TELEVISION IN THE NEW YEAR—FIRST DETAILS

TELEVISION

THE FIRST TELEVISION JOURNAL IN THE WORLD

and SHORT-WAVE WORLD

MONTHLY 1/-

DECEMBER, 1935.

No. 94. Vol. VIII.

BERNARD JONES PUBLICATIONS LTD., CHANSITOR HOUSE, CHANCERY LANE, LONDON, W.C.2.

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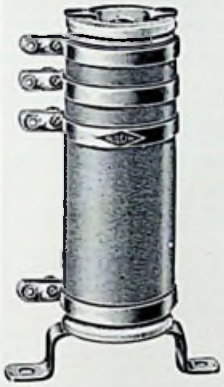

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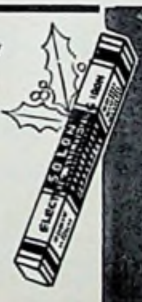

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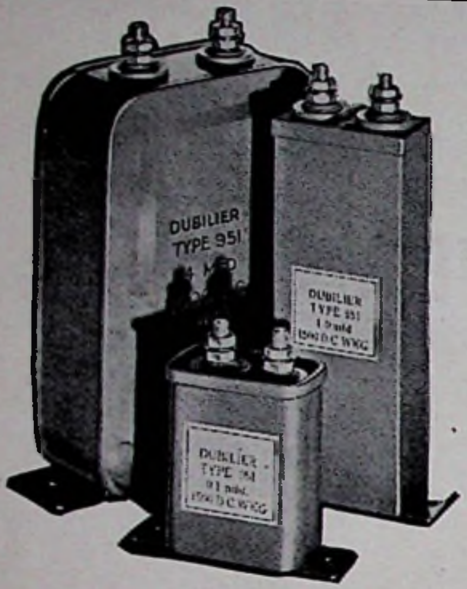

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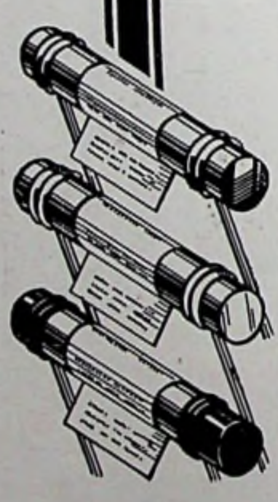

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No. 94 VOL. VIII DECEMBER, 1935.

TELEVISION and SHORT-WAVE WORLD

Special Features

TELEVISION AND SHORT-WAVE WORLD

Proprietors :
BERNARD JONES PUBLICATIONS, LTD.

Editor-in-Chief :
BERNARD E. JONES.

Editor :
H. CORBISHLEY.

Editorial, Advertising and Publishing Offices :
Chansitor House, 38, Chancery Lane, London, W.C.2.

Telephones : Holborn 6158, 6159
Telegrams : Beejapee, Holb., London.

Subscription Rates : Post paid to any part of the world—3 months, 3/6; 6 months, 6/9; 12 months, 13/6.

Published Monthly—1/- net.
(Last Wednesday in every month for following month).

Contributions are invited and will be promptly considered. Correspondence should be addressed according to its nature, to the Editor, the Advertisement Manager, or the Publisher, "Television and Short-wave World," Chansitor House, Chancery Lane, London, W.C.2.

IMPORTANT

"Television and Short-wave World" is registered at the General Post Office, London, for transmission to Canada and Newfoundland by Magazine Post.

COMMENT OF THE MONTH

A Definite Start.

WE are glad to be able to state that at last television is out of the realm of politics and into a world of reality. Plans for the new service have been formulated, contracts have been placed, the administrative and executive staffs are being selected and all the work for the provision of a television service is going right ahead. After the seemingly interminable delays that have been experienced throughout the greater part of the past twelve months, this is good news, and manufacturers will be able to proceed with the production of receivers.

As has often been advocated in this journal a series of radiation test transmissions are to be put out at the earliest date possible, which will probably be early in March. This date, our readers will remember, was forecast in our October issue. Following these radiation tests there will be a series of actual television transmissions of a simple character so that all concerned will have an opportunity of acquiring practical experience on programme technique and similar matters upon which still much remains to be learnt.

From the detailed official information regarding the new service which we give on other pages of this issue readers will be assured that the B.B.C. is now going into television wholeheartedly and the proposed scheme for installation of viewing centres in different parts of London indicates that it is not only the intention to provide a good service, but also to do everything possible to popularise television. This is quite important for the cost of receivers will be high until there is quantity production and quantity production will only be practicable when the "man in the street" feels that he must be able to receive the television programmes as part of his home entertainment. At the present time it is probable that not more than one person in ten thousand has ever seen a television picture of any type and the public therefore has no idea of what has been accomplished. The policy of the Baird Co. in giving several semi-public demonstrations is to be commended as those will do much towards providing a public for the service which is now so well on the way.

At the start, a six-day programme only—omitting Sunday—may be advised, but most people feel that if the response by the public is enthusiastic, the B.B.C.'s intention in this matter, as in a number of other details, will be subject to reasonable modification. It cannot be too greatly emphasised that the future of the television service will depend upon the public's response more than on any other factor whatsoever.

Mr. Gerald Cock, the Director of Television, is an enthusiast who will do his very best, in circumstances which will be initially difficult, to give the public what it wants. And that public may like to know that he is an amiable and accessible person with nothing of the cold formality which some people may, rightly or wrongly, associate with the B.B.C. He starts out with a high ideal of public service.

THE B.B.C.'s PLANS FOR TELEVISION

FIRST OFFICIAL DETAILS

HOW many readers accepted the head-line of the cover of last month's issue " On the Threshold of Amazing Developments " as a promise which would be literally fulfilled? The recent history of television has been so disappointing in its delays that readers might be excused for assuming that delay would continue to be the order. We are happy to announce that there has been a real quickening of pace during the past month. The publication of the October issue of TELEVISION AND SHORT-WAVE WORLD, containing the

MR. GERALD COCK, Director of Televison.

first pictorial layout of London's new television station, caused considerable interest and gave rise to much discussion in high places. The B.B.C., whom we accused, in the same issue, of refusing to provide a word of information on a subject of vast importance to the public at large, has shown sign of a change of heart !

Coming Developments

Facilities have been placed at our disposal in recent weeks as a result of which we hope to keep our readers very closely in touch with developments as they occur in the coming months. And there will undoubtedly be developments, and many of them.

Since the publication of last month's issue, we have had the pleasure of a long conversation with Mr. Gerald Cock, the B.B.C.'s Director of Television, who considerably impressed us with the businesslike way in which, after long delay, the B.B.C. is attacking the problem of providing the public with a television service. He gives us every hope to believe that the television tests will start in March—more or less as we predicted two months ago—and that the service itself will be conducted with energy and vigour and will be an intelligent and conscientious attempt to meet a public need. Mr. Cock was at pains to make us explain that he was telling us what the B.B.C. *hopes* to do, and that our readers must realise that as there is but little experience to go upon and as an entirely new technique has to be created before a permanent television service can be started, whatever schemes and programmes are put forward at this moment are necessarily subject to modification in due course. Naturally, too, Mr. Cock was speaking to some extent for himself, but while many of his ideas and opinions were hardly " official " they were, in the main, backed up by the Television Advisory Committee and by the various officials with whom the Director of Television would be called upon to work in providing the new service.

Recent Progress

For one thing, we were delighted to find that Mr. Gerald Cock is an enthusiast. It is the only type of man that stands any chance of overcoming the very considerable difficulties that lie ahead—technical difficulties which can be foreseen but to which, at the moment, there is unlikely to be any easy key. He was able to tell us, from his own observation, that astonishing progress had been made within the last few months, and he is evidently fully convinced that he can offer the public a satisfactory service. He was insistent on one point; as so much will depend upon the public's response to the B.B.C.'s effort, the service can only succeed if the public is sympathetic and determined to give the necessary indulgence and encouragement, especially at the start.

There is a particularly human side to the problems which the B.B.C. is considering at the moment. Their trouble is not a mere matter of the provision of buildings, studios, equipment, etc. Their job will be to sell the public something which nobody yet has ever tried to sell and it will take something more than scientific machinery to do that; it will take human understanding. The B.B.C. can only succeed by a very sympathetic study of the public to whom it will be offering its wares of sound and vision.

Work at the Alexandra Palace

The public is now already aware that work on the reconstruction of Alexandra Palace, the first public television service station in the world, has now actually

TELEVISION PROGRAMME POLICY

begun. A clearance has been made in the part taken over by the B.B.C. and the interior will be remodelled on the lines shown in the plans and pictorial layout published in TELEVISION AND SHORT-WAVE WORLD last month. The erection of the aerial mast will follow.

The scenery used in the television studio will, for the greater part, be of solid construction, as in film work, and little use will be made of painted back-cloths. The lighting of the studio demands special study, and the costly equipment to be provided will allow of especial directional effects. There has long been in the Alexandra Palace a theatre and it may have been thought that this would lend itself to television, but, apparently, except for rehearsals which will go on all day, it may not come into use for programme purposes for some time and only then after considerable remodelling and reconstruction.

Programme Production

The mention of rehearsals reminds us that these are a much more serious business than in purely sound broadcasting. In a play to be broadcast for sound only, the trained actors—really they need be nothing more than elocutionists—can be allowed to read their lines, providing they have already made themselves thoroughly familiar with them, and the public are seldom able to detect that the actors are not speaking their lines from memory.

But, obviously, that is impossible with television. The actors must have memorised their lines, have perfected their stage " business," have dressed and made-up to their parts and must put up a show of just as great finish as in the ordinary theatre. All this must add to the difficulty and expense of the television broadcast. Incidentally, for example, it must mean the provision of artists' dressing rooms, etc., restaurant services, and the like.

Mr. D. H. Munro, who at present is in charge of studio equipment at Broadcasting House, will go to the Alexandra Palace as Television Productions Manager, and the Programme Staff will include also a film expert, producers, a stage manager, etc., etc.

By the way, there will be close liaison between Broadcasting House and Alexandra Palace and, for the convenience of artists and staff, there will be a regular transport service between the two, the car journey occupying thirty-five minutes.

We present the main lines of the television programme, as the Director of Television sees it at this moment, in a panel on this page. Most of these items speak for themselves, but we may comment shortly on one or two of them. In the first case, it is expected that the programme duration will be three hours a day, but this has yet to be definitely confirmed by the Advisory Committee—one hour in the afternoon, another about 6.15 p.m., and the last of the three hours later in the evening. An attempt will be made to keep each item down to a maximum of fifteen minutes. Most of the items will be shorter than this, but occasionally, as in a cabaret show, twenty minutes will be allowed. It is considered that short items will obviate any possibility of fatigue as might be the case were long periods of concentration necessary.

Film Transmissions

It is not proposed to televise long feature films, but, instead, to offer excerpts from well-known films and, in addition, to transmit a number of amateur films. There will be film talks and criticisms illustrated by selections from the films under discussion. There may be interviews with film stars and other popular personalities; a new form of "In Town To-night" will be invented for the television studio. The television broadcasts will, in general, have a musical accompaniment provided by a special orchestra of at least twenty players, wearing uniforms in colours specially selected from the point of view of effective television. This orchestra will be of the theatre type since chamber music, symphonies, etc., are obviously unsuitable.

Eventually, it may be possible to give scenes from stage plays, it being hoped that theatrical companies will be induced to visit the television studio for the purpose, as to which we shall see. Any prejudices or jealousies of theatrical managers will have to be met and overcome before this will be possible.

The daily news magazine may be transmitted from films taken during the day and in addition will include, it is hoped, well-known personalities who themselves will appear before the scanner.

Certain artists will probably be booked for a week at

The Proposed Television Programmes.

Film Pictures, " talkies " or otherwise.

Orchestral items.

Dramatized News.

Interviews with Personalities.

Trade-sponsored Shows and Demonstrations.

Short Debates between Well-known Public Persons.

Cabaret Vaudeville.

Fashion Parades — dresses, millinery, modes of hairdressing, etc.

Illustrated Talks.

Dramatic Criticism, with excerpts from plays.

Film Criticism, with excerpts from films.

" In Town To-night " type of feature especially adapted for televising.

Outside broadcasts of public events (when possible).

Posed Scenes, Athletic Feats, etc.

TELEVISION SERVICE TO MAKE EARLY START

a time and, as already remarked, their comfort will be looked after, refreshment and rest-rooms, etc., being provided for their use.

Sponsored Programmes

It is not proposed to "sell time," and, following the recommendation made by the Television Committee in its Report published last January, there will be sponsored programmes in the form of, probably, trade shows comprising fashions, demonstrations of various kinds, and so forth.

Many questions relating to the type and form of programme have yet to be settled. The whole subject bristles with difficulties and, even more than in the case of ordinary broadcasting, much will be learnt by experience.

The Woman Announcer

Two really first-class announcers—obviously superlative beings—are likely to be engaged—a man and a woman.

Judging by the "specification" the choice of the woman announcer will prove a very hard task. Here are a few of the things she must have: a low pitched voice, a remarkably good memory, charm, personality, "photogenic features" (otherwise, good looks which televise well); in particular, a *tout ensemble* that will attract listeners of either sex. Her ability to wear clothes is important. She must be educated and cultured. And all for—how many hundreds a year? Apparently, without her the hopes of popularising television will come to nought! We understand that although the "severe specification" will have to be satisfied in most details, hundreds of applications have already arrived at Broadcasting House, among the applicants being film and stage actresses, office girls and, so we are told, factory operatives.

The woman announcer will need, in particular, a quick grip of facts and circumstances; she must not appear before the televisor with a sheaf of notes in her hands. She must be able to make an announcement in perfect style and base it upon, perhaps, a hurried glance at some notes a moment or so before.

O.T.B's

We have always believed that the outside television broadcast means more to the "looker" than any other type of televised item. The public is looking forward to receiving in its homes pictures of current events as they occur and, however difficult the problem that this requirement sets the B.B.C., it is no use blinking the eyes to the fact that it is the outside television broadcast for which the public will ask. A special cable adapted for television relays may cost up to £1,000 per mile by the time it is laid and the technical difficulties are weightier even than the financial ones. Micro-wave relays, however, may make possible many outside broadcasts. There is considerably less difficulty in using lines for distances not exceeding 1,000 ft. and this will make possible the transmission of interesting scenes taking place in the grounds of Alexandra Palace; for example, car and aeroplane demonstrations, etc.

The Television Time Signal

The studio will transmit a time signal consisting of an ordinary clock-face and the sight of this on the television screen will be an indication that the programme is about to start, or as pausing for a new item.

With regard to the coverage of the service, it is understood the B.B.C. hope that their first station will provide a picture to residents of an area roughly 2,000 square miles; that is, over a circular area, very roughly, 50 miles in diameter.

The use of the two systems—Baird and Marconi-E.M.I.—will involve complication and extra work, and for this reason it is proposed to use these two systems on alternate weeks instead of alternate days, as was at first intended. It is believed that one system may prove better for some subjects than the other and vice versa, a matter in which the public will take a very considerable interest.

Studio lighting may also require modification as between the two systems.

It will be noted that we have, so far, confined our remarks to the London television station only. All we can say at the moment about provincial stations is that while they are definitely contemplated, in accordance with the recommendations of the Television Committee, there are no concrete plans in existence for the provision of provincial stations, but a suggestion has been put forward that some points in the provinces may in time be given a picture by means of specially designed co-axial cables and it is even stated that the Post Office authorities propose to instal the first cable of the kind between London and Birmingham.

The Technical Staff

Obviously, there is plenty of work for the engineers and other technicians, and the technical staff at the Alexandra Palace will include the B.B.C.'s own engineers and members of the present technical staffs of Baird and Marconi-E.M.I.

Viewing-rooms

The popularising of television is a subject to which the B.B.C. is giving considerable thought. It is realised that only a small percentage of the public has ever seen television and that the first requirement is to afford it an opportunity of doing so. With this object, a viewing-room is to be established in the London area near Broadcasting House—and to it the public will be admitted without charge.

The ordinary broadcast sound programme is often regarded by the listener as a mere background; for example, the housewife will do her cooking to broadcast music; the household will take its evening meal to a musical accompaniment; the ladies of the household will do their needlework while they listen to the broadcast, and so forth. But a television programme cannot be a mere background. You must *look* at it if you wish to enjoy it fairly intently, but the room will not have to be entirely darkened for the purpose, although, naturally, the screen will have to be shielded from the direct rays of any strong light in the room.

THE DEVELOPMENT OF THE SCANNING CIRCUIT FOR CATHODE-RAY TELEVISION

By G. Parr.

Readers will remember that the publication of a design for a cathode-ray high-definition viewer was promised in a preceding issue. The following articles are intended as an introduction to the theory of the scanning circuit and will enable new readers to become familiar with the principles on which the design is based.

THE fundamental problem of scanning with the cathode-ray tube is that of making the beam move across the screen in such a way that it traces a series of lines at a definite speed and of a definite length. We have in fact to imitate the effect produced by a scanning disc or mirror drum.

Although the effect required is the same, the means of producing it differ radically in the two systems because in one case we are dealing with the area of light of which all but a small spot is masked off at the moment of scanning, or a ray of light which is altered in angle to produce movement across the screen. In the cathode-ray tube the beam has to perform a to-and-fro movement to enable all the scanning lines to be drawn in the same direction !

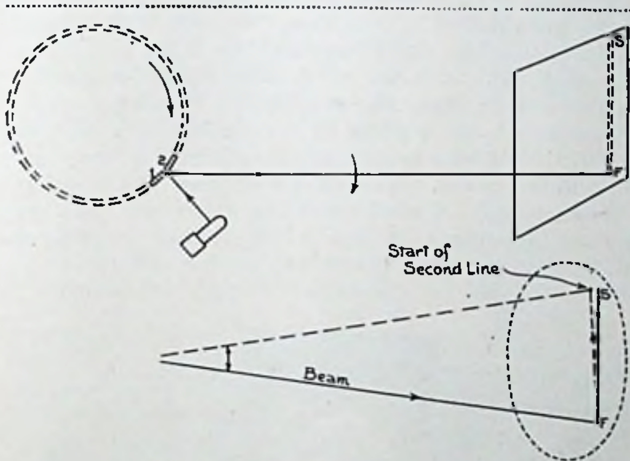


Fig. 1.—Comparison between mechanical scanning and movement of beam in the cathode-ray tube.

This apparently contradictory statement is best explained by referring to Fig. 1, which shows a high-definition scan produced by a mirror drum and by a cathode-ray tube. In the top picture the ray of light reflected from the mirror (1) has just completed the drawing of a line, and mirror (2) is following on to catch the beam at a fresh angle and divert it to the edge of the frame again. In the lower picture the beam has completed one line in moving from S to F, but before it can draw a second one it must be returned to a position in line with S and a little to one side. The drawing of each line is thus followed by a return stroke which places the beam in position for the next one.

For producing a complete line screen on the cathode-ray tube we have therefore to deal with three movements:—

The tracing of the line at a certain speed.

The return of the beam to its original place.

A shift of the beam in a direction at right angles to the line to produce the spacing between them.

Moving The Beam

The movement of the beam can be produced either magnetically or electrostatically. If a pair of coils is mounted on either side of the neck of the tube and a gradually increasing current is passed through them the beam will move across the screen under the influence of the field produced by the coils.

If an increasing voltage is applied to the deflector plates of the tube the beam will move correspondingly —electrostatic deflection.

Since the current through the magnetic deflecting coils is proportional to the voltage applied to them, neglecting for the moment any special effects, the problem for either system of deflection resolves itself into the production of a varying voltage which shall give the required movement of the beam.

Form of Voltage Wave Required

The scanning line must be drawn at a perfectly uniform speed. i.e., the beam must cover equal distances on the screen in equal intervals of time. This means that the voltage applied to the deflector plates to draw the line must increase at a uniform rate. After the line has been drawn the beam must be returned to its initial position as quickly as possible in readiness for the next travel, and so the voltage must abruptly drop to zero after it has reached a given value.

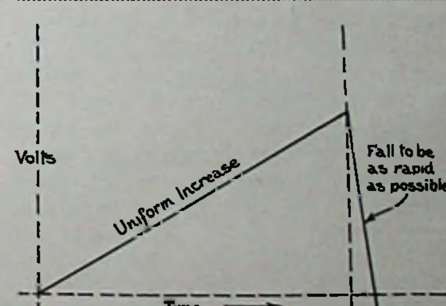


Fig. 2.—Shape of voltage wave required to deflect the beam uniformly and to return it to its starting point.

The two variations can be represented by a curve to which the name " saw-tooth " has been given because of its appearance. The diagram of Fig. 2 shows the shape of the voltage wave required to draw one line and return the beam to its starting point.

We now have to consider the third point—the shifting of the beam in a direction at right angles to the line to produce the sequence of lines on the screen. This could be done by a small voltage applied to the other deflector plates at the end of each " out and back " movement of the beam—a sort of ratcheting action which would move the beam upwards by just the right amount to put the second line alongside the first.

It is less complicated, however, to apply a similar type of voltage wave to each pair of plates and produce the movement by a combined deflecting effect. If we do this the beam will be acted on by both voltages during its travel along the line and will slope slightly upwards the whole way, so that at the end of the line it will be sufficiently displaced to start the next line straight away. The combined deflecting effect is shown in Fig. 3. The path of the beam is shown by the thick and dotted lines in the centre of the drawing and the thin lines below show the curves of voltage change applied to the deflector plates.

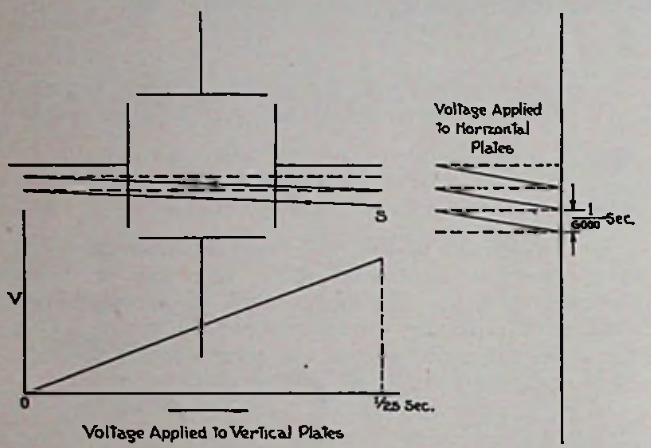


Fig. 3.—The zig-zag trace produced when the two deflecting voltages are applied to the deflector plates.

Suppose we require to draw a 240-line screen 25 times per second. The time required to draw one line of the screen will be 1/240 × 25 or 1/6,000th second. The voltage applied to the horizontal deflectors will therefore rise to its highest value in 1/6,000th second. If now we arrange that the voltage applied to the vertical deflectors reaches its maximum in 1/25th second, the beam will move from bottom to top of the screen in this time and during its travel will have moved across 240 times, 1/25th divided by 1/6,000th. From the drawing it will be noticed that the lines drawn by the beam are slightly sloped, but this is of no consequence since the angle is so slight and the lines are so close together.

The Circuit to give the Deflection

The ideal method of producing the voltage curve of Fig. 2 is by using a potential divider connected across an H.T. supply the deflector plates being connected to the tapping contact arm. This is, of course, impossible in practice since no moving contact could be operated at the enormous speed required to cover the screen in 1/25th second. Accordingly the best arrangement will be to use a purely electrical circuit in which the voltage across one part can be made to vary in the way required.

The most satisfactory arrangement is by using a condenser connected across an H.T. supply in such a way that the voltage across it gradually rises at a rate which can be controlled.

The simplest circuit is shown in Fig. 4, and as this is the fundamental circuit on which all scanning systems are based it is worth while examining it in detail.

The condenser C is connected to the H.T. supply through a resistance R which can be varied. At the moment of switching on there is no potential across the condenser, and the voltmeter V will read zero. As the charging current flows into the condenser the voltage gradually rises and the needle of the meter will creep up the scale until it reaches the value shown on V_1, which is connected across the H.T. terminals. The condenser is then fully charged, and the voltage across it is the same as that of the H.T. battery.

