, as it would be were the instrument to be fitted on a thicker panel. The potentiometer connection is made by a strip of metal clamped between the porcelain base and the panel.

Suitable Valves.

The disposition of the more important connecting wires (those to the variable and grid condensers, the grid and reaction coils) are shown clearly in the photographs. It will be seen that the leads to the valve holders are made with short lengths of "flex," as otherwise the advantages of rubber suspension would be lost.

The choice of valves for a receiver of this description is not a difficult matter; as a detector (V_1), one of some 20,000 to 30,000 ohms impedance, with an amplification factor of, very roughly, from 15 to 20, is difficult to beat. Among representative specimens in this class we have Cossor 610 H.F., Marconi and Osram D.E.8 H.F., Mullard P.M.5X, and a number of others, mostly with their counterparts in the 2- and 4-volt ranges. It is recommended that an H.T. voltage not greatly in excess of 40 should be applied to this valve. As for V_2, we have a still wider choice, as any "L.F.," "general purpose," or "power" type will work well. The maker's instructions as to anode voltage and grid bias should be followed.

Operating Details.

The operation of any receiver, be it crystal set or superheterodyne, can only be mastered by practice, and it is as easy to give really definite instructions on the subject as to prepare a correspondence course on the painting of a masterpiece or the composition of a symphony. While the set under discussion is no exception to the rule, its design is such that operation is a comparatively simple matter. It is suggested that, for the 20-40-metre waveband, the earth clip should be set to include about 6¼ turns of the inductance, starting from the grid end. The aerial tapping may be made on the next turn down, remembering that its exact position should be a subject for experiment. The potentiometer may be set at a central position, or perhaps a little towards the

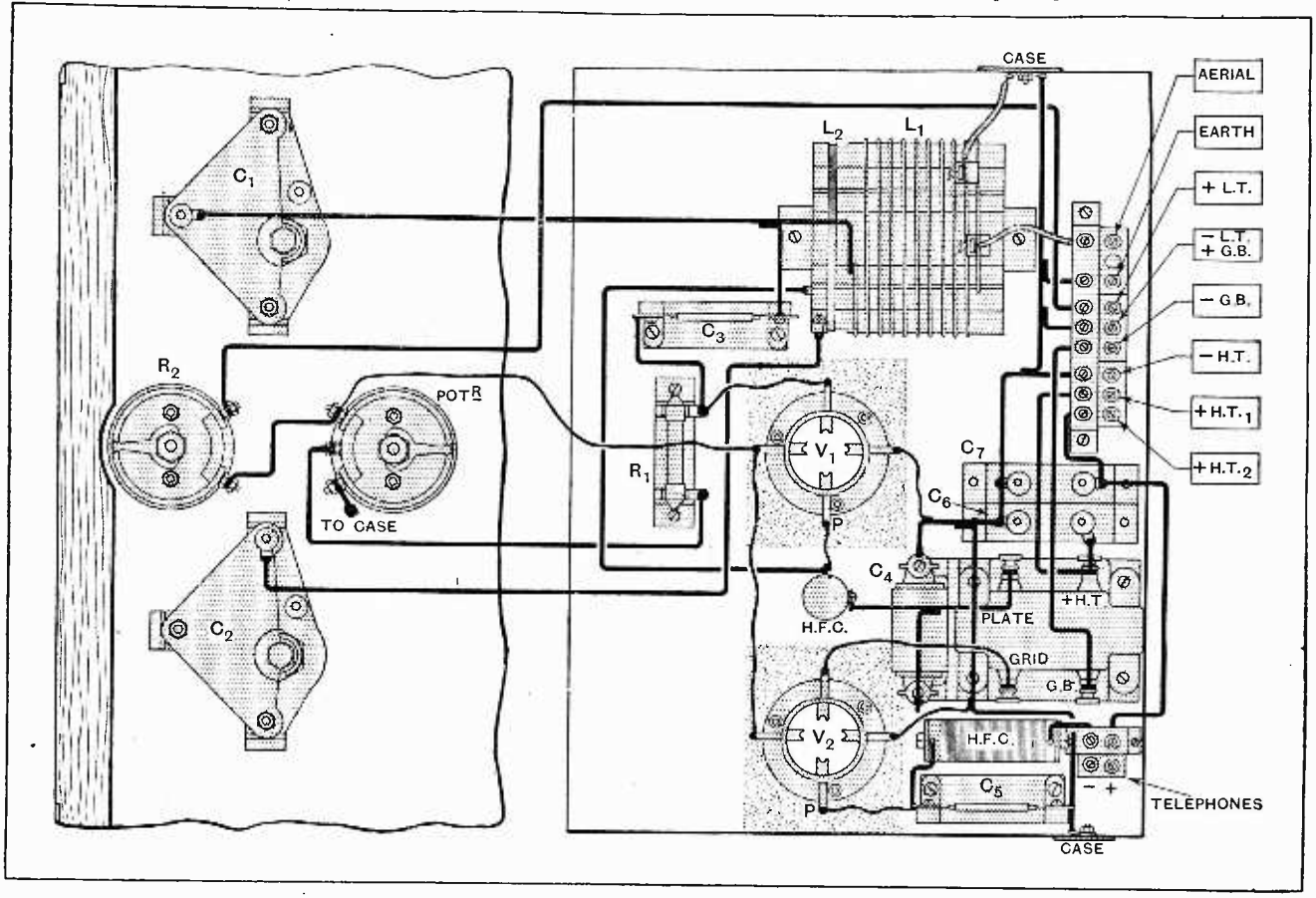


Fig. 6.—The practical wiring plan. The plate of V_1 is joined to the end of the reaction winding nearest to the grid coil.

A 10

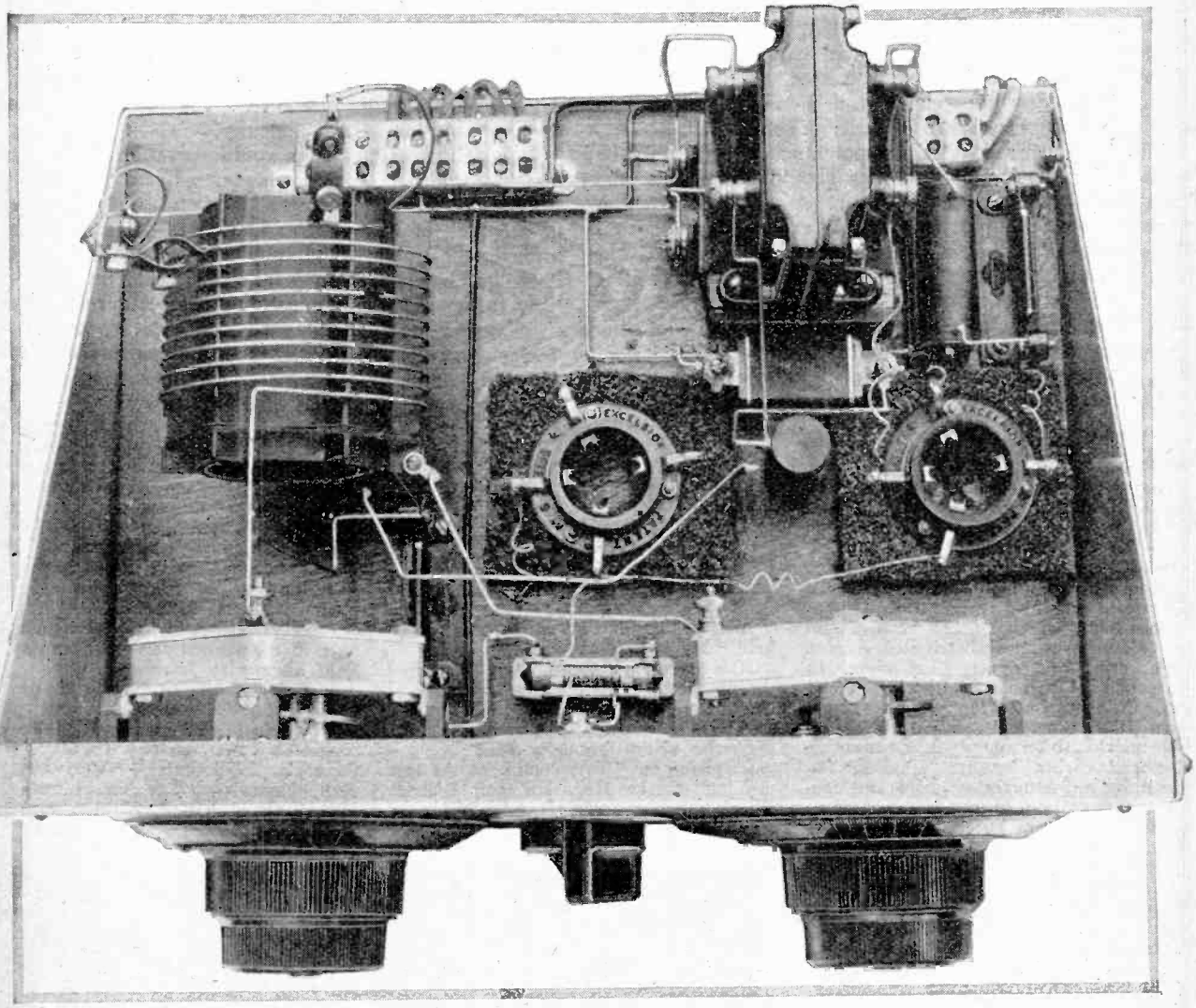
Empire Broadcast Reception.—

negative side, particularly if 6-volt valves are used. The reaction condenser (C_2—the right-hand dial) is now moved slowly from zero towards its maximum position until the valve is on the verge of self-oscillation. Provided that signals or atmospherics are now heard, it is probable that no serious fault exists, and searching may be commended, by rotating the tuning condenser (C_1) slowly and following up each movement with the reaction control in such a way that the set is always near oscillation and thus in its most sensitive condition.

As a guide to the location of the different wavelengths, it may be useful to know that, with the coil tappings as indicated above, the tuning condenser is set at about 30 degrees for the Schenectady station, 2XAD, on 22.02 metres, while the adjustment for the companion transmitter, 2XAF (32.77 metres) is 90 degrees. The Dutch station at Eindhoven, PCJJ, on 30 metres, will be found at about 75 degrees.

For the longer wavelengths, up to 70 metres, the earth tap should be made to the extreme end of the coil remote from the grid, the aerial being joined to a point about 2 turns above it. With this adjustment the Pittsburgh station, KDKA (64 metres), is tuned in at about 145 degrees. Incidentally, this station is "coming over" very indifferently at the time of writing, and is, as a rule, not receivable till the early hours of the morning. The condenser setting corresponding to amateur transmitters on 45 metres is about 90 degrees; these afford good practice in tuning and are generally to be heard working during the week-ends. With the same tappings 2XAF should be heard at about 30 degrees, but it is generally better to work with more capacity on this wavelength.

A wavemeter is admittedly a useful aid to the finding of a desired wavelength, but it is by no means essential. The absorption instrument described elsewhere in this issue is, unfortunately, not of a particularly suitable kind



Plan view of the receiver, with lid completely removed.

Empire Broadcast Reception.—

for use with a totally screened set, as to make a measurement it is necessary to open the case, and, when closing it, to allow for the resulting decrease in inductance. This decrease, however, is not very great and is compensated for by an increase of a few degrees in condenser reading.

The conventional type of aerial, as used for broadcast reception, is quite suitable for short-wave work, but it should be taut and well-insulated, particularly at the "free" end. Any swinging will cause a variation in signal strength. A short earth connection is particularly desirable, as any appreciable drop in H.F. potential in this lead will give rise to capacity effects.

The best adjustment of the potentiometer can only be found by trial; the general idea should be to make the grid as positive as possible, consistent with good reaction control Its setting is, to a certain extent, dependent on the resistance of the leak, and it should be pointed out that if trouble is experienced with "threshold oscillation" (the production of an L.F. howl as the valve goes into H.F. oscillation), an increase in the value of this resistance may help to put matters right.

A few suggestions as to batteries may be of value to those situated in localities remote from civilisation, and particularly in tropical countries. Naturally, under these conditions, the most economical valves will be chosen—probably those rated at 2 volts 0.1 amp. This consumption is not beyond the capabilities of dry cells, which, however, are apt to deteriorate in transit and stock, so "inert" or large-capacity wet primary cells (of which improved types are now available) are generally preferable. An H.T. voltage of 45 is sufficient; this may be derived from about thirty small "inert" cells. Ordinary dry H.T. batteries are quite out of the question. Needless to say, where there are facilities for recharging, the use of accumulators for both high- and low-tension is the best solution of the difficulty.

In conclusion, the writer would stress the point that the reaction condenser should be regarded as a "volume control," and not as a tuning adjustment. In other words, its direction of rotation should always be from minimum towards the point where oscillation is about to be produced. This remark may be superfluous, but, due possibly to the fact that the reaction control *does* have some effect on tuning (only very slight, however, in this particular receiver), it is noticed that beginners almost invariably handle this condenser in the wrong way, incidentally to the annoyance of other listeners.

NEWS FROM THE CLUBS.

Those 200 Yards!

One of the most exciting and profitable Field Days yet held by the Golders Green and Hendon Radio Society took place on Sunday, June 19th, when six parties each equipped with a receiver, frame aerial and a motor car engaged in a hunt for a concealed transmitter.

Zero hour, which was 12 noon, found the different parties distributed over a large area of country extending to Harpenden, Redbourn, Chorley Wood and Chipperfield. Transmission began from the concealed station 5CT on 150 metres (interrupted C.W.) sending 10-second dashes for five minutes, followed by a five minutes pause and continuous repetition in this order. Four of the six parties succeeded in coming within a mile of the secret transmitter before the close of operations at 3.30 p.m., while special credit is due to Mr. Maurice Child's party, which finished up within sight of the transmitter only 200 yards distant! Considering that the party had started operations at a distance of 10 miles, this result was noteworthy. The general opinion was that if a little more time had been allowed the results would have been still more satisfactory.

Hon. secretary: Lieut.-Col. H. Ashley Scarlett, 357a, Finchley Road, N.W.3.

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Tottenham Society's Competition.

A competition for two-valve receivers, which will be judged according to the quality of reception from 2LO, will be held this evening (Wednesday) by the Tottenham Wireless Society at eight o'clock, at 10, Bruce Grove, N.17.

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Manchester Society's Field Day.

The Radio Experimental Society of Manchester proposes to hold a Field Day at Coombes Edge, near Mottram, on Saturday, July 2nd

Another Field Day will probably be held early in September.

Hon. secretary: Mr. J. Levy, 19, Lansdowne Road, West Didsbury, Manchester.

○○○○

Mysteries of the Selenium Cell.

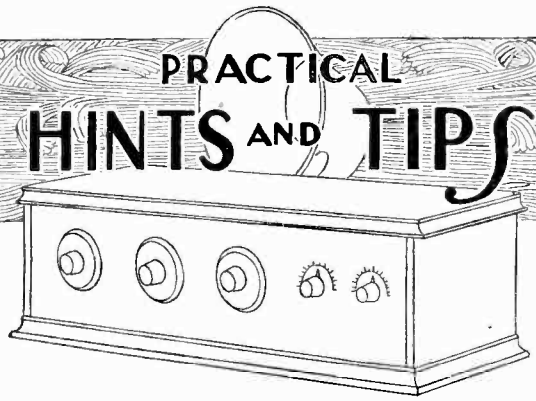
Lecturing on "Television" at the last meeting of the Hounslow and District Wireless Society, Mr. Huntingford gave a brief account of the various systems now being investigated, and compared their respective advantages and defects. The Society having devoted special attention to the selenium cell method, the lecturer conducted a number of chemical experiments demonstrating the nature of selenium and its manufacture. He concluded with an interesting display showing the variations in the electrical resistance of a selenium cell when exposed to light of varying intensity.

The Society hopes shortly to proceed to actual television tests.

Visitors and new members will be welcomed at 8 p.m. on any Tuesday at the Society's headquarters, Holy Trinity Hall, Hounslow. The hon. secretary is Mr. W. R. Collis, 7, Aigar Road, Isleworth.

NEAR THE END OF A PERFECT DAY. Members of the Golders Green and Hendon Radio Society photographed at tea after a strenuous and exciting day in pursuit of a hidden transmitter.

PRACTICAL HINTS AND TIPS



Aids to Better Reception.

Theoretical Diagrams Simplified.

SOME SHORT-WAVE HINTS.

THERE is no real need to use special valves—those of the ordinary "four-pin" type are generally quite satisfactory. In any case, there is no point in using low-capacity valves as L.F. amplifiers.

oooo

Capacity-controlled reaction, although popular, is not the only possible system. The swinging coil method works well, but mechanical difficulties are often encountered. Resistance control depends for its effectiveness on the smoothness of variation in the resistor. Few types are consistently satisfactory.

oooo

A reaction coil may with advantage be wound with very fine wire, in order to reduce the capacity between it and the grid inductance. If this precaution is taken, changes in reaction coupling will make comparatively small changes in tuning.

oooo

Tuning will be extremely difficult if large variable condensers are used, even if a high-ratio reduction gear is fitted. A maximum of 0.0002 mfd. is suggested; a slow-motion dial having a step-down of about 50 : 1 is desirable, and is much better than a separate "vernier" vane. A direct drive is almost impossible, even with a maximum capacity of as little as 0.0001 mfd.

oooo

The majority of short-wave listeners content themselves with headphone reception, and accordingly use only one L.F. amplifier. If two stages are desired, it is suggested that the first (that following the detector) should be coupled by a resistance, followed by a transformer. Very high anode resistances are generally out of place; about 100,000 ohms—depending on valve impedance—will be best.

oooo

When using resistance coupling it is necessary to take precautions against the application of H.F. potentials to the L.F. amplifier. On short waves the easiest way of doing this is to connect a quarter-megohm resistance of the grid leak type directly in the grid circuit of the first L.F. amplifier.

oooo

A taut aerial is necessary for the best possible results; in spite of the fact that the open circuit is almost invariably of the so-called "untuned" type, variations in its capacity will be communicated to the closed circuit, and an apparent fading effect will be produced if the aerial sways with the wind.

oooo

Short-wave chokes should be of low self-capacity and small physical size. It is difficult to better a single-layer solenoid winding of fine D.S.C. wire on an ebonite former about one inch in diameter.

oooo

The majority of those who receive the short waves successfully do so with a simple detector-L.F. combination. Do not attempt the construction of a more elaborate set without having had experience of this arrangement.

oooo

A "noisy" short-wave receiver is an abomination, and no pains should be spared to remove the causes of this trouble. They may most easily be traced by putting the set into an oscillating state with aerial and earth removed. Faulty condenser bearings should always be suspected; a "pig-tail" connector to the rotor is generally preferable to a rubbing contact.

The accumulation of dust between condenser vanes is often responsible for noises. The set should be mounted in a case, while dust may be removed with the aid of a bicycle pump or a Bunsen gas flame.

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A SIMPLE WAY OF CALIBRATING SHORT-WAVE WAVEMETERS AND RECEIVERS.

WHEN we turn our attention for the first time to a new short wavelength—and some of the most interesting wavelengths lie below 90 metres—we are at a loss to find our way about unless we possess a reliable wavemeter or some other means of ascertaining with certainty the wavelength to which our receiver is tuned. One of the simplest and yet most reliable methods is to make use

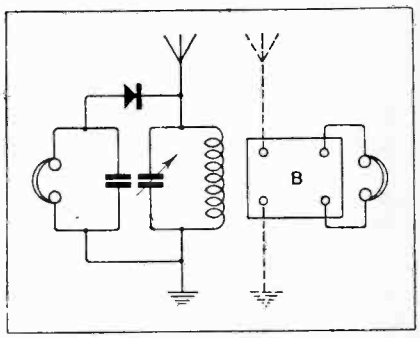

Fig. 1.—A crystal set as an aid to the production of harmonics.

of the harmonics of our local broadcasting station. The fundamental or main wavelengths of the B.B.C. stations are now pretty accurately fixed and widely published. The harmonics have frequencies corresponding to wavelengths which are exact simple fractions of the fundamental wavelength. Thus if the local station has a fundamental wavelength of 360 metres the harmonics

will have wavelengths of exactly ½, ⅓, ¼, ⅕, etc., of this wavelength, that is, 180m., 120m., 90m., 72m., etc. If we can pick out these harmonics on a receiver or oscillating wavemeter we have a number of useful points which at once show us where we are as regards wavelength on various tuning settings.

Harmonics beyond the second and third are, however, often difficult to pick up directly, even if the station does actually radiate them at all, and they are apt to be confused with other signals. An excellent plan for getting the harmonics strongly and free from other signals is shown in the figure. All that is needed is a simple crystal receiver connected to an outside aerial and tuned to pick up the local broadcasting station in the ordinary manner. Nearly everybody has the wherewithal to fix up such a crystal set. It is the property of a crystal detector to generate strongly the whole series of harmonics of the signal to which the aerial is tuned so that when the short-wave wavemeter is placed near the tuning coil of the crystal set the harmonics can be tuned in quite easily as reasonably strong carrier waves. Do not couple any closer to the crystal than is absolutely essential to pick up the harmonics with certainty. Starting with the second harmonic (half the fundamental wavelength) we follow the harmonics downwards, taking the utmost care not to miss any harmonic or lose count. The greatest care in this respect must be exercised when we come to the minimum of our tuning condenser and have to change to a shorter wavelength coil. Much the best way of avoiding difficulties here is to use an auxiliary oscillating wavemeter to "hold" a particular harmonic while the change of coils is being effected. The lower the wavelength, of course, the more crowded do the harmonics become and the greater is the care required in following them. Within five miles of a powerful local broadcasting station it is quite easy to follow the harmonics down to about 20 metres. Needless to say, a short-wave receiver must be calibrated exactly as it is going to be used. If the aerial is to be tapped directly on to the grid coil, then the set must be calibrated with an aerial on, and a supplementary aerial must be used for the crystal set.