The rate at which the condenser voltage rises is controlled by the resistance R—the higher the value of R the longer will the condenser take to charge. The rate of charge can be worked out from a formula which is too complicated to give here, but there is an approximate calculation which can easily be made as follows: The time taken for the condenser voltage to reach 63 per cent. of its final value is called the " time-constant " of the circuit and is given by the product of C the capacity of the condenser in microfarads and R the resistance in megohms. So with a resistance of 5 megohms and a capacity of 1 mfd. the condenser will take over 5 seconds to reach its final voltage ! For scanning requirements we need 1/25th second for one condenser, and this could be given by .01 mfd. and about .3

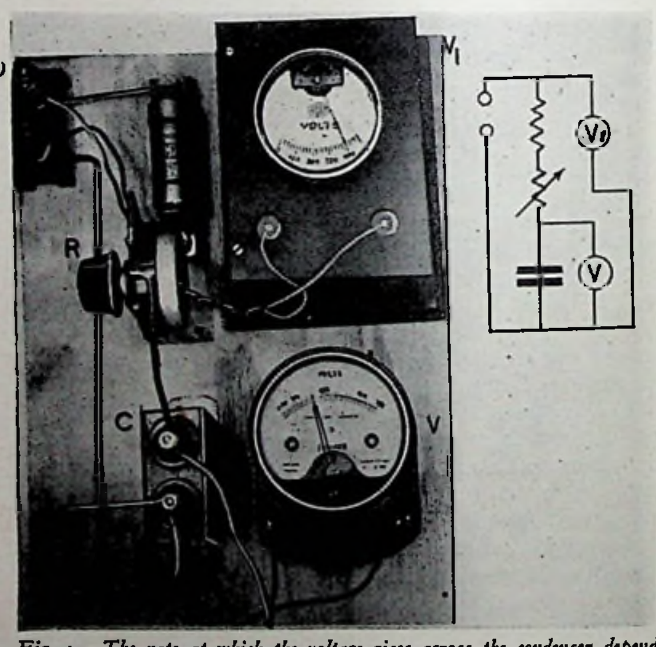


Fig. 4.—The rate at which the voltage rises across the condenser depends upon the capacity C and the resistance R.

megohms. For the 1/6,000th second timing rate a much smaller capacity will be required, say, .0005.

Discharging the Condenser

When the condenser has reached its maximum voltage it must be discharged as rapidly as possible to produce the second part of the voltage wave of Fig. 2. A great variety of circuit arrangements have been devised for giving a rapid discharge and fall in voltage, but for the present we will confine ourselves to the gas-filled relay or "thyratron" which is the simplest and easiest method. The theory of the gas-filled relay has already been dealt with in this journal, so a very brief description is all that can be made in this article.

The gas-filled relay is an ordinary triode valve in which a small quantity of gas such as neon or helium is inserted.

The effect of the gas is as follows; If the grid of the relay is biased to a negative value, current will only flow if the anode voltage exceeds a certain value depending on the construction of the valve. For instance, in the Ediswan HE/AC relay a bias of 9 volts on the grid would mean that no current would flow from the cathode to the anode until a voltage of 160 was applied. Once the current flows a coloured glow is seen in the bulb, and then the grid has no further control over the discharge. The anode current can only be stopped by reducing the anode voltage to a very low value, and when the glow has ceased it will not start again until the anode voltage is raised to its original value of about 160. From this it will be seen that the relay can be used to discharge the condenser of Fig. 4 in a very satisfactory way.

The valve is connected across the condenser and the grid is given a negative bias. As the voltage rises across the condenser the discharge suddenly starts at a value determined by the grid bias, and at this point the condenser is short-circuited by a very low resistance (the glowing valve). As soon as the condenser discharges the voltage falls and the discharge eventually ceases when the voltage has fallen to zero. The relay is now non-conducting and the condenser is left free to charge again.

The simple arrangement of the whole circuit is shown in Fig. 5. The relay is shown connected across the condenser, and the deflector plates of the tube are taken from the anode and cathode connections of the relay, i.e., across the condenser. The voltage variations of the condenser are therefore reproduced across the plates. The condenser C_1 isolates the plates from the H.T. supply. The bias battery for the grid of the relay is seen at the bottom of the board, and the heater leads at the lower left-hand corner. Next month we can discuss some of the difficulties of this circuit and the improvements which can be made.

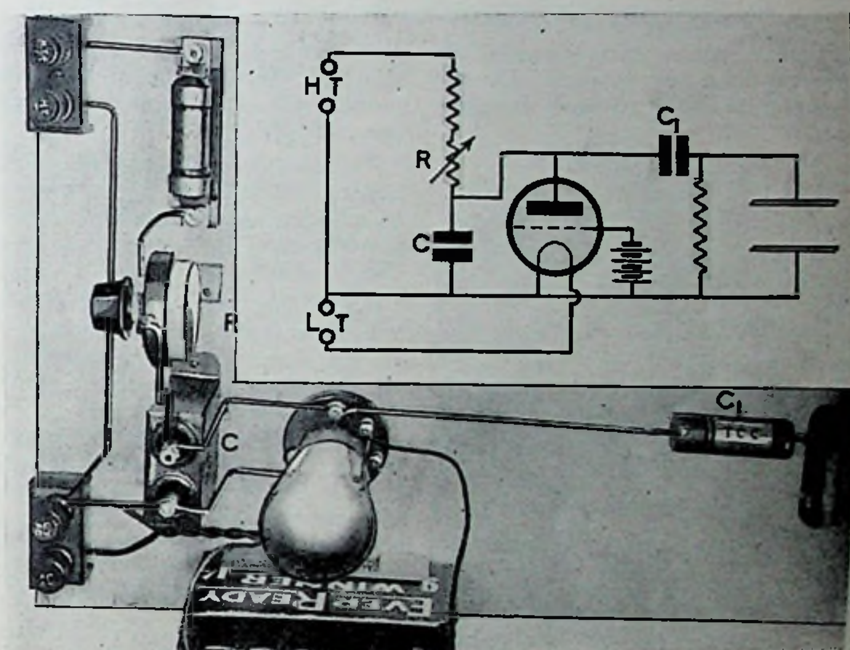


Fig. 5.—A simple scanning circuit shown diagrammatically and as a layout. The various components can be easily identified.

Field Strengths and Wavelengths

Measurements have been taken by the Baird Company of the attenuation of transmission in urban areas on wavelengths of 8, 5 and 3 metres. The loss of signal with distance increases greatly as the wavelength is decreased. Also it has been found that a 7-metre wave will pass over the top of a hill and give a much better distribution of signals in the valley beyond than a 5-, 3- or 1-metre wave. The diffraction decreases rapidly with wavelength. There is a further difficulty which is encountered on wavelengths below 6 metres, namely, that as the wavelength is reduced intereference is experienced from motor-car ignition systems, electrical machinery, and domestic electric appliances, making practical reception very difficult.

Baird Patents in Australia

It is learned that Baird Television, Ltd., has satisfactorily concluded negotiations with the Australian Radio Manufacturers' Patents Association, Ltd., of Sydney, N.S.W., whereby that Association has been appointed the exclusive representatives in Australia of the Baird Company, both for the construction and operation of television transmitting stations and the manufacture of television receivers under the Baird patents.

This alliance is looked upon by the Baird Company as being of great importance, as the Australian Radio Manufacturers' Patents Association, Ltd., is composed of a majority of the leading radio manufacturers throughout the Commonwealth of Australia, and it is their intention to develop television as an adjunct to sound broadcasting.

It is proposed to erect experimental transmitters in Sydney and Melbourne in the near future, with a view to the ultimate provision of a commercial high-definition television service.

Prophets of 50 years ago

Jules Verne a Thousand Years Too Late!

The following are extracts from an article by Jules Verne, which appeared in the New York Forum in 1889, and a book entitled " The XXth Century, the Conquest of the Regions of the Air," by A. Robida, published in 1884. Jules Verne portrayed a scene supposed to happen in the year 2889. Robida made a much more accurate prophecy with the year 1945.

The Phonotelephotograph—Described by Jules Verne

" . . . Francis Benett awoke that morning in a bad humour. His wife had been in France for eight days now,

and he felt rather lonely. It may seem incredible, but in all the ten years of their married life, this was the first time that Mrs. Edith Benett, professional beauty, had been absent so long from her husband.

" As soon as he was aroused and fully awake, Francis Benett started to operate his phonotelephoto machine, *the wires of which ended in his own house in the Champs-Elysees quarter.*

" The telephone, completed with the telephotographer another conquest of our civilisation! If the transmission of words by means of electric currents is a very old idea, it is only recently that we have been able to transmit images. A precious discovery for which Francis Benett is not the only one to bless the inventor when he sees a picture of Mrs. Benett reproduced in the telephotographic mirror, despite the enormous distance between them.

" A delightful sight! A little tired after the dance and the theatre, Mrs. Benett is still in bed. Although it is nearly mid-day there in France, she is asleep with her pretty head sunk in the lace of the pillow."

The Telephonoscope—Described by A. Robida

" Among the sublime inventions of the XXth century and the thousand marvels of an age rich in magnificent discoveries, the telephonoscope may be considered as one of the most surprising, one of those inventions which bring the fame of scientists nearer to the stars.

" The old electric telegraph, that childish application of electricity was dethroned by the telephone and then by the telephonoscope, which is the supreme and final development of the telephone. The old time telegraph allowed us to understand a correspondent at a distance, but the telephonoscope allows us both to see and hear him at the same time.

" The invention of the telephonoscope was received with the greatest delight. The apparatus was attached to the instruments of all telephone subscribers who desired it, on payment of a supplementary charge. Dramatic art found in the telephonoscope an opportunity for immense prosperity. The theatrical performances transmitted by telephone became all the rage when it was also possible to see the performers as well as hear them.

" Theatres had thus, besides the ordinary number of spectators in the building, a number of listeners-in and spectators in their own homes connected to the theatre with the wire of the telephonoscope. Here was a fresh source of gain and box-office receipts. No limit to profits now, ' no house full ' limits to a theatre! When a show enjoys a big success, in addition to the three or four thousand spectators in the theatre, fifty thousand spectators are in their homes, and fifty thousand at least in other countries of the world.

" The Universal Company of Theatrical Telephonoscopy, founded in 1945, has now 600,000 subscribers scattered in all countries of the world. This company centralizes the wires and pays the dues to the theatres for the reception of their performances and programmes.

" The apparatus consists in a simple plate of crystal let into a wall of the apartment or placed like a mirror over any piece of furniture. The subscriber without disturbing himself, sits down before the mirror or plate, chooses his theatre; switches on the communication and enjoys the show.

" The telephonoscope, as the word indicates, allows us both to see and hear. Dialogue and music are transmitted as with ordinary telephone lines, but at the same time the stage, with all illumination, its decor, its actors appear on the glass screen as clear as anything seen in direct vision. The performance can be witnessed with both ears and eyes. The illusion is complete and absolute. It is like being in a box at the opera or theatre."

SIMPLE TELEVISION TRANSMISSION

GENERATING A SIGNAL

By Robert Desmond

THE suggestion put forward by a reader last month that old 30-line apparatus can be used for experimental purposes without the aid of a radiated signal is excellent.

Many enthusiasts will probably consider trying to make their own generator of a television signal, which is really quite simple if one is content with "stills."

The simplest form of apparatus consists of a projection or "magic" lantern, scanning disc and driving motor, a photo-cell and simple convex lens. The last-mentioned is what we will consider rather fully.

The theoretical lay-out of such apparatus is shown in Fig. 1. The parts which go to make up the projection lantern are very cheaply obtained in the form of a toy magic lantern-cum-cinema, many being on the market from 5s. upwards. If one of these toy outfits is used the light source will have to be altered as it will not be powerful enough. One of the best lamps than can be fitted is a 12-volt 100-watt home cinema lamp, such as made by G.E.C. or Philips. For "stills," slides or odd lengths of old standard cinema film can be used if care is taken that it is not fired by the heat of the lamp; if you are an amateur photographer you can prepare your own slides. Standard slides are $3\frac{1}{4} \times 3\frac{1}{4}$, these will probably have to be cut to fit in a small lantern. Those who have sub-standard cinema projectors can use these for the lantern section.

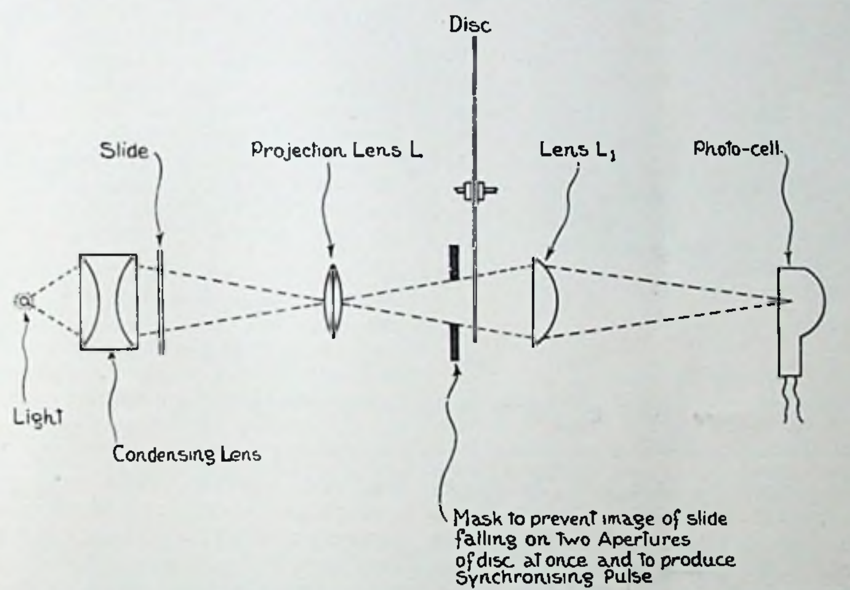


Fig. 1.—Diagram showing layout of simple transmitter.

Having arranged your lantern to give maximum brightness of picture, project the image on to the edge of the disc, as in Fig. 2, this image will be very slightly magnified. The disc to be satisfactory must have equally sized holes, those of the Baird exponential type are not suitable, as the area of the first and last three apertures in the spiral are larger than the rest and allow more light to pass through with a consequent rise of signals for that part of the picture scanned by these six holes.

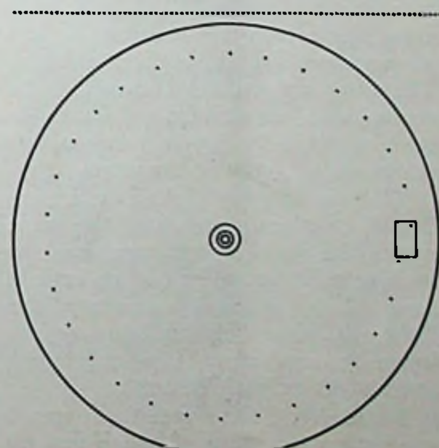


Fig. 2.—The image is projected on the disc through a mask, which does not allow the two apertures to scan the image at the same time.

The photo-cell, as shown in Fig. 1, is placed on the other side of the disc; at first without the lens L_1. The photo-cell should be shielded from extraneous light as much as possible and at the same time screened electrically except for the necessary window to let the light fall on the cell. A very suitable amplifier for bringing the signal up to good phone strength was described in TELEVISION, in the August, 1934, issue, on page 437.

In Fig. 3, D is part of the scanning disc showing an aperture H, C is the cathode of the photo-cell. Now if a blank screen (white) is projected on to the disc, all the light will be stopped by it except that passing through H, which will fall on the cathode C. The light ray is shown dotted; if H moves downward (as the disc rotates) the rays passing through H will sweep across C and as the light is of constant intensity in the form of a blank white projected on to D, a uniform light will sweep across the cathode, which will give rise to a similar emission of electrons or signals.

Unfortunately the cathodes of photo-cells are not uniformly sensitive, so what should be a plain white screen will appear probably as a kaleidoscope of shades rather like interference caused by local static. To overcome this it is necessary for all the rays to fall on the same part of the cathode, which is brought about by the lens L_1. This lens, therefore, is used to focus the surface of the projection lens (L, Fig. 1) on to the photo-cell cathode. The image on the cathode may be of a convenient size relative to the object (lens L) as the relative sizes of lens and cathode may demand.

The reader may not quite understand how this works, it is admittedly hard to visualise, though once realised one wonders how at first it may not have been understood.

In Fig. 4, O is the surface of the projection lens and I the image. The light cone is shown by eight rays. Now suppose you slide an opaque slide with one small aperture along

GENERATING EXPERIMENTAL TELEVISION SIGNALS

line D D, once the aperture entered the cone produced by OX OY the image of O would be produced at I, though of much less brilliance than if the mask with aperture were not there. Those readers who have cameras with focusing screens can easily check this for themselves. The fact that the cone of light happens to produce an image of some object on the disc does not affect the view of L_1 of L.

The image on the disc does, however, affect the amount of light in different parts of the cone so that the aperture in the disc, though not affecting the position of the image of the projection lens on the cathode of the cell, does alter its intensity or brilliance according to what part of the image in the light cone it happens to be passing through.

It should be noted that L_1 must be of sufficient diameter to collect the cone of light passing through the disc, which means that the smaller the diameter of the lens, the nearer it must be to the disc. In practice it is often found convenient to place the lens L_1 in such a position as to have the projection lens and the photo-cell twice the focal length from the lens, which gives an image the same size as the object. If the image on the cathode is much smaller than the cathode, it is sometimes advisable to move the cell, so that the image falls on a more sensitive part.

The photo-cell can be either vacuum or gas. The former have no frequency characteristics, the latter, however, are more sensitive and are good enough for 30-line $12\frac{1}{2}$ pictures per second provided they are not run too near their "flashpoint," 10 per cent. below being a good value to start with.

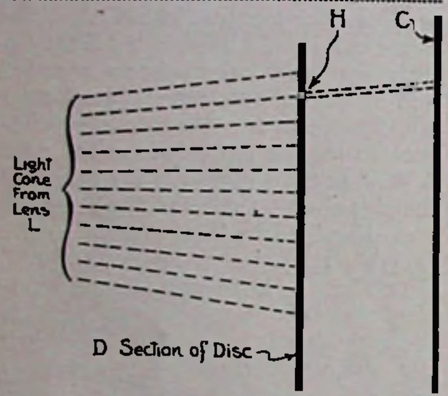


Fig. 3.—The projection of a blank screen.

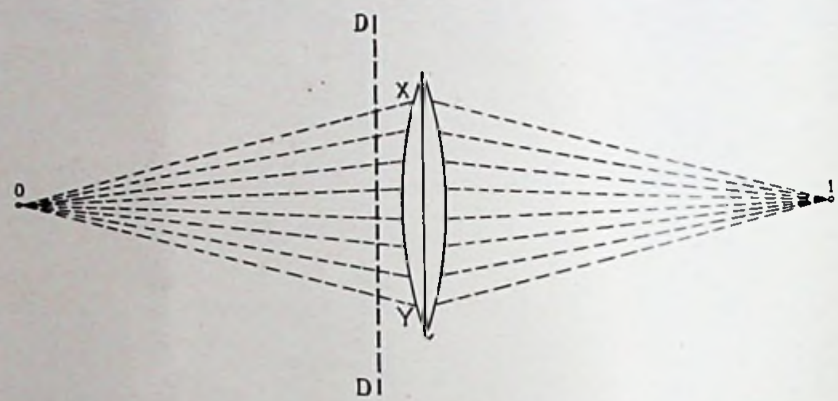


Fig. 4.—Diagram showing how the light cone is focused.

METALLIC REFLECTORS

THE possibility of using metallic reflectors in place of the more fragile and bulkier glass type for mechanical scanning devices raises the interesting question of the reflective powers of various metals and alloys. In R. W. Wood's "Physical Optics," a table is given showing the reflecting powers in per cents. of various metals and alloys at normal incidence, for thirteen of the commoner metals, and for twenty different wavelengths from $.251\mu$ to 1.500μ. Since the white metals show little change in the visible spectrum, it will suffice to quote the figures for one wavelength only, viz., $.600\mu$:—Silver, 93; glass backed by silver, 82-88; magnalium (69 A, 31 Mg.), 83; mercury, 75; glass backed by mercury, 70; nickel, 65; platinum, 64; Schneider alloy (66 Cu, 22 Sn, 12 Zn), 64; steel, 55.

The highest reflecting power appears to be possessed by metallic sodium, for which R = 99.7. In general there is a gradual falling off in reflecting power with decreasing wavelength, and this is more marked for platinum and nickel than for steel. The alloy magnalium shows a quite remarkable constancy. Silver is peculiar in showing a very sharp minimum at $.316\mu$ in the ultra-violet.

When a beam of light is twice reflected by plane mirrors of the same metal, the above percentages have to be squared; thus after two reflections from glass backed by mercury, the light will have only half its original intensity, and after two reflections from steel only three-tenths.

Naturally, the results depend largely on the state of polish and on the cleanliness of the surface. With exposed metal, tarnish is a source of continual trouble, while a glass protective covering reduces the reflecting power by from 5 to 10 per cent. with the added inconvenience of a faint secondary image.

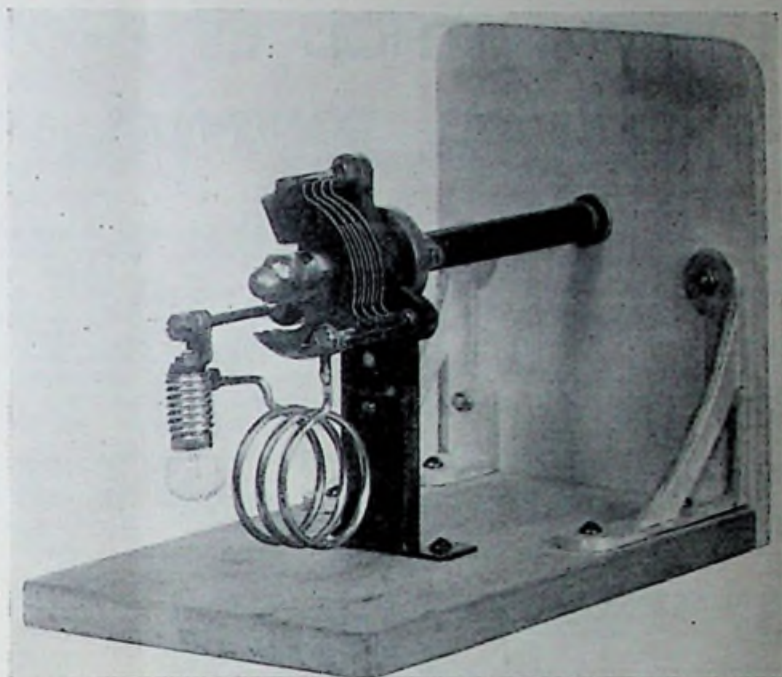
With polarised light there are other losses. The light emerging from the second Nicol prism is plane-polarised (the direction of vibration lying in a plane parallel to the shorter diagonal of the end-face of the prism, and at right angles to the balsam interface). When this light falls upon the large mirror, if the direction of vibration makes an angle with the plane of incidence, it can be resolved into two component vibrations, one perpendicular to, the other in, the plane of incidence.

In the case of light vibrating perpendicular to the plane of incidence, the reflected light increases gradually in intensity from normal to grazing incidence. But for the component with vibrations in the plane of incidence the reflected ray diminishes in intensity from normal incidence to a certain angle at which it becomes a minimum, it then increases again to grazing incidence. This minimum is little marked for silver, but is very decided in steel and certain metallic oxides.

A 56 M.C. Absorption Wave-meter

THIS very simple absorption meter is for the 56-mc. band. Construction is so obvious that it really does not require very much explanation. It consists of a 15-micro-microfarad brass-vaned tuning condenser, 6-volt, .3-amp. bulb, home-made five-metre coil, an insulated bracket for mounting the condenser, a 3-inch extension spindle, a knob and some oddments.

As can be seen from the circuit the coil and bulb are in series across the tuning condenser and are quite self-supporting. One end of the coil is connected directly to the fixed plates of the tuning condenser. The centre contact of the bulb is soldered directly to the moving plates of the condenser, the other side of the coil and bulb are joined together.

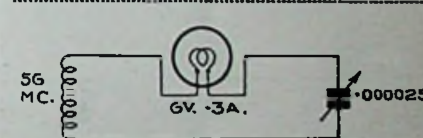


The lamp is connected directly to the tuning condenser.

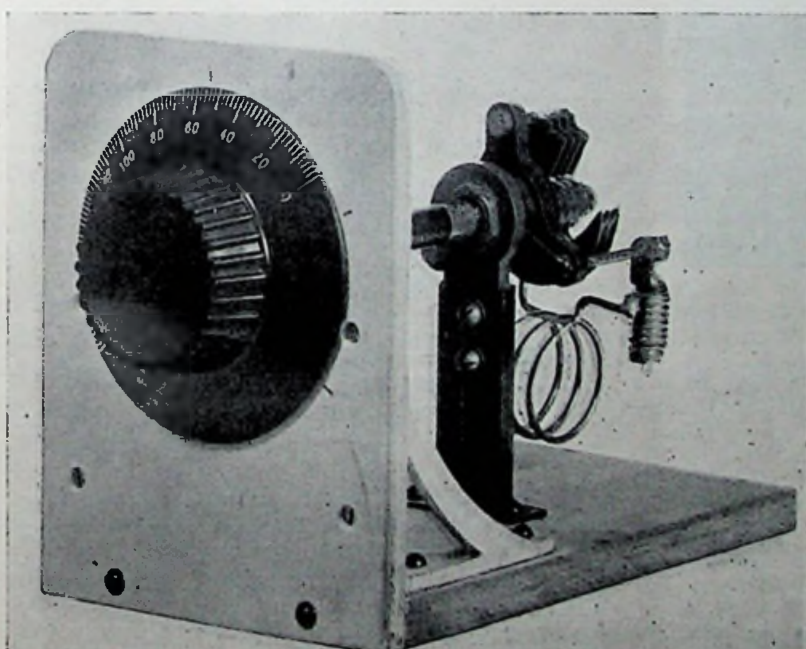
If the wave-meter is to be used for frequency checking on a receiver then the meter should be calibrated against a harmonic of a 20-metre phone station on a normal short-wave set or up against another calibrated frequency meter.

With the increase in interest on the five-metre band it is now comparatively simple to locate some amateur with a transmitter who could calibrate the meter from his own transmissions. Of course, if no such facilities are available then the simplest method is to calibrate a receiver from a 20- or 10-metre harmonic.

Although Lecher wires are easy to build and provide a reliable method of frequency measurement, we have found that a vertical tapped-on aerial cut to length with a bulb in the exact centre is the simplest and quickest way of finding out just when the transmitter is oscillating on the 56-mc. band. This meter can then be calibrated up against the transmitter in the usual way. With a three-turn coil of one-inch diameter and spaced ⅛ between turns, the five-metre band was tunable at approximately 60 degrees, the entire band covering 40 degrees. The gauge of the wire, although not very important, should be reasonably stiff, so we suggest 14-gauge bare copper.



Make the coil of stiff wire so it is self supporting. Any movement will upset the calibrations.



The lay-out is quite simple and the panel can be of ply-wood.

The chassis for this meter should be six by four ins. and the panel five by four ins. The actual components used were:

One Eddystone condenser, type 900, 15 m.mfd.
One Eddystone adjustable bracket, type 1007.
One Bulgin extension spindle, type EH5.
One 6-volt .3-amp. bulb, type B630 (Bulgin).
Two, type PB3 panel brackets (Bulgin).
One plain three-inch tuning knob.

A small quantity of 14-gauge wire will be required for the coil, the actual length being about 12 ins.

A NEW METHOD OF PHOTO-TRANSMISSION

THE BELIN COMPANY'S LATEST APPARATUS

THE Belin Company has devised an apparatus for radio transmission of pictures by means of which fading—the principal difficulty in the past—is done away with, and which enables pictures to be wirelessed with as much sharpness as they can be cabled.

The new system of transmission is the result of considerable experiment, which for the last six months has taken the form of test emissions between Paris and Algiers. The first regular installation for commercial purposes is to be installed in Djibouti, very shortly, for communication of pictures from Abyssinia to Paris.

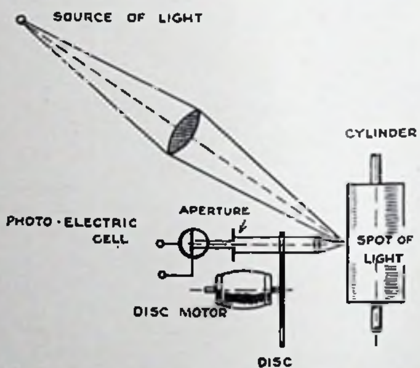
By kind permission of the proprietors of "Photography," a valuable technical and commercial monthly periodical published by the Cosmopolitan Press Limited, 48, Fetter Lane, London, E.C.4, we are enabled to reproduce from their December issue an article describing one of the latest methods of photo-transmission. We acknowledge our indebtedness to "Photography" for the illustrations published in this article.

An experimental transmission, Algiers to Paris, by the new system.

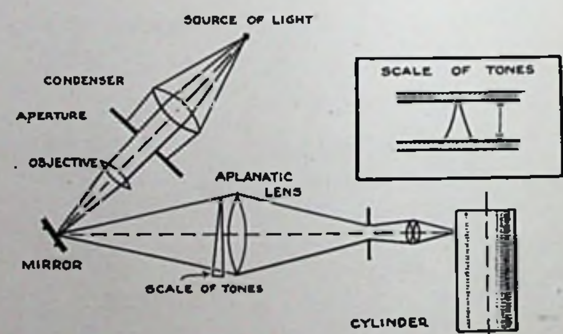
Although no regular commercial service has yet been worked, the pictures have on one occasion been used with good results. This was at the time of the accident in which Governor-General Renard lost his life. At the request of the Post Office, Monsieur Belin undertook to transmit these pictures experimentally from Algiers. They were published at the time in *Paris Soir*.

The System

The new transmitter comprises two parts, the first an ordinary transmitter such as is used in cable transmissions, the second a device for changing variations in current amplitude to variations in time.



The Belin transmitter for cable work. For radio transmission this is the first part of the apparatus.



Schematic diagram of receiving apparatus. In the radio transmitter the second part is similar, a slotted disc being employed and the receiving cylinder being replaced by a photo-electric cell.

The first part consists of a cylinder on to which the picture to be sent is fixed, and which is lighted by a small spot of light. The revolution of the cylinder causes this spot to fall on every point of the photograph, and the reflected light is caught by lenses and thrown on to a photo-electric cell.

In order to facilitate the amplification of the current obtained in the cell, the light is interrupted 1,300 times per second by means of a slotted disc which revolves between the picture and the photo-electric cell.

In the cabled transmission, this current is then sent out after amplification, but, in the wireless transmission, it is amplified and rectified, and then goes to an oscillograph. A beam of light, running through a slitted screen, falls on the mirror of this oscillograph and is reflected through a diaphragm containing an opening roughly triangular in shape.

Behind this screen is a revolving disc in which are a number of slits, so arranged that they run parallel with the altitude of the triangular opening.

In this way, according as the beam of light falls near the point or near the wide end of the triangular opening, it will pass for a longer or

(*Continued on page* 752).

TRANSMISSION AND SYNCHRONISATION WITH THE GOLDMARK ELECTRON-OPTICAL SYSTEM

By Dr. Peter C. Goldmark.

Details of this system were given in the preceding issue. This article deals with the method of transmission and synchronising. Dr. Goldmark is desirous of commercialising his system and will be glad to hear from anyone interested.

The Transmitter

(a). Direct Pick-up.

This transmitter works on a similar principle to that of the receiver. Through an objective lens the scene to be transmitted is projected on to a mirror-drum of the same construction as in the receiver. The rotating drum moves the picture, one zone after the other, across a photo-electric slit which is located inside a small cathode-ray tube. This tube, like the receiver projector tube, has an electron gun, concentrating electrodes, and one pair of deflecting plates which move an electron beam in saw-tooth wave oscillations across the photo-electric surface.

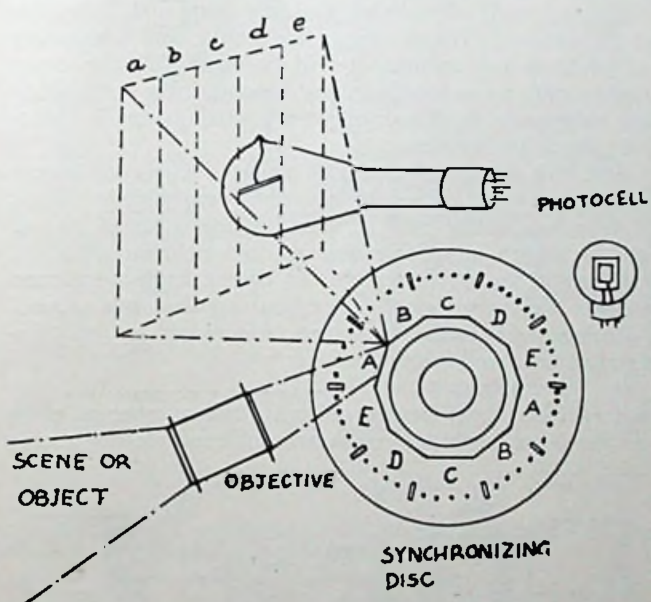


Fig. 7.—Schematic outline of the transmitting arrangement.

Since the scanning in this tube only occurs in one direction (vertical motion of the image being carried out by the rotating mirrors), the photoelectric surface is a narrow band, of similar dimensions to the scanning line at the screen of the projector tube in the receiver. This light-sensitive strip consists of a great number of small particles of photo-sensitive material, precipitated on a dielectric (mica) surface, which is spread over a metal surface. The photo-sensitive particles together with the dielectric and the common metal plate on the other side form a quantity of small condensers, which are charged by decreasing amounts of electrons due to the photo-electric influence of the projected picture, and are discharged through the moving electron beam. The discharge current varies with the amount of light falling on each small condenser; the so varying current suitably amplified modulates a wireless transmitter.

The advantage of this optical-electron arrangement is the small photo-electric surface (a strip of 1 to 1½ ins. long and 1 mm. wide is necessary) so that uniform coating is easily obtained, also reducing at the same time the cost of the equipment, due to the small size of the scanning tube. In the same way as at the receiver, the scanning electron beam has a comparatively large diameter (between ½ and 1 mm.) thereby making it possible to transmit pictures with a great number of lines and requiring low amplification due to the size of the scanning spot.

Fig. 7 gives the schematic outlines of the transmitter arrangement. The dotted lines indicate the outlines of the entire picture and zones into which the picture is broken up after reflection from the rotating drum; the zones are marked a-e and the corresponding mirrors A-E. The same optical calculations and formulæ used with the receiver are valid for the transmitter.

(b) Film transmitter.

For the transmission of moving picture films the same transmitter scanning tube used in the direct pick-up is employed. The rotating mirror drum, on the other hand, has to be replaced by a different one. Since it is desirable to keep the film in steady uniform motion, the picture still being broken up in zones, the tilted mirrors producing the zones have to apply to each successive zone an additional movement in order to compensate for the forward movement of the film.

In practice this is solved by arranging the mirrors as shown in Fig. 8. The drum here scans at one revolution two complete pictures, five zones building up one picture. (Of course, any number of zones can be used.) The angles of the mirrors to the axis of rotation are the same as those used at the receiver drum; each mirror is tilted a small amount more than the preceding one, producing thereby the zones. The angle between adjacent mirrors, measured in a plane at right angles to the axis of rotation, is not the same at each mirror, as was true at the receiving drum, but increases gradually from mirror A to the last mirror, each mirror increasing its angle by the same amount. The result is that when the moving film, projected through the objective lens on to the drum, is reflected by the latter on to the photo-sensitive surface, and is moved one-fifth of its width forward, the additional angle on the corresponding mirror (first zone) throws the picture

ELECTRON-OPTICAL SYNCHRONISING

backwards simultaneously with the forward movement of the film, thereby neutralising this movement and producing on the photo-sensitive surface a picture which is moved the same way as in direct pick-up.

Fig. 9 shows five successive positions of the film (corresponding to five zones) and also the actual zones produced by the mirrors (arranged as explained before) on the rotating drum. It has to be kept in mind that the length of one zone (ordinarily equal to the height of the picture) is equal to one-fifth less than the picture height. If there are ω zones and the picture is H inches high, the distance between mirror-drum and photo-

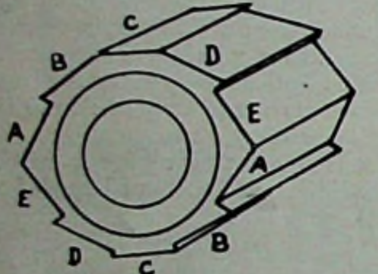


Fig. 8. — Diagram showing the arrangement of the mirrors on the transmitting drum.

electric surface has to be chosen so that at a given optical system the length of each zone will be:

$$h = H(1 - 1/\omega) \quad \text{.......} \quad (23)$$

where h is the length of a zone. This reduction in the length of the zones is what compensates for the forward movement of the film.

Summing up: For the transmission of outdoor scenes (direct pick-up), as well as films, one and the same electron-transmitting tube is used, this tube having a narrow strip of photo-sensitive mosaic surface. Two different mirror-drums are necessary: for direct pick-up a drum identical with the receiver drum, where the angles between mirrors along the circumference are equal; and for film transmission a drum where these angles increase the same amount from mirror to mirror, thereby accelerating the scanning from zone to zone so that the forward movement of the film is entirely compensated.

Synchronisation

The problem of synchronisation in the present system is comparatively simple. The motor driving the mirror-drum at the receiver has on the same shaft a perforated disc, the holes representing a certain group of lines. A light beam directed through these holes acts on a photo-electric cell and produces strong impulses which are transmitted simultaneously with the picture signals. For instance, a picture of 250 lines and five zones is to be synchronised. The total amount of lines is 5 times 250, equal to 1,250 lines. At a rate of 24 complete pictures per second, 30,000 lines are produced per second. The number of pictures per revolution of the drum is two, the drum having, therefore, 10 mirrors, since five zones are used.

The drum and the synchronising disc make 12 revolutions per second, or per revolution there are 30,000/12 = 2,500 lines scanned. Provided a synchronising impulse is produced at every 10th line, the disc has to have 250 holes. Considering the high synchronising frequency (3,000 signals per second), it is sufficient to produce signals after every 10th line only. At the receiver the saw-tooth shape oscillators, working at line frequency, are easily kept in step by the lower (1/10th) frequency.

At the end of each zone, that is, ten times in one revolution of the mirror-drum and synchronising disc, a stronger signal is given. This means that every 25th hole in the disc is larger by being slotted longer, so that it lets a greater amount of light fall through on to the photo-cell. These zone frequency signals constitute what in other systems is called the frame frequency. Instead of giving one stronger signal after completion of the entire picture, the present system gives after each zone (in this example five times) a strong impulse, thereby insuring good synchronisation. For the example here calculated, the line frequency of the synchronising signal will be 3,000 per second, and the zone frequency (framing) signal 24 times the number of zones (five) that is, 120 impulses per second.

The above signals at the receiver act partly on the cathode-ray tube projector oscillator as a frequency divider system (1 : 10) and partly on a phonic wheel or phonic motor, which drives the mirror-drum. The strong zone frequency signals are filtered from the line frequency and, after being suitably amplified, drive the mirror-drum. When using five zones and producing 24 pictures per second, it will be clear that the drum makes only 12 revolutions per second. Its dimensions are extremely small and only very small power is necessary to drive the drum.

For this reason, instead of using a universal motor which is synchronised by an additional phonic wheel, it is much better and simpler to use a small phonic motor, which is nothing else than a synchronous motor, running at zone frequency. In the example mentioned before, the zone signals were 120 impulses per second. The motor should make 12 revolutions per second. Referring to a well-known relation:

$$\text{r.p. second} = f/t \quad \text{.......} \quad (24)$$

where f is signal frequency and t the number of poles on the phonic motor for the present example the phonic

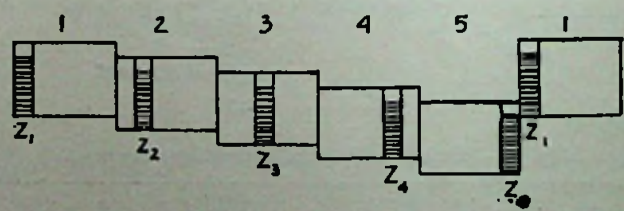


Fig. 9.—Diagram showing the zones produced by the special mirror drum.

motor will have 120/12 = 10 teeth or poles. A self-starting arrangement will start the drum off at the same time that the line frequency oscillator is switched on, and the framing of the picture is accomplished by rotating the armature of the motor.

Colour Television

The system here described is very adaptable for tele-

(Continued at foot of next page).

British Amateur Radio G5GQ

AFTER our comments on the general untidiness of some of the British stations, we have received illustrations and data on G stations which have been built in rack formation.

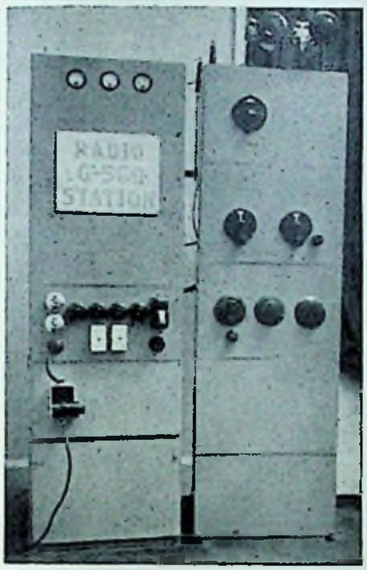


Fig. 1.—The universal power pack.

G5GQ, operated by Basil Wardman, is one of the many efficient South London stations. He has been active for several years and developed from an ultra low power battery lash-up to a modern station using high power apparatus. It is mainly used to develop amateur transmitting valves and so in many ways the equipment is unusual.

The main item is the power panel shown in Fig. 1. It consists of a steel frame rack into which the various units are mounted. First of all the filament supplies are suitable for any normal filament voltage giving 2.5, 6 or 7 volts, brought out to a special plug with the option of 4.0, 7.5 or 11 volts if required. H.T. supply is made up in three distinct units. The first gives 350 volts and 120 milliamps., the second 500 volts at 250 milliamps., which is enough for all normal requirements.

A final supply gives 5,000 volts at 500 milliamps., rectification being by a bank of GU1 mercury vapour valves. This supply is arranged by means of a tapped transformer so that voltages from 1,500 upwards can be obtained. In addition a series primary resistance enables the output voltage to be reduced to one-third. The transmitter operates on 14,031 and 14,378 kilocycles and is housed in the right-hand rack. It is perfectly conventional up to the final stage, which is a screened-grid valve, and shown in Fig. 2. It is coupled in exactly the same way as the receiving type of screened-grid valve but has particularly efficient screening and high L. output. The tuning condenser is practically at zero.

Fig. 2.—The connections to the S.G. power amplifier.

For a receiver a T.R.F. and a Hammarland crystal super-het are in use, this being satisfactory as telephony is not used.

It is a credit to this station that owing to the design, interference to B.C.L.'s is negligible even with high power, while little interference is caused on the band owing to the non-use of phone.

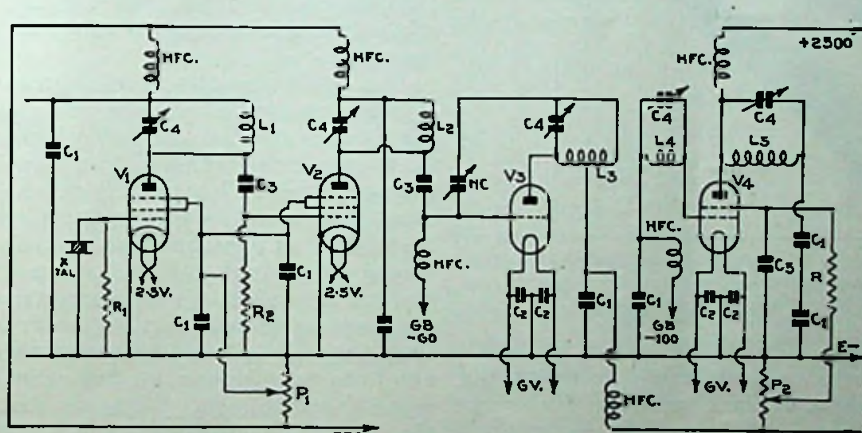


Fig. 3.—The four-stage transmitter is quite conventional but maximum gain has been obtained from each stage.

Goldmark Electron-Optical System

(*Continued from preceding page*)

vision in natural colours. The mirror-drum carries as many times more mirrors as there are basic colours used. For a three-colour system and z number of zones, 3z mirrors are on the drum. The drum rotates three times as fast as it would with one set of mirrors. (At five zones this would still amount to only 72 revolutions per second.) Each group of mirrors is stained with one of the three basic colours, so that after one revolution of the drum the picture is scanned three times with three colours within 1/24th of a second. Since the picture is produced actually at a rate of three times 24 = 72 frames per second, the picture frequency can easily be reduced to one-half of this amount, so that each colour builds up one complete picture in 1/12th second. No flicker will be noticeable since the actual picture frequency is 36. The electron beam of the projector tube has to be deflected at a rate according to 36 frames per second. Experiment will show whether this frequency can still further be reduced.

At the transmitter of the colour system a similar three-coloured mirror-drum projects the scene or picture to be transmitted on to the photo-electric surface of the transmitter electron-tube. The photo-electric particles on the light-sensitive surface of the tube are produced by a mixture of three different photo-electric substances, each of these three being extremely sensitive to only one of the three basic colours used in the system. The light-sensitive mosaic thus composed will accumulate an electric charge only when the rotating three-colour drum projects such part of the picture to the surface of the photo-electric strip which [illegible] photons of that particular colour.

A CHECK ON QUALITY

A NOTE ON THE H.F. TEST CARD

IN the February issue of TELEVISION AND SHORT-WAVE WORLD, there was published a note on the special test patterns used by the B.B.C. television engineers for visually testing the response of a television system. The H.F. test pattern has on several occasions been televised at the end of one of the 30-line broadcasts with an accompanying announcement explaining how the looker can judge the quality of his receiver by counting the number of lines from the apex in which the spot blurrs over the black and white sectors. A drawing of the pattern is reproduced in Fig. 1, while over it are traced the lines traversed by the scanning spot. It will be clear that because the size of the spot is much greater than the separate black and white areas enclosed by the lines near the apex the area near it will be blurred to a uniform greyness.

Resolution and Spot Size

We have seen it suggested that because a high-definition scanning system offers a greater degree of resolution, owing to the smaller spot, it is to be expected that blurring, with such a system, would be observable only at a fewer number of lines from the apex. A little reasoning will show the fallacy in this argument. The point is that although the spot is admittedly smaller and although more detail of the pattern itself will be visible, the relative proportions remain unaltered. The blurred area *of the pattern* will be less, but the number of lines occupying the blurred area will be the same because they are correspondingly narrower and occupy less space.

Some elementary mathematics will substantiate these remarks. We can assume, to a very fair degree of approximation, that the black and white sectors of the pattern will begin to be separately distinguishable on a line where the diameter of the spot is equal to the width between sectors. This obviously varies slightly for different sectors, but in the case of the middle one will by inspection occur on the sixth line, that is to say we can expect to count five blurred lines. Drawing the outline of the middle sector only in Fig. 2, if we find the distance x from the apex to the point where the width of the base d is equal to that of the spot, or line, of

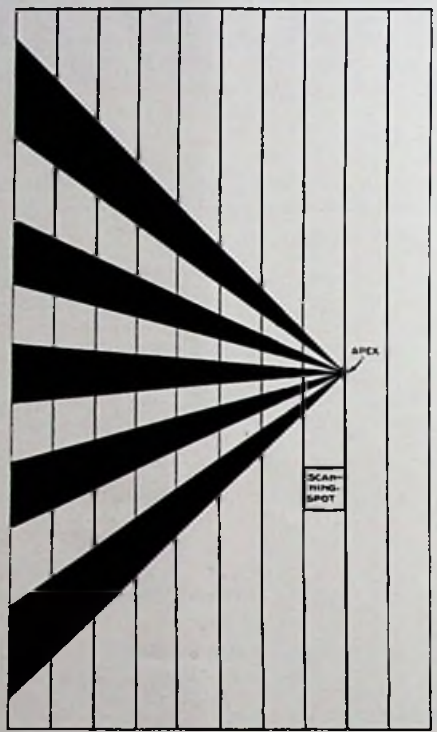


Fig. 1.—Test pattern for investigating H.F response of a television system, with imaginary scanning lines drawn on it.

course, we can easily estimate the number of lines involved. Referring to Fig. 2, by simple trigonometry,

$$\tan\frac{\alpha}{2} = \frac{\frac{1}{2}d}{x}$$

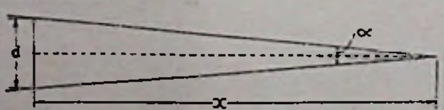


Fig. 2.—Geometrical construction of middle section for ascertaining number of blurred lines.

$$\text{whence } x = \frac{d}{2\tan\frac{\alpha}{2}}$$

Clearly $\frac{x}{d}$ will give the number of lines covered by x; thus we have

$$\frac{x}{d} = \frac{1}{2\tan\frac{\alpha}{2}}$$

The important point to notice is that the expression $\frac{1}{2\tan\frac{\alpha}{2}}$ involves *only* the angle at the apex and is entirely independent of the definition of the system in use. Substituting figures for α, which happens to be 10 degrees in the case in question, we get $\frac{1}{2\tan 5^\circ} = 5{\cdot}7$, from which we deduce that after the fifth line it should be possible to distinguish the separate sectors if the receiver and transmitter are both functioning efficiently.

This applies equally to all degrees of definition, so lookers who perhaps again see this pattern when they look-in to the new high-definition programmes may still expect to see the same degree of blurring in terms of the number of lines from the apex. It should be mentioned that the figure of five, arrived at by the foregoing argument is rather greater than has been generally experienced with the now obsolete 30-line system when lookers used to report the figure 4 as the maximum number of blurred lines. This is because correction for aperture attenuation at higher frequencies was introduced by the B.B.C. apparatus to an extent which produced far more detail in one direction of scanning than the other. With the low-definition given by 30 lines this was permissible, and indeed well worth while, but is not likely to be employed to such an extent in the future when the obvious criterion will be equal detail in each direction.