THE REACTOR VALVE ON SHORT WAVES.

THE advantages gained by the use of a separate reactive valve, which are often sufficient to justify its inclusion in a receiver designed for the normal broadcast waveband, are more pronounced when receiving on the short waves. As far as the former are concerned, it must be fairly obvious that better use may be made of the extra valve by making it operate as a pure H.F. amplifier, although admittedly this course will necessitate another tuning control. On the very short wavelengths, however, such amplification is impracticable, and any device which will improve reaction control should not be neglected. To obtain smooth regeneration with the ordinary arrangement it is, as a rule, necessary to effect a compromise, as the best grid voltage adjustment from the point of view of detection is not always best for reaction.

The circuit diagram of a short-wave receiver, including a separate reactor valve, is given in Fig. 2. All the components may have conventional values, while their disposition may follow standard practice. The inductances of the aerial-grid coil L_1 and of the reaction coil L_2 will, as usual, depend on the waveband to be covered, and are similar to those used in a reacting detector set, except that extra turns may be necessary on L_2.

A consideration of the diagram will show that the steady voltage of the detector grid (V_2) is determined by the setting of the potentiometer, as it is insulated from the bias battery G.B.$_1$ by the grid condenser. This battery serves to bias the reactor (V_1), and should be of such a voltage that it is working on the straight part of its characteristic curve. A 20,000 ohm "H.F." valve is suitable for this position; it will be operating correctly with 1½ volts negative on its grid and an anode voltage in the order of 100.

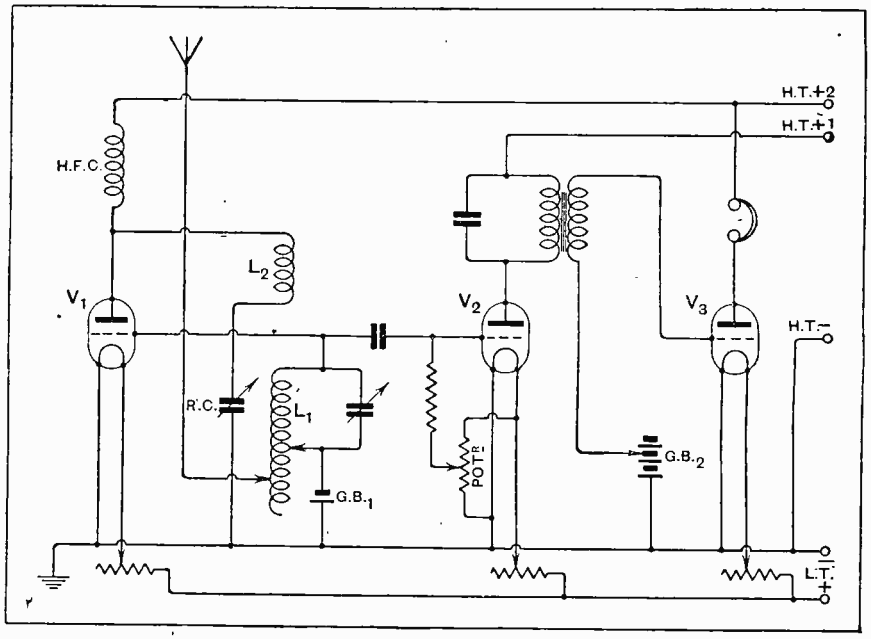

Fig. 2.—Smooth control of reaction on the short waves.

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LOOSE CONTACTS AND SHORT-WAVE RECEPTION.

WHEN an oscillating receiver is being used for the reception of signals below 60 metres it is essential to avoid variable contacts not only in the set and aerial circuits themselves, but also between any two adjacent metal bodies anywhere near the set. Two objects, such as a pair of scissors and a screwdriver, touching each other lightly within two feet of the receiver may easily give rise to distracting scraping noises in the telephones. The lower the wavelength the more pronounced is this sort of effect, and on wavelengths as low as 20 metres one may have to look quite far afield for the cause of scraping noises.

COMPARISONS.

THE human ear is notoriously unreliable, and unfortunately retains its impressions for an extremely short space of time. Most of us have found this out when changing over alternative pieces of apparatus in order to judge their comparative effectiveness either from the point of view of quality or signal strength. Unless the change is made with extreme rapidity, it is found that, by the time the second component is in position, there remains but a hazy impression of the conditions prevailing with the first.

To facilitate the making of a quick change, it is strongly recommended that the apparatus should be wired to a double-throw switch with a suitable number of poles. The slight extra trouble involved will be compensated for by the more definite results obtained by the test. Single- and double-pole switches, mounted on stout porcelain bases, are suitable and are readily obtainable at a low price.

When testing apparatus associated with H.F. circuits, care must be taken to retain a reasonable degree of electrical symmetry in the connections to the components under test; otherwise totally misleading results may be obtained, due to variation in tuning or other causes.

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USE GOOD GRID CONDENSERS IN TUNED ANODE RECEIVERS.

THE last coupling condenser in the ordinary form of tuned-anode H.F. amplifier is also the grid condenser for the detector valve which functions on the leaky-grid principle. Now one side of this condenser is at full H.T. voltage while the other side is connected to the grid of the detector valve, and since this grid is isolated except for a grid leak of one or two megohms the slightest leakage on the part of the condenser will cause irregular positive charges to flow on to the grid. This will give rise to hissing or crackling noises. A grid leak detector valve is most sensitive to the smallest leakage of this nature, and very perfect insulation is needed in the condenser, both in the dielectric itself and the casing in which the condenser is enclosed. It is safe to say that the best insulation in the whole of a tuned anode set should be in the detector grid condenser. The dielectric should be mica or something at least as good.

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SOLDERING TO NICKEL-PLATED METAL.

IT occurs sometimes, but fortunately not often, that we have to make a soldered connection to a nickel-plated article. Nickel is not a very good metal to solder, and nickel-plating often does not adhere any too firmly to the metal below. For this reason it is advisable to file the surface where the joint has to be made until the main metal (usually brass) is exposed before any attempt is made to tin the surface.

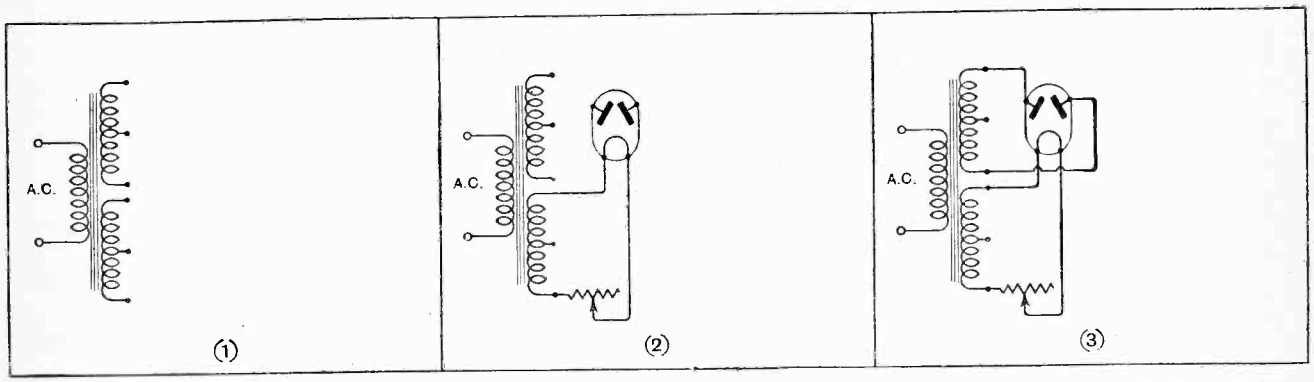
DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 74.—An H.T. Eliminator with Full-wave Rectifier.

(To be concluded in next week's issue.)

The present series of diagrams is intended to show progressively, and in an easily understandable manner, the various points to which special attention should be paid in the design of typical wireless instruments, and at the same time to assist the beginner in mastering the art of reading circuit diagrams. The eliminator shown below operates on A.C. mains, and gives full-wave rectification by the use of a double-plate valve.



The primary winding of the transformer is connected across the A.C. supply mains.

THE transformer must be designed to work on the voltage and periodicity of the supply mains. The filament lighting winding should have from 4 to 6 volts across its ends, according to the type of valve to be used. This voltage should approximate closely to that at which the

The low-voltage winding is connected in series with the filament and a controlling rheostat.

valve is actually rated, in order that a minimum value of series rheostat may be necessary.

It is suggested that the voltage between the centre tap and each of the ends of the high voltage winding should be about 150. There are thus 300 volts across the whole secondary,

The ends of the high-voltage secondary winding are connected to the anodes.

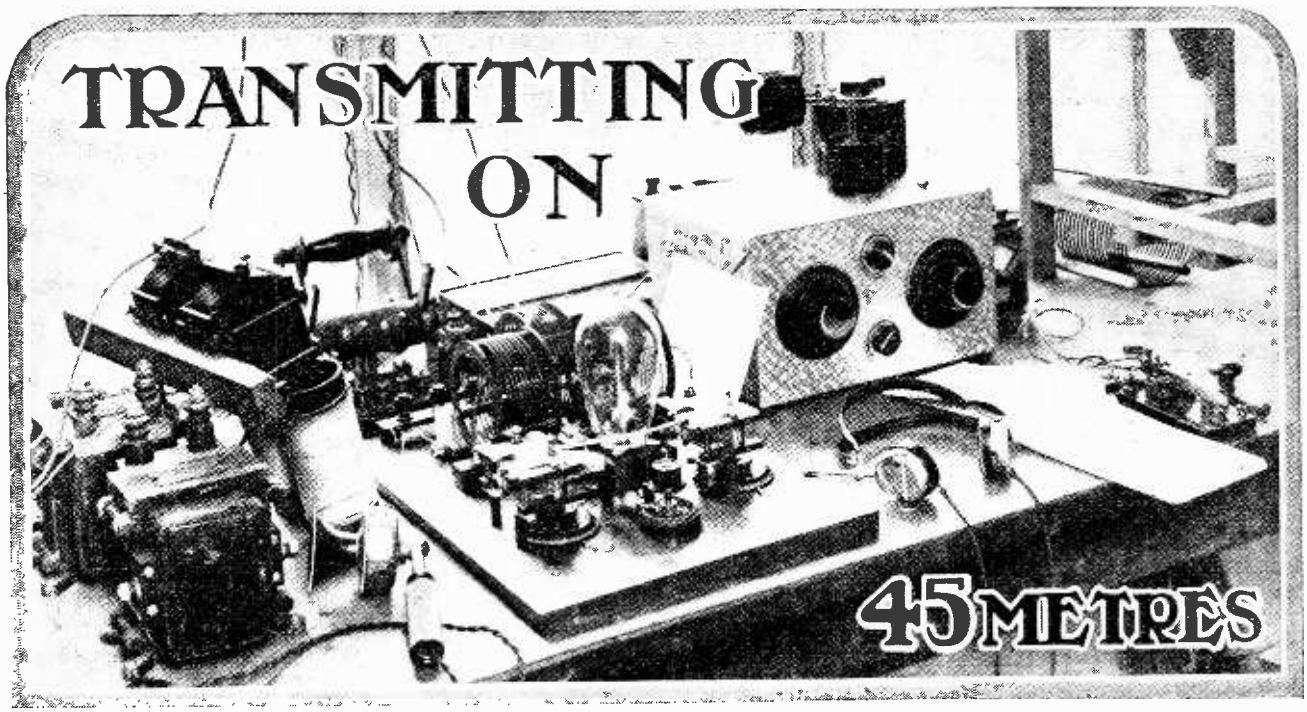
but only half of this is applied to the plates.

Several manufacturers produce double-plate valves for eliminators of this type; their filaments generally consume rather more than one ampere and give a working emission of about 40 mA.

SHORT-WAVE TRANSMISSIONS.

IN compiling the following list of stations which transmit fairly regularly on short waves, we have selected those which are likely to prove of service to experimenters in this country. Many other short-wave stations heard are engaged only on tests of a temporary nature, and these have been omitted.

Wave-length. (Metres).	*Call-sign.*	*Station.*
12.25	AGA	Nauen.
13.5	AGA	Nauen.
14.09	U 2XBC	Rocky Point N.Y.
14.28	F FW	Ste. Assise.
14.93	U 2XS	Rocky Point, N.Y.
15.0	GLS	Ongar.
	U 2XAW	Schenectady, N.Y.
16.0	AGA	Nauen.
	WSS	Rocky Point, N.Y.
16.02	U 2XT	Rocky Point, N.Y.
16.57	WLL	Rocky Point, N.Y.
17.0	SPI	Rio de Janeiro.
	NKF	Bellevue, Anacostia, D.C.
18.0	POF	Nauen.
20.0	AGK	Nauen.
	NAL	Navy Yard, Washington, D.C.
	OCTN	Mourillon, Toulon.
	POX	Nauen.
	GFR	Flowerdown, Hants, R.F.A.
	GLSQ	S.S. "Olympic."
	J 1PP	Tokyo.
20.8	NKF	Bellevue, Anacostia, D.C.
21.0	PCTT	Kootwijk, Holland.
21.4	WDJ	Harrison, Ohio.
21.48	WIK	New Brunswick, N.J.
21.8	KEB	Los Angelos, Calif.
22.0	VIS	Sydney, N.S.W.
	VIT	Townsville, Queensland.
22.02	U 2XAD	Schenectady, N.Y.
23.0	PKH	Soerabaja, Java.
23.25	FFW	Sainte Assise.
23.3	WBQ	Schenectady, N.Y.
24.0	GBL	Leafield.
	GBM	Leafield.
24.3	KFD	Denver, Colo.
24.5	GLQ	Ongar.
24.7	NKF	Bellevue, D.C.
25.0	PCMM	The Hague.
	POY	Nauen.
	HZA	Saigon.
25.5	AGB	Nauen.
25.6	NKF	Bellevue, D.C.
25.728	VIZ	Melbourne (Beam Stn.).
25.906	GBH	Grimsby (Beam Stn.).
26.0	AGA	Nauen.
	VIS	Sydney, N.S.W.
	WNU	New Orleans, La.
26.086	GBK	Bodmin (Beam Stn.).
26.269	CG	Montreal (Beam Stn.).
26.6	AGB	Nauen.
27.0	PCPP	Kootwijk, Holland.
	RCRL	Central Lab., Leningrad.
27.5	PCMM	Kootwijk, Holland.
29.3	KEL	Bolinas, Calif.
30.0	GBL	Leafield.
	GBM	Leafield.
	U 2XI	Schenectady, N.Y.
30.2	PCJJ	Eindhoven, Holland.
30.6	NAL	Navy Yard, Washington, D.C.
32.0	FL	Eiffel Tower.
	ANE	Malabar, Java.
	IDO	Rome.
	HVA	Hanöi, Fr. Indo China.
	VIS	Sydney, N.S.W.
32.77	U 2XAF	Schenectady, N.Y.
33.0	OCDJ	Issy les Moulins.
	OCTN	Mourillon, Toulon.
33.5	AQE	S.S. "Sir James Clark Ross."
34.0	NAJ	Great Lakes, Ill.
	XDA	Mexico City, Mex.
35.0	BWW	Gibraltar, North Front.
	BXW	Seletar, Singapore.
	BXY	Stonecutters Isld, Hong-Kong.
	BYB	Whitehall, R.C.
	BYC	Horsea.
	BYZ	Rinella, Malta.
	BZE	Matara, Ceylon.
	BZF	Aden.
	VKQ	Garden Island, Sydney, N.S.W.
	NPM	Honolulu.
	J 1PP	Tokyo.
35.03	WQO	Rocky Point, N.Y.
36.0	PCMM	Kootwijk, Holland.
	LPZ	Buenos Aires.
	OCRB	Rabat, Morocco.
36.8	NPM	Honolulu.
37.0	PCRR	Kootwijk, Holland.
38.0	PCUU	The Hague, Holland.
	U 2XI	Schenectady, N.Y.
39.0	OCMY	Mont Valerien.
40.0	NAJ	Great Lakes, Illinois.
	NAS	Pensacola, Florida.
	NOSN	Coco Solo, Panama.
	WNU	New Orleans, La.
40.2	AGC	Nauen.
40.5	J 1AA	Iwatsuki, Japan.
41.5	OCBA	Bamako, Sudan.
41.6	NKF	Bellevue, Anacostia.
41.95	FFW	Ste. Assise.
42.0	VIS	Sydney, N.S.W.
	VIT	Townsville, Queensland.
42.5	TFA	Reykjavik, Iceland.
42.98	WIZ	New Brunswick, N.J.
43.0	NPG	San Francisco, Calif.
	JOC	Otchishi, Japan.
44.03	WAQ	Newark, N.J.
44.5	SPI	Rio de Janeiro.
45.0	NPG	San Francisco, Calif.
46.0	OCMY	Mont Valerien.
	PCLL	Kootwijk, Holland.
46.5	TSB	Norwegian s.s. "Helder."
47.0	POZ	Nauen.
	ICX	Massawa.
	SPI	Rio de Janeiro.
	SUC2	Abu Zabal, Cairo.
49.5	KRP	Salt Lake City, Utah.
	TFA	Reykjavik, Iceland.
50.0	OCTU	Tunis, La Casbah.
	WBZ	Springfield, Mass.
	SAJ	Karlsborg, Sweden.
51.0	AIN	Ain Bordja, Casablanca.
	TSB	Norwegian s.s. "Helder."
51.5	WQN	Rocky Point, N.Y.
	VIS	Sydney, N.S.W.
52.0	VAS	Louisburg, Nova Scotia.
	WKK	Ceiba, Porto Rico.
	WGW	Vieques, Porto Rico.
52.02	WLW	Cincinnati, Ohio.
53.0	ZWT	Bremerhaven.
	NPU	Tutuila, Samoa.
54.0	NBA	Balboa, Canal Zone.
54.4	NKF	Bellevue, Anacostia, D.C.
54.5	WQN	Rocky Point, N.Y.
56.0	GBL	Leafield.
	GBM	Leafield.
	ANF	Malabar, Java.
	U 1XAO	Belfast, Maine.
57.0	OCTN	Mourillon, Toulon.
	WQN	Rocky Point, N.Y.
58.0	OCBV	Beyrouth.
58.79	KDKA	East Pittsburg, Pa.
60.0	U 1XAO	Belfast, Maine.
61.0	NKF	Bellevue, Anacostia, D.C.
65.5	U 2XK	South Schenectady, N.Y.
67.0	U 8XS	East Pittsburg, Pa.
68.0	NPO	Cavite, Philippine Islands.
70.5	NQG	San Diego, Calif.
70.54	WRP	Pinecrest, Florida.
	WFV	Poinciana, Florida.
70.74	WRB	Miami, Florida.
71.25	NKF	Bellevue, Anacostia.
74.0	WIR	New Brunswick, N.J.
75.0	F 8GB	Ste. Assise.
	WGN	Rocky Point, N.Y.
	FL	Eiffel Tower.
80.0	NEL	Lakehurst, N.J.
83.0	RDW	Moscow.
84.0	NKF	Bellevue, Anacostia.
90.0	KIO	Kahuhu, Hawaii.
100.0	U 2XI	Schenectady, N.Y.



Building an Inexpensive Long-range Transmitter.

By F. H. HAYNES.
(2DY, 2DZ.)

THE increase in the number of transmitting permits during recent months reveals the growing interest in transmission. That thousands of amateurs are not limiting their activities to broadcast reception is evidenced by the popularity of certain short-wave transmissions. Much interest attaches to short-wave reception, both telephony and Morse signalling, and when a working knowledge of the code has been acquired the amateur feels that the scope of his experimental work can be greatly extended by the setting up of a small transmitter.

Starting in Amateur Transmission.

The new field for experiment thus opened covers the study of fading, long-distance communication in relation to wavelength and conditions, short-wave aerials and directional effects, circuit systems for ultra-short waves, crystal control, as well as methods of keying and modulating, all of these considerations involving principles not to be found in the development of apparatus for reception purposes.

The circuits in most general use to-day for short-wave work are modifications of the Colpitts oscillator. On the longer waves of 150 to 200 metres and 440 metres used until recently by amateurs, Hartley and tuned grid coil oscillating circuits were generally favoured. Fundamentally, all of the oscillating systems are similar inasmuch as the oscillating voltage at any moment applied to the grid of the oscillating valve is of the opposite sign to that existing on the plate, while each of the circuits gives exactly similar performance and all are equally efficient. It is merely a matter of convenience of control that has led to the several circuit systems.

The part played by unwanted capacity stands in the way of using the same methods on the ultra-short waves as were adopted on wavelengths of 100 metres and upwards, emphasising the need for feeding the circuit only through nodal points of zero radio-frequency potential and placing less reliance in the use of choke coils. It should be the aim therefore to devise a circuit arrangement which does not depend for its correct operation upon the performance of H.F. chokes, owing to their self-capacity, while the points of connection of the battery leads can be conveniently adjusted so as to prevent stray earth capacities forming a path for radio-frequency current.

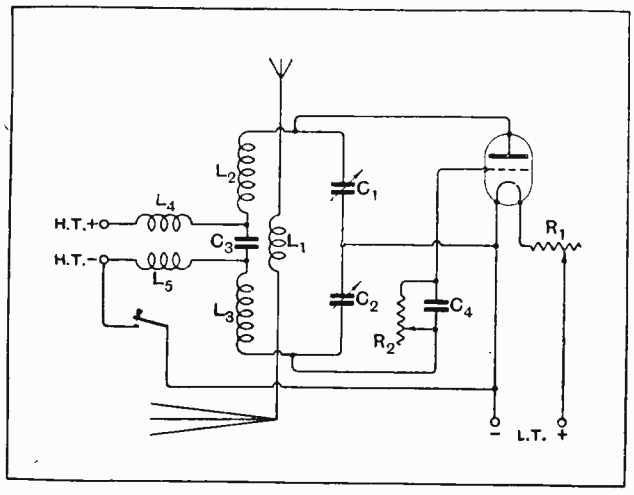
Modified Colpitts Circuit.