It will be noticed that the angle of each sector of the pattern is the sole factor in determining the number of blurred lines to be expected, and the particular pattern is a convenient but not the only size which could be used. A smaller angle would mean more blurring, and vice versa.

Scannings and Reflections

By THE LOOKER

Press Club's Television Dinner

THE Baird Company is certainly doing its best to popularise television ahead of the public service that is coming early in the New Year. It is putting on a most interesting show at the Dominion Theatre, London, and a few weeks ago, actually on November 9, it provided a programme at a special Television Dinner held at the Press Club, London, whose chairman, Mr. Horace Sanders, journeyed to the Baird studios at the Crystal Palace where his features and voice were transmitted to the Press Club, just off Fleet Street, London. In the dining room a cathode-ray receiver gave a brilliant black and white picture of 240 lines definition and measuring 12 ins. by 9 ins. At the Crystal Palace two transmitters were at work, one transmitting vision on a wavelength of 7 metres and the other sound at 8.5 metres. The occasion is probably a record in one respect—it is probably the first public or semi-public gathering to see a 240-line radiotelevised picture. In this issue is given an impressionistic story of Mr. Sanders's experience as a televisee, made available to us through the courtesy of Mr. Sydney Moseley, who presided at the dinner.

Sunday

No Sunday television programme at first! Most people will regard this as rather a pity, but the arguments in support of the B.B.C.'s decision are sound so long as the restriction to six days a week is regarded as something applying during the experimental period only.

Interference

A problem exercising the minds of the B.B.C. engineers is the prevention of interference from electric signs, motors, etc. It is a problem, too, that will worry a great number of other people when the television service comes. Aberration of a musical note is not detected by everybody, but the distortion of visual lines is noticed by most people. Interference can play the very dickens with a televised picture and the B.B.C., in settling upon the position of their first public viewing-room, which will be somewhere in the west of London, are obliged to take the problem very closely into consideration.

Television and Aviation

Wireless and aviation have always worked more or less hand-in-glove with each other, because once the pilot is in the air, wireless is the only medium which can keep him in constant touch with the ground. Nowadays, it is doing a lot more for him than that. It will give him his bearings, and even keep him automatically on a predetermined course so long as he is in the air. At the end of the journey it will further allow him to make a "blind" landing when fog shuts out any direct view of the aerodrome.

Landing operations are usually carried out with the help of ultra-short waves. Three-metre radio beacons are installed at the aerodromes, and transient beams which intercept the aeroplane in flight, and tell the pilot when he is crossing the boundaries of the landing field. A similar beam, radiated at the correct angle to the ground, then guides him safely down to earth.

All this naturally requires a rather complicated set of indicating instruments on the dashboard of the aeroplane, and the latest suggestion is to replace the lot by a television screen, on which the pilot can see his own machine moving over the landing field. Of course, this is only necessary in case of fog, where direct observation is impossible, but it is an interesting illustration of how television can be adapted to serve a useful purpose in the air.

The scheme involves the use of wireless direction finders at the aerodrome which first "spot" the position of the unseen craft. Its movement is next projected on to a map of the landing-field, showing all the various buildings and other possible points of danger, and the whole picture—including the moving spot representing the plane in motion—is then "televised" back to the pilot. The latter is thus able to "see" where he is to land, and what obstacles he must avoid in his descent, even in the densest fog.

At the Dominion Theatre

At the forthcoming public demonstration of big-screen television at the Dominion Theatre, London, which will be ready before Christmas, the public will see a picture on a 24-ft. screen. Baird's will transmit from the Crystal Palace, by permission of the Postmaster-General, and possibly will use their intermediate method according to which photographs are taken on cinematograph film, developed, and transmitted, there being a time lag of only half a minute or so. The special interest of the experiment is the means to be taken to obtain sufficient illumination to allow of a picture occupying a 24-ft. screen. Readers of Captain West's article in our last issue will be aware of the methods of projection now being tried out and in that article is described the method to be employed at the Dominion Theatre. The picture on the cathode-ray tube at the receiving end will be photographed on to a continuously-moving film by a special camera containing two drums which rotate at a constant speed. The film, having been exposed to both vision and sound, is developed for 20 seconds, washed for five, fixed for 20, washed for a further 15, and dried for about 60 seconds; thus in a total period of less than two minutes it passes into a cinematograph projector which projects it on to the screen. This is by no means the system by which the true big-screen television picture will come. It is just an improvisation.

In Japan

Tokyo, Japan, hopes to have an experimental television transmitter at work next spring, a committee having been created by the Japanese Posts Minister to study the existing television systems.

MORE SCANNINGS

The Television Director

"The B.B.C.'s Director of Television," said someone who knows him well, in speaking of him to us the other day, "is a man who speaks to people easily and can just as easily be spoken to." This will mean a great deal in instituting a new service where the human factor will be of tremendous importance.

Medium-Wave Relays

The B.B.C.'s regular medium-wave transmissions are proposing to borrow from television. That is to say, when the sound material accompanying televised pictures happens to be suitable for separate transmission, the B.B.C. will borrow it for general use, and in this way will assist, it is hoped, in helping to popularise television.

Alexandra Palace

Readers were very pleased with our pictures last month of the Alexandra Palace layout, and congratulations came to us from many sources, including officials at the B.B.C. Our layout presented a reasonably good idea of what the station will be like, though of course there will be certain detail modifications. It is hoped to give detail plans in an early issue.

To Lead the World

Will Great Britain lead the world in television next spring? Judging by what Mr. Gerald Cock, the B.B.C.'s Director of Television, told us last week, we should think there is every chance that it will. There is no doubt that we have the most generally acceptable radio service at the present time. Visiting Americans appear to regard it with a certain amount of disdain—they are accustomed to a great number of stations each working at high pitch—but when you get down to brass tacks you soon learn that they have a high opinion of the technical quality of B.B.C.'s service, although the programmes themselves are far from suiting the American taste.

On the continent of Europe there is the most outspoken praise for English transmissions.

Transmissions from the Stratosphere

It is these special transmissions which make one realise just how necessary is the short-wave receiver. Many readers must have heard the two American airmen broadcasting from Explorer II during its recent stratosphere flight. Listeners were kept in complete touch with the progress of the balloon by means of a five-metre transmitter linked up to the ordinary medium wave American broadcast stations.

Listeners in Europe could have heard the transmission quite well through various short-wave stations. I tuned in quite accidentally about 6.30 p.m. to W2XAD on 19 metres when the balloon was 60,000 feet up, and listened in to the cryptic comments of the observer until 7.15 or perhaps just a little after when the balloon had reached just over 70,000 feet.

Police Radio

Users of all-wave sets must have heard some of the police stations operating on the 160-metre band. There is some talk that owing to the interference caused by amateur and trawler stations that this band will be cleared up and kept solely for the use of police radio. It is expected that amateurs may have to go down to 80 metres and the trawlers down to below 130 metres.

Ten-metre Records and Sun Spots

In 1929, J. W. Matthews, G6LL, forecast that between 1935 and 1937 conditions on ten metres would undergo great changes. In view of this it is interesting to note how G2YL, G5BY and other stations have been able to work the entire world on this ultra-short-wave band.

The exceptionally fine conditions are apparently due to sun spots which have been noted just recently, but it will be interesting to keep a check on this waveband for the next twelve months.

Cathode-ray Lectures in Scotland

Scotland has always taken a keen interest in television developments and this is evidenced by the large audiences attending the lectures given by Mr. G. Parr, of the Edison Swan Co., on "The Cathode-ray Tube and its Applications."

On Wednesday, November 13, a demonstration was given to the members of the Glasgow University Physical Society which has been in existence for over fifty years, Lord Kelvin being the originator.

On Thursday, November 14, the lecture and demonstration was repeated to 180 Glasgow dealers and their friends. The remainder of Mr. Parr's itinerary included Edinburgh University, Glasgow Post Office engineers, and Aberdeen radio dealers.

At all the lectures the greatest interest was shown in the developments taking place and the Scottish radio trade is fully alive to the possibilities of future television demonstrations and the need for a closer study of the subject.

Kerr Memorial Lecture

The Television Society has decided to hold an annual Kerr Memorial Lecture in commemoration of the discoverer of the Kerr Cell, which has played such an important part in television. Readers will remember that an exclusive article on the original Kerr cell appeared in this journal last year. The lecture will be given by Mr. J. L. Baird, at the Royal Institution, in December, and tickets of admission can be obtained from Mr. J. J. Denton, 25 Lisburne Road, Hampstead, N.W.

Pictures by Wire

The American Telephone and Telegraph Company are at present linking up New York and Philadelphia with a new cable or transmission line which is capable of carrying frequencies up to several million cycles. The cable is of the coaxial type comprising an inner wire and an outer tube, spaced apart by a series of insulating washers. The actual conductor, apart from a projecting sheath of lead, is less than an inch in diameter. By doubling the diameter the width of the frequency-band is quadrupled, so that a 2-in. cable is able to handle a frequency-band of approximately five-million cycles, which is more than enough to cover any television requirements for some years to come.

Our own Post Office have recently decided to lay down a similar line between London and Birmingham which, later on, is to be extended as far as Edinburgh. One of its uses will be to relay "National" television pictures by wire from a central studio to various provincial transmitters, in much the same way as telephone trunk lines are now used to distribute the B.B.C. sound programmes.

. . . . . AND MORE REFLECTIONS

Town Representatives

In view of the increasing interest in short waves amongst amateurs and ordinary broadcast listeners, the Radio Society of Great Britain is introducing a new scheme by which any town with six or more short-wave enthusiasts, can have their own R.S.G.B. representative which they themselves elect. In this way short-wave listeners in one group should be able to keep well in touch with other groups.

"A Renting Plan"

I see that a scheme is being advocated in America for "renting" television sets on a large scale, instead of selling them direct. In this way manufacturers hope to avoid upsetting the existing radio market, as it is thought renting will interfere less than a "hot" selling campaign. The advantage to the customer is that he will get a guaranteed service, which is no small matter in the case of a complicated box of tricks like a cathode-ray receiver.

It is difficult nowadays to tackle a breakdown of the ordinary mass-produced wireless set, but the overhaul of a television receiver would be a hopeless job for any but the keenest "fan." The idea of so much "down," and so many monthly payments—with service—sounds attractive enough in theory, and under proper guarantees it ought to work out well in practice.

A New Science Magazine

A large proportion of the readers of TELEVISION AND SHORT-WAVE WORLD will be highly interested in a new magazine that has just been published from our offices. "Ralph Stranger's Science Review," 1s. monthly, is something entirely new in its way. It is a monthly publication devoted to modern scientific research and progress. It is obtainable through newsagents or can be subscribed for at the rate of 13s. 6d. per annum, post free; 6s. 9d. for six months or 3s. 6d. for three months. Members of the World-wide Radio Research League, originated in connection with *World Radio*, the B.B.C. publication, get the magazine in return for a yearly subscription of 10s. 6d. Ralph Stranger, whose technical books and articles are well-known, is the Science Editor of the new magazine, and the Editor-in-Chief of TELEVISION AND SHORT-WAVE WORLD, is the General Editor.

While the new magazine is exceptionally readable and interesting it is, at the same time, authoritative, and contains in its first number the work of such well-known scientific writers as Professor Carl Störmer; C. Bernard Childs, Ph. D., A.Inst.P.; M. Grimes; L. G. H. Huxley, M.A., D.Phil.; G. Ashdown, I.M.E., Eng. A.I.B.; A. G. Cutts, B.Sc.; A Hine, B.Sc.(Tech.), and Ralph Stranger. Among the articles in the first issue are "Shall We Ever Fly at 10,000 m.p.h.?"; "Weather and Weather Maps"; "A Stratosphere Flight"; "Splitting the Atom"; "The Moon and Wireless"; "Short-wave Wireless"; "My Visit to Mount Wilson"; "From 50,000,000° A to Absolute Zero," and many others.

I strongly advise you immediately to apply to your newsagent for a copy or to send us a subscription when we shall have great pleasure in forwarding your copies regularly by post. Address your communications to Bernard Jones Publications, Ltd., Chansitor House, 37-38 Chancery Lane, London, W.C.2. The new magazine will appear every month on much about the same day as TELEVISION AND SHORT-WAVE WORLD itself.

South Kensington Museum

To Baird's original apparatus permanently exhibited at the South Kensington Museum is to be added, the rumour reaches us, the Baird 30-line transmitting gear so long in use at the B.B.C. and recently dismantled. It includes the scanner, the apparatus rack embodying the amplifiers, etc., and the control panel, and is actually the property of the Baird Company.

Dramatised News

This should be a great feature of the television broadcasts. It will be illustrated by posed scenes and by films of the actual events of the day and obviously opens up great possibilities.

> The JANUARY issue of
>
> **"TELEVISION AND SHORT WAVE WORLD"**
>
> •
>
> Owing to the Christmas Holidays the next issue (January, 1936) will be published on
>
> **TUESDAY, DECEMBER 31.**

Marconi-E.M.I.

Few details of Marconi-E.M.I. methods and apparatus are yet available. The company has an enormous manufacturing interest in radio sets and this naturally influences their policy as regards publicity, but I understand that they are making huge plans to cover the demand for television receivers some time in the New Year.

Small Helpings

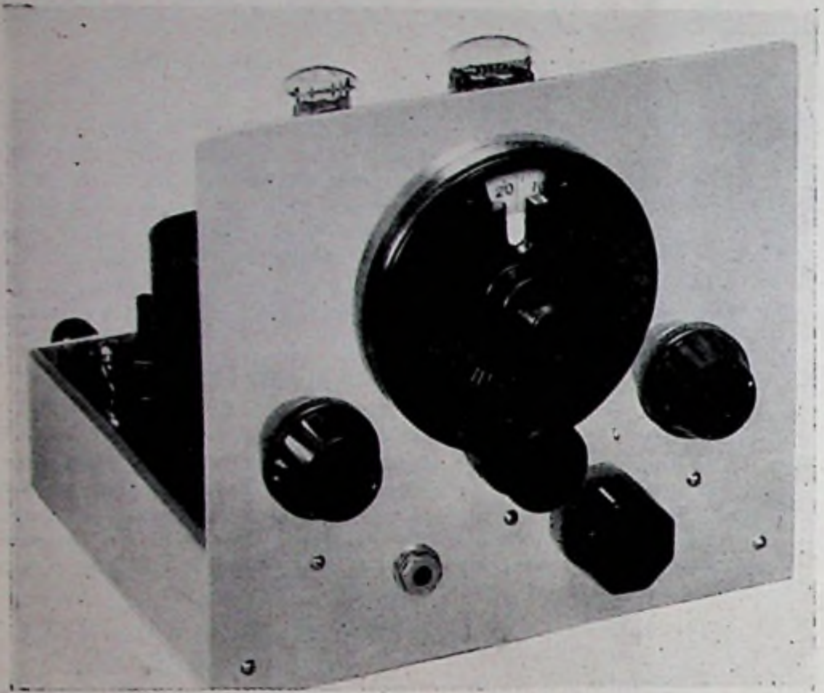
I like the idea of the television programme being made up of short items, particularly during the introductory period in which the public's taste in televised pictures will have to be gradually learned. I should like to see as many five-minute items as possible.

What a High-definition Transmission Sounds Like

Practically all broadcast listeners are familiar with the sound produced by the thirty-line transmissions, for at one time or another most people have tuned them in. Equally distinctive is the sound of the 240-line 25 pictures per second transmission. The predominant sound is a high-pitched whistle upon which there appears to be imposed a rapid burbling sound. Obviously with 240 lines and 25 pictures per second the line synchronising frequency will be 6,000 cycles per second and it is this which produces the high-pitched whistle. The burble is due to the picture synchronising impulse which occurs at a frequency of 25 times a second. The variations of the scan which produce the picture are, of course, above audible frequency and not heard. The sound of the E.M.I. 405-line transmission is rather similar except that the note of the whistle is not quite so high and the burble resolves itself into a hum, the frequency in this case being fifty.

Another use for the Photo-electric Cell

A new road safety device which is to be used on a new double-track by-pass near London, includes the use of a photo-electric cell, the invisible beam of which crosses the gap between pedestrian railings at a marked crossing. When pedestrians enter the gap interruption of the beam automatically operates traffic signals guarding the pedestrian crossing and changes the lights to stop the traffic.



The Short-wave Battery Two is simple and compact.

A Two-valve Short-wave Battery Receiver

This receiver has been designed for general use. Principally it was intended for reception of American and other short-wave programmes, but as band spreading has been included, is ideal for amateur use. The designer, Norman Brandon, finds it excellent between 10 and 200 meters.

IT is most unusual for an amateur station not to have a two-valve battery-operated receiver of some kind or another. In many instances, this type of set is in general use while others simply have the small set for when conditions are bad.

Loud-speaker reception of American stations is quite general at this time of the year although to those who have not had any experience of short-wave listening this may seem rather a tall order. We do not intend to explain just why this is or to prove the point, but the fact remains that anybody building this or any other receiver of a similar type, will obtain American short-wave stations on the loud-speaker with reasonable regularity.

There is not very much to choose between simple short-wave sets so it is not until one has actually experienced difficulty in tuning or has used a poor set that the important features of short waves are appreciated.

First of all here are but a few of the ideas embodied in this set and the reasons for so doing. A metal panel almost precludes any possibility of hand capacity. It is very annoying to find a station vanish when the receiver is finely adjusted.

The tuning dial is almost devoid of metal. The idea of this is to prevent rustle and noise when tuning. For band-spreading a very small condenser is used and, as there is not a really suitable band-spread condenser on the market, anyway that is our opinion, we have modified the nearest one we could find to our specification.

A plug and jack is used for loud-speaker or headphone connections and at the same time, acts as an L.T. switch. A potentiometer of the semi-fixed variety applies grid bias to the detector valve. This small feature alone makes a wonderful difference to the results obtained.

Automatic grid bias keeps quality to a reasonably high order, makes quite sure the valve is used correctly, while the high-tension battery can be run until it is almost worn out and results begin to deteriorate. Incidentally it saves the bother of a grid bias battery.

At first sight it may seem rather unnecessary to have an L.F. volume control. When tuning with headphones and sometimes the loud-speaker, the volume obtained from certain powerful stations and also from certain commercial telegraphy stations is colossal, so that by keeping the volume at a low level, tuning is much more pleasant.

Reaction was obtained by the usual well-tried Reinartz system, but here again we have chosen one of the few condensers that is really smooth and quiet in operation. In series with the aerial is a .0001 baseboard mounting pre-set. This when adjusted to suit any particular aerial, helps to prevent blind spots on different parts of the waveband.

Choke-filter output prevents D.C. current feeding into the headphones and also prevents H.F. reaching the phone leads. All of these features do not make a remarkable receiver, but just a two-valve set which gives as much as can be obtained from a set of its kind, is simple to operate and reliable.

Components for Two-valve S.W. Battery Receiver.

CHASSIS AND PANEL.
1—aluminium chassis 8 x 7 x 3, 16-gauge (Peto Scott).
1—panel 8½ x 7½, 16-gauge (Peto-Scott).

CONDENSERS, FIXED.
2—2-mfd. type 250 volt working (T.M.C.).
1—.0001-mfd. type M (T.C.C.).
1—.001-mfd. type M (T.C.C.).
1—.01-mfd. type M (T.C.C.).
1—.0002-mfd. type 34 (T.C.C.).

CONDENSERS, VARIABLE.
1—.0001-mfd. baseboard pre-set (J.B.).
1—15 m.mfd. type 900 (Eddystone).
1—100 m.mfd. type 900 (Eddystone).
1—150 m.mfd. type 942 (Eddystone).

COILS.
1—set as required, four-pin (Eddystone).

CHOKE H.F.
1—all-wave type 982 (Eddystone).

CHOKE L.F.
1—Ni-choke II (Varley).

DIAL.
1—Indigraph type (B.T.S.).

HOLDERS, VALVE.
1—4-pin chassis-type less terminals (Clix).
2—4-pin type VH7 (Bulgin).

PLUGS AND TERMINALS.
2—terminals type B marked Earth and Aerial (Belling Lee).
4—Insulated sockets (Clix).
1—double circuit jack (B.T.S.).
1—loud-speaker plug (B.T.S.).

RESISTANCES, FIXED.
1—2-megohm type 1-watt (Erie).
1—100,000-ohm type 1-watt (Erie).
1—500-ohm type 1-watt (Erie).
1—400-ohm bias resistance (Eddystone).

RESISTANCES, VARIABLE.
1—500,000-ohm volume control (Erie).

SUNDRIES.
Insulating sleeving and connecting wire (Golstone).
6 inches screened cable (Goltone).
2 dozen 4 B.A. nuts and bolts (Peto-Scott).

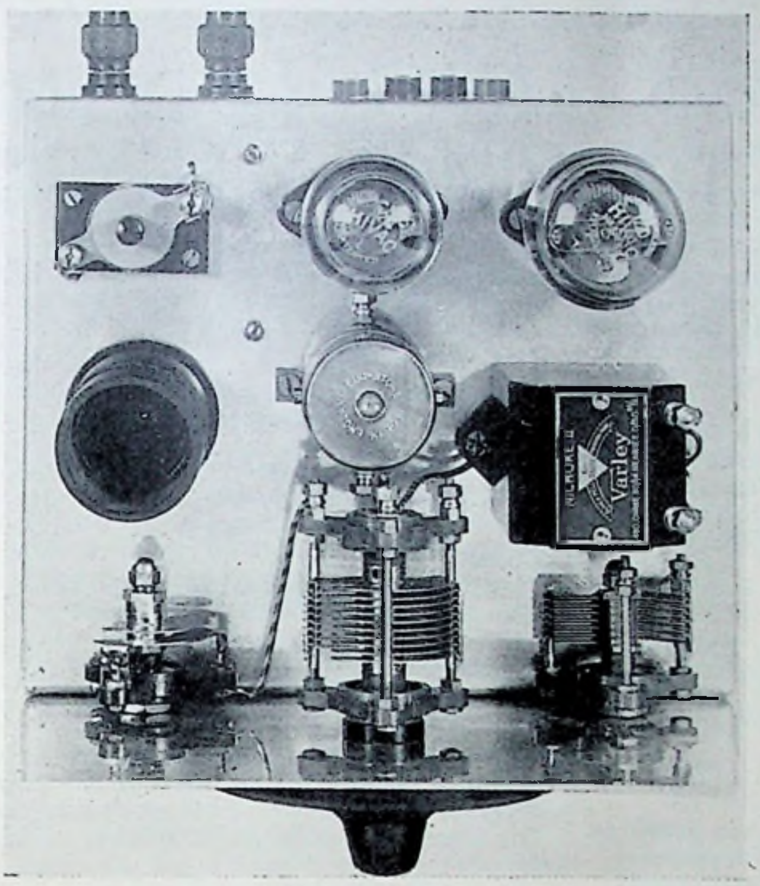
Accessories.

ACCUMULATOR.
1—DTG-C (Exide).

BATTERY.
1—120-volt standard (Vidor).

LOUD-SPEAKER.
1—midget (W.B.).

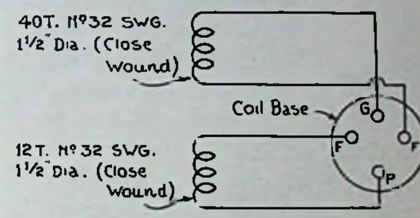
VALVES.
1—D210 (Hivac).
1—Y220 (Hivac).



At the left of the chassis is the aerial pre-set condenser. This needs adjusting for each coil used.

As regards the circuit the two-valver has a triode leaky-grid detector with a simple tuned grid circuit with the aerial directly on to the grid end through a small capacity. A screened all-wave choke in the anode circuit enables the *set to be used on broadcast bands if required.* Resistance coupling primarily saves money. It gives almost the same gain as a transformer-coupled stage; anyway the difference is hardly noticeable and, at the same time, is simple and space saving.

The output valve is one of the new Harries type made by Hivac, and readers will appreciate just why we specified this valve when the set is first used. Take a look at the plan view. On the left-hand side is the band-spread condenser, which is in parallel with the main tuning condenser seen in the centre. The reaction condenser is on the right-hand side behind the Varley

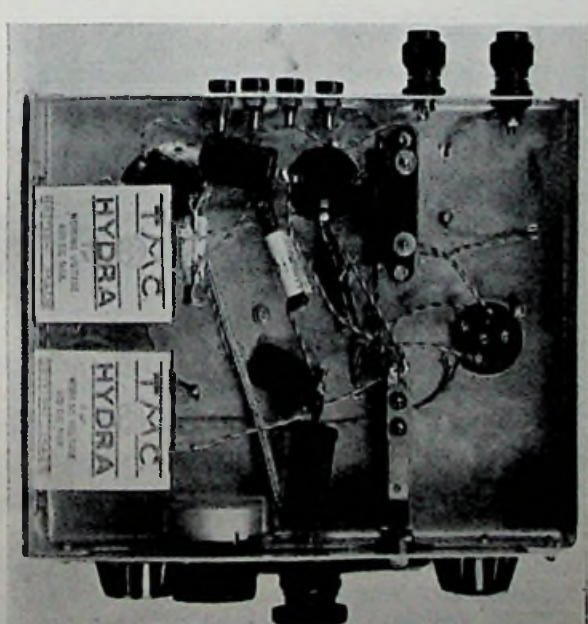


Home-made coils can be made and they are connected in this way.

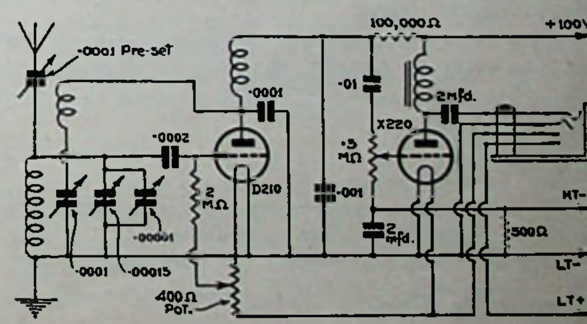
output choke. In the very centre of the chassis is the Eddystone screened all-wave choke. Do use this component for it is most important if satisfactory results are to be obtained. We have noticed in the past that many readers are inclined to put in any old chokes and have then wondered just why reaction could not be obtained on one band or another.

The two Hivac valves at the back of the chassis are, on the left the detector, and on the right the output valve. Although we have specified Eddystone plug-in coils of a standard type the energetic constructor can build these coils without much difficulty.

The front view shows the panel layout. The B.T.S. tuning drive in the centre is quite well known. The other three knobs are—on the left band-spread, on the right reaction, bottom right L.F. volume control.



This shows how the smaller components are fixed beneath the chassis.



A two-valver of this kind is ideal for the beginner or transmitting amateur using morse code.

The photograph on the left shows the under-baseboard, the resistances and various tag condensers can be quite clearly seen. The two terminals at the back are for the aerial and earth. Notice that the aerial terminal is kept insulated from the panel.

Battery consumption is approximately 9 milliamps. at 120 volts.

A LIST OF EFFECTS AND LAWS USED IN TELEVISION PHYSICS

A reference often occurs in writings on the subjects of Television and Physics to various effects which are known by the discoverer's name. The following lists, without being comprehensive, will give brief information on some of the phenomena likely to be encountered in technical papers.

Ampere's Rule

To determine the direction in which a needle is deflected by a conductor carrying a current in a given direction. Imagine yourself swimming in the wire in the direction of the current, and facing the needle. The north pole will be deflected toward the left hand, the south pole being deflected in the opposite direction.

Ampere's Theorem

The magnetic field due to an electric current flowing in any circuit is equivalent to that due to a simple magnetic shell, the bounding edge of which coincides with the conductor and the strength of which is equal to the strength of the current.

Archimede's Principles

A body immersed in a liquid loses a part of its weight equal to the weight of the liquid displaced. The pressure exerted by gases on bodies immersed in them is transmitted equally in all directions.

Avogadro's Law

Equal volumes of all gases at the same temperature and pressure contain the same number of molecules.

Becquerel Effect

A change in electrode potential produced by illuminating the electrode surface in an electrolyte.

Belopolsky Effect

When a beam of light is reflected from a system of moving mirrors, and the light is subsequently analysed with a spectroscope, the spectrum lines are displaced by a small but measurable amount.

Boyle's Law

The volume of a given quantity of gas varies inversely as the pressure, if the temperature is constant. This is only true for actual gases, and for low and medium pressures.

Brewster's Law

If n is the refractive index of a substance and B is the polarising angle, then $n = \tan B$.

Charles' Law

All gases heated at constant pressure expand by an equal fraction of their volume at 0 c. for equal increments of temperature.

Corbino Effect

When a uniform radial current flows through a circular disc of metal placed in a magnetic field normal to the plane of the disc, there is produced a circular current, the density of which is inversely proportional to the radius.

Cosine Law

See Lambert's Light Law.

Coulombs Law

The force exerted by two small charged conductors on one another is directly proportional to the product of their charges and inversely proportional to the square of the distance between the bodies.

Curie Point

All ferro-magnetic substances have a definite temperature of transition at which the phenomena of ferro-magnetism disappear and the substance becomes merely para-magnetic.

This temperature is called the Curie Point, and is usually lower than the melting point.

Dalton's Law

In a mixture of gases, each gas exerts the same pressure as it would exert if it were alone present in the volume occupied by the mixture.

In a mixture of gases, if the several gases have the same temperature and if they all occupy the same volume, then the pressure exerted by the mixture will equal the sum of the pressures exerted by the gases severally.

Doppler Effect

The apparent change in the wavelength of light produced by the motion in the line of sight of either the observer or the source of light.

Edison Effect

When a lamp filament is heated, a small current will flow to another metal plate placed within the lamp, but only in one direction, namely from the negative end of the heated filament to the plate.

Einstein Theory

See: Richardson. Electron theory of matter. 1914, *p.*296, 314. *Ann. der Physik.* 22, 183, 1907. *Phys. Zeit.* 21, 88, 1920.

Elster and Geitel Effect

Clean metal surfaces lose a negative charge when exposed to the action of ultra-violet light, but retain a positive charge. The effect is most marked in the case of electro-positive metals, and roughly it is in the order of the metals in Volta's contact electricity series.

EFFECTS AND LAWS IN TELEVISION PHYSICS (Contd.)

Ewings Theory

To explain the phenomenon of magnetism. See Proc. Roy. Soc. 1890. 48. *P.*342 *and later Proc. Roy. Soc.* 1922. 100. *P.* 449.

Faraday's Law

Whenever the number of lines which thread through any conducting circuit is changed, an electromotive force will be produced during the change in the number of lines, and this will tend to produce a current in the circuit.

Faraday Effect

If the beam of light is passed through a strong magnetic field the plane of polarisation is rotated.

Faraday's Law of Electrolysis

Whenever a current passes across a junction between a purely metallic and a purely electrolytic conductor, a chemical change occurs, the amount of which, expressed in chemical equivalents, is proportional to the quantity which passes and is independent of everything else.

Fleming's Rule

Clench the right hand, and then open out the thumb and first two fingers, making them as nearly as possible at right angles to each other. Then place the hand so that the forefinger points along the wire in the direction in which the current is flowing. If the second finger points to the magnetic needle the third will indicate the direction in which the N. pole will be deflected.

For determining the direction of rotation of a machine first finger represents flux, second finger flow of current, and thumb motion.

Fraunhofer Lines

If sunlight is examined through a spectroscope it is found that an enormous number of dark lines cross the spectrum, parallel with the slit. These dark lines are known as Fraunhofer's Lines. Kirchhoff conceived the idea that the sun is surrounded by layers of vapours which act as filters of the light emitted by the sun and abstract those rays which correspond in their periods of vibration to those of the components of the vapours.

Thus reversed or dark lines are obtained in the spectrum due to the absorption by the vapour envelope, instead of the bright lines found in emission spectra.

Fresnel-Arago Laws

1. *Two rays of light polarised in the same manner interfere in the same manner as ordinary light.*
2. *Two rays polarised at right angles do not interfere.*
3. *Two rays polarised at right angles from ordinary light, and brought into the same plane of polarisation do not interfere in the ordinary sense.*
4. *Two rays polarised at right angles (obtained from plane polarised light) interfere when brought into the same plane of polarisation.*

Gauss Theorem

Relates to the charge given to a particle at a particular point in an electrostatic field.

Gay-Lussac's Law

The pressure of a gas being constant, the volume varies directly with the absolute temperature.

Heaviside's Expansion Theorem

Press. —Electrician, 83, 449, 1919.

Hallwach's Effect

The photoelectric activity of a freshly polished electrode diminishes with time, causing a form of 'fatigue.' Modern methods of preparation have minimised this effect.

Hall Effect

When an electric current flows across the lines of force of a magnetic field, an electromotive force is observed which is at right angles to both the primary current and the magnetic field.

When a thin rectangular sheet of metal carrying a current flowing in the direction of its length is subjected to a powerful magnetic field normal to the sheet, the current stream lines are deflected towards one edge of the sheet.

The rotations when the light is reflected from Ni. or Co. instead of from Fe. is in the same direction as for Fe.

When a steady current is flowing in a magnetic field, electromotive intensities are developed which are at right angles both to the magnetic force and the current, and which are proportional to the product of the current strength, the magnetic force, and the sine of the angle between the direction of these quantities.

Hertz Waves

An oscillating circuit sends out electromagnetic waves which have all the properties of light waves, except that the wavelength is very much greater. The production of these electromagnetic waves was predicted by Maxwell.

Hysteresis

Primarily, the tendency of any magnetic substance to retain the magnetism imparted to it by the magnetising force. Also applied to any effect which tends to lag behind a change in the cause of producing it.

Joule's Law

The heat produced by the passage of a current through a metallic conductor is proportional to the resistance of the conductor, the square of the current and the time.

$$JH = RI^2t = EIt.$$

where J is Joule's equivalent of heat, and H the number of heat units.

Kerr Effect

The rotation of the plane of polarised light by reflection from the polished surface of a magnet.

Also sometimes referred to as the elliptical polarisation of light by the passage of a beam through a strong electric field. The former, however, is the true Kerr effect.

Kirchoff's Laws

At any point in the circuit there is as much current flowing into the point as there is flowing away from it.

The sum of the several potential drops (IR) around any one path of an electric circuit is equal to the sum of the E.M.F.s impressed on the same path.

Lambert's Law

Each layer of equal thickness absorbs an equal fraction of the light which traverses it.

Snell's Law (Sine Law)

When light passes from one medium to another, the incident ray, the normal to the surface at the point of incidence and the refracted ray are all in the same plane.

The ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for the same two media, and depends only on the nature of the media.

$$\frac{Sin\ i}{Sin\ r} = u \text{ index of refraction.}$$

Steinmetz' Coefficient

A constant for magnetic materials which is a measure of the hysteresis loss unit.

Thomson Effect

A reversible thermal effect produced when current flows along an unequally heated conductor. In the case of copper heat is absorbed when the current flows from the cold part to the hot.

3/2 Power Law

The maximum current which can pass between two parallel plates in a high vacuum is inversely proportional to the square of the distance between them and proportional to the 3/2 power of the voltage.

Tyndall's Phenomenon

If a beam of light enters a darkened room in which dust particles are floating, its path is rendered evident by the scattering of the light at the surface of the particles ; each one appears as a brightly moving speck. This effect is used in the detection of colloidal solutions. The light which is scattered is partly polarised.

Volta Effect

When two metals are placed in contact whith one another in air, one becomes positive and the other negative, although the charges are feeble.

Weinstein Formula

For determining the inductance of coils in high frequency measurements.

Wied. Ann. 21, 329, 1884.

Young's Modulus

The force required to stretch a material of unit cross section to double its length (within the elastic limit). It is constant for any one material.

$$M = \frac{LF}{ea}$$

L = length of body, a = area, F = force applied, e = total elongation produced by F.

Zeeman Effect

The distortion of the spectrum lines in the light emitted by a flame when subjected to strong magnetic fields. (See Houston—Treatise on Light.)

THE SURFACE CHARGE OF THE EARTH

PROFESSOR E. V. APPLETON, in the course of a recent lecture of the Sir Halley Stewart Trust, on atmospheric electricity, defined the reason for the persistence of the surface charge of the earth. The surface of the earth, and particularly elevated objects such as the tops of trees and houses, he said, are negatively charged in fine weather, while the air immediately above possesses a positive charge. As a result of the electric attraction, the positive charge passes into the ground tending to neutralise the surface charge of the earth. But, in spite of this influence, the surface charge persists and the cause of the persistence is at first puzzling. Many suggestions had been put forward concerning the manner of compensation in the electrical problem, but only recently has the real reason been identified.

Not till measurements were made over the oceans by American observers in the non-magnetic ship *Carnegie* was the real hourly variation of the earth's charge apparent, and then it was found that there was a maximum effect all over the world at the same universal time (7 p.m. G.M.T.). It is now believed that the maintenance of the earth's charge is due to the influence of thunderstorms, which are found to send an appreciable amount of negative electricity into the ground. A kind of profit and loss account has been made out and it has been shown that the daily supply of thunderstorms is sufficient to replenish the negative charge and to produce the hourly variations observed.

In the upper atmosphere the electrification is a thousand times denser than it is in the lower atmosphere. The marked solar control of the density indicates unmistakeably that the ionisation is due to solar radiation and, as so often happens in physics, the problem to be solved is whether the radiation consists of waves or particles. The matter has been tested in radio observations made in recent solar eclipses and the results have decided very definitely in favour of the theory that the cause of the electrification is ultra-violet light, and not a swarm of solar particles as some had supposed.

A difference in the behaviour of the lower and upper levels of the ionosphere has been recognised recently. The lower stratum is found to be about twice as dense in summer as in winter, due to the more direct influence of sunshine. This is exactly the amount of variation predicted by theory. But for the higher region there is not the expected increase in summer. To account for this anomaly the theory has been put forward that, at a height of 150 to 200 miles, the atmosphere is raised to a high temperature by the sun. Expansion results from this heating so that the electricity is attenuated in density. To account for the observed facts it appears necessary to assume that at this level the summer noon temperature is at least 2,000° Fahrenheit.

The density of the ionoscope appears to follows the sunspot cycle of 11 years, and it will be of great interest to continue the measurements now in progress until the next sunspot maximum in 1939. The minimum of solar activity occurred about the latter half of 1933 and both magnetic and radio observations now show that activity is increasing again. It is expected, as a result, that the radio engineer will find substantial differences in the wireless wavelengths best suited to his purpose for long-distance communication.

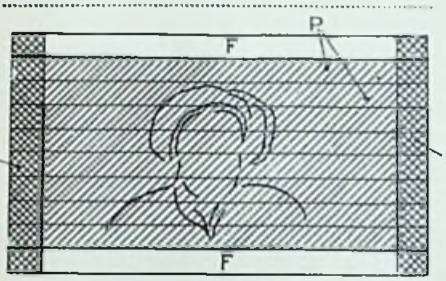
RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS
Specially Compiled for this Journal

Patentees:—J. L. Baird and Baird Television Ltd. :: Fernseh Akt. :: Radio Akt., D. S. Loewe and H H. Wolff Radio Akt. and D. S. Loewe :: Compagnie Compteurs.

Synchronising Signals
(Patent No. 433,552.)

The line and frame synchronising impulses are transmitted in opposite phase relatively to the mean value of the picture signals. As shown in the figure the impulses L, sent out between each line P of the picture signals, reduce the carrier-wave to zero,



Improved Synchronising Device. (Patent No. 433,552.)

whilst the "frame" impulses F produce a voltage in the high-light region. Both impulses are produced by a picture frame F of alternate light and dark zones.—(*J. L. Baird* and *Baird Television, Ltd.*)

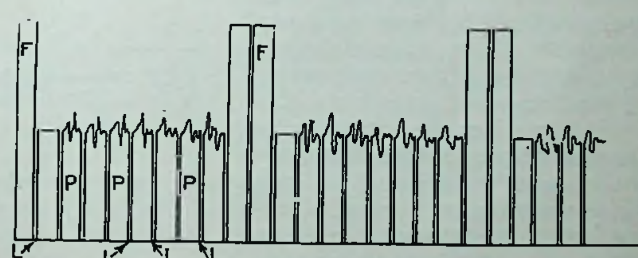


Diagram explaining the Baird synchronising (Patent No. 433,552.)

Colour Television
(Patent No. 432,989.)

In order to produce coloured effects, two (or three) complete images are thrown on to separate fluorescent screens, each of which has a distinct colour response. The images are then superposed on each other by an optical system interposed between the screens and the eye of the observer.

One of the screens may be made of calcium tungstate which gives a blue fluorescence, another of zinc silicate which emits a green colour, whilst the third may be zinc phosphate which produces a red colouration. The electron stream is so controlled inside the tube that, after completing a scanning-line of the first screen, it passes to a line on the second screen, next to the third, and then back to the first, and so on. This reduces the time-difference between successive images, and so prevents colour "fringing."—(*Fernseh Akt.*)

Scanning Systems
(Patent No. 433,295.)

In one known method of transmitting television signals, the light-and-shade values of the picture are determined by the speed at which the cathode-ray is made to move over the surface of the fluorescent screen. This means that the rate-of-change of the potential applied at any moment to the control electrodes of the cathode-ray tube must be proportional to the intensity of the particular picture-element being reproduced.

If the signals are transmitted by the ordinary method of amplitude-modulation, any fading of the signal produces a two-fold distortion at the receiving end, because, owing to the falling-off in signal strength, the original light and shade values are shown out of proportion, whilst the actual position of each picture element is also affected.

According to the invention these difficulties are overcome by using a method of modulation in which each picture element is represented by a change in the phase or frequency, but not in the amplitude of the radiated carrier wave.—(*Radio Akt. D. S. Loewe* and *H. H. Wolff.*)

Scanning Films
(Patent No. 433,853.)

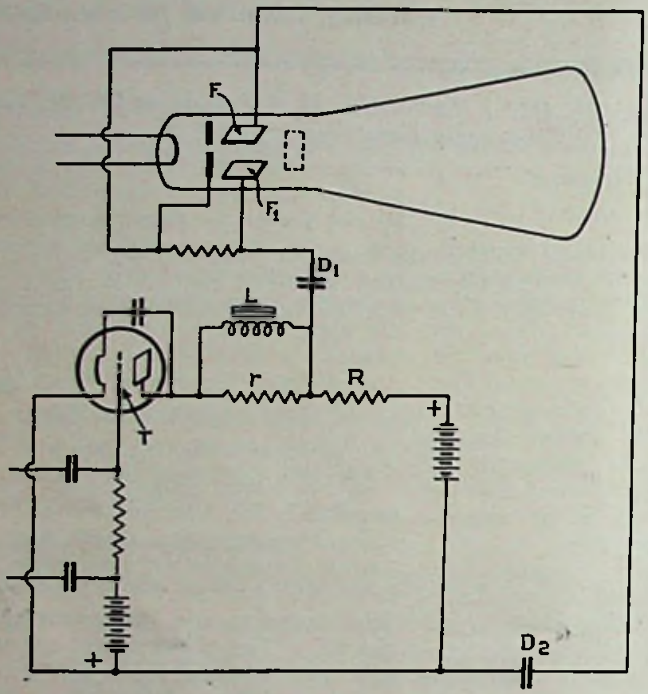
A continuously-moving cinema film is scanned by a spot of light which, in addition to making the usual line-traverse, is rhythmically moved in a direction at right-angles to the line and opposite to the movement of the film. The arrangement allows every frame of the film to be fully scanned in, say, half the normal period taken by the frame to pass through the gate. In other words the transmission channel need only be used intermittently for a complete scanning of the film. The arrangement can be applied to interlaced scanning.—(*J. L. Baird* and *Baird Television, Ltd.*)

Televising Cinema Films
(Patent No. 434,274.)

Many cinema films are found to be unsuitable for transmission by television because the distribution of light and shade is not sufficiently well balanced to allow the light-relay at the receiving end to operate efficiently. The object of the invention is to overcome this limitation, so that any normal type of film can be used to produce satisfactory pictures. This result is attained by applying extra amplification to the potentials produced by scanning a part of the film where the change in light intensity is small, so as to increase the original contrast. A similar compensation is applied to the high-light parts of the film, so that the total effective contrast of the film is kept within the operating limits of the receiver.—(*Radio Akt. D. S. Loewe.*)

Time-base Circuits
(Patent No. 432,856.)

In scanning systems of the kind in which the deflecting-electrodes of a cathode-ray tube are discharged periodically through grid-controlled gas-discharge tubes, there is a tendency for the "stroke" to develop a curvature, particularly at low frequencies such as those applied to the framing-electrodes. In order to offset this effect, a compensating voltage is applied to the electrode, in addition to the normal charging-voltage.



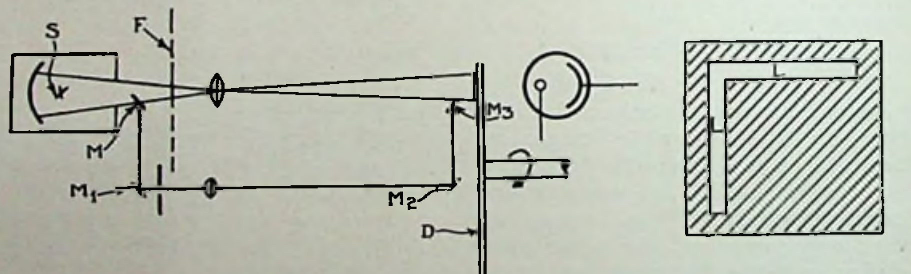
Time-base circuit. (Patent No. 432,856.)

As shown in the figure a resistance *r*, in parallel with an inductance L, is inserted in the anode circuit of the gas-discharge tube T. One of the framing-electrodes F of the cathode-ray tube is connected to the cathode of the discharge tube T through a condenser D2, whilst the second framing-electrode F1 is connected through a condenser D1 to a point between the ordinary charging-resistance R and the compound impedance L, *r*, so that it receives the supplementary voltage generated across that impedance. A similar falling-off in linearity also occurs in connection with the more rapid line-scanning voltages, and may be similarly corrected.—(*Compagnie " Compteurs."*)

Synchronising Systems

(Patent No. 434,278.)

In scanning a film F, a part of the light from the source S is intercepted by a mirror M and diverted through a separate path from the main beam by mirrors M1, M2, and M3, so that it reaches the scanning-disc D as a margin of light L brighter than any part of the picture. This is shown separately in Fig. 1A, and is utilised as the source of the frame and line synchronising impulses.



Figs. 1 and 1a.—The Radio Akt. synchronising system. (Patent No. 434,278.)

The pulses are transmitted on the same carrier wave as the picture signals, though there is no overlap between them since no picture signals are radiated during the synchronising periods. The arrangement is particularly suitable for use with gas-discharge saw-toothed oscillation generators, which only require a relatively low triggering voltage.—(*Radio Akt D. S. Loewe.*)

A Summary of Other Television Patents

(Patent No. 432,209.)

Improvements in the scanning and control electrodes of cathode-ray television receivers.—(*Radio Akt. D. S. Loewe* and *K. Schlesinger.*)

(Patent No. 432,268.)

Push-pull amplifiers, particularly for use with photo-electric cells.—(*A. C. Cossor, Ltd.*, and *O. S. Puckle.*)

(Patent No. 432,783.)

Synchronising system in which the " line " oscillator tube controls the " frame " oscillator without the use of an intermediate tube.—(*Compagnie des Compteurs.*)

(Patent No. 432,970.)

Improvements in the mounting and setting of the electrode system of cathode-ray tubes.—(*Fernseh Akt.*)

(Patent No. 433,442.)

Improvements in the construction of electro-magnetic light-valves.—(*Electrical Research Products, Inc.*)

(Patent No. 433,720.)

Fixed-aperture system for interlaced scanning with rotating discs.—(*J. L. Baird* and *Baird Television, Ltd.*)

(Patent No. 433,766.)

Improvements in picture-transmission systems.—(*Electrical Research Products, Inc.*)

(Patent No. 433,935.)

Improvements in the scanning and illumination of films used for television.—(*J. L. Baird* and *Baird Television, Ltd.*)

(Patent No. 433,945.)

Method of producing motions in two directions from a beam of light so as to improve its optical efficiency or " light grasp."—(*Scophony, Ltd.*, and *J. H. Jeffree.*)

(Patent No. 434,111.)

Producing image-points of high definition in a cathode-ray tube.—(*Radio Akt. D. S. Loewe* and *K. Schlesinger.*)

(Patent No. 434,469.)

Interlaced scanning systems in which the scanning-line frequency is a whole number plus a fraction of the framing frequency.—(*Marconi's Wireless Telegraph Co., Ltd.*)

(Patent No. 434,496.)

Television system in which the synchronising signals occur between spaced picture signals, and are in opposite phase from a datum line.)—(*Marconi's Wireless Telegraph Co., Ltd.*)

"TELEVISION NIGHT" AT THE PRESS CLUB

Mr. HORACE SANDERS GIVES HIS IMPRESSIONS OF "BEHIND BEYOND"

NOVEMBRINE shadows and darkness. Glittering pins and needles of rain. A tortuous way. A bleak, pillared cavern of desolation. Rising steps. Then a terrace flanking a great sullen barrier of weeping sheen. Towering in the mist like a glazed iceberg. A wide horizon of impenetrable mist. A forlorn, nocturnesque figure. A statue distorted in the florics of a swirling mist. A quick, staccato scrunching of sodden gravel. A running figure. Presently a red-rimmed glass door. Within a sense of subdued light, and a pervading air charged with an expectancy of the occult. . .

The right setting for the strange adventure that was to follow. A foray into the ether. A helter-skelter ride through space at the rate of 186,000 miles per second!