In the circuit diagram the tuned oscillatory circuit comprises the series connected inductances L_2, L_3, bridged by the series connected condensers C_1, C_2. Grid potentials are determined in respect to the filament which is connected to the mid-point between the two condensers. The feed-back, radio-frequency potential passed to the grid is increased when C_1 is increased, it being obvious that for a given wavelength an increase in the value of one of the condensers must be compensated for by a reduction in the value of the other so that the resultant capacity remains unaltered.

To avoid the need for blocking condenser and choke such as are commonly fitted in the Hartley circuit, the tuning inductance is divided and the battery connection

Transmitting on 45 Metres.—

made at the nodal point of zero radio-frequency potential. The condenser C_3, which is interposed, has little influence on the oscillation constants of the tuned circuit providing its capacity is large compared with the resultant capacity of the two series connected tuning condensers. It serves as a barrier to maintain the D.C. potential on the anode of the valve, and should therefore be capable of withstanding the H.T. voltage as well as being suitable for handling a comparatively large high-frequency oscillating current at low potential.



Modified Colpitts transmitting circuit. The H.T. and L.T. batteries as well as the key are at zero radio-frequency potential and changes of earth capacity do not affect the operation of the circuit. The choke coils L_4 and L_5 are not required when the circuit is correctly adjusted.

Nodal Points and Earth Capacity.

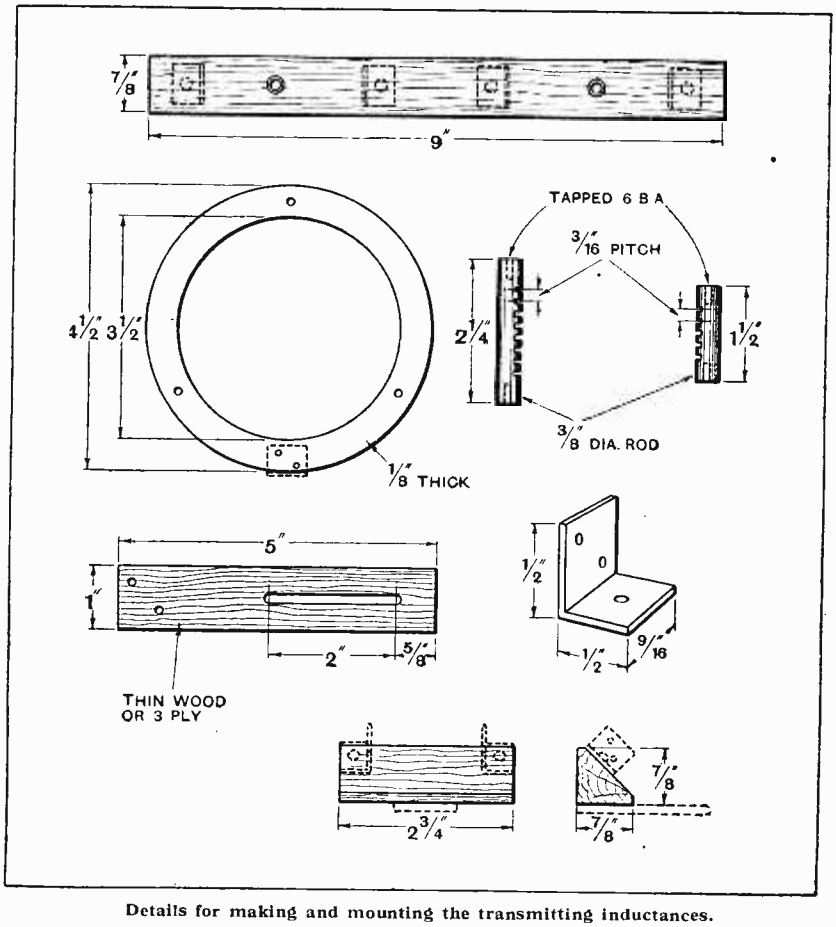
Assuming the correct adjustment of the relative values of C_1 and C_2, then the operation of the circuit will be uninfluenced by the large earth capacity of the L.T. battery. Similarly no difficulty will be experienced when the H.T. supply, which is always virtually earth connected, is joined to the mid-point of the tuning coil. Both sides of the bridging condenser C_3 are at zero radio-frequency potential, as its capacity is large compared with the tuning capacities. It is this consideration with regard to the battery connections having no effect on the tuning of the circuit that so strongly recommends the adoption of this circuit for transmission on wavelengths below 100 metres, and no longer is it necessary to space the L.T. battery from earth or introduce an elaborate arrangement of H.F. chokes in the high-tension supply. Actually choke coils L_4, L_5 are provided between the high-tension terminals and the oscillatory circuit, but these only serve as a safeguard until the correct adjustments of coils and condensers are made. Obviously there is no difference of radio-frequency potential between the mid-points of the condensers and coils which are connected across by the keying lead between L.T.– and H.T.–, and the chokes shown become unnecessary when the best relative values of condensers and coils have been found.

Other details of the circuit require little comment. The aerial load is critically adjusted by a variable coupling L_1, while the negative grid biassing potential is created by a resistance R_2 shunting a condenser C_4.

Constructional Hints.

The few components required for this transmitter render construction easy. Building is simplified by mounting all components on a baseboard in preference to the use of a vertical front panel. The design is readily modified, however, and if desired the tuning condensers and filament rheostat can be carried by a panel without the need arising for any change in wiring layout. With the addition of the aerial ammeter and plate current milliammeter to the upper part of the panel well above the condenser dials a more portable set can be produced.

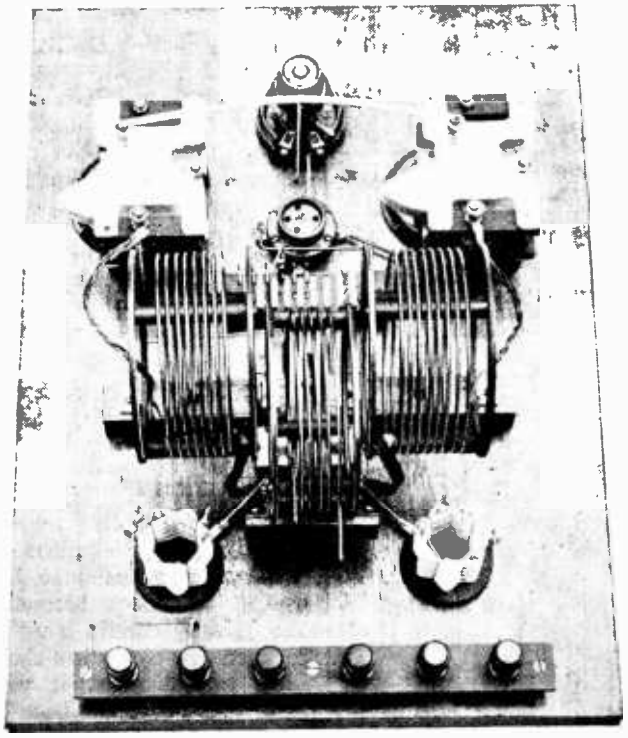
It is always the case when constructing a transmitting set that certain of the parts must be of new design and are not to be found among the component apparatus on the market. In this instance the transmitting inductances,



Details for making and mounting the transmitting inductances.

Transmitting on 45 Metres.—

choke coils, and grid leak resistance are not standard. The drawing of the coils shows the use of two ebonite rings $\frac{1}{8}$in. in thickness, supporting three $\frac{3}{8}$in. pieces of ebonite rod. Small brass screws, such as 6 or 8BA, $\frac{1}{4}$in.

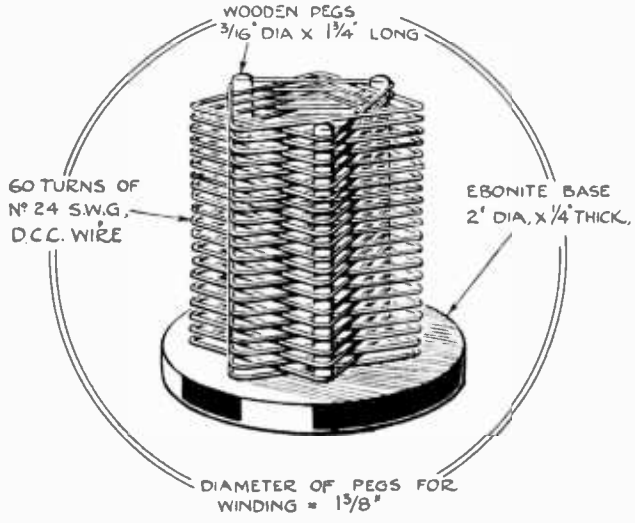


Plan view showing the arrangement of the components. The radio-frequency circuits are connected by short direct leads.

in length, secure the rods to the rings, and the turns of wire are carried in slots. As the turns are spaced by an amount roughly equal to twice the diameter of the wire (No. 14 S.W.G.), it is necessary to move the positions of the slots in the three rods by an amount equal to the thickness of the wire when passing from one rod to the next to allow for the spiral formation. After being straightened by stretching, the wire is wound tightly with turns touching upon a former about $\frac{1}{8}$in. smaller than the required coil diameter. The turns are lifted into position and adjusted, the ends being terminated by bends which grip the bars. All windings are, of course, in the same direction, the two outside coils (L_2, L_3) being identical.

The two ends of any coil terminate on the same crossbar, and reference should be made to the drawings showing the apparatus and wiring layouts before fixing the supporting brackets. Small pieces of angle brass or angles bent from strip secure the coils in position, and are fixed to the ebonite rings by 6 or 8BA screws and nuts.

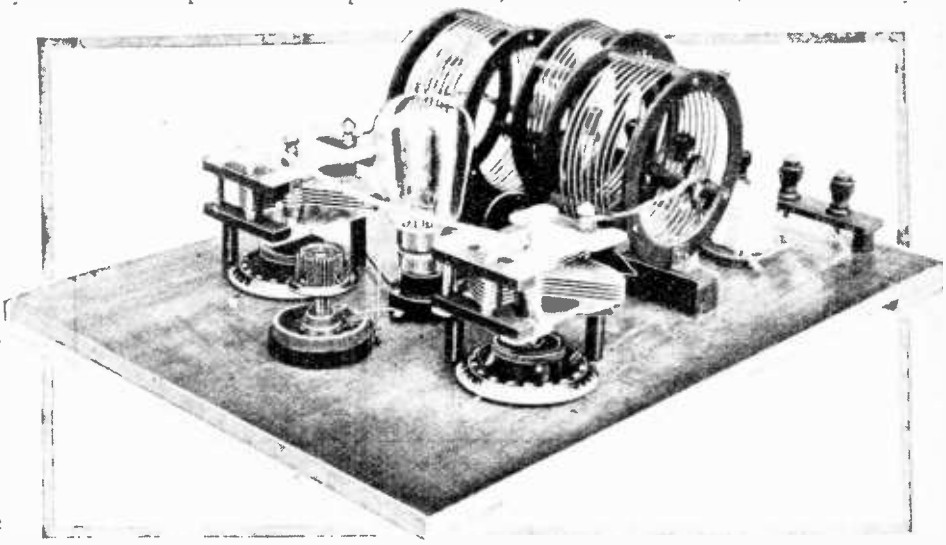
The choke coils are wound upon seven-peg formers, tied round with cotton, and then transferred to the ebonite bases with supporting pegs. As there is a difference of potential equal to the H.T. voltage between the two choke coils it is advisable to make use of the ebonite disc bases as shown in the sketch giving the constructional details. Almost any form of short-wave choke coils can



Constructional data of the H.F. choke coil.

be substituted, as these coils serve no useful purpose when the set is properly adjusted.

The grid leak is wound upon a piece of $\frac{1}{8}$in. ebonite measuring 1in. × $3\frac{3}{4}$in. It carries 10 slots $\frac{1}{8}$in. wide by $\frac{3}{16}$in. deep, into each of which are wound 100 turns (about 12 yards) of No. 44 D.S.C. "Eureka" wire. Before winding seven pieces of No. 18 tinned wire are inserted in pairs of holes, as shown in the diagram of the layout



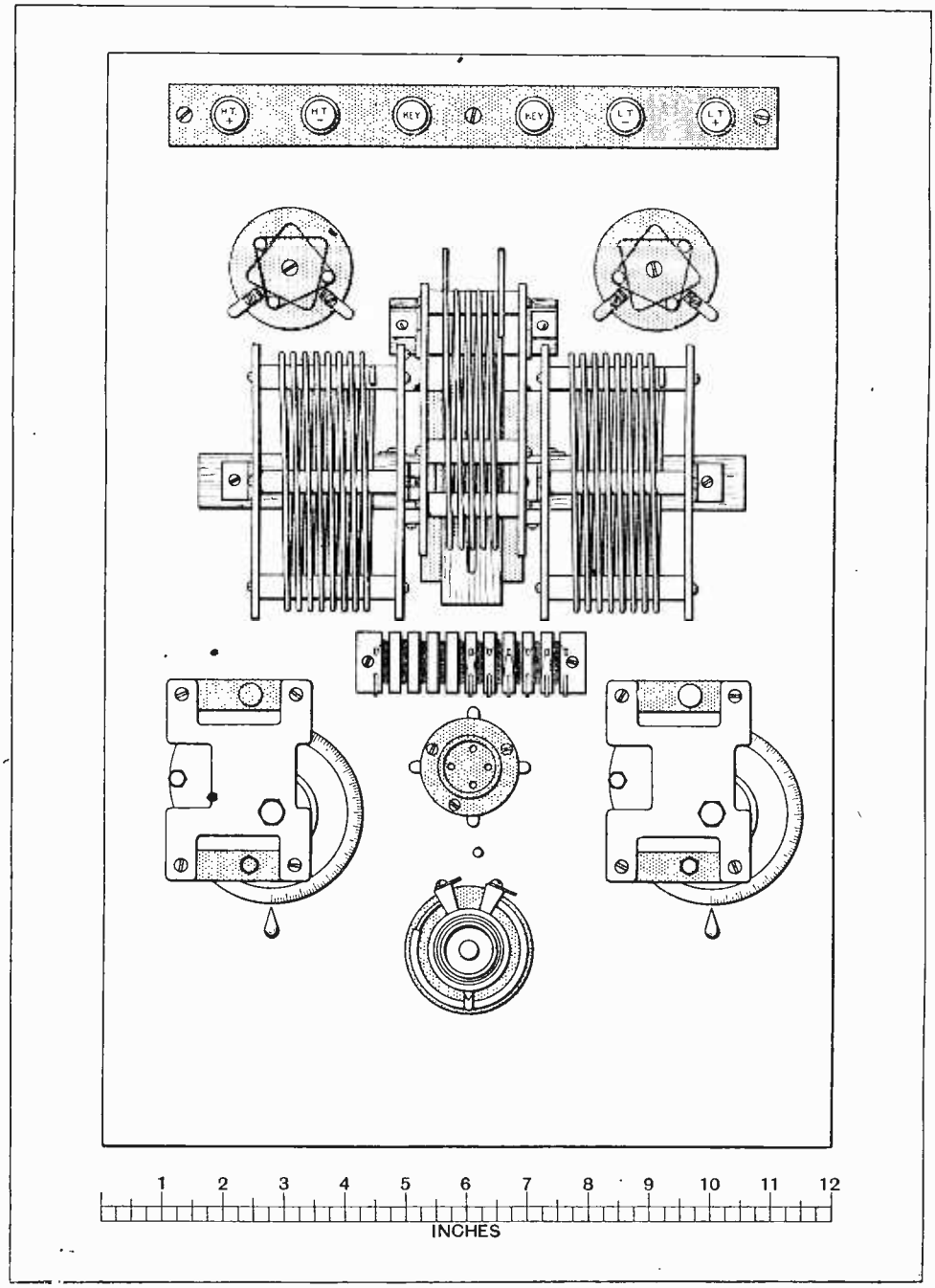
The finished transmitter. The key may be connected by a flexible lead to the terminals provided, while no special precautions are necessary in regard to earth capacity created by the batteries.

Transmitting on 45 Metres.—

of components to serve as terminal and tapping points. Whether or not the direction of the turns is reversed on passing from one section to another is unimportant, for the winding is certain to be inductive, and in other forms of transmitting circuits the use of an inductive leak may be necessary. The leak is mounted with screws and spacers.

When a baseboard layout is adopted the mounting of tuning condensers generally presents difficulty, particularly as regards setting up the indicator for the scale. In this instance the condensers are supported on short ebonite stems as usual, but are inverted, while the holes are carried right through the dials, giving the arrangement shown in the illustration on page 822. Three small holes are drilled in the normally top end-plate of each condenser and the ebonite supports are drilled for 6BA screws.

All other details of construction, including the setting up of the coils, are shown in the drawings. There is very little wiring, and convenient routes which may be taken by the leads are indicated in the practical wiring diagram. Thin strips of copper foil connect the bridging condenser C_3 with the coils, plaited braid connects the clips to the tuning condensers, and the condensers are bridged with three strands of No. 16 tinned copper soldered together. Both condenser spindles are at zero radio-frequency potential.



Scale drawing showing the arrangement of the components on the board.

45 m. Aerial Dimensions.

Before proceeding to test the set a few observations on aerial dimensions may be useful. Although harmonic and Hertz aerials are in common use for ultra-short wave transmissions, it will as a rule be found best to work the aerial near its fundamental. The aerial arrangement and dimensions should therefore be governed by the wavelength it is intended to use. This observation has no bearing, of course, upon aerial arrangements for short-wave reception. The relationship between the height of the typical amateur mast, the usual length of ground available at the back of the premises, and the height of the first floor window to 45 metres is a happy one. Thus the length of wire between the lead-in and the aerial insulator should be just less than a quarter of the wavelength, and the length required for 45 m. is therefore 36 feet. An exactly similar length is needed for the counterpoise, and should be measured off with care before erecting. The best wire to use is No. 12 S.W.G. copper. The aerial is excited

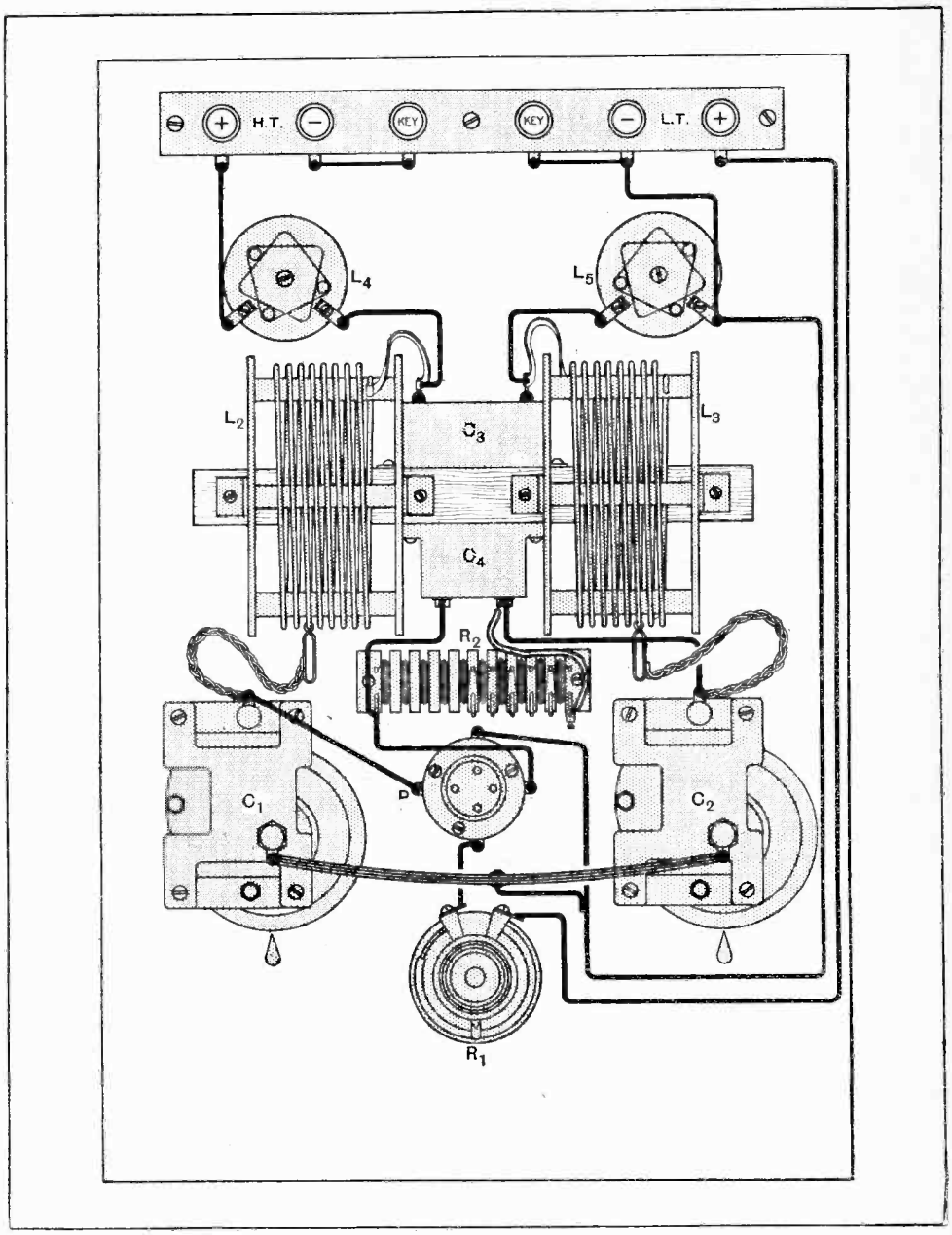
Transmitting on 45 Metres.—by means of the coupling coil thus connected at the exact centre.