Away along a corridor, and, by a sudden turn, into a lofty room with oblongs and squares of light, like sinister giant lilies in a phantom land. As I laid my ulster and hat upon a throne I heard the voice of a high priest. Intoning, so it sounded.

By an alcove there stood a golden goddess in a dew of light. Golden hair, golden face, and a golden dress. A delight to see. She stood immovable. A glamorous statue. Alert young men moved here and there purposefully, stepping over many cables lying there like serpents inert after the exhaustion of writhing.

The priestly voice ceased. From behind a screen which faced the blazing lights came a man grave of mien, and preoccupied in manner. I had a feeling that I had disturbed some solemnity of rite. The golden goddess moved glintingly to the screen, and passed from sight.

Were these two the sorcerers-in-chief that set the spell of ether-speed for the transportation and transposition of personality? My moment had come! A master of magic beckoned to me, directing me to come behind this screen and take a high stool. I perched. As I looked to my left low down beside me sat the golden goddess, reposeful and silent.

Peering at me was a baby cannon with a glass eye for a mouth. A miniature mountain-gun of a thing, or so it seemed, swivelled on a tall tripod. Its attendant magicians conferred and moved this odd telescope up and down, and about. It was hot. Phew! Blazing hot. Summer had come pleasantly upon me

> *A "Television Night" was held at the Press Club on November 8. Mr. Sydney Moseley, who is well known to old readers of this journal, presided. Mr. Horace Sanders was televised and made a short speech from the Baird Studios at the Crystal Palace and here he gives his impressions of the "ordeal." Later in the evening a programme of entertainment was transmitted from the Palace to the Press Club where two Baird receivers were installed.*

from those white-glowing lilies that surrounded this throne. The golden goddess was imperially still. The glass-eyed gun stared me in the face. A basilisk scrutiny. Then a guardian of this electric eye, in its artillery casing, motioned me to descend, and in my place came the man of sonorous words. He made faces at the electric eye. No words this time came from his lips. A high priest in mufti.

I was called into an arcana in the wall, and there high in a long black panel I saw a small brilliant black and white picture of the high priest, making a series of remarkable and mirth-provoking expressions. It was good fun. He must be the jolliest of high priests despite his austere air.

* * *

The golden goddess had gone. In company with the high priest I was marched out of this temple of light, thence along a corridor to a small room with mirrors. We sat facing one another in this tiny room, like two spiritually frozen Englishmen in a railway compartment on a long journey.

"Grease your face and then powder with white powder" was the decree of a necromancer at the door. As the high priest set about his task with technique I remembered him. It was the "Vicar of Mirth," Vivian Foster. As white-faced men we faced the firing squad again. But who, I wondered, was the golden goddess who had vanished. At last a slow reviving remembrance told me that I had seen her long before, "Comin' through the rye"—it was Alma Taylor.

With a deft touch to his neck, Vivian Foster became the "Vicar of Mirth." Even the stolid eye of that gun seemed to twinkle at so joyous a caricature created facially and vocally by a talented artist.

Once again to our little dressing-room. Here there was laid before us golden paint in a tube, golden powder, a small brush and purple salve for the lips. A few minutes under the ministrations of a mentor with swift hands and a quick appraising eye, and we were changed to golden gods. And thus gilded we parried any facial intrusion by infra-red ray, whose hunting ground was in these temples of light.

No one should see behind our shaven chins it seemed. Hilarious and happy moments with the "Vicar of Mirth."

Suddenly. Time. My journey of necromancy was to begin. I found myself in a new location. A greater and a loftier temple of light. Scarlet bannisters rose up with stairs to a door high up on a verandah. A red door bore the words "control room," and the man behind it saw all things in three temples at once.

I perched on a high chair at the edge of a long and deep dais. Above my head swung a small squat object. Was this the Chair of Elocution with electrocution hovering above it? Or was it "the mike"?

A great sheet of plate glass faced me some distance away. Like the dim window of a store at twilight. Shadowy figures moved behind it grotesquely and indistinctly.

A voice said, "When the red light glows begin speaking, and pitch up your voice." Then silence. The ghostly silence of a mausoleum. Utter loneliness. It must be like that in the solitudes of the white poles. My mind begins to spin a little. I feel a sense of tension. I know there are tiny beads of perspiration gathering at the nape of my neck. Would I remember what I intended to say? I have never read a speech in my life. How my mind spins. If only I could read my speech. But you can never read a speech by this medium, or you will be as a man talking in his sleep.

I know I am like a solitary wax model in a bankrupt's shop window with midnight outside and a garish incongruous light left on inside. Or like a torpid flat-fish floating sluggishly in a vast glass tank. I feel stupid and taut. Suspense in ether. Starkness of mind in space.

The red star on the horizon glows. I am galvanised into speech. To what am I speaking? To where? That glass window in the distance? I am as a man fast in the fumes of fantasia. Am I just raving in a lethal chamber in which I have been trapped?

Is this the operation of the new euthanasian creed whereby after-dinner speakers are finally eradicated from the human system? My mind begins to spin again. Mental tumult and cloudiness. My lips are moving and my vocal chords vibrating, but what is the next sentence to be? Where is the end even of this one I am now uttering? That infernal red star burning into the consciousness of extempore effort. Is it a touch of " telefright "?

* * *

And suddenly the tension dissolves. A pleasant comforting picture swims into the mind, of the old familiar dining hall which I am addressing six miles away. Then I " see " Sydney Moseley enjoying himself in the scarlet and oak chair as he presides over " Television Night." There are visitors at the Long Table whom I have not yet seen.

There are faces of members leaping up into my mind's eye. I am no longer the " great big stiff " in a desolate shop window, no longer a spell-bound squid in a tank, no longer a puppet flung bewildered into an ocean of ether. I am " in touch " pyschologically. I can think easily and rapidly. I escape from the clutches of a rambling sentence in the nick of time. I wonder if they have spotted that. . . . I have said my say.

A sudden fear grips me again. I could swear I had stopped speaking. I can feel that my lips are shut. Yet I hear myself say something I am sure I said some moments agone. This is awful. I'm talking aloud to myself. I wish to bolt from this glare which makes me visible to an unseen audience. Then it came to me that I was hearing myself from somewhere else, speak after I had spoken. I heard my own voice for the first time in my life objectively. How people have stood it so patiently in the past I can't think. It seemed to me such a hectoring, booming, implacable vocal drill.

Now I know there is a time-lag of 20 seconds when a speech is televised by the indirect method, and I could have left my high chair of elocution, walked in labial silence to the television apparatus, seen myself and heard myself still talking, and been back in my seat in time to start my next sentence without any hearer being in the least aware that I had a split personality when he saw me on the screen. It is sheer sorcery.

I did that swoop from the Palace to the Press Club on the ether at the rate of 186,000 miles a second, and when I came away from the loneliest chair on which I have ever sat I found in the genial presence of the " Vicar of Mirth " and in the charming smile and golden voice of Alma Taylor a re-inspiration to buoyancy of mind again. It was my premiere on the air. If there is a next time the spooks of silence will fail to gyrate my mind.

* * *

And so through the rain and murk to my empty chair at the Press Club where later at night on the televisor I saw the golden goddes as compère and the jollities of the Vicar of Mirth. I realised that they were masters of the medium, easeful, delightful and joyous to watch in their appearance, as were Leonard Henry and others who were materialised out of the ether. As I cast my mind back from my dinner seat, amid all my old friends, and in my native street, my Crystal Palace adventure seemed so remote as to be phantasmagoria.

* * *

I was amused to hear that when I appeared at the outset in the wig and white collar of a Puritan Editor reading a 300 year old newspaper, the engineers in the Press Club thought the Crystal Palace had loaded up some oddity by mistake, and so they instantly turned the sound down to a murmur lest some language unbefitting the occasion came from the lips of this unexpected " Praise God Barebones." A quick telephone call to the Crystal Palace put their minds at rest, and power was restored to my voice.

* * *

A night of trance and entertainment on the golden road to Ṣamarkand.

Top Band Frequency Register.

It was the original intention to publish a list of top band stations with their frequencies in the District 8 Letter Budget, but in view of the number of demands from interested stations, we are publishing it herewith.

We have endeavoured to list all of the top band stations which are actually active on the 160-metre band, but we have not included those stations which only make rare appearances. This list has been compiled with the assistance of G6PA, G6GO and G6KD, to whom we are indebted. Several stations may find that the frequencies listed do not exactly agree with the nominal frequency of their crystal, but we have only changed the frequencies after actual checks by 6PA.

Will any stations we have omitted or who wish to correct the frequencies listed, please get in touch with us giving the required information.

Frequency.		Frequency.	
1726	G6GO	1774	6SO
1735	6BO	1774.5	6NU
1740	5HO	1775	6ZQ
1740.7	5ZJ	1780	6BO
1742	5WL	1780	5RI
1752	2KL	1780	5BK
1753	6KV	1780	6BO
1754	6ZR	1780	6HD
1754	6GO	1781.5	5VS
1755	6PY	1785.5	·ZT
1756	2AO	1787.5	2XP
1759.5	5JW	1788.5	2GG
1760	5AR	1789	6IF
1760	5BM	1790	5UM
1760.5	2KT	1790	2SN
1762.5	2ZN	1791	5AK
1764	5NW	1794	5JU
1766	2WO	1795	2UY
1769	5GC	1801.5	5LL
1769.5	5FI	1802.9	5ZJ
1770	5PR	1806	5MM
1773.1	5BC	1810	2LD

Frequency.		Frequency.	
1810	5PP	1875	6WF
1815	2DQ	1881	6FV
1818.5	2OG	1884	5KJ
1824.5	2WG	1888	2XC
1824.5	6UJ	1890	2MI
1830	5KG	1893	5RD
1830	6QB	1900	2PK
1836.5	6RQ	1905	6QA
1840	2JU	1910	2NO
1844	6VD	1913	2OV
1849	5CJ	1916	5VT
1850	2CD	1925	6CT
1850	2HF	1925	6UU
1850	6SR	1930	5OD
1850	6UD	1936.6	5IL
1850	6VD	1940	6PA
1852	2KV	1950	6KD
1857	6TQ	1950	5SZ
1857	2CF	1960	5UK
1860	6QM	1965.5	5LL
1861	2KL	1970	6UT
1862	6WY	1975	6OM
1869	2PS	1980	6KV
1870	2PL	1988	5WN
·1870	5RI	1874.5	2XP

TELEVISION AND SHORT-WAVE WORLD

INTERLACING AND DEFINITION

By Manfred Von Ardenne

This article is a translated abstract from the German publication " Funk Technische-Monatshefte " and represents the views of a leading research worker on the advantages, or otherwise, of interlacing.

EXPERIENCE in the reception of television transmissions by the Berlin transmitter, which, as is well known, take place with 180 lines and a picture-frequency of 25, has shown that the definition of the pictures can be regarded as adequate when the transmitter and receiver are working flawlessly. For the transmission of pictures where the picture-content is specially difficult to recognise, a slight further increase in horizontal and vertical definition would be desirable. While the definition of the pictures is, on the whole, satisfactory, with the increase in distinctness of the pictures received, there appears yet more plainly a defect which is felt to be specially irksome in transmissions lasting some length of time, i.e., flickering of the pictures in the brighter parts.

Obviating Flicker

The removal of this disturbance is one of the most important tasks of television technique to-day. The simplest method of removing flicker consists in increasing the picture-frequency, e.g., from 25 to 50 per second. This measure would, however, necessitate doubling the frequency range for transmission. If at the same time as doubling the number of pictures the definition is increased, then the frequency-band transmitted would have to be extended about four-fold, as compared with the frequency-band customary to-day. Such a considerable extension of the frequency-band can hardly be considered from a practical point of view, for various reasons.

Apart from the fact that the transmitters at our disposal to-day would scarcely be capable of dealing with a frequency-range of two megacycles, and apart, also, from the enormous increase in difficulties in the transmission of such wide frequency-bands by land line from the place of reception to the transmitter, the number of stages in the receiver would rise alarmingly, even in single side-band operation.

Some numerical values may illustrate this. On the basis of the slope of the usual commercial valves and the usual sensitivity, the number of stages required to accommodate a band-width of 500,000 cycles amounts to about 4. With a band-width of a megacycle, the number of stages rises to 6. Taking into consideration the number of valves required in a television set this increase seems just permissible. When the frequency-range is doubled to 2 megacycles the number of stages rises, in the I.F. amplifier, to 11 or 12, which is no longer commercially admissible. Even the development of special valves with still higher slopes would not keep the cost of the set within reasonable limits, with such high band-widths, for the anode current requirement must necessarily be considerably increased.

This being the state of affairs, the use of a frequency range of over one megacycle does not seem to be practicable, even in the distant future. The question is: With what standards of definition can the highest admissible frequency range of one megacycle best be used?

Transmitter Interlacing

Quite lately a procedure has been devised and tested in various places, which permits the number of pictures per second to be multiplied, and more especially to be doubled, without an increase in the frequency range or a decrease in the definition of the picture. This procedure consists in doubling the number of pictures and scanning the even-number lines in one picture and the odd-number lines in the following picture. It is quite sufficient to double the number of pictures, since this is adequate to remove the flickering disturbance, even in very bright pictures (50 – 100 lux).

The author has already pointed out the practicability of this procedure in connection with higher picture-frequencies in the periodical *Fernseher*, April, 1931, p. 70. It is proposed, there, to chose the line-frequency in such a way that it is not not an even number multiple of the picture-frequency, in order to produce a displacement of the lines, i.e., interlacing. This method has the advantage that no new devices are necessary on the receiver, only on the transmitter. To carry out interlacing of the lines according to this method is specially simple if cathode-ray scanning devices are used on the transmitting side. In order to pick up a transmission which works by the method of line interlacing, in the way described, it is only necessary to double the frequency of the picture-scanning circuit on the receiver.

In England a complicated procedure has lately been brought out, in which line interlacing is also achieved. Here the difficulty is transferred from the transmitter to the receiver; in the receiver it is arranged by means of additional devices that pictures following one another are interlaced one opposite the other, in their total height, by exactly the breadth of a line. The deflection is so slight that this interlacing requires only a relatively small additional contrivance, which generally amounts to adding a simple glow lamp saw-tooth generator (with synchronisation from 50 to 25 cycles) to the deflecting apparatus.

Only when the adjustment of the amplitude of the 25-cycle deflection is exactly right does the observer get the impression of a line-screen on which the number of lines is not reduced as compared with 25 picture changes. Since further complications are not desirable on the receiver side, the achieving of line interlacing from picture to picture by measures on the transmitting side is much superior to the procedure just discussed.

For lack of a commercially practicable transmitting apparatus for high numbers of lines and line-interlacing, the author has confined himself to studying interlacing only on the receiving line-screen without picture-content. The result is as follows: 180-line screens with interlaced lines and 50 picture changes seem to be almost free from flickering, however bright the pictures. Flickering between the lines is visible only on observation from a short

(*Continued in 3rd col. of page 721.*)

CHECKING THE WIRELESS SET WITH THE CATHODE-RAY TUBE

This article explains some simple methods of employing the cathode-ray tube for checking the output of the ordinary wireless receiver.

THE suggestions given in this article form the basis of an interesting demonstration of the uses to which the cathode-ray tube may be put in checking an ordinary wireless receiver. One or two simple circuits will be required for some of the effects shown, but without going to any trouble the tube can be made to show some striking phenomena when applied to an ordinary radio receiver.

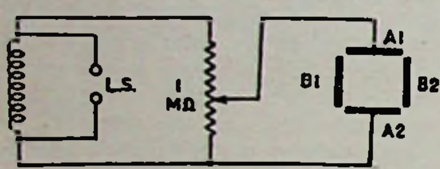


Fig. 1.—Connection of plates across loud-speaker for observation of accustic wave-form. B1 and B2 plates are connected to the time base.

The deflector plates will draw no current from the circuit to which they are connected, and hence will not upset the operating conditions of the receiver when they are connected between any two points in it. On the other hand, the potential applied to the plates may be too high for a reasonable deflection and a high-resistance potentiometer is sometimes desirable to control the voltage applied to the deflectors.

With an anode voltage of 1,000 on the tube a good deflection would be given by 50 volts on the plates, and this figure should be borne in mind when the tube is connected to the receiver.

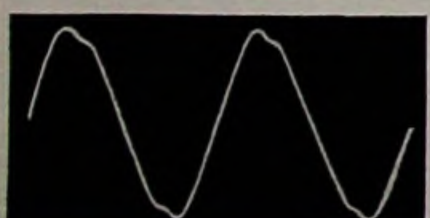


Fig. 2.—Typical wave-form of sustained pure note.

The tube will not be damaged by excessive voltage applied to the deflector plates, the only effect will be that of forcing the beam off the screen.

The audio-frequency wave-form applied to the loud-speaker is the simplest effect to study and for this a single linear time-base will be required, constructed according to the article in the issue of February, 1934, page 59. The vertical deflector plates are connected directly across the loud-speaker transformer secondary terminals, and the voltage will usually be found suffifficient to give a good deflection. If it is too high, a 1-megohm potentiometer may be connected across the plates as shown in the circuit of Fig. 1.

The frequency of the notes from the speaker is continually varying, of course, and it will seldom happen that the wave remains stationary on the screen, but the speed of the time-base can be adjusted to give a stable well-defined wave for the greater part of the time. When a single note is sounded in the middle of an orchestral piece the wave-form of the instrument will stand out like the example in Fig. 2.

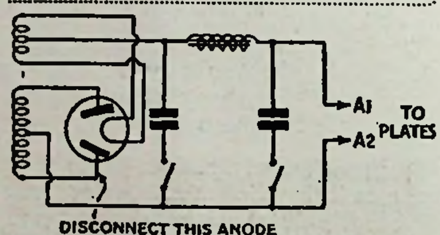


Fig. 3.—Rectifier circuit arranged to show half-wave rectification and effect of smoothing.

Constant-frequency Records

A constant-frequency record can be used to give a steady wave-form if a radiogram is available, and this can be used to check the constancy of the gramophone motor. A wavering motor, or an irregularity in the turntable rotation will cause the wave-form to oscillate slowly backwards and forwards across the screen.

A constant-frequency record is also invaluable for checking distortion in audio-frequency stages in a receiver. The deflector plates can be arranged by means of a change-over switch to record the wave in the first L.F. circuit and comparison with the wave at the speaker terminals can be made.

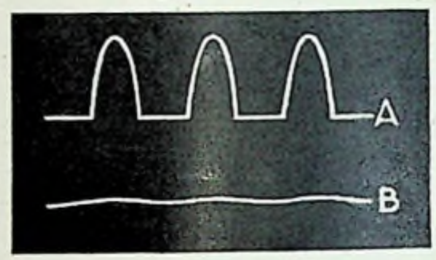


Fig. 4.—Effect of smoothing condenser in rectifier circuit.

If a constant-frequency record is not available, a good effect can be obtained by disconnecting the set from the aerial and increasing the reaction until it howls. With careful adjustment a low growl can be obtained which will record easily with the time-base running at a moderate speed.

In the case of sets employing battery bias, it is an easy matter to show the effects of over bias on the amplifying valve, and to see how, in extreme cases, the valve will rectify the audio-frequency signal. In this case it is advisable to disconnect the speaker during these experiments to avoid distracting the attention by the dreadful sounds emitted.

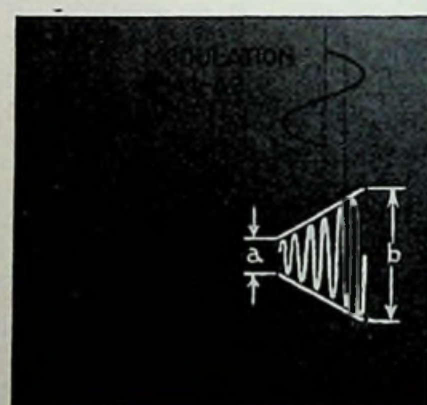


Fig. 5.—Showing figure produced by modulated H.F. on the plates.

It is surprising how little the functions of the reservoir and smoothing condensers in a mains unit are appreciated, and the cathode-ray tube will show their use in a very striking way.

The best effect will be obtained if the rectifier be modified to half wave by disconnecting one anode terminal of the normal full-wave rectifier. Also the set should be disconnected so that the rectifier is on no-load, and the deflector plates should be connected directly across the H.T. terminals through a potentiometer (Fig. 3). Disconnect both condensers at the points marked X, X and switch on.

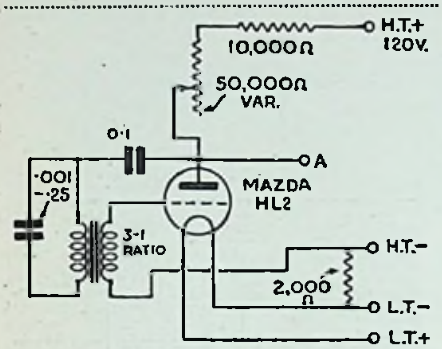


Fig. 6.—Circuit of simple audio-frequency oscillator for experiments with wave-forms.

The wave-form of a half-wave rectified voltage will appear on the screen, but it will be considerably displaced from the centre. This is because the D.C. component of the voltage is permanently pushing the beam off centre. The movement can be controlled, however, by connecting a bias battery in series with the opposite plate and adjusting its value until the wave appears as Fig. 4 (a).

With the reservoir condenser reconnected the result will be as Fig. 4 (b). The voltage will be practically free from ripple. In that case what is the use of the smoothing choke and second condenser? The answer is given at once on putting a load on the rectifier. As soon as the set is reconnected the reservoir condenser loses its charge and the humped wave reappears. The addition of the choke and the second condenser will once more restore the voltage to the approximate straight line of Fig. 4 (b).

Modulated Radio-frequency

A slightly more difficult effect to obtain, but a very interesting one, is that of the figure produced by the application of modulated radio-frequency to the deflector plates.

If the radio input is applied to the plates with the beam deflected by the time-base, the ordinary modulated carrier-wave can be seen if the voltage is sufficiently high to produce a good deflection. A better plan is to dispense with the time-base and connect one pair of plates across the audio-frequency and the other across the modulated radio-frequency. The resulting figure on the screen will be a sort of irregular triangle with a blunt apex if the modulation does not reach 100 per cent. The reason for the figure is seen from the details of Fig. 5, which show the effect of each wave on the beam and the resulting deflection.

This picture is somewhat difficult to obtain on an ordinary receiver, but with a modulated oscillator it can easily be produced and the depth of modulation measured by comparing the heights marked *a* and *b* in the figure. (If the modulation is linear the coefficient of modulation is $\frac{b - a}{b + a}$ measured from the figure.)

An experimental audio-frequency oscillator for the study of wave-form can be simply constructed from the stock components which are usually at hand. The theoretical circuit is shown in Fig. 6 and with the values shown the frequency can be varied from 100 to 5,000 cycles per second, but this depends on the type of transformer used to couple the anode and grid circuits. With an old Ferranti 3-to-1 transformer inverted the figures quoted were obtained with three different values of tuning condenser ranging from .001 to .25 microfarad.

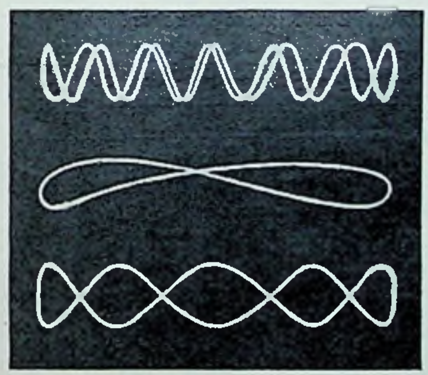


Fig. 8.—Patterns made by the oscillator of Fig. 6 used with a 50-cycle A.C. supply on the other pair of plates.

The circuit is bound to oscillate, however, if the transformer is connected round the right way and the values of the components can be left to the judgment of the constructor. Using a 50-cycle mains supply for one pair of deflector plates and with the oscillator connected across the other pair, a variety of beautiful patterns can be obtained. The circuit of Fig. 7 shows the connections for producing the patterns, and Fig. 8 gives an indication of some of the simplest forms produced.

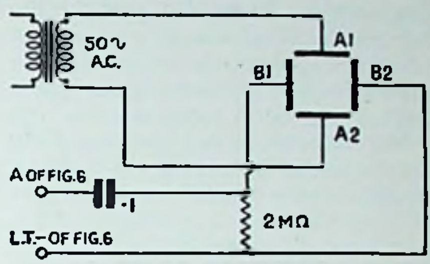


Fig. 7.—Connections for making patterns with the oscillator of Fig. 6.

"Interlacing and Definition."

(Continued from page 719).

distance. It may be concluded from the total impression of the line-screen, that the horizontal definition of the interlaced picture with an apparent number of 180 lines it not felt to be less than the horizontal definition of a picture which really does show 180 lines. The disadvantage of pictures with interlaced lines, the flickering between the lines in the brighter parts of the picture, which even in the 180-line screen has no very disturbing effect, would be wholly negligible if a still further increase in the number of lines were adopted—perhaps 240-270 lines. This increase would, at the same time, bring about the augmented definition.

It is proposed to carry out experiments in practical transmission with the interlaced line method with 50 picture changes and an apparent number of 270 lines. Only when experience with such or similar definition standards is available is it possible for industry to produce in quantities receiving apparatus, which would not have to be regarded as out of date after a short time.

The decision on the final standardisation is, therefore, specially important, because the normal receivers for present-day line-screen standards, taking into consideration the greater frequency reception alone, are not capable, as is well-known, of receiving flawlessly transmissions which make use of a finer picture-definition.

CONTROLLING BACKGROUND EFFECTS

By L. S. Kaysie

SINCE the film is destined to play such an important part in the future of television, one cannot afford to ignore the problems that arise from its use, either at the transmitting end or in reception.

For instance, it is a comparatively simple matter to control the lighting conditions in a studio to suit the particular requirements of television. But the idea of television was scarcely present in the minds of those responsible for " shooting " most of the well-known films of to-day. They were naturally concerned only with what was necessary to reproduce the picture at its best in the cinema theatre, not what was best for the television screen, and the two do not necessarily coincide.

Most cinema films present a number of different backgrounds at successive periods of the story. A more or less subdued interior, for instance, may be followed by a sunny outdoor scene, where the general illumination is much more intense. These differences in background introduce a slow variation of " average " illumination, which it is very necessary to preserve since it forms part of the " action " of the story.

In reproducing the film on a television screen it is found that there is a tendency for the light intensity to remain at a more or less "monotonous " level. This is due to the fact that the circuits of the valve-amplifier are not able to follow very slow fluctuations in current. In other words, if the frequencies are too low—as they are in the case of the " background " variations in question—the receiving circuits simply ignore them, and so tone down a sunny exterior or other brilliant scene until it looks almost as " grey " as the dull interior of a furnished room.

It must be remembered that the output valve used for feeding the amplified signals to the neon lamp, or to the Wehnelt cylinder of a cathode-ray receiver, works about a datum " black " line which is fixed by the applied grid bias.

If now we consider the wave-form of a high-light picture, such as a sunny exterior we can represent it by the curve marked A in Fig. 1, the periodic " dips " below the datum line corresponding to the synchronising signals. By comparison the wave-form of a picture with a darker background is shown in the right-hand curve, marked B. The main dfference between the two is that in A the average amplitude or height of the curve above the datum or "black" line is greater than it is in B.

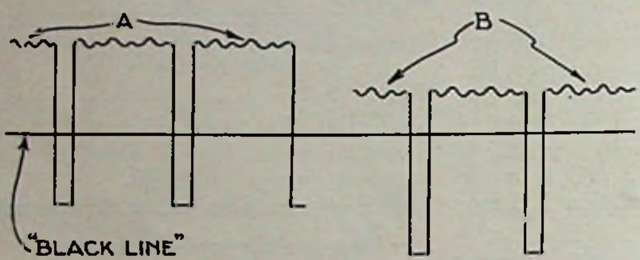


Fig. 1.—Showing the positions of high-light and low-light signals relative to the black datum line.

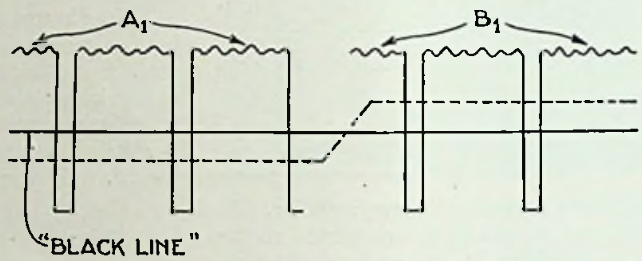


Fig. 2.—Showing the levelling effects of the receiver circuits.

Now when both signals pass through an amplifier valve operating on a fixed grid bias, the valve tends to work as much above the datum-line as it does below it. The result of this redistribution of energy is that the average amplitude of the signals above the " black " line is reduced, as shown at A_1 in Fig. 2 in the case of the high-light picture; whilst in the case of the low-light picture B_1 the amplitude remains very little altered as compared with B. The consequence is that both pictures appear to have practically the same " average " light intensity.

The correct tone balance would, of course, be restored if the initial grid bias could be made to follow the dotted-line path shown in Fig. 2. But, as already explained, such a change is too low in frequency for the valve to handle.

Of course, if the grid bias lead were tapped to a potentiometer and fitted with a control knob, one could vary the bias according to the particular part of the film being received, and so keep pace with events by manual control. But this would be an irksome job at best.

What is wanted is some form of automatic control which will keep the datum or " black " line of the grid bias of the amplifying valve in step with the average light intensity of

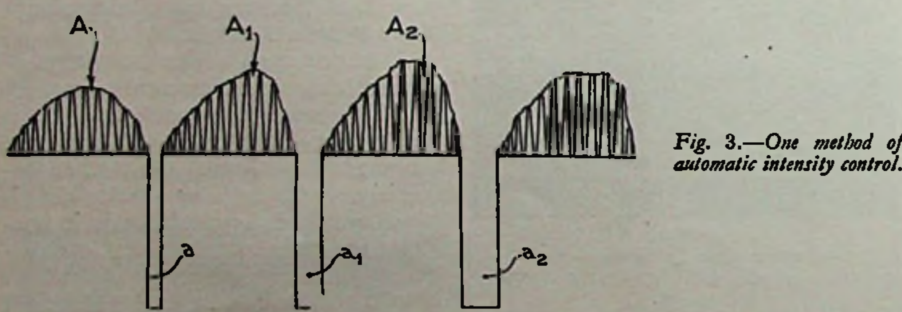


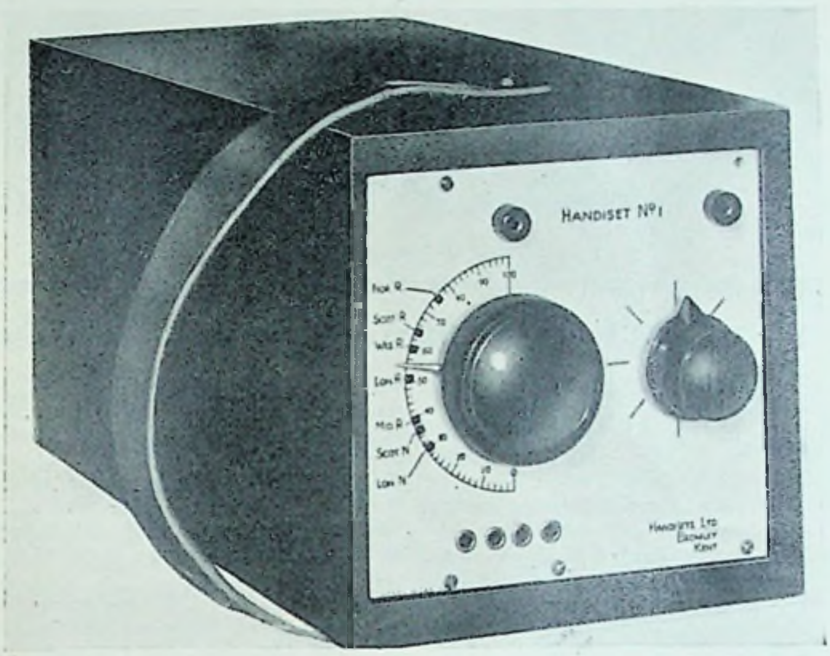
Fig. 3.—One method of automatic intensity control.

(Continued on page 724).

A Portable Noise Detector

We are adopting the unusual course of describing for the benefit of constructors a commercial midget portable receiver which has many uses.

VERY few amateurs, in fact few short-wave listeners of any kind, can claim to be entirely fre from local interference. The Post Office, while doing all they can to eliminate this trouble, are not always able, for various reasons, accurately to locate its source.



This No. 1 Handiset is just what its name implies. It has many uses.

Local Interference

During some of our television experiments we have been troubled very consistently by spark from a local generator which only came on spasmodically, making it even more difficult to locate.

At the recent Radiolympia we obtained one of the latest midget portable radio receivers just as a matter of curiosity. During our tests we were always able to receive several stations even under the most adverse conditions, as, for example, the London Regional programme could be heard in a tube train while stationary at Notting Hill Station. The last news bulletin and the dance music was heard through the whole of a train journey for 40 miles.

Four Pounds Total Weight

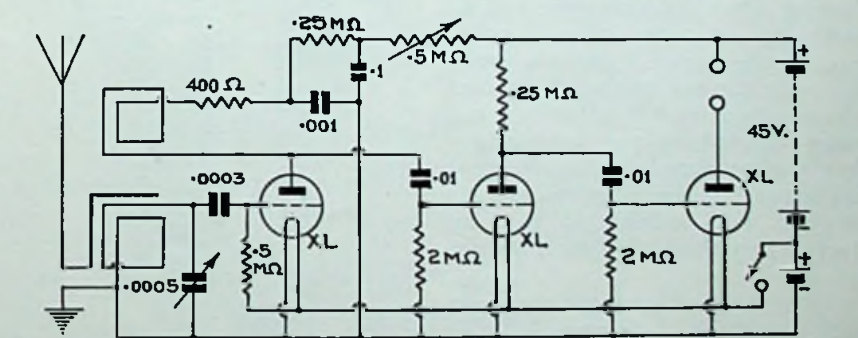
The total weight of the receiver, including battery, accumulator and headphone is under 4 lbs., so that this will not inconvenience anyone. While admitting that in normal circumstances after dark at least twenty stations can be received, we were particularly struck by the extreme selectivity of the frame aerial, and at once realised its possibilities.

Locally-generated interference cannot be found with an ordinary radio receiver, while the average large portable with A.V.C. has not a sufficiently selective frame to give any indication as to the direction from which the interference is coming. With this Handiset one can walk around in a circle, and, after three or four tests, accurately locate the direction of the interference. It is then merely a matter of narrowing the circle until the noise is actually discovered. Our particular tests were not quite as simple as this, for the interference was apparently being conducted along telephone wires, so that directly the receiver came within the field of phone wire the noise level increased.

However, by keeping out of the way of all phone wires, we finally tracked down the noise to a small workshop about half-a-mile away. It was then a simple matter to fit a Belling-Lee suppressor, which completely wiped out the trouble.

A Miniature Portable

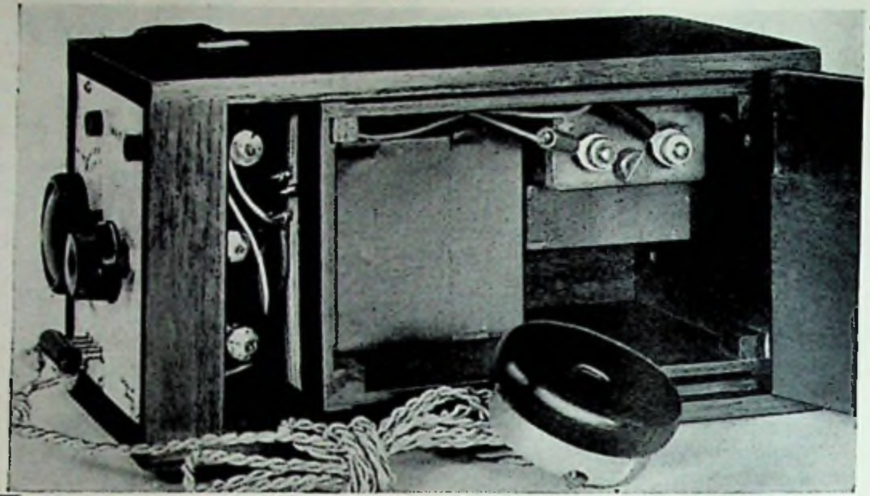
This Handiset is one of the smallest reliable portables available, and, in view of the fact that it can be used as a radio set, a noise detector, phone monitor and check receiver, we feel that many amateurs will either want to buy or build it. It has been made possible by the use of the new High-Vac midget valves, Exide midget accumulator and the latest Drydex miniature H.T. battery. The circuit, which is quite simple, consists of an XL valve used as a leaky-grid detector with a frame aerial consisting of 25 turns of double silk covered wire closely wound around a 6½ by 4 framework. The reaction winding consists of 10 turns of double silk covered wire wound in the reverse direction but in the same manner as the grid winding. Notice how control of reaction is obtained by means of a half-megohm variable resistance in the anode circuit of the detector valve.



The circuit is quite simple, but notice the method of obtaining regeneration.

Two L.F. stages are used with quite conventional coupling methods, but the grid returns are taken directly to earth. No bias is required, for the valves are all of the medium impedance-triode type.

Fig. 1 shows the suggested layout for the components. The three midget High-Vac valves are in line, while in the centre of the panel can be seen the half-megohm variable resistance. Beneath this is the .0005 mfd. tuning condenser of the mica dielectric type. Most of the components are beneath the chassis, but as these are only midget tubular condensers and small metallised resistances very little space is taken up. The cabinet is approximately 9½ × 5 × 5 ins., allowing a little over 4 inches by 2½ inches for the actual radio chassis. The makers of this receiver—Handisets Ltd., of Bromley, Kent,—will supply a complete kit of components to any home constructor who wishes to build for himself. The price of this kit is £3 2s. 6d. A complete receiver can be purchased, of course, the price being £3 15s. od.



This gives some idea of the size and method of construction.

"Controlling Background Effects."

(*Continued from page 722*).

the incoming picture as it changes from one type of scene to another.

The possibility of such a control does in fact exist at the transmitting end. There a high-light scene produces a heavier direct-current component in the photo-electric cell than a picture with a dull background, and if this slowly-fluctuating D.C. component could be restored to the receiver the problem would be solved.

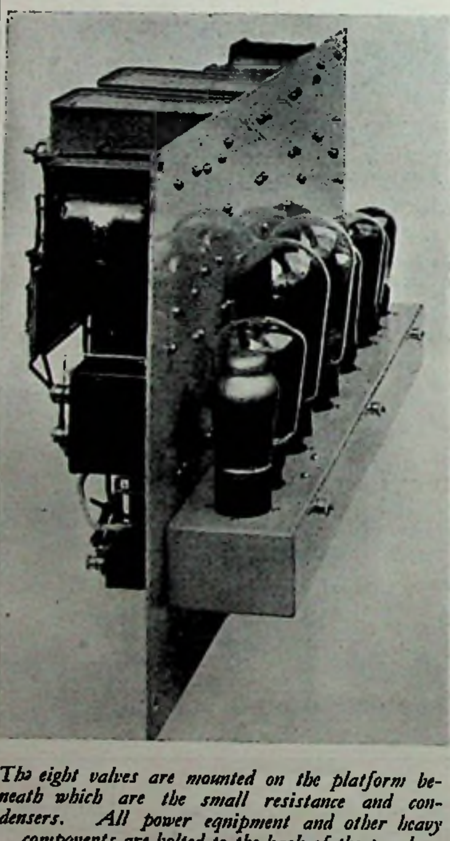
One method of overcoming the difficulty is to transmit with the picture signals, a special "control" signal, which is repeated at a frequency which can be handled by the receiving circuits.

The control signal is obtained at the end of each scanning line by flashing a ray of light, typical of the particular picture then passing through the "gate," on to a special photo-electric cell at the transmitter. The corresponding "pulse" of current—although it may only change slowly in amplitude—is easily rectified by the receiving valve, and the resulting D.C. current is then applied to vary the grid bias on the output valve.

Fig. 3 shows a scheme for automatic "intensity" control in which the duration of the usual synchronising pulses, a, a_1, a_2 is gradually increased as the average brightness or tone-value of the corresponding picture-signals A, A_1, A_2 rises. Since the energy of the control signals is thus kept in step with the varying light-content of the picture-signals, any relative change in picture brightness is repeated at the receiving end.

Further Notes on the 45-watt Amplifier

In our last issue we gave certain technical and major constructional details of the 45-watt low-loading amplifier. Certain other details are now available which are of interest. Firstly it is advisable to connect in series the grids of the two DA30's, 1,000-ohm half-watt resistances. The base of the valve platform can be removed by simply unscrewing four knurled nuts so that the inclusion of these resistances will not mean very much alteration to wiring. It is well known that although the idea of low loading is not a new one the development of the principle of low loading is due to the M/O Valve Co., whose valves, including the DA30's, are sold under the trade name of Marconi and Osram.



The eight valves are mounted on the platform beneath which are the small resistance and condensers. All power equipment and other heavy components are bolted to the back of the panel.

The M/O Valve Co. have pointed out that until the DA30's have had a long period of controlled life test, they cannot determine the maximum wattage available from the two valves in this amplifier. In the circumstances they cannot accept responsibility for failure if the valves are run over the maximum of 45 watts.

This matter was briefly pointed out in the original constructional article although we did add that the amplifier was at present running giving an output of 60 watts.

Those amateurs who desire to reduce the output to 45 watts and to make quite sure that this output is not exceeded should replace the ACP1 by an ML4.

If a microphone is to be used a head amplifier will be required so as to boost up the small voltages developed. However, the use of a Mullard 994V in the first stage in place of the AC/HL or MH4 will, with the majority of microphones, enable the head amplifier to be omitted. The 994V is a triode valve having an amplification factor of 125, but is only necessary for microphone use.

Several amateurs have been in doubt as to how the amplifier is constructed without a base-plate. The photograph in this page shows how the valve platform is bolted to the front of the panel while the heavy components are bolted to the back of the panel. This keeps wiring very short and reduces hum to the minimum.

THE PHOTO-CELL AS A SIMPLE PHOTOMETER

By R. L. Ashmore.

IN previous issues (August and September) the writer has shown how elementary photometer measurements are made, also the effects of colour in picture recording work. Now we will examine how the photo-cell can be used as a simple photometer. First of all let us consider the circuit arrangements for using the photo-cell. The simplest is that of Fig. 1*a*, which is just a photo-cell with a meter and resistance in series,

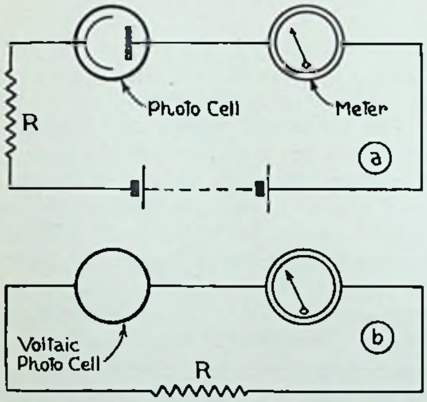


Fig. 1a & b.—Circuits for photo-cells of the voltaic type.

the meter to read the current and the resistance a limiter or safety device.

If the photo-cell is of the voltaic type, such as those made by Westinghouse, the circuit dispenses with the battery and often the resistance (Fig. 1*b*). In such circuits the meter reading is proportional to the incident light on the cell, the arrangement in Fig. 1*b*, commercially appearing as photo-electric exposure meter, of which numerous makes have recently appeared on the market, the meter scale being calibrated in terms of exposure.

Such arrangements are quite suitable where the intensity of the light to be measured is relatively high—such as used for photographic recording.

Where small changes of light or weak light have to be measured the meter must have a high degree of sensitivity and in consequence is fragile, and only suitable for laboratory work. Considerable increase of sensitivity is brought about by the circuit arrangement shown in Fig. 2. The valve is suitably biased for anode-bend rectification with no potential on the photo-cell, then with the cell in darkness an H.T. potential is applied which indicates on the meter some small amount of current, say, 5 to 10 per cent. of full-scale deflection.

It will be realised that where a few microamperes emission from the photo-cell would be useless through the meter to actuate it, the voltage produced by their passing through the resistance followed by amplification of the valve makes a highly sensitive device. Such a circuit will, however, produce errors if there is any variation in the potential applied to the valve.

Should it be required to measure light flux of less than .5 lumen per square foot it is generally better to interrupt the incident light falling on the photo-cell, with some form of shutter and use an A.C. valve amplifier followed by a rectifier, than use a D.C. valve amplifier with the accompanying technical difficulties of construction.

For the purpose of this article we are not concerned with the detection of light much below 1 lumen per sq. ft., so the apparatus we will consider will be of the type of Fig. 2.

Photo-cell Types

The photo-cell will first be considered. This may be of two types, gas or vacuum, the first being more sensitive and the second more constant. Gas-filled cells have an increasing sensitivity as is shown in Fig. 3, as a critical voltage is applied to them. This voltage is the ionisation or "flash point," and a cell which has this voltage applied is filled with bluey-pink glow. Should this point be reached the cell should be immediately disconnected or damage will be done to it.

It should be noted that a cell can have, say, 100 volts applied in dim light with no sign of "flashing," but on increasing the illumination it immediately starts to glow. When it is necessary to work cells near this critical voltage, they should be adjusted in the brightest light to which they will be submitted. In all cases for accurate and constant results a

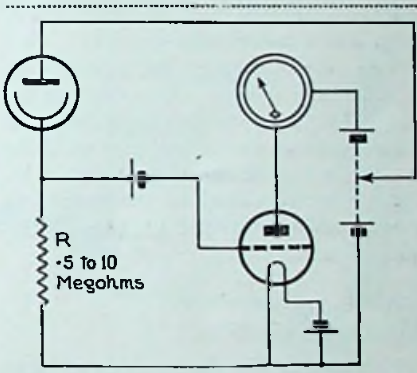


Fig. 2.—A typical photo-cell circuit.

vacuum cell is to be recommended. Incidentally a gas cell can be used as a vacuum one if worked below a potential which produces no secondary effects in the gas—generally about 15-18 volts. It should be noted the only cells we are considering are those of the caesium type, of which three of the best known types made in this country are those of B.T.H., G.E.C. and the Oxford Instrument Co.

Light Values

Having decided on a photo-cell one should ascertain what its emission per lumen is. This is done by placing the cell a certain distance from a known light source. And here we have introduced a difficulty in defining a known light source! As pointed out in previous articles to get an exact standard of light is most difficult so we shall have to take an approximate one.

A 40-watt gas-filled lamp if constructed to ring standards gives an average of about 6.7 lumens per watt, so as a *very rough guide*, if a 40-watt lamp is placed in the centre of an imaginary sphere of one foot radius 21.3 lumens will fall on every square foot of the sphere's surface so that a photo-cell with a cathode of one square inch area receives .148 lumen if placed one foot from the lamp.

The actual placing of the lamp relative to the cell is important as the light flux is not actually equal in all directions as can be easily proved by placing the cell in different positions round the lamp, keeping the distance from the lamp constant. The accompanying table gives the results of some cells taken at random.

It will be noted that in the readings in the fifth column this is not always four times that of the fourth as it should be, while those of the sixth, compared with the fifth, show even more inaccurate results. One would expect them to be twice those of the fifth column. This error is because the lamp is far from being a mathematical point as it should be for the law that light intensity is inversely proportional to the square of the distance from the source of illumination.

Light Measurement

Now let us see the amount of light we can reasonably measure with the vacuum cell in the above table, if used in the circuit of Fig. 2, the valve being a Mazda HL2, the resistance .5 megohm. This resistance is low because the bias was fixed at a relatively low value of 1.7 volts, while the meter instead of an 0-100 microampere meter of the previous measurements was replaced with 0-1 milliammeter. The H.T. voltage on the cell was put at 40, which gave a "dark" reading of .13 milliampere. It was considered that the difference of .13 to .15 was about the practical limit which the meter could be read and taking 3 microamperes as about the working limit of the previous meter, gives us a means of recording about 60 times less light on a meter 1/10th as sensitive. The preceding table gives the information in tabulated form.

Oxford Photo-cell, vacuum type.
Area of cell windows—1.25 sq. ins.

Meter Reacting in milli-amperes.	Distance from lamp.	Lumens on cell.	Lumens per sq. foot density.
.7	1"	.185	21.3
.25	2"	.046	5.33
.18	3"	.02	2.36
.17	4"	.011	1.32
.15	5"	.007	0.85

Such a degree of sensitivity of the circuit described is quite sufficient for general light measurements as used in ordinary private houses. It is quite easy to read the difference of the light of a 100-watt lamp reflected from a dark blue velvet curtain 7 ft. × 7 ft., on which was pinned a piece of white cardboard 2 ft. square, the lamp and the photo-cell being 7 ft. from the centre of the curtain.