Sources of H.T. Supply.

As an inexpensive transmitter and to suit the needs of the amateur who has not yet made provision for using supply mains as a source of H.T., it is pointed out that quite good work can be conducted with dry H.T. batteries of the "super-capacity" class giving 300 volts. The load taken from these batteries is no greater than that taken by the average power amplifier, and they are not, of course, in continuous use. This set has been tested with dry cells, using an L.S.5A valve, giving a feed current of 25 mA. Stations have been easily worked in Central Europe, Northern Africa, and Palestine, the low-power input from dry cells giving a steady wave without involving keying difficulties.

If higher power is used, such as rectified A.C. or direct current from an H.T. machine, a D.E.T.1 valve may take the place of the L.S.5A. When D.C. mains of 220-240 volts are available the best arrangement is undoubtedly to charge an H.T. accumulator of 100 or more volts and discharge it in series with the supply voltage.

Before attempting to bring the set into operation an absorption wavemeter, comprising coil, condenser, and pea lamp, should be constructed. The calibration can be checked by comparison with the receiving set when tuned to the many transmissions indicating the 45 m. wavelength allocated to British amateurs. American amateur stations work on wavelengths of 37.5 m. and 42.8 m.



Practical wiring diagram. The filament wiring is arranged beneath the baseboard.

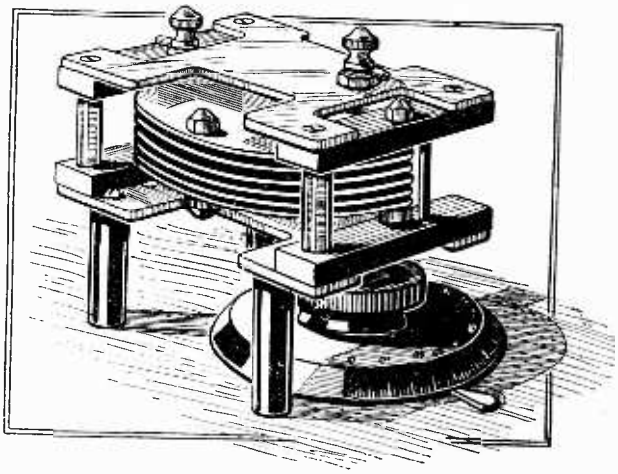
Adjusting the Transmitter.

A milliammeter with a scale reading of 50 or 100 mA. will be found helpful when making adjustments. It should be connected in the H.T. positive lead and the coil L_4 will serve to protect its winding from damage by high-frequency currents. Each of the tapping clips should be connected at one turn down from the maximum inductance end of the coils. With the aerial coil disconnected the tuning capacities are varied to give the minimum feed current, an increase on one condenser being compensated for by a reduction on the other when adjusted correctly for wavelength. The key terminals are, of course, short-circuited while adjusting, and the grid leak resistance should be increased in value in the process of tuning. After connecting the aerial and counterpoise leads to include the entire aerial coil, further adjustment of the condensers is necessary, and it will be found that the maximum reading on the aerial ammeter will be obtained on the correct wavelength providing that no error has been made in measuring off the aerial wires

LIST OF PARTS.

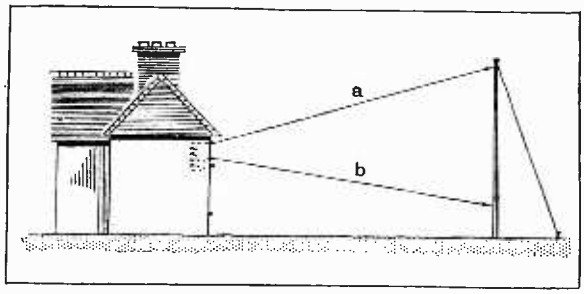
Set of 3 transmitting inductances (Peto-Scott).
1 Baseboard, 18×12.
1 Fixed condenser, No. 620, 0.001 (Dubilier).
1 Fixed condenser, No. 577, 0.001 (Dubilier).
2 Variable condensers 0.00025, R/122 (Ormond).
1 Rheostat, 6 ohms (Ashley).
1 Valve holder (Pye).
2 "Deckorem" dial indicators (A. F. Bulgin).
6 Ebonite shrouded terminals (Belling & Lee).
½ oz. No. 47 "Eureka" wire.
2 oz. No. 26 D.C.C. for choke coils.
2 Bases for choke coils (Peto-Scott).
1 ft. Phosphor bronze strip, ⅜"×No. 30 S.W.G.

In the "List of Parts" included in the descriptions of THE WIRELESS WORLD receivers are detailed the components actually used by the designer and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.



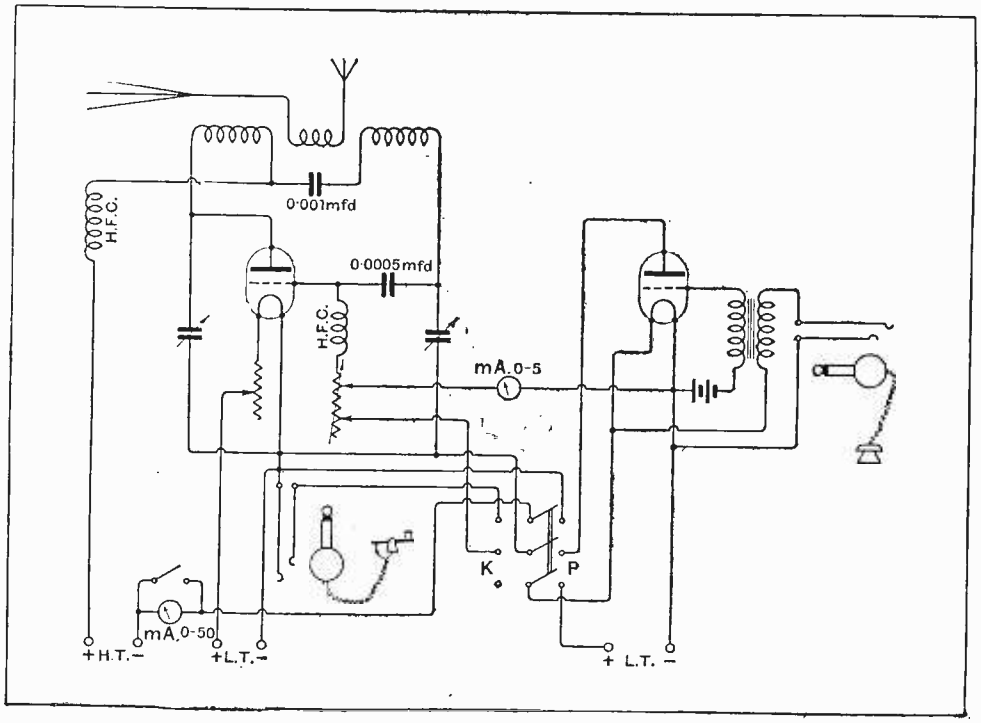
Method of mounting the tuning condensers so as to provide good insulation and to permit of the condenser scales being read against pointers on the baseboard.

A cheap aerial ammeter is connected in the lead to the counterpoise with a maximum scale reading of 0.5 or even up to 2 amperes. The meter will have appreciable resistance, and should be short-circuited after everything has been adjusted.



Symmetrical arrangement of aerial and counterpoise for short wave transmission on the aerial fundamental.

It should be borne in mind that all the tuning adjustments are more or less locked together, and a change at one point in the circuit may call for a compensating adjustment at another. A double-pole switch should be arranged to readily disconnect the H.T. supply so that a variety of adjustments can easily be carried out.



Circuit of grid modulated transmitter with two-way switch for telegraphy or telephony transmission.

Telephony Transmission.

Remembering that the set is intended for use where a liberal H.T. supply is not available, grid modulation may be adopted if telephony transmission is required. The only merit of modulation in the grid circuit is, of course, economy in H.T. supply, and a circuit arrangement is given showing the modulator valve functioning as a variable grid leak. The battery used to supply filament current to the

Transmitting on 45 Metres.—

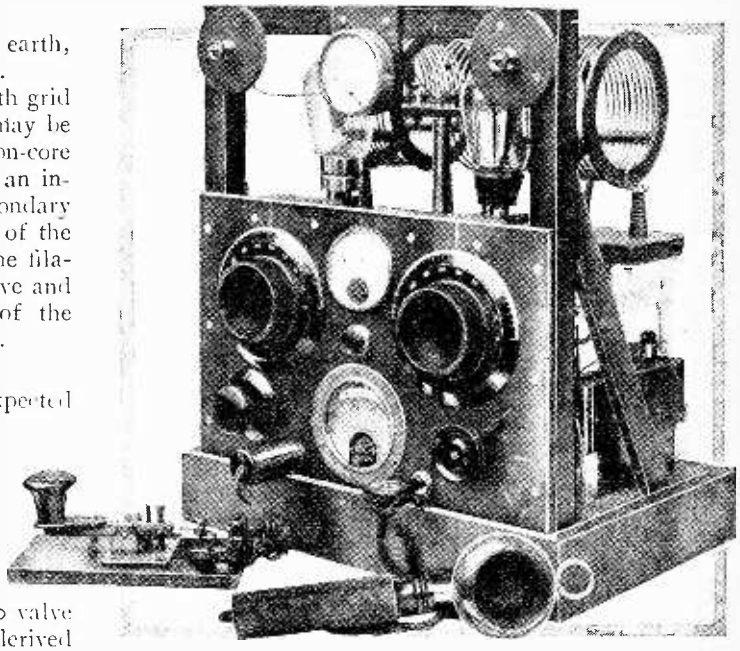
modulating valve must be well insulated from earth, and its capacity should be as small as practicable.

Although excellent results have been obtained with grid control, choke modulation is to be preferred, and may be introduced by inserting in the H.T. supply an iron-core choke coil of liberal current-carrying capacity and an inductance value exceeding 20 henries such as a secondary winding of a small H.T. transformer. The plate of the modulating valve is connected to H.T. positive, the filament is connected in parallel with the oscillator valve and between the grid and filament is the secondary of the microphone transformer with grid biassing battery.

Performance.

As an indication of the range which can be expected from this transmitter, it may be mentioned that working from station 5YZ telegraphy communication has been established with the following :—

British, GI6MU, GI5ZY, 6PU, 6HZ, and 32 others; French, 8JZ and 10 others; German, 8 stations; Italian, 1CW, Tripoli; while speech has been exchanged with 6PU, 5DC, GI6MU. 6JK, CI5ZY, and 42 others, using a Mullard 0-20 valve as the oscillator and an H.T. potential of 250 volts derived from wet cells. These stations have reported very favourably on the quality of telephony when using the grid method of modulation.



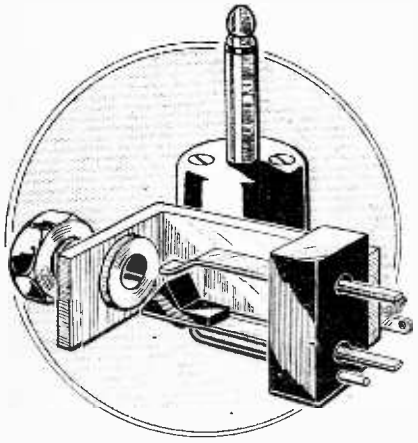
Compact transmitting set (5YZ) employing the circuit system described with the addition of grid modulation. A switch is introduced for changing over from telegraphy to telephony as shown in the diagram on the previous page.

NEW APPARATUS.

WEARITE PLUG AND JACK.

To avoid the use of an "on and off" switch a plug and jack loud-speaker or telephone connector is now commonly employed in which contacts are provided for closing the filament circuit when the plug is inserted.

A new jack of this type is among the recent products of Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N., and differs from the usual



Wearite loud-speaker jack. The local circuit contacts are insulated by an ebonite spacer of liberal thickness.

form in that an ebonite face spring is used for making connection with the additional contact. By this means a liberal thickness of insulation is obtained, permitting of the use of the auxiliary contacts in a high-frequency circuit if desired, while the contour of the insulating piece gives a good snap action.

The frame of the jack is of nickel-plated angle brass, and the plug is fitted with a turned ebonite mount with simple provision for connecting the loud-speaker or telephone leads.

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T.C.C. CONDENSER MODIFICATION.

The Telegraph Condenser Co., Ltd., Wales Farm Road, North Acton, London, W.3, will in future supply a small bracket with their fixed capacity condenser to permit of them being mounted horizontally. Sometimes when building a receiver it is inconvenient to stand the H.T. bridging condenser vertically, and by means of the new strapping piece the condenser can be turned on its side and screwed to panel, baseboard, or on one of the inside walls of the cabinet. The straps vary in size according to the thickness and capacity of the condenser, and are finished with green enamel similar to the cases of T.C.C. condensers.

NEW FEATURE OF THE SIEMENS GRID BATTERY.

To avoid the difficulty of fitting up some form of mounting for the grid battery such as metal clips or strips of wood with screws, Siemens Bros., Ltd., of Woolwich, have introduced a very simple form of fixing.

In future, Siemens grid batteries will be provided with a cardboard cover over the sockets. On breaking the seal the card-

Siemens grid batteries are now fitted with a flap for use in securing the battery to the inside of the cabinet.

board piece is folded back, and, by means of two brass eyelets, the battery can be readily attached to the interior of the wireless set cabinet with a pair of screws or more simply by drawing pins. With this easy attachment the battery hangs securely in position and fits flat against the wall of the cabinet.

CURRENT TOPICS

Events of the Week

FIGHTING THE HOWLER.

An anti-oscillation league has been formed at Southend.

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NEXT SATURDAY AT HENDON.

Wireless telephony will play a leading part at next Saturday's R.A.F. display at Hendon Aerodrome. The aerial drill to broadcast music will provide the principal novelty.

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REGULAR WIRELESS PICTURE SERVICE.

A regular service of wireless picture transmission will be inaugurated between Berlin and Vienna on Friday next, July 1st. The Telefunken-Karolus-Siemens system will be used.

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EIFFEL TOWER WIRELESS FATALITY.

A young wireless engineer, M. Jean Herr, was accidentally killed at the Eiffel Tower broadcasting station early last week. M. Herr had just switched on the transmitting current when he came in contact with a lead carrying 10,000 volts and was killed instantly.

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MODESTY UNVEILED.

The use of indoor aerials failed to secure the privacy sought for by three Dublin wireless "pirates" who, with twenty-four others, were fined in the Dublin District Court last week for contravening the Wireless Telegraphy Act, 1926. In one case the fine amounted to £5.

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FREQUENCY FEVER.

Apropos the proposal of the B.B.C. to talk in kilocycles instead of wavelengths, it is interesting to note that the same step has been insisted upon by the American Federal Radio Commission. The U.S. newspapers have been diligently engaged in defining "the new radio terminology."

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FISHING FLEET WIRELESS.

Wireless telephone apparatus is being carried on Hull trawlers which are now proceeding to Greenland to explore new fishing grounds. Successful telephony tests have been conducted between two of the vessels, one lying off Grimsby and one in St. Andrew's Dock, Hull.

The apparatus will permit of closer touch between the vessels of the fleet for the purpose of discovering the most suitable fishing grounds.

STILL GOING STRONG.

"This noted pianist has just completed his centenary for the B.B.C."—Wireless Paper.

He must have many quaint recollections of broadcasting in pre-Victorian days.

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AUTUMN WIRELESS SHOW IN PARIS.

A Paris wireless exhibition is to be held in the Grand Palais from October 28th to November 13th inclusive, under the auspices of the Syndicat Professionel des Industries Radio Electriques.

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INTERNATIONAL RADIO TELEGRAPH CONFERENCE.

Tuesday, October 4th, has been fixed as the opening date of the International Radio Telegraph Conference at Washington.

in Brief Review.

DEARER LICENCES IN GERMANY.

Many protests are being made in Germany at the decision of the Postmaster-General to raise the wireless licence fee from two to three marks a month.

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TRANSATLANTIC TELEPHONY QUESTIONS.

An average of three calls per day from this country is being maintained on the Transatlantic Telephony service to America, according to a statement in the House of Commons last week by the Postmaster-General. From the American side there is a daily average of four calls.

Asked whether there had not been a very considerable loss on the service, the Postmaster-General said, "No, the working expenses are covered."

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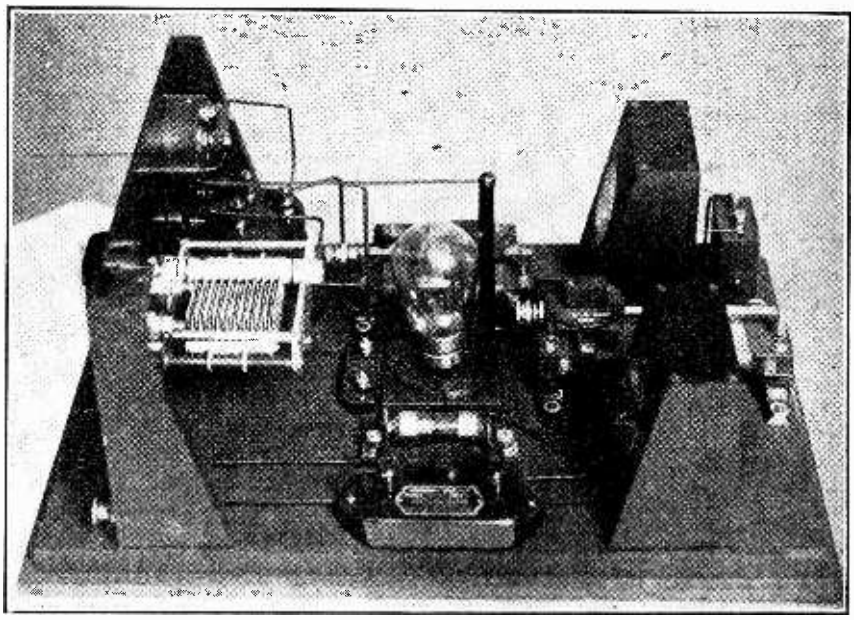
IN THE "WILD AND WOOLLY."

At a joint conference of Australian wool growers and wool workers at Adelaide a resolution was passed urging the establishment of wireless stations and aerial services to link up isolated parts of the continent.



AMATEURS AND THE ECLIPSE. To ensure accurate observation during the Solar Eclipse the Incorporated Radio Society of Great Britain calibrated the apparatus used by members by means of the wavemeter shown above. This instrument, which was designed and constructed by members, was calibrated at the National Physical Laboratory and is probably the most accurate instrument in the possession of any radio society. Note the Weston thermo-coupled galvanometer, the plate milliameter and filament voltmeter.

SOUTH AFRICAN BEAM TESTS.

At the time of going to Press it is understood that the Post Office tests with the new beam service to South Africa have been highly successful.

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PCJJ ENCIRCLING THE EARTH?

On Thursday last, June 23rd., PCJJ, Eindhoven, was heard relaying the programmes of Daventry, Langenberg, and Radio Paris.

The interesting announcement was made that many listeners to PCJJ had reported an echo effect. No echo was present in the studio, said the announcer, and it was thought that the effect might be due to the fact that the signals were travelling once or twice round the earth.

A HANDSOME PRIZE. The R.C. Threesome, with accessories, constructed by the Birmingham No. 1 Branch of the British Legion on behalf of the Children's Outing Fund.

R.S.G.B. SUMMER MEETING.

An interesting fixture for August 1st (Bank Holiday Monday) is a "Conventionette," in the form of a lunch and tea and a visit to 5XX, to be held by the Mid-Britain section of the Radio Society of Great Britain.

Any member of the Society, and friends, will be welcomed to the "Conventionette," tickets for which (5s. per head, inclusive) are obtainable from Mr. G. A. Jeapes (G2XV), "Chandos," Great Shelford, Cambs. Applications should be made not later than July 11th.

The rendezous for the "Conventionette" will be the Cock Hotel, Kingsthorpe, Northampton.

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AUSTRALIAN WIRELESS PATENT CHALLENGE.

Several large firms in Australia have challenged and have refused to pay the patent royalties charged by Amalgamated Wireless (Australasia), Ltd. (says *The Times*). Giving evidence before the Royal Commission on Wireless on June 15th, Mr. Fisk, the managing director of the company, declared that the company had spent £200,000 on patents and research and had only received £76,000 from royalties.

CLYDE LIGHTHOUSE WIRELESS.

The Cumbrae and Toward lighthouses on the Clyde have established wireless intercommunication for the purpose of facilitating shipping reports and giving directions during fogs.

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WIRELESS BOOMING IN TURKEY.

A sudden and remarkable interest in wireless is being evinced in Turkey, where the number of listeners during the past year has increased from a few individuals to many thousands. According to a *Times* correspondent, wireless dealers in Constantinople are finding themselves unable to cope with the demand for radio material.

The only broadcasting station—"Radio Stambul," Osmanié, gives a daily programme on 1,200 metres, consisting of Oriental and Occidental music in judicious proportions.

Because of their prohibitiye cost wireless sets are not yet within the reach of all, but hotels, restaurants, cafés, chemists, barbers' shops and the like have installed loud-speaker sets. The annual receiving licence (for ordinary listeners) costs about 30s.

WIRELESS AT WESTMINSTER.

BY OUR PARLIAMENTARY CORRESPONDENT.

Broadcasting Post Office Advertisements.

In the House of Commons last week Sir Harry Brittain asked the Postmaster-General whether, seeing that many facilities of the Post Office in the matter of telephone service, aerial mail, etc., were not fully known or appreciated by members of the public, he would suggest that the British Broadcasting Corporation occasionally made known these facilities for the financial benefit of his department and of the public generally.

Sir William Mitchell-Thomson said that the telephone service and other services conducted by the Post Office had been broadcast on a few occasions as matters of general public interest; but he did not consider that it would be advisable to use the broadcasting service regularly as an advertising medium for Post Office facilities.

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Telephone Wires and Aerials.

Mr. Hore-Belisha enquired whether it was the intention of the G.P.O. to issue instructions that, wherever possible, telephone wires should not be run across, either above or below, wireless receiving aerials.

Sir William Mitchell-Thomson said that there was already a standing instruction which provided for the alteration of telephone wires on private property which interfered with wireless reception, and he did not consider that further instructions were necessary. If the honourable member would furnish him with particulars of any case in which reception was hampered he would be happy to see what steps could be taken to remedy matters without incurring undue expense

TRANSMITTERS' NOTES AND QUERIES.

The R.S.G.B. Wavemeter.

On the opposite page appears a photograph of the wavemeter used by the Incorporated R.S.G.B. for calibrating the wavemeters and other apparatus used by members during the eclipse. It is, perhaps, one of the finest instruments of its kind in existence. It was designed and constructed by members of the Society and calibrated at the National Physical Laboratory.

The wavemeter, which is "crystal checked" to ensure high accuracy, tunes to exceedingly high frequencies. The valve is an L.S.5 with a plate voltage of 200 volts.

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For over a year 2XAF has broadcast time signals three times a week to Mr. F. G. Smith, who was in unexplored parts of Brazil, and it is expected that these

A BIRMINGHAM STATION. G 2AK, owned and operated by Mr. C. H. Young, at 52, Maidstone Road, Handsworth, showing the short-wave transmitter and receiver.

will have proved of great assistance in the preparation of accurate maps. The explorer is now on his way back to the United States, and it will be interesting to learn how these signals were received by him.

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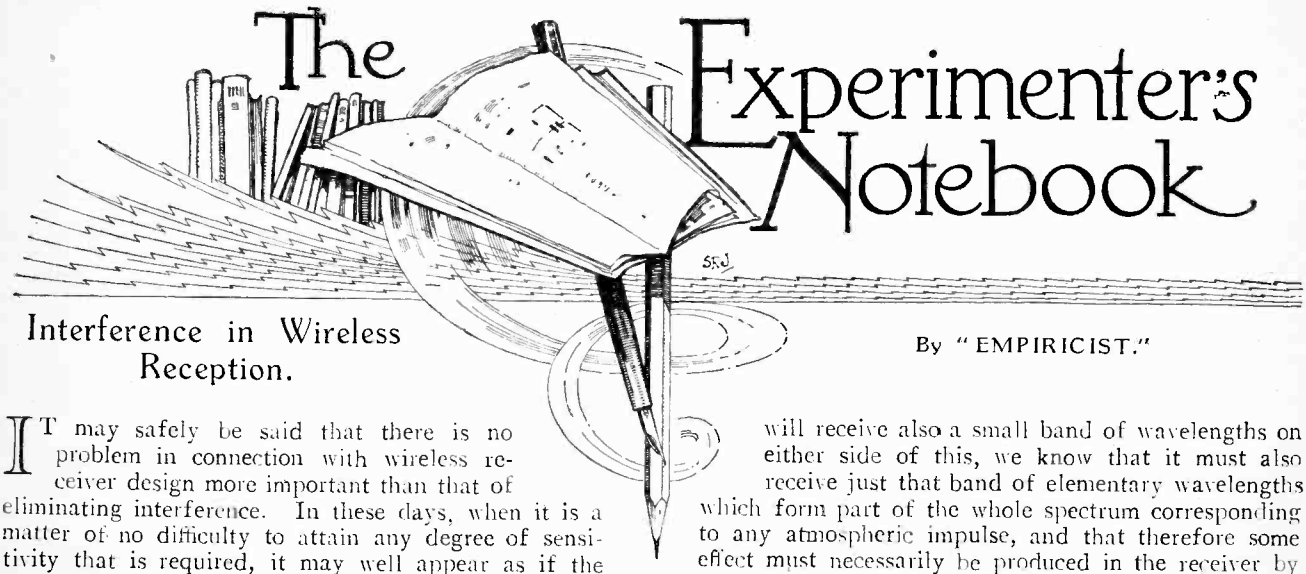
New Call-signs and Stations Identified.

2CX	J. D. Chisholm, 27, Gresham Rd., S.W.9; transmits on 45 and 180 metres and will welcome reports.
2JD	J. L. Summerfield, "Poldhu," 2a, Salisbury Rd., Seven Kings, Essex. (Change of address.)
5PR	H. Porter, 141, Waterloo Rd., Wolverhampton.
5QP	(ex 2BPP) J. V. Parsons, Holland House, Holland Rd., Sutton Coldfield, Birmingham. Transmits on 8, 23, and 45 metres.
6PB	H. Berry, 156, Lea Rd., Wolverhampton.
GW 16B	H. J. Duncan, 2, Albert Rd., Sandycove, Co. Dublin. (Change of address.)
GW 16C	G. Horander, 44, Dufferin Ave., South Circular Rd., Dublin; transmits on 45 metres and will welcome reports.
GW 17C	J. B. & R. D. Scott, 9, Upper Garville Ave., Rathgar, Dublin.
2AWJ	P. Lacon, 19, Merridale Lane, Wolverhampton
2BQK	J. M. Wilkie 102, Stanley St., Aberdeen.



The Experimenter's Notebook

Interference in Wireless Reception.

By "EMPIRICIST."

IT may safely be said that there is no problem in connection with wireless receiver design more important than that of eliminating interference. In these days, when it is a matter of no difficulty to attain any degree of sensitivity that is required, it may well appear as if the owner of a really powerful seven- or eight-valve set should be able to receive any station at will; actually those who have used even the best instruments of this kind very soon discover that the basis on which one must consider the problem of what is, and what is not, possible bears little relation to the potentialities of the receiver, but is rather settled automatically by the relation between the strength of signal to that of interference.

In saying, therefore, that the problem of eliminating interference is of such great importance, we do so with a slightly pessimistic tone; there is so much interference, and has been so much since wireless telegraphy was first invented, and so very little of it has ever been really eliminated.

Atmospherics.

Let us first consider the large class of interference which originates at some source of electrical disturbance. In this we include both natural sources, such as those electrical discharges which are held to be the origin of atmospherics, and also artificial sources which occasion so much trouble to the users of sensitive receivers in town areas.

Elimination of atmospherics in telephony is very much more difficult than in telegraphy, and the latter problem, in spite of numberless attempts, has not yet been solved. Engineers are slowly coming to the conclusion that there is really no satisfactory means for cutting out atmospherics, simply by virtue of the fact that they must necessarily partake of the same nature as a signal which is being received, whatever be the character of the latter.

A helpful means of visualising the problem is afforded by the conception of an impulse, such as an atmospheric, as consisting of a "spectrum" of continuous waves, spread all over the whole band of wavelengths. Any impulse, of whatever wave-form, can be resolved into such a spectrum, and the distribution of the various component waves which form this spectrum will vary according to the nature of the atmospheric impulse which is being received.

If, therefore, we arrange that our receiver is tuned-in to a certain wavelength and thus, by implication, that it will receive also a small band of wavelengths on either side of this, we know that it must also receive just that band of elementary wavelengths which form part of the whole spectrum corresponding to any atmospheric impulse, and that therefore some effect must necessarily be produced in the receiver by the latter.

The narrower we make the band of wavelengths which is efficiently received, the less will be the effect of the atmospheric, but, on the other hand, curtailment of this band to too great an extent will result in distortion in telephony, or even in the wave-form of Morse signals. There is thus a limitation to what can be done by simple tuning, and it is one which is very soon encountered by anybody who attempts to design a receiver which is to operate an automatic recorder from high-speed Morse.

Serious atmospheric disturbance is far more of a problem on very long waves than on the short ones, and this is one of the contributory reasons for the extraordinary success which has attended recent developments in short-wave reception. Therefore, in considering establishing communication between two points, one would naturally give a lot of thought to the selection of the right wavelength for the purpose, but such considerations are not very helpful when it is a matter of receiving to the best advantage a transmission which already exists.

Electrical Machinery.

Coming next to the sources of disturbance which are artificial in origin, we are on ground which is in a certain degree more hopeful, seeing that, to some extent at any rate, the sources themselves are capable of being controlled. The nature of the interference consists in general of impulses of arbitrary wave-form which are just as difficult to get rid of by tuning as are atmospherics.

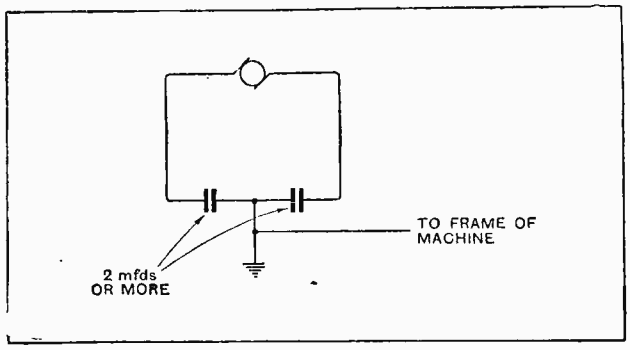
The sources which are troublesome are most diverse in their nature, and, peculiarly enough, those which at first sight appear highly trivial are often the worst in actual practice. Within the writer's experience the most pernicious of all is a fan motor, though there is no doubt that other small motors of kindred type would be equally troublesome; fan motors, for some reason or other, appear to have a greater tendency to sparking at their commutators; at any rate, one fan motor in a building can most certainly "poison" the latter quite effectively as far as long-distance reception is concerned.

The Experimenter's Notebook.—

Another troublesome source, apart from the large class of motors with sparking commutators, which are always a plague to wireless, is afforded by telephone systems. Interference of this character is very bad sometimes when there is a branch exchange in the neighbourhood of the receiver, as the insertion and removal of the plugs and ringing of the various bells seem to make a great deal of disturbance. It is not absolutely clear what the exact nature of the trouble is, and, fortunately, it does not seem to afflict the user of a wireless receiver who has an ordinary telephone line connected to his house. It is, however, as well to arrange that the receiver is as far as possible from the telephone and that the aerial does not run parallel to the telephone wires.

The cure of motor disturbances can be undertaken to a certain extent, but with somewhat varying fortune. Not infrequently a pair of condensers connected in series across the brushes of a motor or dynamo, and having the centre point connected to earth, will produce a great improvement in the interference; such an arrangement is shown in the circuit diagram.

Reverting once more to the receiver itself, the only really hopeful method of minimising interference of an impulsive character is based on the directional properties of various aerials, of which, of course, the simple frame aerial is the best known. Statistically, one would expect that a frame aerial which is non-receptive in two directions in the horizontal plane would, on an average, pick



Interference from a dynamo or motor can often be cured by connecting large condensers in series across the brushes and earthing the mid-point to the frame of the machine.

up less atmospheric disturbance of the type which originates at a distance. Furthermore, any specific source of interference can be cut out, or very greatly reduced in intensity, provided its direction is not the same as that of the station which it is desired to receive. A combination of a frame and open aerial will enable a station to be received at optimum strength when it is in a direction 180° apart from a source of interference which is simultaneously cut out. This corresponds to the well-known "heart-shape" diagram of reception.

Interference from Other Stations.

Coming next to the question of the interference occasioned by other wireless stations, we are confronted by a problem at once more complicated and more hopeful of solution than that of atmospherics and impulsive interference in general. Wireless stations, whether for the purpose of telegraphy or telephony, are designed to operate on a very restricted band of wavelengths, and, in consequence, if reception is not desired on the particular band on which the interference occurs, there is every hope of being able to "tune out" the undesired station.

In considering this question it is, of course, of great importance to know the difference in strength between the station which it is desired to receive and that of the interfering source. For instance, we may have a receiver which will cut out a station separated 5 metres from the wavelength of the desired station, provided the signal strengths of the two are equal. If, however, the undesired station turns out to be within a radius of 5 miles, whereas the desired station is at a distance of 200 miles, the case is very different, though the problem is by no means insoluble.

There are two main lines of attack in respect of the elimination of a powerful near-by station. First, we may sharpen up the tuning of the receiver itself until it selects the desired band of wavelengths and rigorously excludes all others, or, secondly, we may employ a receiver of average good selectivity and use in association with a device which will cut out the particular band of wavelengths on which the undesired station is operating. Devices of the latter type have been frequently described in the technical press under the name of wave-traps or rejector circuits.

Supersonic *versus* Neutrodyne.

When radical improvements are desired in the selectivity of a receiver one is led almost inevitably to supersonic heterodyne methods, but a receiver built on this principle lays itself open to special kinds of interference from which other types are immune. First there is the well-known fact that a "super" will accept two bands of wavelengths separated by equal frequency intervals from the wavelength of the heterodyne oscillator; interference of this type has been described as "second channel interference" on account of the two channels of wavelength to which the instrument responds. Secondly, owing to the instrument having a highly sensitive amplifier operating on a relatively long wavelength, it is peculiarly liable to pick up interference on stations which operate on this wavelength; for obvious reasons this is generally known as "intermediate frequency interference."

The design of a supersonic heterodyne receiver so as to avoid, in the greatest measure possible, the disadvantages which tend to be present is a matter of the greatest interest and importance, and, subject to success in this respect, which in the writer's opinion is obtainable in a very large degree, the results obtained are amazingly good.

When the question of selectivity is not of such extreme importance, there is no doubt that "straight circuit" receivers embodying any of the well-known methods of neutralisation offer many advantages over the average supersonic heterodyne instrument, and there seem to be immense potentialities in the direction of combining such a receiver with a device which selectively rejects any unwanted powerful station. The only real disadvantage in connection with such receivers appears to lie in the difficulty of obtaining really adequate strength of reception

The Experimenter's Notebook.—

when using a frame aerial. This precludes the use of directional methods of reception, which are of such great importance in connection with eliminating interference of all kinds.

A word should be said on the subject of interference from spark stations. The transmissions from the latter are of peculiar character, inasmuch as they tend to spread over a band of wavelengths, and will thus have an impulsive effect upon a receiver similar to that of an atmospheric, even though there may be a wide separation between the nominal wavelength of the transmission and that to which the receiver is tuned. Interference of this class is very troublesome on the coast when it is desired to receive broadcasting stations inland. Here the "heart-shape diagram" yielded by the combination of a frame aerial and an open aerial is of the greatest service, inasmuch as it enables the receiver, as it were, to "turn its back" upon the sea and receive only from inland.

Set Noises.

The last class of interference with which it is proposed to deal consists in that which originates within the receiver itself, or the apparatus connected to it. This is almost invariably due to some definite trouble such as a bad contact, a faulty component, or a defective high-tension battery. Bad contacts need not receive any special consideration here, as they are usually readily traceable and can, of course, be easily put right. In the matter of faulty components the most frequent offenders are low-frequency transformers and grid leaks; the former have a regrettable tendency towards a breakdown in their primary winding, occasioned by corrosion, and during their last few hours of life this results in the production of most alarming crackles, which start usually after the receiver has been turned on for a few minutes. This fault can be identified as occurring within the receiver by short-circuiting the grid of the detector valve to the filament, the noise originating in a transformer persisting under these conditions. Trouble from a defective H.T. battery occasions interference of much the same character, and the only satisfactory way of distinguishing between the two is by interchanging components and batteries.

A defective grid leak will occasionally give rise to crackles of a similar character, but more usually results in the production of a hiss which disappears when the leak is short-circuited. The easiest way of checking this defect is replacement by another leak, which offers no difficulties, owing to the readiness with which these components can be removed from their clips.

In some cases it is difficult to say whether interference originates within the receiver or outside it. There is a general tendency for distant telephony stations to be accompanied by extraneous noises of ill-defined character popularly known by the suggestive name of "mush." The difficulty lies in the fact that this interference becomes apparent only when the receiver is tuned-in to the carrier wave of a broadcasting station, and as a result it is not easy to settle the origin of the trouble.

A few pointers may not be out of place in indicating how a problem of this kind may be attacked.

Locating Mush.

First, it is worth checking that the mush does not originate in the microphone of the transmitting station; this can be ascertained by making a careful observation when the station starts up, and comparing the noise with that which occurs when the microphone is switched on. There is almost invariably a difference, and in some cases a serious additional noise has been perceived. Secondly, or as an alternative to the former, the set may be disconnected from its aerial and a local oscillator set up so as to imitate the carrier wave from the distant station. If the mush originates within the receiver it will "come up" when the set is tuned-in to the local oscillator, and a comparison between the conditions when the local oscillator is used and when the set is receiving normally will give a good indication of the true state of affairs. A method of this kind is of great value in improving the design of supersonic receivers.

Lastly, it is worth noting that a set which receives a wide band of wavelengths is more liable to a certain type of mush than one which is very sharply tuned. Here we are in a difficulty, as some of the interference may be external in origin and occur on frequencies which are desirable for the true reproduction of the sibilants in speech. Under these conditions, owing to the prevalence of external interference, a sacrifice of theoretically correct quality by sharpening up tuning may result in more pleasing reception, particularly in the case of certain musical items in which the very high harmonics are not of such great importance.

Walker Bros., Ltd., St. Joseph's Works, Bramley, Guildford. Illustrated price list of W.B. "All-Wood" Loud-speakers and Horns.

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Weston Electrical Instrument Co., Ltd., 15, Gt. Saffron Hill, London, E.C.1. Leaflet illustrating and describing Weston pin jack and panel voltmeters.

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Runbaken Magneto Company, Tipping Street, Ardwick, Manchester. Pamphlet (illustrated) dealing with the Runbaken Radio charges for H.T. and L.T. Batteries.

o o o o

Graham Amplion, Ltd., 25, Savile Row, London, W.1. Catalogue of Amplion cone speakers; also catalogues of Amplion horn speakers and gramophone attachments respectively.

BOOKS AND CATALOGUES RECEIVED.

"Le Poste de L'Amateur de T.S.F."—New and revised edition, by P. Hémardinquer. A simple textbook for the amateur, describing and explaining the functions of aerials, crystal receivers, valve receivers, amplifiers, typical circuits, loud-speakers, recording instruments, batteries, etc. pp. 328, with 347 illustrations and diagrams. Published by Etienne Chiron, Paris, price 20 francs.

The Wet H.T. Battery Co., 12, Brownlow Street, High Holborn, London, W.C.1. Booklet relating to "Standard" Wet H.T Batteries, including price list and full particulars, instructions for use and working hints.

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"Les Lampes à Plusieurs Électrodes et leurs Applications en Radiotechnique," by J. Groszkowski. Translated from Polish into French by G. Teyssier, with a preface by René Mesny. A treatise on the theory and practice of two-, three-, and four-electrode valves employed as detectors, amplifiers or generators, with notes on typical valve circuits. pp. 348, with 207 illustrations and diagrams. Published by Etienne Chiron, Paris, price 40 francs.

ABSORPTION WAVEMETER

For Use on all Wavelengths Between 14 and 200 Metres.

By H. B. DENT.

THE wide publicity recently accorded the short wave transmissions has led to a considerable increase in the number of experimenters exploring this interesting waveband. It is quickly realised, however, that reception on 30 metres is a vastly different proposition from that on 300 metres, and owing to the very high frequency the short wave represents, careful design of the receiving equipment becomes necessary. The tuning condensers must have a small maximum capacity, with the result that only a limited waveband can be covered with any one coil. Apart from this, the very few stations having regular schedules of transmission adds considerably to the difficulty of determining the tuning capabilities of the receiver. Searching for 2XAF or KDKA under these conditions is like looking for the proverbial needle in a haystack, and many weary hours have to be spent "knob twiddling" with a variety of coils before results are forthcoming. This waste of time, labour, and mental fatigue could be obviated if a reliable short-wave measuring instrument was available. The reference to a wavemeter immediately conjures up visions of an instrument embodying a valve with its accompanying high- and low-tension batteries, or alternatively one employing a buzzer and dry cell. It might be advisable to mention at this stage that a buzzer wavemeter is as good as useless on the very short waves, owing to the "flatness" of the wave generated, with the result that accurate readings are impossible. This, however, does not constitute the "alpha and omega" of wavemeters, and those functioning on the absorption principle have not in the past been given that consideration which is their due.

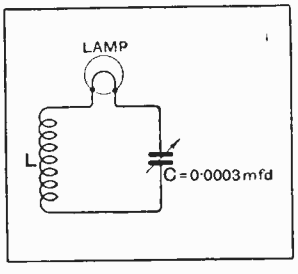

Fig. 1. The circuit diagram.

The reader has no doubt occasionally made use of a rejector circuit for the elimination of the local broadcasting station to enable those more distant, but closely related in wavelength, to be received. It will have been noticed that the rejector circuit had to be tuned to a definite wavelength for extinction of the unwanted signal, and that this tuning was sharply defined. Now, if facilities had been available for the calibration of this circuit, the reader would have noticed that the greatest diminution in signals occurred when the "rejector" was tuned to the same wavelength as that of the unwanted station, it will therefore be seen that this simple piece of apparatus actually constitutes a wavemeter. For simplicity of construction and ease of operation an absorption wavemeter is perhaps unrivalled, and if we couple with this a standard of accuracy sufficiently high for the needs of the average short-wave listener we have an instrument which should occupy the place of honour second only to that of the receiver.

The Circuit.

The circuit of the wavemeter described in these columns is given in Fig. 1, and from this it will be seen that a coil, a variable condenser, and a small lamp comprise the necessary components. The lamp is included so that the instrument can be employed for wavelength measurements of short-wave transmitters as well as receivers; however, this can be omitted if the wavemeter is required only for reception purposes.

The actual assembly of the wavemeter parts is a simple matter, but the calibration of the completed instrument presents certain obstacles unless access can be gained to one previously calibrated from a standard. To overcome this apparent difficulty, a Cyldon 0.0003 mfd. logarithmic condenser is employed, and the reason for this will be more readily appreciated when the instructions for calibrating the wavemeter are read.

The experimenter always has a warm corner in his heart for anything constructed with his own hands, but in the

Absorption Wavemeter.—

preceding chapters reference has been made to "simplicity of construction," and to justify the use of this expression Igranic short-wave coils are employed in this instrument. Three of these are required, one 4-turn coil, one 6-turn coil, one No. L25 XLLOS coil, and a Gambrell "A" coil (new series), these together covering the wavelengths 14 metres to 200 metres.

It has been previously mentioned that a small lamp is included in the circuit for the purpose of measuring the wavelength of a short-wave transmitter, but the photograph of the instrument clearly indicates that two such lamps are employed. Actually, one only is "live," namely that occupying the top right-hand corner of the instrument; the other is a spare to be taken out and inserted in the "live" holder should at any time the original occupier endeavour to rival the performance of a 60-watt lamp. This departure to the land of the setting sun may be brought about by inadvertently coupling the wavemeter too tightly to the transmitter, and every amateur who oscillates violently with P.M.G.'s permission knows to his chagrin that when this happens a spare lamp is difficult to find. The holders employed are flush panel mounting type, made by Messrs. the Grafton Electric Co. The lamps used should have a small current consumption, and in this instrument 3-volt 0.15 amp. flashlamp bulbs have been used.

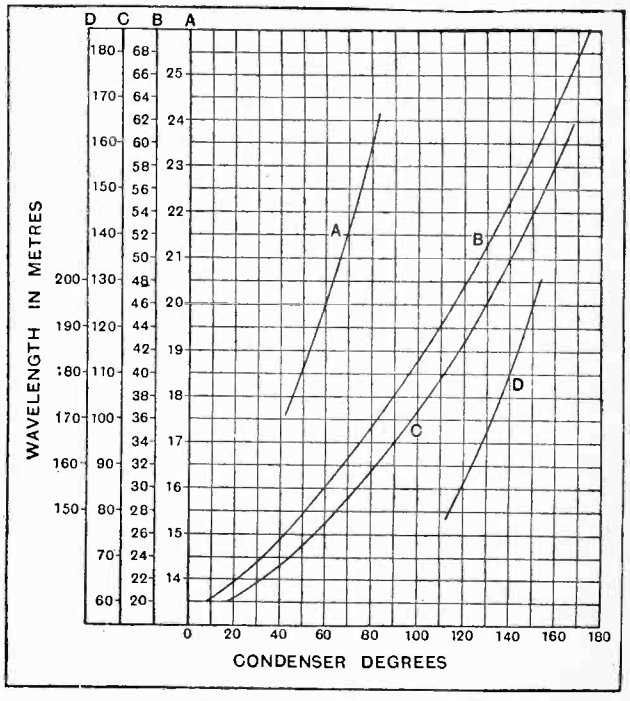

Fig. 3.—The Calibration chart.

To obtain a pleasing appearance of the completed instrument a slight departure is made from standard practice, and a sloping cabinet is employed. This may be home-constructed if desired, but in the model described a 6in. × 6in. × 4½in. deep case was obtained from Messrs. Carrington Manufacturing Co., Ltd., and modified in the following manner. First, a wedge-shaped portion was cut away by measuring down one side to a depth of 2¼in. and sawing through to the top edge of the opposite side. When the case was obtained the base overlapped the sides by ½in. all round, and to enable the case to be used on its side this overlap was trimmed off, after which the entire base was removed. These alterations naturally left scratches on the polished surface, and accordingly the back was temporarily fixed in position by four screws and the case rubbed down with fine glass paper. When all the polish had been removed the whole was given a thin coating of stain, and when this had dried a coating of carriage varnish was applied.

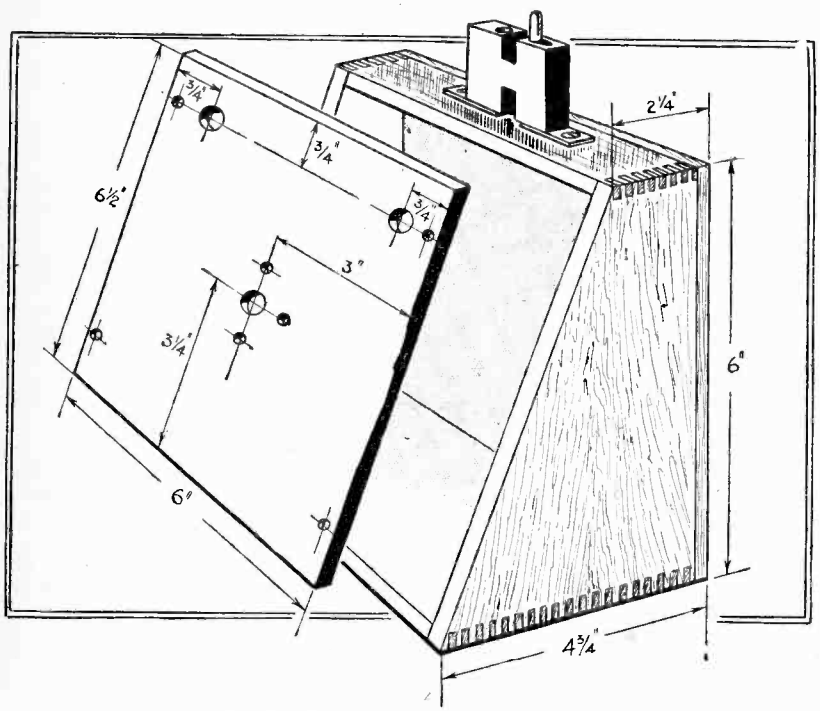

Fig. 2.—Details of the panel and cabinet.

Whether the cabinet is entirely home constructed or a modification made to a commercial article must be left to the tests and capabilities of the reader, so we will now turn our attention to the front panel.

This should be cut from ¼in. ebonite, and if the particulars given for the construction of the cabinet are faithfully followed the size of the panel required will be 6in. × 6⅝in. The top and bottom edges will require chamfering to give a neat appearance to the finished instrument. This is then drilled for the mounting of a Cyldon 0.0003 mfd. log-line condenser, a template for this purpose being supplied with the carton. Two ½in. holes must now be drilled—one at the top right-hand corner and one at the left-hand corner, these being required for the purpose of mounting the lamp-holders, which are held in position by hexagonal nuts on the underside of the panel. The left-hand holder is to accommodate the spare lamp,

Absorption Wavemeter.—

and no connection will be required, but the other is in circuit with the condenser and coil so that before assembling this a loop of wire should be placed between the fixing nut and the panel, leaving a short length protruding to act as a soldering tag. Before assembling the condenser and lamp-holders it will be necessary to drill four holes to take the wood screws which hold the panel in position and scribe a line midway between the two $\frac{1}{2}$in. holes. This line can be filled in with some suitable white material, such as plaster of Paris or white paint, and is intended as an indicator for positioning the dial. Should any difficulty be experienced in following the above, a reference to Fig. 2 will enable these instructions to be more easily followed. The panel can now be fixed on the front of the cabinet, using four $\frac{5}{8}$in. countersunk brass wood screws, and the few necessary wires soldered in position. One wire should be taken from the condenser to the centre contact of the "live" lamp-holder and one from the end of the wire loop under the lamp-holder fixing nut, through the hole in the cabinet, to the coil plug. A third lead is now taken from the remaining coil plug soldering tag and through the case to the remaining contact of the variable condenser. The two wires which pass through the holes in the wooden case should be covered with sistoflex or other suitable insulating material. It is advisable to fix the dial on the spindle before screwing home the back of the cabinet so that the moving plates can be correctly positioned. When these are fully interleaved with the fixed plates, the 180° mark on the dial should be uppermost—that is to say, the same position as the figure 12 on a clock face. The dial must now be securely fixed to the condenser spindle by means of the fixing screw, care being taken to guard against any tendency to slip. The back of the cabinet can now be fixed in position by four countersunk brass wood screws $\frac{3}{4}$in. long.

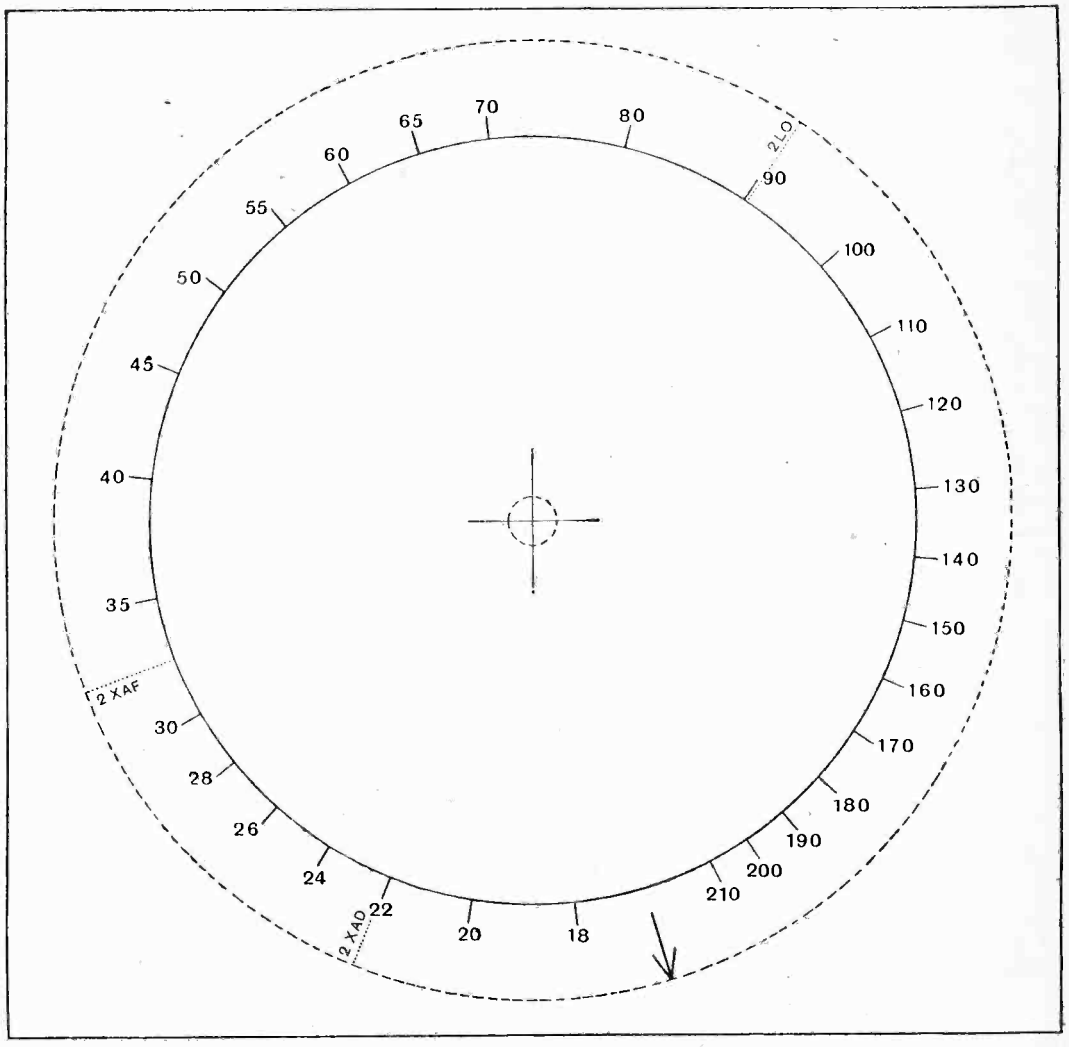

Fig. 4. The logarithmic scale of wavelenths.

Advantages of Logarithmic Condensers.

The actual construction of a wavemeter embodying either S.L.F. or S.L. condensers does not present many difficulties, but an impassé is invariably reached when attention is turned to the calibration. When a logarithmic condenser[1] is employed the usual difficulties encountered in obtaining a true calibration immediately disappear for the reason that the required wavelengths can be engraved on the dial. These will be correct irrespective of the coil used, provided, of course, these wavelengths are within the tuning capabilities of the coil. It will be seen, therefore, that any slight discrepancy in the inductance of commercially made coils will not affect the calibration of the instrument for the reason that this can be compensated for by adjustment of the dial.

[1] See "The Logarithmic Condenser," by F. H. Haynes, *The Wireless World*, May 18th, 1927.

LIST OF PARTS.

1 Cyldon 0.0003 mfds. variable condenser.
1 Wooden case, 6×6×4½in. deep (Carrington Manufacturing Co., Ltd.).
2 Lamp holders, 11a/21 (Grafton Electric Co., Ltd.).
2 Small bulbs, clear, 5i/87 (Grafton Electric Co., Ltd.).
1 Coil plug (Wright & Weaire, Ltd.).
1 Igranic short-wave coil (4 turns).
1 Igranic short-wave coil (6 turns).
1 Igranic XLLOS No. L25 coil.
1 "Mandem" 4in. dial (McLeod & McLeod).
1 Ebonite panel, 6¾×6×¼in. thick.
1 Gambrell "A" coil (new series).

In the "List of Parts" included in the descriptions of THE WIRELESS WORLD receivers are detailed the components actually used by the designer and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

Calibrating the Wavemeter.

Before proceeding with the calibration, the logarithmic scale (Fig. 4) should be either cut out by following the dotted line, or a very careful tracing taken. The condenser dial must now be removed and this scale placed over the spindle, after which the dial can be replaced, leaving sufficient clearance between it and the panel for the easy rotation of the scale. The scale would have greater rigidity and be more robust if, before assembling on the condenser spindle, it was glued to thin cardboard or a piece of celluloid cut to the same diameter. To accurately calibrate the wavemeter it will be necessary to tune in on the receiver a station whose wavelength is known, and with an Igranic short-wave coil No. 4 in the wavemeter loosely couple this to the receiver inductance. The wavemeter should then be tuned to the setting where the signals are rejected, and the coupling loosened to the point where the rejector tuning is sharply defined.

Let it be assumed that the "check" station received is 2XAD (22.02 metres), then by rotating the log scale until 22.02 coincides with the 180° mark on the bakelite dial the wavelengths covered by this coil can be read off the log scale by using the 180° line as the pointer. The log scale must remain stationary during this process, and to facilitate the correct positioning for all future occasions a line must be scribed on the panel opposite the "arrow" on the log scale. The scribed line should then be marked "A," which represent the 4-turn Igranic short-wave coil. The 6-turn coil should now replace the 4-turn and the above procedure repeated; however, in this case the line scribed will be marked "B." Before considering the calibration of the next range it will be necessary to have available a "check" signal on a higher wavelength, and the 4th harmonic of 2LO can be advantageously employed; this is to be found a little over 90 metres and is receivable at fair strength.

The Igranic XLLOS coil No. L25 must be inserted in the wavemeter, and having correctly tuned or "rejected" this station a line should be scribed in accordance with the instructions previously given. The tuning curve for this coil is marked "C" in Fig. 3. With these three coils the instrument covers all wavelengths from 14 metres to 180 metres, but if desired this range can be extended to considerably over 200 metres by the use of a Gambrell "A" coil (new series). The tuning curve corresponding to the wavelengths covered by this coil is marked "D" on the chart. If the wavemeter has been constructed strictly in accordance with the instructions given, then the curves in Fig. 3 will be sufficiently accurate for employment as a guide to readers whose short-wave receivers are tuning to some unknown wavelength. It is strongly urged, however, that when the receiver has been brought to heel and is functioning on the desired wavelengths, no time should be lost in correcting the wavemeter by check readings on known stations and using the logarithmic scale.

TRADE NOTES.

Darimont and General Radio.

An agreement concluded on June 8th between Darimont Electric Batteries, Ltd., and General Radio Co., Ltd., places the sole and exclusive manufacturing and selling rights relating to Darimont Patents on electric primary, cells, appliances and accessories in the hands of General Radio Co., Ltd., who will hereafter produce the well known Darimont Batteries and charges, etc.

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Cossor's Trade Monthly.

"Does the Impedance Matter?" is an important question dealt with in a novel manner in the current issue of Cossor's *Radio Mail*. The question is answered in the course of an imaginary interview between a salesman and his customer. The *Radio Mail* contains several other features of special interest to wireless dealers. It is published by A. C. Cossor, Ltd., Highbury Grove, N.5.

Valve as Golf Ball?

The astonishing robustness of a Mullard valve picked up from the sea at Hoylake is commented upon in a letter which the Mullard Co. has received from Mr. W. S. Booth of Daresbury, nr. Warrington. "It may interest you to know," says the writer, "that I have in my possession one of your bright emitter valves which was recently salved from the sea at Hoylake, and the surprising thing is it still functions although the bulb is a little loose, no doubt owing to the thorough soaking it had got." On testing the valve the Mullard Co. have found that the emission was only slightly under that of a new specimen.

Receiver Cabinets.

Owing to the expansion of their business, Messrs. W. E. Marson, Ltd., makers of scientific instrument cases, have been compelled to remove to more extensive premises, their address now being Windus Works, Windus Road, Stamford Hill, N.16. The new works are fully equipped with the latest types of machinery, special facilities being available for the development of the wireless cabinet section.

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The Igranic Neutrosonic Seven.

"The Giant Stride" is the title of a new publication of the Igranic Electric Co., Ltd., dealing with the Igranic Neutrosonic Seven Receiver. The booklet contains useful information for the ordinary purchaser regarding the general principles of this receiver together with a technical description and illustrations of the set in various types of cabinet. Neutrosonic accessories are also described.

News from All Quarters: By Our Special Correspondent.

Dominion Short-wave Programme.—Alternative Programmes in August.—B.B.C.'s Director-General.—Listening Post for Brussels.—"S.B." by Wireless Link.—Poor Sets in Schools.

Empire Broadcasting.

The first serious step towards the realisation of Empire broadcasting comes, not from Britain, but from one of the Dominions.

On Friday next, July 1st, when Canada celebrates the Jubilee of Federation, an effort will be made to broadcast to other parts of the Empire the speeches by the Governor-General and Prime Minister. The transmission will be made from the high-power Marconi beam station at Drummondville, Quebec, on 26.18 metres. The B.B.C. will endeavour to pick up the programme at Keston and relay it to all stations, while similar efforts will be made in South Africa, New Zealand, and other Dominions.

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The Time Table.

The broadcast will begin with a fifteen-minute inauguration programme at 5.15 p.m. (British Summer Time), followed at 8.30 p.m. (B.S.T.) by the ceremonial speeches. At 3.30 a.m. (B.S.T.) a three hours' national all-Canadian programme will be broadcast.

A stand-by receiver will be provided by the Marconi Company for use in the event of failure being experienced at Keston.

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Brightening the "Dog Days."

The introduction of regular programmes early in August from the Daventry Experimental Station, 5GB, should exercise a tonic effect on the broadcast ether. The "dog days" are inclined to make their presence felt just as much in the broadcasting sphere as in other directions, but the exciting prospect of an alternative programme should help to break the spell.

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5GB's Limitations.

It is extremely unlikely, I am afraid, that anything like a complete alternative bill of fare will be provided this side of Christmas. The new station will not start up at three in the afternoon and gaily proceed to give us "something different" all the while until 11 p.m. The transmissions will remain for the time being in the nature of an experiment, and the mere mention of "experiment" may cover a multitude of sins. It is quite possible that the five stations which will ultimately comprise the regional scheme may not include the present experimental station.

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The Power Question.

The wavelength, or rather frequency, of 5GB is still unsettled. During the past few weeks the engineers have been taking advantage of silent periods to utilise the wavelengths of many of the other B.B.C. stations, without any decisive result.

TRIALS OF THE BROADCAST LISTENER. Two "Wireless World" readers photographed at a somewhat awkward moment. The wire halyard had slipped down the side of the pulley. The choice of a suitable halyard and pulley when the aerial was erected would have saved time and trouble.

The real mystery attaching to 5GB is in connection with the power employed. This has not yet exceeded 10 kW., a power which, in the light of the present tests, appears to be inadequate.

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Daventry and the Post Office.

The new equipment at Daventry provides for a power of at least 20 kW., and it would be interesting to know exactly what influence is at work to prevent 5GB from operating at its maximum efficiency.

The last word in matters concerning the licensing of experimental wireless stations lies, of course, with the Post Office. Is the Post Office giving 5GB every opportunity to justify the hopes of those responsible for the regional scheme?

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Does 5GB Interfere?

If 5GB exhibited a tendency to interfere with the working of official and commercial stations, the Post Office could, quite rightly, offer objection to the granting of a licence for the higher power. But has 5GB interrupted any service? Such news has yet to reach me. And if 5GB on 10 kW. is perfectly innocuous, is there not a possibility that the same station might still be harmless on 20 kW.

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The Ether Policeman.

The desirability of establishing some sort of etheric policeman to keep a watchful eye on the wavelengths used by the European broadcasting stations has already been emphasised in *The Wireless World*, and the decision to institute such an authority was referred to in the issue of May 25th.

I understand that this official listening post, which will be controlled by the Union Internationale de Radiophonie, is to be set up at Brussels.

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The Technical Hub.

While Geneva can be regarded as the administrative hub of European broadcasting, Brussels can be looked upon as the technical pivot. It was in this city, under the careful supervision of M. Braillard, that the Geneva wavemeters were calibrated.

A Wavemeter Tragedy.

Mention of these wavemeters reminds me that several of the instruments distributed to the European stations in November have already shown signs of falling from grace. At one station, which shall be nameless, the engineer-in-charge protested loudly against the charge that he was "off" his correct wavelength. According to his Geneva wavemeter he was "dead on," and in the politest manner possible he suggested that not he, but his accusers, were "off."

Finally, the wavemeter was sent to Brussels, where it was found to have strayed from the paths of virtue to the extent of several metres.

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Prince Henry to Broadcast.

Prince Henry's speech at the opening of the new Leas Cliff Pavilion, Folkestone, on July 13 will be relayed to 2LO and 5XX.

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To-night's Variety.

Donald Calthrop is appearing before the microphone this evening (Wednesday) in a sketch entitled "Archie and the Lawyer," by R. Guy-Reeve. Variety turns included in the same evening's programme are by the Ramblers, Wish Wynne, the Musical Avalos, and Charles Heslop and Cyril Smith. A concertina act will be given by Harry Morton.

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A Gipsy Programme.

In memory of George Borrow, the gipsy writer, who immortalised the gipsies by such books as "Lavengro" and "Romany Rye," a gipsy programme will be broadcast from Newcastle station on the 124th anniversary of the author's birth, July 5th next.

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Trouble with the Wireless Link.

Manchester listeners have been complaining at the poor quality of the Daventry transmissions when relayed to 2ZY *via* wireless. That the wireless link is used for any inter-station communication may come as a surprise to some readers.

Certain provincial stations occasionally dispense with the land line for their morning transmissions, but the practice is not encouraged in official quarters. The wireless relay may be very useful for special running commentaries and other outside broadcasts, but it lacks the reliability and freedom from interference enjoyed by the land line.

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Its Use in Emergency.

In more than one emergency, when a land line has suddenly failed, the use of the wireless link has saved the situation. For this reason each of the B.B.C. stations is equipped with a receiver which can be tuned into a distance transmission and connected up to the control room.

Emergencies of this sort, however, are rare. The last occurred, I believe, at Glasgow during the general strike. Usually when a land line fails the Post Office engineers can instantly resort to an alternative line.

Programmes in Strips.

A handy type of wireless programme guide is being issued by the American Westinghouse Company, which controls KDKA and other broadcasting stations. It takes the form of a perforated sheet in which a strip is devoted to the programmes for each day of the week.

As each day's programmes are completed, a strip is torn off, and the listener avoids the embarrassing possibility of mistaking to-morrow's programme for that of the day before yesterday.

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Cricket Commentaries.

Running commentaries on the Gentlemen *v.* Players match on July 6th, and on the Surrey *v.* Lancashire match on July 16th, will be relayed from Kennington Oval. Commentaries will also be broadcast on the Oxford *v.* Cambridge and Eton *v.* Harrow matches at Lord's. In the former case descriptive comments are to be given in the mornings of July 4th, 5th, and 6th and during the afternoons at times when no interference will be caused to any important transmissions from the studio. In the case of the Eton *v.* Harrow match the commentary will take place between 2.30 and 5.15 p.m. on July 9th.

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FUTURE FEATURES.

London.

JULY 3RD.—Albert Sandler and the Grand Hotel, Eastbourne, Orchestra.
JULY 4TH.—"Abraham Lincoln," a play by John Drinkwater.
JULY 5TH.—Mass in B minor. Part II. Bach. Relayed from York Minster.
JULY 7TH.—Wireless Military Band and Vocalists.
JULY 9TH.—Concert Party from Folkestone.

Birmingham.

JULY 4TH.—Eye-witness account of County Cricket Match—Warwick *v.* Hants.
JULY 8TH.—"Royal Quixotes" Concert Party.

Bournemouth.

JULY 7TH.—Light Concert of the Moderns.
JULY 9TH.—A Saturday Soufflé.

Cardiff.

JULY 5TH.—A Request Programme.
JULY 7TH.—"The Powdered Player" Concert Party.

Manchester.

JULY 7TH.—An evening at Blackpool. "On with the Show of 1927."
JULY 8TH.—"Sonia," a farcical play by Victor Smythe.

Newcastle.

JULY 5TH.—A Gipsy Programme.
JULY 9TH.—Norwegian Programme.

Glasgow.

JULY 5TH.—Mr. G. F. Luke on Aviation. "Oscillations": a radio revue.
JULY 7TH.—Offenbach Programme.

Aberdeen.

JULY 8TH.—Inverness Wool Fair Concert.
JULY 9TH.—Variety Programme.

Belfast.

JULY 7TH.—Military Band Programme.
JULY 9TH.—A Novelty Programme.

Your Turn Next?

An SOS message of a new sort is being sent out every Friday night from the New York broadcasting station, WOKO. It consists of the names of heirs to unclaimed estates; consequently this weekly item comes in for a good deal of attention from optimistic listeners.

Among the missing heirs announced on the first night, says *The Manchester Guardian*, was the son of a German immigrant who died in New York in 1880 and left an estate then valued at nearly £2,000. Another heir who is missing could claim an estate worth £100,000.

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When the Anchor's Weighed.

Newcastle listeners will hear a novel programme on July 9th, when the pleasure cruiser, *Stella Polaris*, leaves the Tyne for the Norwegian fjords. Microphones will be placed on board prior to the sailing of the ship, and a commentator will hold the captain of the vessel and other officials in conversation on the bridge. At the same time the various sounds connected with the ship's departure, leave-takings, etc., will be absorbed by the microphone, and a short orchestral concert provided by the ship's orchestra will be broadcast from the saloon.

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Inferior Sets in Schools.

Many factors go towards making or marring a broadcast lesson intended for schools. Much depends on the subject chosen, and much depends upon the abilities of the broadcast teacher.

In the opinion of that pioneer of school wireless, Mr. R. J. Hibberd, who writes on the subject in *The Teachers' World*, the reason why many educational authorities have been reluctant to encourage wireless in schools is that they have heard school demonstrations where inferior amplifiers and loud-speakers have been used.

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The Useless Lesson.

The B.B.C. endorses this opinion while acknowledging that the technique of wireless teaching is still in an evolutionary state.

"Unless reception is reasonably good," writes an official of the Corporation, "the wireless lessons should be stopped, for the prejudice against this form of teaching induced in the young mind by a practically unintelligible lesson may do irreparable harm."

Few will quarrel with this statement of the case; but the other factors are equally important. The clearest reproduction will not compensate for the waste of a pupil's time in laboriously listening to a broadcast lesson which could just have easily been delivered by the teacher in the classroom.

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

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

EMPIRE BROADCASTING.

Sir,—In the most recent copies of your journal to reach me I notice a growing demand for a British short-wave broadcast transmission voiced from all parts of the Empire.

I feel that we in the less accessible parts of the Empire would derive a greater benefit from reliable reception of broadcast than those in the older Colonies. Our news is for the most part three weeks old, and musical entertainment is confined to the gramophone. The comparative unimportance of our appeal from the numerical point of view will surely be balanced by the benefit at stake per individual.

I have with me here a five-valve neutrodyne set (3 H.F.), with which I obtained fair reception of Bournemouth and London up to the end of March. Since then, however, atmospheric conditions have become steadily worse. At the present time to put on the headphones is sheer pain—a fair imitation of a battle fitly describes the noise.

I have with me also a two-valve Reinartz set with short-wave coils. With this set I can hear 2XAF on 32.77 metres on any Tuesday, Thursday, or Saturday—if I can keep awake long enough—at "phones on the table strength." KDKA suffers slightly from X's.

I wish particularly to stress the point that the 32-metre band suffers practically nothing from atmospheric disturbances in a locality where storms just now are about as violent as any in the world. (I have continued listening to 2XAF—at reduced strength—during a storm, with aerial removed.) Further, on this wavelength fading is very slight, and daylight seems to have only a small effect on signal strength.

Last night—very near midsummer now—I heard PCJJ as strongly as ever at about 6.30 p.m. G.M.T., i.e., broad daylight in Holland. It is dark about 6 p.m. G.M.T. here.

I presume high-power stations are constructed with distance as the object. Then why in the world are they fooling around with 50 kW. on 400 metres when we can hear all we want throughout the year of a transmission on 32 metres, using only a fraction of the power? And with a receiving set which costs a fraction of that required to hear the 400-metre transmission for a fraction of the year only!

Now, then, England! Don't be more than two years behind the U.S.A. this time.

G. A. MOUNTAIN,
A.M.I.E.E.

Nigeria.
May 31st, 1927.

INTERNATIONAL ASPECTS OF BROADCASTING.

Sir,—Mr. G. Rolland Willans' article in *The Wireless World* of June 8th is a very fine example of the colossal amount of loose thinking and talking that has been done almost ever since the first wireless licence was issued. Stripped of its high-sounding phrases, the purport of the article is this: "Broadcasting is of world-wide importance. As such, it is, therefore a *national* trust. But, do not expect the nation to pay for the administration of this trust. Instead of that, make merely two-and-a-quarter millions of its population pay—and also suffer much inconvenience and boredom for the sake of the rest of the Empire and the world."

We are getting used to hearing, *via* the loud-speaker, nice loud gentlemen—and, worse still, dear old ladies—with bees buzzing in their wireless bonnets, that we are apt to overlook the elementary justice of the axiom that the people who pay the piper should be the people who call the tune. The licensee pays mainly for entertainment. He should get it.

The B.B.C. are besieged by clever people who know just what we *ought* to have. It may be religious propaganda, or high-brow music, or dry and dusty educational discourses, or simply general uplift; but all the busybodies feel that they really should do something for the poor, dear listener, who only thinks he knows what he wants. Now comes this last and most terrible proposition that an important function of the B.B.C. is to cater, not for their own customers, subscribers or financial supporters, but for Imperial politics, Imperial prestige, Imperial interests, Imperial commerce. In short, we—a paltry two and a quarter million people, paying for and expecting reasonable entertainment value for our money—are to uplift and inspire the rest of the universe; to fill the all-pervading ether with such wonders as a Prime Minister's voice delivering messages of truth and majesty to the inhabitants of Australia and South Africa.

For the moment we will agree with the *Evening News* what a really "wonderful thing" it would be if one of our chief politicians could be heard talking all over the Empire at once. We will even admit that it may cement the Empire more closely; that it may bring us more trade; that it may make the rest of the world realise what fine fellows we are; and that, ultimately, it may bring us that universal freedom from wars which we all so much desire. But, if broadcasting can accomplish all these miracles, then is it not time that the nation (and not merely its listening-in population) pulled itself together, erected its own Empire Propaganda Broadcasting Station, and did its own duty, without expecting to get the job done for nothing by the B.B.C.

To suggest that licensees only should be taxed, and suffer inconvenience, and voluntarily bore themselves, for the benefit of the whole nation and Empire, is as ridiculous as suggesting that the Navy should be entirely supported by the inhabitants of coastal towns.

Should the Board of Trade, or the Foreign Office, or the Admiralty, or the War Office, or the House of Commons wish to give the world inspiring messages from time to time, to show that the British nation is still alive and vigorously kicking, then let them erect and work their own station on its own particular wavelength—and not unnecessarily interfere with the innocent and healthy enjoyment of the people of these islands. After all, we over here do not want to be continually listening to our own backs being scratched.

If it is simply a question of the rest of the world sitting by its fire side enjoying the programmes we want (and get) ourselves, then the matter is easy of solution. Let the Government relay from the B.B.C. and rebroadcast from its own ether-penetrating, high-power station, just those items which it considers most desirable for foreigners to hear. The Government (or a special authority acting on its behalf) could intersperse items of its own, additional to the relays of such mundane stuff as song and music. Incidentally, the nation should pay the B.B.C. for any material so used from the latter's programmes. This is common justice. There is no reason why entertainments provided for a section of the community (and definitely paid for by them) should be pirated by the nation as a whole for purposes of national or international benefit.

There is not only too great a tendency to regard the B.B.C. as a national milch cow, but there is also a constant endeavour to bully or persuade it into performing specific work in which the average listener is not interested.

The broadcasting of those weighty and stereotyped utterances by prominent politicians, for instance, is a novelty at first, but the time will soon come when it will be a bore. Most listeners who can understand German would far rather listen to an opera or a running commentary on a Rugger match in Berlin than they would listen to von Hindenburg explaining precisely how important was some particular theory or project of his own countrymen.

It may be argued that licensees should be proud to support financially the performance of work of international importance. Possibly; but they are merely taking on their shoulders a responsibility which rightly belongs to the nation, or its appointed representatives—the Government. Why should a nation shirk such responsibilities and the expense they entail?

The B.B.C. is a monopoly which, unless we are very careful, will tend to degenerate into a hunting ground for cranks, uplifters, and bores. It is vital that listeners should never lose sight of the fact that it is they who pay the piper and they who should consequently call the tune.

Let the cranks, uplifters, bores, nationalists, and internationalists get together and formulate and broadcast their own programmes. But let them leave us alone. Then we shall all be happy.

BERTRAM MUNN.

Twickenham.

MUSICAL INTERPRETATION IN THE CONTROL ROOM.

Sir,—In connection with the establishment of the proposed regional broadcasting scheme, there is one point I hope will receive attention, and on which I believe all music-loving listeners would welcome information.

One of the principal artistic defects of the present low-power broadcasting system is the absence of what one might call a "volume datum." The searcher after good quality spends much time and money in bringing his set to a high standard of tonal reproduction and then finds that he is deprived of one of the essential requirements of satisfactory musical performance by circumstances over which he has no control. I refer, of course, to the control of modulation at the transmitter, which, in altering the true relative loudness of the various musical passages, detracts from the enjoyment of items where great differences in volume take place. This was very evident to me on a recent Sunday afternoon when the *crescendos* in Schubert's "Unfinished" Symphony actually came through as *diminuendos* and all sense of musical climax was entirely lost.

Much of this control at the transmitter is obviously done for the benefit of the crystal user, but I hope that under the new scheme a minimum field strength will be chosen so as to give every listener an adequate volume on the very soft passage whilst still keeping "hands off the controls" throughout musical items. My view is that this will ultimately be the only satisfactory state of affairs and that it is now time for the position to be reviewed bearing in mind both the receiver and its distance from the transmitter On the other hand, the listening public require to be educated to the fact that unless a receiver is capable of handling an impressive volume, enjoyment of big orchestral works and the like is out of the question. May we also hope that receivers will ultimately be sold according to the power-handling capacity of the last valve and not merely labelled "loud-speaker receiver"

Some day, perhaps, we shall have much larger power valves, cheap in price, and, when the new Electricity Commission gives us a uniform public supply we shall be able to feed them cheaply without trouble and obtain a really adequate reproduction from a whisper to the full volume of an orchestra or organ without continual adjustment at the receiving end. This is a question which should engage the combined attention of musician, broadcaster, manufacturer and listener.

After all, what is the use of engaging a conductor of world-wide fame if the control engineer makes it impossible for his interpretation of the score to be transmitted?

Lofthouse, June 11th, 1927. F. HARTLEY.

DAVENTRY AND SPARK INTERFERENCE.

Sir,—I note in the issue of your valuable paper for June 8th two paragraphs upon which I should like to comment.

Your note on page 734 as to spark interference on 5XX suggests that this interference is due to ships, but I am informed by an expert telegraphist who has made notes upon this transmission that it is due to a high-power spark land station at Madrid. This interference frequently occurs between 9.45 and 10.30 p.m., and is extremely irritating, as it often spoils the best part of a good programme. There has also of late been an almost continuous undercurrent of what appears to be the harmonic of a high-powered arc station.

My second comment is on the report, on page 733, that, in reply to the B.B.C. referendum, a listener living 300 miles from 2LO states that he most frequently listens to that station. May I suggest that care should be taken concerning those listeners who, when asked to what station they generally listen, will reply, "London," whereas really they are listening to the London programme through 5XX. I have often met listeners who seem to be under the impression they are hearing the London programme direct from London, whereas in reality they are hearing it from Daventry. No doubt this is due to the announcement so often heard through 5XX—"London calling."

GRAHAM HUNT.

Torquay, June 9th, 1927.

SMALL LECLANCHE CELLS.

Sir,—I imagine that your correspondent, Mr. R. S. Smetzer, has had but little experience with primary sal-ammoniac cells when he refers to the wet cell as having a greater output than a dry cell.

If he is referring to ampere-hour capacity, this depends largely on the volume of zinc and the consistency of the electrolyte, and it is possible to put just as thick a zinc in one type as the other.

But the dry cell, by virtue of its lower internal resistance, maintains a higher voltage on a given rate of discharge, and the watt-hour output (or B.T.U.'s) is therefore *greater* than with a wet cell.

If, on the other hand, Mr. Smetzer refers to rate of discharge, the dry cell always has the advantage and comparative figures for internal resistance, for two cells approximately the same size can be represented by 0.4 ohm (wet) and 0.2 ohm (dry) taken on an ohmic value of two.

I have yet to be convinced that wet cells are at all suitable, and my own experience is that, however well regulated a receiver may be, the H.T. currents are usually too heavy.

Manchester, June 4th, 1927. M. E. HAYES.

Sir,—We have read with interest the reply of Mr. M. E. Hayes to the letter of Mr. R. S. Smetzer, which you were kind enough to forward to us for comment. The contention that the capacity depends on the "volume of the zinc" is quite wrong. The output is proportional to the size of the depolariser and the quantity of oxygen it contains. When the whole of the oxygen in the depolariser is used up it is necessary to have a new sac. Mr. Smetzer is quite correct in saying that the output depends on the size of the depolariser.

Again, we cannot agree that a dry cell has a lower internal resistance. On the contrary, the internal resistance of a dry cell is higher than that of a wet cell. Further, the output of a wet cell is greater than that of a dry cell using the same size of sac element. A simple proof of this can be established by obtaining a 9-volt, 6-cell grid bias battery and removing the sacs from three of the cells. Put these sacs in small jars with a circular zinc, and use an electrolyte of zinc chloride 2 oz., sal-ammoniac 3 oz., water ½-pint. Connect the six cells in series and discharge through a resistance to give about ten milliamps at the commencement of run. It will be found that the wet cell has a very considerably increased output over the dry cell, taking the output either in ampere-hours or watt-hours.

The remark also that the H.T. current may be too heavy for a sac leclanche cell is incorrect. Take a super-het. receiver requiring 35 milliamps; it is quite possible to make a sac leclanche cell that will run for twelve months without renewing the elements. We are now making a sac leclanche cell that will be suitable for L.T., and will last twelve months without attention.

If Mr. Hayes would like to have any technical data on wet batteries we shall be pleased to supply it. The facts regarding Standard Wet H.T. batteries can be briefly stated as follows:—

(1) By reason of the improved electro-chemical action which takes place in a fluid to that which takes place in a paste or jelly the output of a wet battery of equal size sac element is increased by at least 50 per cent.

(2) The containing jar, tray, and rubber insulating bands are permanent. Only sacs, zincs and electrolyte are consumable. No need to throw away a battery with half its material still unused. Couple this with the increased output, and you see the obvious economy.

(3) The cells of a Standard Sac Leclanche battery are always fluid, and the jars do not leak. Consequently the causes of crackling noises practically always experienced when a dry battery is becoming exhausted do not arise. The Standard Sac Leclanche battery gives a current free from extraneous noises throughout the whole life of the elements.

M. E. WATES.
(The Wet H.T. Battery Co.)

London, W.C.1, June 9th, 1927.

AMATEUR SHORT-WAVE TRANSMISSIONS.

Sir,—As an amateur transmitter, I write to take exception to the remarks of your correspondent, Mr. John Willings, in *The Wireless World* for June 8th. In the first place, it is extremely unlikely that the interference complained of on 2XAF emanated from an amateur station. There are few stations in England operating on that wave, and at the time 2XAF is audible they would certainly not be louder than R1, if that, owing to skip distance effects. There are no Americans licensed for that wave, and Australians and New Zealanders, who are the principal occupiers of that band, are not heard till much later in the morning. It is far more likely that the interference was caused by one of the numerous commercial stations down there, who operate without, seemingly, any pause day or night, and who never sign any call.

Mr. Willings' suggestion that amateurs should keep off the air after B.B.C. hours—for that is what his remarks *re* monopoly imply—is at least very unfair. British amateurs keep off the air during B.B.C. hours purely from a sense of sportsmanship and fair play, not because they have to. How, then, are they going to do any work if they must give up non-B.B.C. hours? And is it reasonable to expect them to do so?

K. E. B. JAY
(G2HJ).

Amersham,
June 16th, 1927.

Sir,—I regret reading such comments, so detrimental to the "brass-pounding" fraternity, as recently suggested by your correspondent Mr. John Willings. I think I am correct in stating that the 32-metre permits (in this country) are at present only issued to a few transmitting members of the R.S.G.B., "Special Research Section." These members are well-known amateur research workers, each must possess a wavemeter, and their knowledge of transmitting apparatus is above the average. As your correspondent had to listen for a solid half-hour to "blibetty blah," otherwise Morse telegraphy, why did he not give in his letter the call-sign of the offending station? If he can only read "blibetty blah" (letter V?), then why suggest that the Morse was from an amateur station at all? I know it is an easy matter for a transmitter to stray unintentionally from his licensed wave. If this had so happened with the offending station, would it not have been a better policy on the part of Mr. Willings (if he reads Morse?) to have notified the station concerned, thereby keeping the said station "off the grass" for future uninterrupted programmes? Evidently NU 2XAF is not DX to your correspondent, nor is he a "DX-hound." I would now like to know what a "DX-hound" really is? Is it not a general tendency on the part of B.C.L.'s to label every scrap of Morse interference they receive as originating from amateur stations, mostly without justification on their part?

Your correspondent may or may not be aware that amateur transmitters, just to mention three more countries—Australia, New Zealand, and South Africa—use the 32-metre waveband. A transmitter tuned to a wavelength near 32.77 metres, and situated in any of these countries, could be "brought in" by the carrier wave of NU 2XAF. Why accuse only the "brass-pounders" in this country?

I suggest that Mr. Willings might be a little more considerate to the amateur transmitter; try and help him, not throw unnecessary criticism about because he may not read Morse or understand the difficulties the transmitter has to contend with in his research.

J. O. J. HUDSON
(G5GU).

London, N.18.
June 17th, 1927.

Sir,—I read with interest Mr. John Willings' letter in your June 8th issue. As a very old experimenter I consider his remarks rather hasty.

Would it not have been better to give the call-sign of the offending station?

The amateur, both in this country and U.S.A., has done a considerable amount of pioneer work using high frequencies, and is to a large degree responsible for their use in the long-distance transmission your correspondent enjoys.

Why send out a general complaint? I am sure it is not justified.

The "hoary joke" Mr. Willings refers to I must confess I am inclined to think, after years of listening to U.S.A. broadcasting on short and medium wave, has quite a lot of truth in it.

Can your correspondent get consistently good-quality music or speech from American S.W. stations? I have received excellent results sometimes, but to say such transmissions are reliable is another matter.

The B.B.C. engineers are not ignorant of the possibilities of such frequencies, and I believe programmes will be available in the near future from this country using short waves for their propagation. There is a considerable amount of experimental work yet to be done before short waves are a certain means of long-distance broadcasting, and I suggest that amateur transmitters be helped, not hindered, in this field.

Allow the B.B.C. engineers time to complete their experimental work on these high frequencies. It is better than erecting a 100-kilowatt 20-metre station only to find that something better could have been done a month or so after.

We have something to be proud of in our broadcasting system when compared with that of the U.S.A.

C. R. CHADFIELD
(G6AS)

Melton Mowbray.
June 10th, 1927.

SMALL ADVERTISEMENTS.

Sir,—I wonder if you would care to mention the following points in *The Wireless World* for the guidance of small advertisers?

Goods should not be sent on unsolicited approval. Recently a despairing advertiser informed me that he had received no less than 50 copies of a particular number of a periodical for which he advertised.

In forwarding fragile articles through the post the stamps should be placed on a "tie-on" label, not on the package itself. I have just received a valve which only just escaped being smashed to smithereens by the blow from the stamp obliterator.

A correspondent, Mr. Shaull, of Brixton, raises a curious point when he refers to the good will existing among advertisers in your columns. He is quite right. There is never any quibble, and no one need have any qualms about sending cash or goods on approval to your readers. This is a very pleasant state of affairs, and I hope it may long continue.

H. BRAITHWAITE.

Southbourne.
June 18th, 1927.

ULTRA-VIOLET RAYS.

Sir,—Listeners-in amongst your readers who have heard me speak at one time or another about the value of sunlight may be interested in a novel and arresting piece of independent testimony. It has just come to me from Kew.

Some weeks ago two boxes, each containing six lettuce, were sown on the same day, one beneath ordinary glass, the other beneath the special glass which admits the sun's ultra-violet rays. They have been tended in exactly the same manner, and they have been plucked on the same day and weighed.

And with what result? The weight at the end of six weeks of the six grown under ordinary glass was 8½ lb.; of the six grown under vitaglass 9¾ lb.—that is to say, the ultra-violet rays, and any others of value which vitaglass may transmit, have added 1¼ lb. to the weight of six lettuce in six weeks. Under them they grew up much sturdier, of a deeper shade of green and with bigger hearts.

The authorities, very naturally, are now proceeding to test other plants of economic and dietetic value on the same lines. I for one should be very much surprised if the results do not give added proof of the value of ultra-violet rays in the cultivation of plants as of animals and children.

C. W. SALEEBY,
M.D., F.Z.S., F.R.S.

London, N.W.6.
June 18th, 1927.

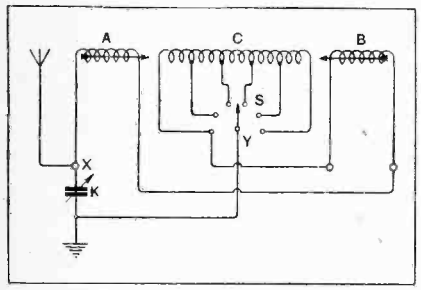
RECENT INVENTIONS

The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

A Multiple Tuner.
(No. 254,338.)

Convention date (France): June 29th, 1925.

An arrangement of tuning inductances for long and short wavelengths forms the subject of a patent granted to Compagnie pour la Fabrication des Compteurs et Material d'Usines à Gaz. The invention relates to an arrangement of long- and short-wave tuning coils so that the short-wave sections are not appreciably influenced by the long-wave sections. The short-wave tuning coils shown in the accompanying diagram are divided into two equal portions A and B connected in



Multiple tuner circuit. (No. 254,338.)

series and spaced some distance apart. The two sections A and B are so arranged that the directions of the windings are opposite. The longer wave coil C is connected electrically in series with the two portions A and B and is placed between them in the manner indicated. The aerial tuning condenser is shown at K and the aerial and earth terminals at X and Y, while a multiple switch S is used to connect the various portions of the tuning coil in circuit. The specification states that the effect of the coil A upon C will be equal and opposite to the effect of the coil B upon C, and, therefore, since the two coils A and B constitute the short-wave portions, the long-wave portion will have no appreciable effect.

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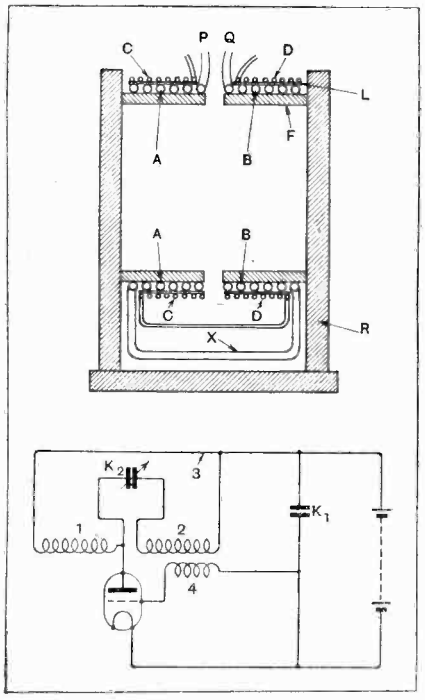
Inductance Construction.
(No. 267,196.)

Application date: November 30th, 1925.

A particular form of inductance construction suitable, for example, for wavemeters, is described in the above British patent by K. E. Edgeworth. The invention consists in making the inductance in two portions, the extremities of which are connected together, while the inner ends are brought out for connection to some circuit. The same method of construction may also be employed for coupling inductances together, or for transformers. The illustration shows two inductances coupled together according to the invention, while a wavemeter circuit employing this type of coil is also indicated. The first inductance consists of two portions A and B, wound on an insulating former F. The extremities of these windings are connected at X, while the adjacent ends P and Q are brought out for connection purposes. An insulating layer L is placed over the two windings A and B, while another similar inductance consisting of two portions C and D is wound upon it, the whole being connected to a framework R. An inductance of this type is also shown connected



Wavemeter coil construction (No. 267,196.)

to a wavemeter, the advantage of the system lying in the fact that the earth or filament connection to the inductances renders the system less liable to the influence of capacity effects. The outer ends of the anode coils 1 and 2 are joined at 3 and earthed through a blocking condenser K_1. The anode circuit is tuned by a condenser K_2, while reaction is obtained by means of a grid coil 4 coupled to the section 2 of the anode inductances.

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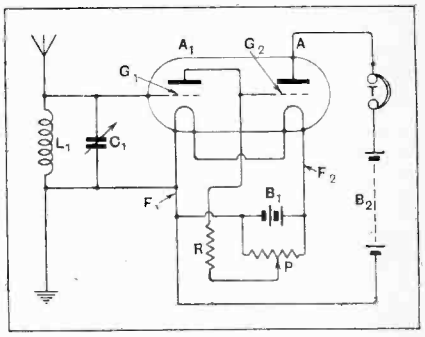
A Low Voltage Amplifier.
(No. 267,198.)

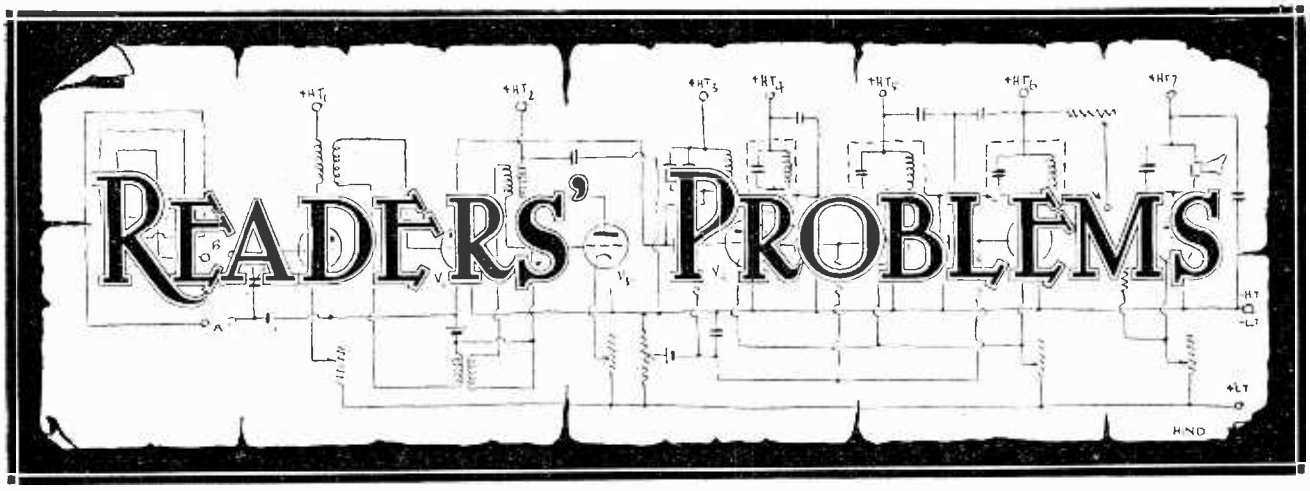
Application dates: December 3rd, 1925, *and January 4th*, 1926.

A. H. Midgley describes in the above British patent a form of amplifier which works at a very low high-tension voltage. The invention either makes use of a special valve with two sets of electrodes or two ordinary valves. The accompanying diagram shows one arrangement of the circuit in which the ordinary aerial tuning circuit L_1, C_1 is connected to the first grid and filament G_1 F_1. The anode A_1 is connected through a resistance R to a low voltage obtained by means of a potentiometer P working in conjunction with a filament battery B_1. The anode A_1 is connected directly to the grid G_2 of the second valve or set of electrodes. The



Dual valve for low-voltage amplification. (No. 267,198.)

second anode A_2 is connected in the ordinary manner through telephones T to a normal high-tension battery, B_2. The value of the resistance R may be between a half and two megohms, while the positive potential given to the anode A_1 and grid G_2 through this resistance may be of the order of three or four volts. It is also mentioned that the value of the resistance may be increased to five megohms, in which case the voltage should be increased to about forty. Another feature of the circuit is the connection of the two filaments F_1 and F_2 in series.



"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Converting a D.C. Battery Eliminator.

My high-tension is at present drawn from a D.C. battery eliminator, but I am now informed that very shortly a change over to A.C. will be made. Not wishing to incur unnecessary expense in purchasing a new unit, I propose to convert my present eliminator into one capable of being used on an A.C. supply. Unfortunately, my knowledge on this subject is very limited, and I should be obliged if you would supply me with a circuit diagram showing the necessary alteration.

D. H. W.

It will not be a difficult matter to convert your D.C. battery eliminator for use on an A.C. supply, actually this can be accomplished by the construction of an additional unit which can be attached to your present eliminator. You will require a special rectifying valve and a transformer having a primary winding and secondary windings for the high-tension and filament heating. The construction of a suitable power transformer is not recommended unless the home constructor is experienced in the making of such components, and we think you would be well advised to purchase one ready made. The names of manufacturers of small power transformers can be obtained by reference to the miscellaneous advertisement columns at the end of this journal.

With reference to Fig. 1 it will be noticed that the filament winding on the transformer has a centre tap, this being necessary to locate the "electrical centre" of the rectifying valve filament from which the H.T. is taken. In cases where this winding has no centre tap, the desired effect can be obtained by connecting a potentiometer of about 400 ohms across the valve filaments and taking the H.T. lead from the slider.

The fuses shown in the mains supply leads to the primary winding are not essential but are nevertheless advisable, as they will blow if an excessive load is imposed on the circuit, due to a short-circuit of either of the secondary windings. Unless a safety device of this nature is incorporated, damage may result to the primary, or excessive heat be generated, which will "char" the insulation of the coils. This will bring about short-circuited turns and various complications will arise, the least serious of which would be an unnecessarily heavy consumption of current in the primary winding.

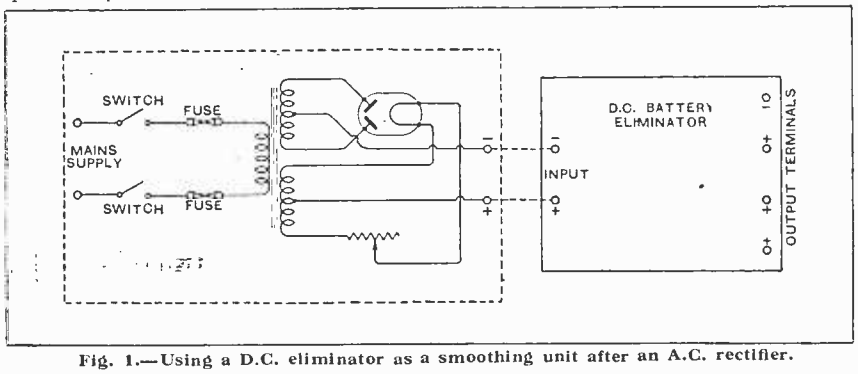


Fig. 1.—Using a D.C. eliminator as a smoothing unit after an A.C. rectifier.

Detector Bias.

I should be obliged if you would clear up a misunderstanding regarding the "Everyman Four" set. On page 29 of the booklet describing this instrument it is stated "If 2-volt valves are used it is necessary to remove the two resistors R_3 and R_4 and to join the wires, etc. . . ." On page 31 it says "As the Cossor 0.1 R.C. is a 2-volt valve taking 0.1 amp. the resistors R_3 and R_4 can be of 15 and 30 ohms respectively." These statements seem to be contradictory.

D. N.

We think that this misunderstanding will be cleared up when we say that the statement on page 31 applies only when a 2-volt detector is used in conjunction with 6-volt valves elsewhere. It refers back to the preceding paragraph, in which a combination of 2- and 6-volt valves is suggested. When using 2-volt valves throughout, it is no longer possible to take grid bias from the drop in voltage across one of the resistors, and for further information on this subject you are referred to a reply given to another reader in our issue of April 13th.

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Below the Broadcast Wavelengths.

I am thinking of constructing a receiver for covering the band of wavelengths below 200 metres as far as 90 metres, and am intending to use a stabilised type of plug-in coil. Could you tell me what you consider the best circuit for my needs? P. S. R.

In our opinion the best circuit to construct under the circumstances is a detector and L.F. We should advise that the aerial be coupled to the grid tuning coil by means of aperiodic coupling wound over the grid coil, or by an auto-tapped grid coil, which are, as you may be aware, upon the market. With regard to reaction, we think that one of the usual methods of capacity control of magnetic reaction may be suitable.

Black or Blue?

I am a new reader, and notice in your journal reference to a receiver named the "All-Wave" Four. Can you supply me with a blue print of this circuit? P. T.

This receiver was described, with full constructional details, practical and theoretical wiring diagrams published, and dimensional drawings of panel and baseboard, etc., in our issue dated April 27th, 1927, which may still be obtained from the publishing department at a cost of 4d., post free. The practical wiring plans, etc., are printed in black and white, as is our custom, and not in blue and white, although naturally this has no effect on their efficacy.

aerial-grid transformer of the "Everyman-Four" receiver if you are going to confine your work to the 200- to 600-metre waveband. On the long wavelengths, however, it will be desirable to use the ordinary system of loose coupling with plug-in coils, the aerial coil being tuned by the condenser shown in dotted lines as in the case of the "All-Wave Four." The intervalve transformer preceding the detector valve may consist of the "Everyman Four" or the "All-Wave Four." types of intervalve transformer, except that no neutralising winding will be needed as the set will be automatically stabilised, due to the fact that the sequence of tuned grid and plate circuits is broken by the interposed resistance-a similar value of grid bias, although one amplifies and the other rectifies. This is arranged for in the construction of the valves, as the negative potential on the grid of the H.F. valve will bring the operating point on to the straight part of the operating curve, whilst in the case of the rectifier valve it will bring the working point on the bottom bend. Grid bias in the case of the second H.F. valve is arranged for by the potential drop across the filaments, which are in series, the valve being so constructed that this automatically puts the correct bias on the grid. Similarly, in the case of the first L.F. valve, the valve is so arranged that the correct bias is put on the grid when it is joined to L.T.−. The filaments of

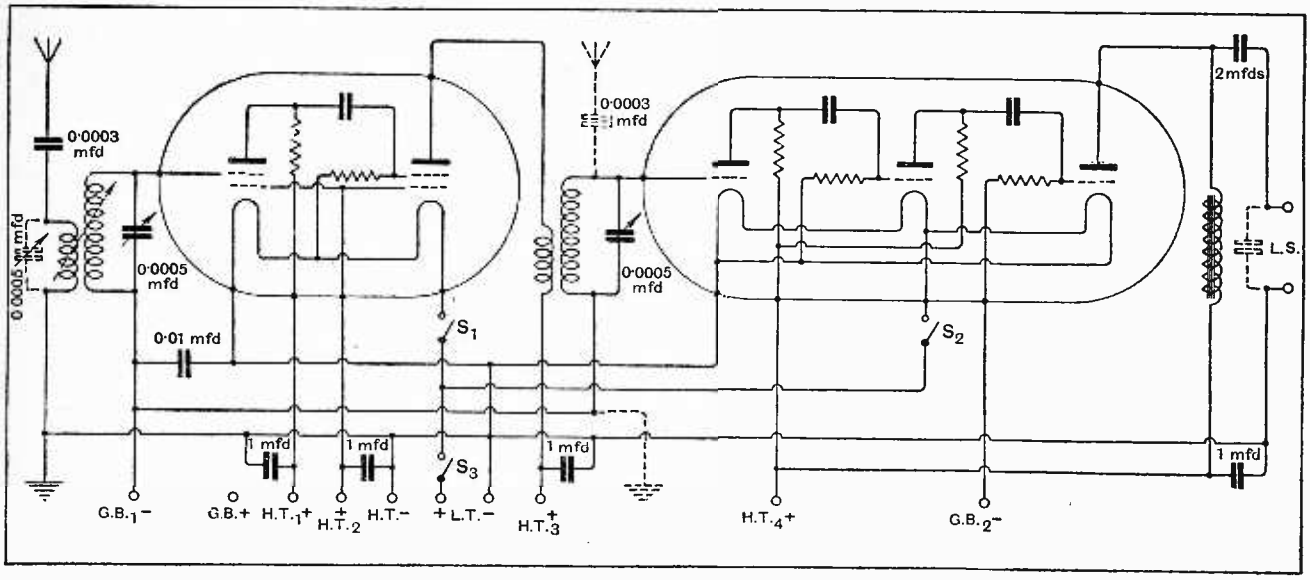

Fig. 2.—A practical arrangement making use of Loewe multiple valves.

Multiple Valves.

I have obtained two of the Loewe multiple valves, one marked H.F. and the other N.F., and desire if possible to use them with H.F. transformers of the "Everyman" type, and also wish to run my loud-speaker from a choke filter circuit. D. G.

These two valves consist of a complete high-frequency amplifier enclosed in a glass bulb, the H.F. bulb containing two complete four-electrode valves coupled to each other by means of resistance coupling. The terms H.F. stand actually for the German words *Hoch Frequenz*, and the symbols N.F. of the other instrument stand for the German words *Nieder Frequenz*. The N.F. instruments contain an anode bend detector followed by two resistance-coupled L.F. stages, the complete amplifier being built in the bulb.

We give in Fig. 2 a diagram for using these two valves. Each "valve" has six legs, which fit into a special socket, and from our diagram both internal and external connections are seen clearly. We show the ordinary system of aerial coupling which may be aperiodic and may consist if you so desire of the coupling. Thus we have a tuned input circuit followed by a stage of resistance coupling, and then we follow on again with another tuned circuit uniting the second H.F. valve with the detector. The L.F. choke in the output stage may be of the usual type advocated for this purpose, and a fixed condenser may be connected across the loud-speaker in the usual manner if it is so desired.

By connecting the aerial and earth system to the points which we show in dotted lines, you will be able to use the detector and two L.F. valves on the local or Daventry stations with good effect. In the case of the local station, the grid coil, of course, will be a No. 50, and in the case of Daventry a No. 200, depending on aerial capacity, etc. It should be pointed out also that if using plug-in coils preceding the H.F. valve, and using ordinary plug-in coils with tuned primary, you will need a 50-turn coil in the primary and a 50- or 65-turn in the secondary on the normal broadcasting wavelengths, with a 200-turn coil in the primary and a 250-turn coil secondary on the long wavelengths.

It will be noticed that the first H.F. valve and also the detector valve receive the detector and two L.F. valves are, it will be noticed, connected in a series-parallel arrangement.

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Hand Capacity.

I am using a straightforward two-valve det.-L.F. receiver and get good results from the local station, but if an attempt is made to tune in distant transmissions, hand-capacity effects at once become troublesome, and in fact, to receive any other station is an extremely difficult matter. Will you please give me your advice as to how matters may be improved?

G. E. H.

We think it probable that you are using one of the more modern tuning condensers, in which the rotor is connected to the frame. Now it is intended that the moving plates of these condensers should be connected to the earthed side of your tuning coil, and we think if you make the necessary alteration, hand-capacity effects will no longer be troublesome, as the spindle and frame will be at the same potential as the hand of the operator.