Make and Type of Cell.	Gas or Vacuum.	Effective Cathode area.	Emission in micro-amperes at distances of			Lumens on cell at	
			2 ft.	1 ft.	6 ins.	2 ft.	1 ft.
1	2	3	4	5	6	7	8
G.E.C.:							
C.M.G.8 Plate type	Gas	1°	3	12	36	.037	.148
Oxford Window type	Gas	1.25"	3	10	40	.046	.185
Oxford Window type	Vacuum	1.25"	2.3	5.5	14	.046	.185
C.M.G.8 Window type	Gas	1.6"	3	10	34	.059	.239

Lumen per square foot density equal:
21.3 at one foot } from lamp.
5.33 at two feet }

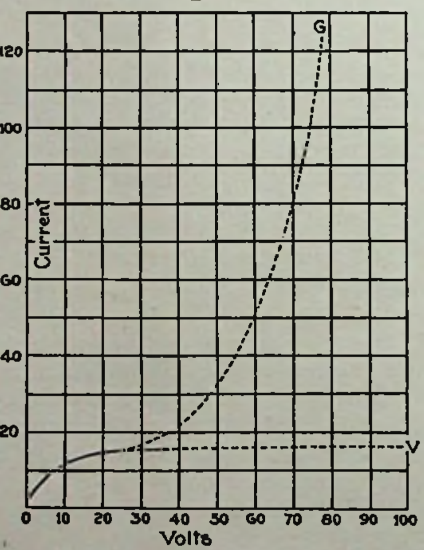


Fig. 3.—Characteristic curve of gas-filled photo-cell.

In the case of stronger illuminations, with the circuit values suggested, the grid bias can be increased to increase the range, but the writer would advise that a greater intensity of light than about 22 lumens per square foot should be allowed to fall on the cell. When greater intensities are to be measured the cell should be protected by a filter, such as ground glass or opal.

With a simple photo-cell photometer a lot of quite useful experiments can be done. One of the first things to realise, however, is that the caesium cell is sensitive to ranges of vibration other than those which are visible to the eye. For example, placing the cell two feet from a 40-watt lamp gave a reading of .25, but putting it the same distance from one element of an electric stove gave .3!

The photo-cell, of course, is mostly sensitive to rays in the infra-red, which are the rays of heat radiation, so if one is using the cell for photographic work with "½ watt" light it is advisable to measure all light through a filter which is opaque to such rays and this will, of course, reduce the apparent sensitivity.

Ediswan Short-wave Valve

IN the issue of April last we reviewed the Ediswan short-wave transmitting valve E.S.50, which has aroused interest in transmitting circles.

The Ediswan Company inform us that they have slightly revised the characteristics of this valve, the impedance being lowered and the dissipation being increased from 50 to 65 watts.

The new type is renamed E.S.501, and is available at the original price of £4 10s. net.

The valve has been further improved by bringing out a connection to the mid-point of the filament, which is of thoriated tungsten. Official tests have shown that the valve will oscillate satisfactorily down to 2 metres.

Revised characteristics and full particulars can be obtained from the Radio Division, The Edison Swan Electric Co., 155 Charing Cross Road, W.C.2.

A NEW STROBOSCOPIC SPEED INDICATOR

DETAILS were given in the February issue of a novel system of speed control for revolving mechanisms which employed a tuning fork. Fig. 1 shows the principle of the system, and it will be seen that the motor which is is wished to control has fitted to its shaft a wheel with standard involute teeth which engage with a thin tongue of tempered steel, called a "detent," fitted to one of the tuning fork arms, the fork itself being held firmly.

The detent is set so that it only just touches the tips of the teeth. As

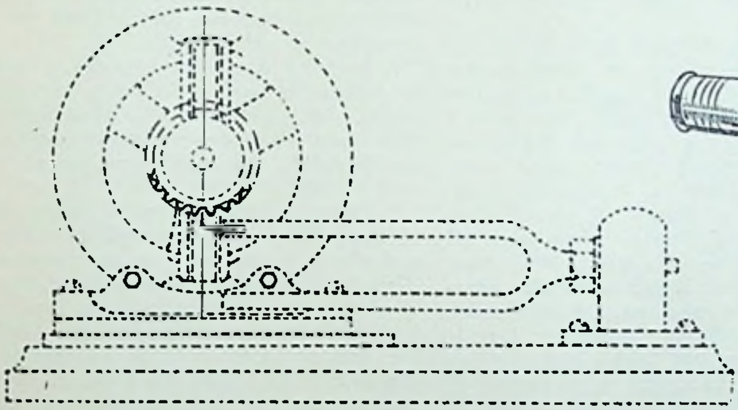


Fig. 1. Diagram showing the principle of the Ashdown speed control.

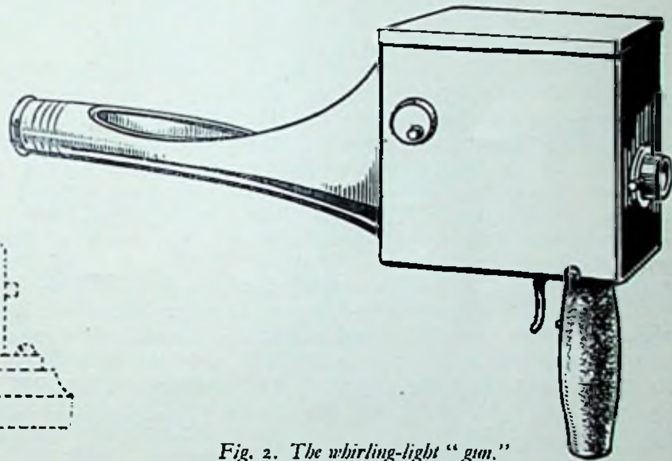


Fig. 2. The whirling-light "gun."

soon as the motor is switched on, it runs up rapidly to the speed at which the teeth of the wheel are moving at a rate of speed corresponding with the frequency of the fork, at which instant the arm starts oscillating, and by its amplitude, carries the detent deeply into the toothed spaces, thus providing a perfect chronometric escapement at speeds up to as high as 800 beats per second.

The speed of the toothed wheel is naturally in direct proportion to the frequency of the fork used, and inverse to the number of teeth in the escapement wheel.

This device has now been incorporated in a stroboscopic type of speed indicator termed the Relator, the instrument being manufactured by A. J. Ashdown, Ltd., of East Mosely, Surrey.

There are two essentials in the Ashdown "Relator" system of speed checking: first, a whirling-light thrower which is called the "gun." This is shown by Fig. 2. It consists of the tiny lamp-house at the muzzle, having means for correctly focusing an intensely powerful spot of light on to the very centre of a concave mirror attached to the spindle of a little permanent-magnet type of electric motor in the main housing of the instrument.

The motor spindle on the opposite side carries a gear pinion the teeth of which just barely touch a small slip of hardened and tempered steel (called a "detent") fixed to one leg of a tuning fork of fixed frequency: 440 beats per second. The battery to operate the motor is also contained in this housing, thus making the instrument self-contained. The tuning fork runs down the inside of the handpost, in front of which is the control trigger. When the trigger is pressed the motor is started, running rapidly up in speed. The teeth of the gear pinion lightly rub past the steel detent until the acceleration has been sufficient to bring up the tooth speed (r.p.m. × number of teeth) to the speed of vibration of the fork. The instant this frequency is reached (i.e., 440 pinion teeth are passing the detent every second) the tuning fork immediately bounds into sympathetic vibration, causing the detent to engage the pinion teeth with a pure escapement action, so holding the motor dead to the standard (or "master") speed of 3,000 revolutions per minute with an accuracy greater than one in ten thousand.

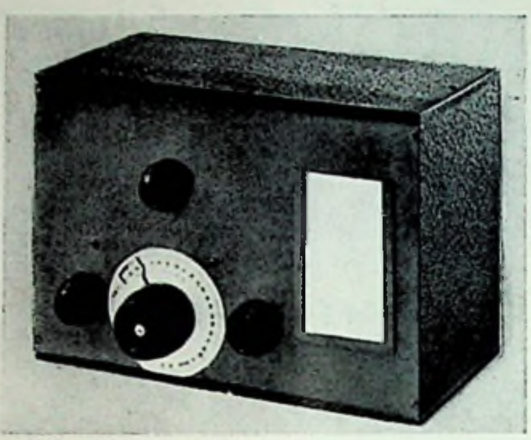
Connected electrically, in parallel with the motor, is the little spot light, which lights up simultaneously, throwing its beam on the centre of the concave mirror set obliquely a few degrees; thence the beam is reflected in the form of a whirling ray of light having constant speed without variation.

This light is by its nature "stroboscopic," i.e., if any object within its compass happens to be moving at a speed of exactly 3,000 per minute, this object appears completely stationary; hence, it could be used to check such speed.

On the other hand, should the two speeds be slightly different to one another the object would appear to be moving, either in the same or opposite direction, at a speed equal to the actual difference between its own rate and that of the stroboscopic beam.

Commercial Receivers for the Short Waves: No. 8.

The Mavox B4S Colonial Receiver



One tuning control covers all wavelengths from 15 to 550 metres. A good set for tropical use.

THIS is one of the most interesting receivers so far tested, possibly owing to the extraordinary number of stations that were heard on the short-wave side. The receiver was originally designed for colonial use. It consists of two distinct sections, the chassis being in a metal case and the loud-speaker in its own special teak cabinet. The radio half is completely enclosed in a metal cabinet with the lid screwed on tightly so it is absolutely impervious to dust, insects and damp.

Another point that will interest colonial users is that no perishable materials are used such as rubber and silk, etc. All coils, transformers, chokes and fixed condensers are impregnated so that the common complaint of ants eating the wax and so on is completely overcome.

The receiver is a four-stage superhet, with triode pentode frequency changer which oscillates quite freely down to 15 metres. Iron-cored I.F. coils are used throughout having a frequency of 110 kilocycles. A double-diode-triode is the second detector valve, while a pentode valve giving 1,100 milliwatts is in the output stage.

Controls are master tuner fitted with a two-ratio slow-motion drive which comes into operation on the short-wave band.

A second condenser tunes the grid circuit of the triode pentode, but this is comparatively flatly tuned so the receiver is virtually single-dial control. The wavechange switch on the left-hand side has three positions, each position covering a different waveband. First 15-31 metres, second 30-85 metres, and third 220-500 metres.

Although there is no long waveband so that the big stations such as Hilversum and Radio Paris can be received, this is of little importance, for up to 200 stations can be received on the short wavebands. The set can be used with almost any type of aerial and there is absolutely no need to take those precautions which are considered necessary with the average type of short-wave set.

During the original tests more stations were received on short waves than on medium. During the afternoon W3XAL, in Boundbrook, New Jersey, on 16-metres, W2XAD and W8XK on 19 metres were all received quite easily on the loud-speaker. Commercial stations, such as Rocky Point, Berlin, Cairo, Rio and Buenos Aires were all received during daylight when using their lower wavelength channels. Amateur stations on the 20-metre band came in with monotonous regularity; for example, during one hour's test the following were but a very small section of the amateur stations heard. All, of course, were on the loud-speaker. W2BSD, W6LO, G5NI, W1HCM, W4CJ, W3MD, LU9NE, K4SA, W2JJ, VE2GA, W2HFS, W1GJX, W1CCB, W1AF, and so on. The station with K index number is from Porto Rico, VE Canada, all W's American, and G, of course, Great Britain. Naturally, the American commercial broadcasters such as New York, Chicago, Schenectady, Boston, and Philadelphia can be received very well and more often than not entirely free from fading, so making them of good entertainment value.

In practice, the short-wave side is sufficiently good for amateurs to consider this set for station use, while any reader wishing to become accquainted with short-wave listening would be well advised to give it a trial.

All-wave receivers generally fall down on one waveband or another, but this Mavox was fully up to normal selectivity on broadcast bands and brought in rather more stations than expected for a four-valve super-het chassis. Putting it another way the performance on medium waves was fully up to that of an efficient conventional super-het without a short-wave section, showing that the addition of short-waves has not affected the performance on other bands.

Selectivity averages between 9 and 10 kilocycles and on a very average aerial over 30 stations will always provide more than 500 milliwatts output. Incidentally, the maximum output is over 1 watt.

Automatic volume control takes up most of the fading on medium waves and about 75 per cent. on short-waves. This is as good as anything we have tried so far. As regards power supply, a 120-volt large-capacity battery, 6-volt bias cell, and a fairly large accumulator are necessary. Smaller batteries will operate the receiver satisfactorily, but larger batteries will very considerably reduce running costs. The price complete with loud-speaker is £18 18s.

The makers of this receiver are National Radio Service Co., Ltd., 15-16 Alfred Place, Tottenham Court Road, W.1.

New Bulgin Interference Suppressor.

A. F. Bulgin & Co., Ltd., recently brought out a new type of interference suppressor to be used with any receiver without any alteration having to be made to the wiring. It is fitted with standard five-amp. plugs and sockets for insertion in the mains leads. Condensers of .25 mfd. capacity and tested at 1,000 volts are incorporated.

On test we find that interference reaching the receiver via the mains leads was effectively cancelled out when this suppressor was used with an independent earth. Care must be taken, however, to see that the interference is actually coming in via the mains.

TELEVISION AND SHORT-WAVE WORLD

FIRST STEPS IN HIGH-DEFINITION RECEPTION

By J. H. Reyner, B.Sc., A.M.I.E.E.

The first two articles of this series appeared in the September and October issues. The series relates to experiments which have been conducted over a period of several months.

3.—ADJUSTING THE CATHODE-RAY TUBE.

WE have discussed so far the design of the aerial, the tuning arrangements and the precautions necessary to ensure satisfactory high-frequency response so that the detail in the picture will be satisfactory. We still have to investigate the problem of the low frequpency response which affects the relative black and white in the picture. This question, however, is to some extent bound up with the operation of the cathode-ray tube itself and we can conveniently consider the two together.

The general operation of the cathode-ray tube will be familiar to those readers who have studied the articles already appearing in these pages. We have to provide two time bases one for the line frequency scan, the other for the picture frequency traverse as in the case of the old 30-line transmissions. The main point of difference lies in the high frequency traverse or line scan time-base which has to operate at a frequency of 6,000 cycles per second for a 240-line picture, assuming 25 pictures per second. For the 405-line interlaced picture a still higher frequency of 10,125 cycles per second is required.

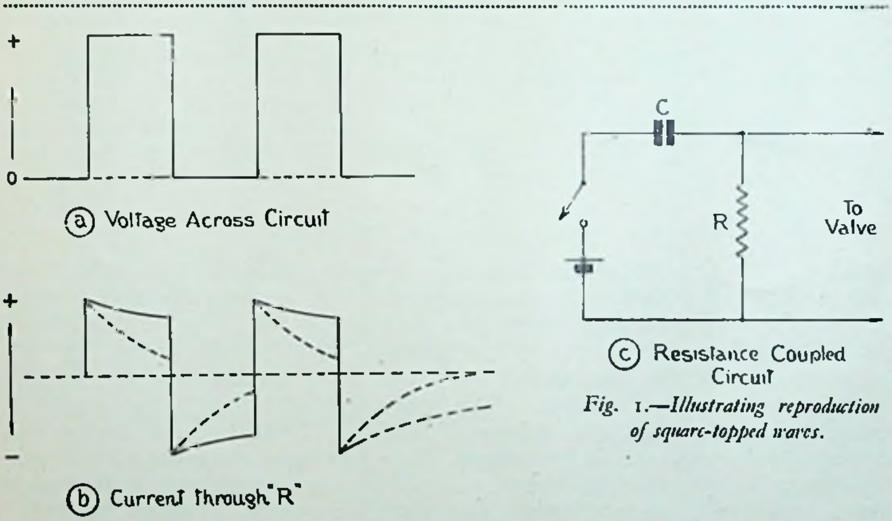


Fig. 1.—Illustrating reproduction of square-topped waves.

The methods adopted for producing these high frequencies do not concern us at the moment. The ordinary gas-discharge tube has certain disadvantages which have led to the increasing use of hard-valve time-bases which are more stable in operation. We will, however, assume for the moment that the necessary scanning has been arranged on both pairs of deflector plates. Thus, when we apply the correct voltages to the several anodes and the shield, we shall obtain our raster consisting of the requisite number of horizontal lines repeated the correct number of times per second.

Varying the Brilliance

The brilliance of this raster as a whole can be varied by adjusting the voltage on the shield or the voltage on the first anode. The latter voltage, however, is used for focusing the spot (in the Ediswan tube). In the Cossor tube where there are three anodes focusing is mainly controlled by the second anode. There are, therefore, a number of possible settings corresponding to a given brightness of raster. If we increase the negative shield volts the raster grows fainter, but if we increase the first gun voltage we shall restore the brilliance to its former value, but this time with a different focus.

Clearly there is only one setting which is correct, this being the arrangement which gives a sharp focus of the spot so that the line structure of the picture can just be seen. This is a little difficult with 200 odd lines and it may be convenient to make the preliminary adjustment with fewer lines leaving the final adjustment to be made on the actual picture by a slight manipulation of the two controls together. An important point is that the small increase in the negative shield volts must black out the raster. It is possible to obtain apparent focusing in positions with too little negative volts on the shield, in which circumstances an increase in the negative shield volts may cause an actual increase of the brilliance, and this is not the correct condition for operation.

With the tube set to run in this manner modulation is now applied to the shield from the television receiver and this, by causing the shield voltage to vary from instant to instant, causes the spot to become light or dark in the different portions of the line, and so builds up the image in the customary manner. The extent of the modulation must be controllable so that the tube is not overloaded as we shall see later, while the relative brightness of the picture as a whole is controlled by the adjustment of the steady bias on the shield.

L.F. Response

Now, bearing these remarks in mind, let us consider the question of L.F. response. The question is one of considerable interest because defects in the amplifier at this end of the frequency spectrum can be masked .. even partially overcome by suitable setting of the tube, whereas the same does not apply to the high-frequency response. If the higher frequencies are missing, the detail in the

D.C. AND A.C. AMPLIFICATION

picture will be smudgy and that is all there is to it, whereas I have obtained quite passable pictures with an amplifier which cuts off in the region of 2,000 cycles in the L.F. !

The consideration of bass response requires a clear understanding of the difference between the ideal D.C. or uni-directional modulation produced in the photo-cell at the transmitter or in the detector stage of the receiver, and the equivalent A.C. wave-form which is produced in the amplifying stages of the receiver. I propose, therefore, to discuss the simple square topped wave-form to try and make this point quite clear.

Fig. 1 shows a rectangular wave caused by the application of the few volts positive for a small period and then the cessation of this voltage for an equal period. This is a uni-directional wave in which the voltage is always positive and is the type of voltage which would be generated in the anode circuit of a photo-cell or at the detector of a receiver. In practice we apply this voltage to a resistance capacity network to feed it to the next valve, as shown in Fig. 1c.

When we switch on the voltage, current starts to flow into the condenser through the grid leak. This current rises almost instantaneously to a high value and then falls off rapidly as the condenser charges up, until when the condenser is fully charged no current is flowing. The voltage which is handed on to the next valve is the voltage drop caused by this current flowing through the grid leak so that we see this voltage starts by being large and in fact practically equal to the applied voltage, and then it begins to fall off as the current falls off, until ultimately it will fall to zero. This is, in fact, the fundamental difference between a D.C. amplifier and an A.C. amplifier, namely, that a steady voltage cannot be transmitter indefinitely.

The time taken for the current to die away from its initial value is dependent upon the values of condenser and resistance. If either or both of these are large, the condenser takes a long time to charge, and therefore the current continues at a fairly high value for an appreciable fraction of time and this is the trick which has to be adopted in order to approximate to the required conditions. The condenser and leak are in fact made so large that during the period required the current charging the condenser has only had time to fall off by relatively small amount.

Consequently, the voltage transmitted to the next valve is of the form shown in Fig. 1b, which is roughly the same as the original square-topped wave. The dotted line shows the form the wave will take if the " time constant " of the circuit is not high enough, i.e., the product of the resistance and capacity is too small so that the condenser charges too quickly and the current has time to fall off quite appreciably before the end of the allotted time.

At the end of the first period we switch off the applied voltage. The current in the condenser now immediately discharges and this produces a voltage in the opposite direction. An exactly similar state of affairs applies, the current being large at first and gradually dying away so that once again we obtain a slightly sloping top to the wave, the relative steepness of the slope depending upon the time constant of the circuit. The essential point to note, however, is that the wave-form applied to the grid of the valve is alternating, being first positive and then negative and symmetrically disposed about the centre line which is the steady bias on the valve.

Duration of Pulse

The question arises as to how long we should be able to maintain the voltage reasonably steady, and this is determined by the maximum black required in the picture. Theoretically the transmission of a continuous white is just as difficult, but in practice the presence of the synchronising band or pulse, or even the black edge to the picture, means that the signal corresponding to white is always interrupted at least once every line so that we only have to maintain the voltage reasonably steady for a length of time corresponding to one line which is of the order of 1/6,000th of a second or less.

The transmission of black, however, is different.

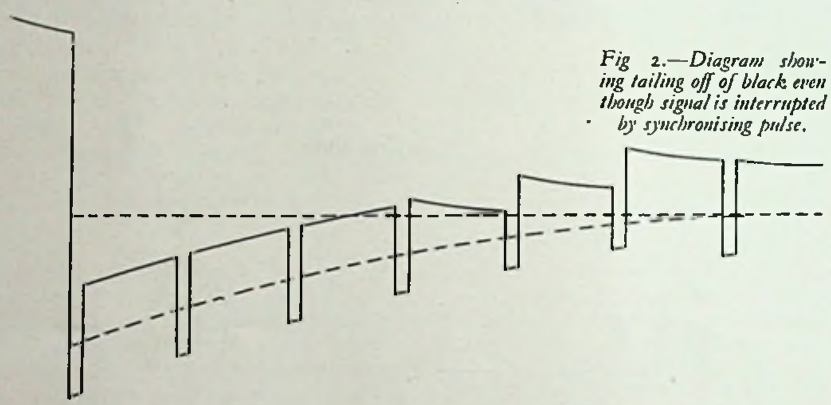


Fig 2.—Diagram showing tailing off of black even though signal is interrupted by synchronising pulse.

In the old Baird transmissions black was the maximum signal and a continuous (vertical) band of black several lines in width meant an uninterrupted signal lasting perhaps one-third or one-half of the picture period. With the new high-definition transmissions even a black signal will be interrupted at the end of each line by the synchronising pulse.

At first sight this seems to put the blacks on the same footing as the whites but further examination shows that this is not so. Fig. 2 illustrates a white signal changing suddenly to black. At the conclusion of the white there will be the normal synchronising signal, followed by a voltage rising to only about one-third of the maximum value (this being the level laid down for black as explained elsewhere). This does not charge the condenser in the opposite direction. It does not even fully discharge it, so that during the black period the condenser goes on discharging and the successive pulses of black alternating with synchronising signal gradually float up until the signal is once more alternating in character, fluctuating about the mean value.

But the mean value corresponds to

(*Continued on page* 732)

Transmission for the Beginner

By Kenneth Jowers

These fundamental circuits will help the beginner to undertake the construction of a low-power transmitter. A Post Office permit is required before construction is begun.

Oscillators

THERE are two types of oscillators used in amateur transmitters: the self-controlled type, in which the frequency of the oscillations generated is dependent upon the electrical con-

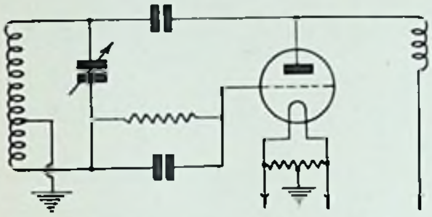


Fig. 1.—The conventional Hartley oscillator.

stants of the circuit; and the crystal-controlled type, in which the physical constants of the controlling crystal determine the oscillator frequency. The self-controlled oscillators can employ either inductive or capacitive coupling

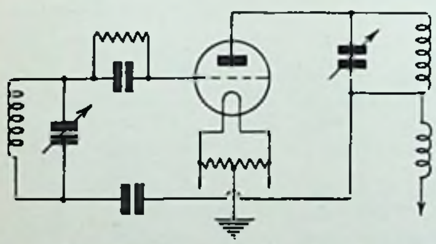


Fig. 2.—Tuned-plate tuned-grid oscillator.

to feed back energy from the plate to the grid circuit.

The Hartley oscillator, shown in Fig. 1, is a very popular self-controlled

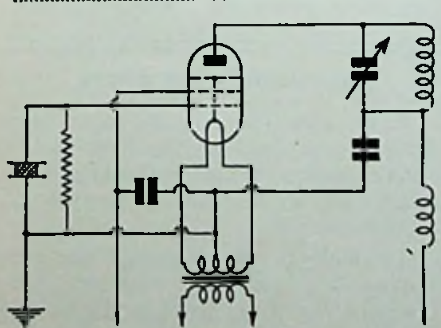


Fig. 3.—Crystal controlled pentode oscillator.

circuit employing inductive feed-back. With this circuit high-C (high capacity) is used in order to obtain stability and minimise frequency drift. The tuned-plate tuned-grid oscillator circuit is shown by Fig. 2. At the higher frequencies, the plate tank circuit and the grid tank circuit are not inductively coupled, the capacity of the valve providing feed-back. Like the Hartley oscillator, the tuned-plate tuned-grid oscillator requires a high-C tank circuit for stability.

Crystal-Controlled Oscillator

A crystal-controlled oscillator, using the type 24M, which is probably the best crystal oscillator valve known to-day, is shown in Fig. 3. Plate voltages of

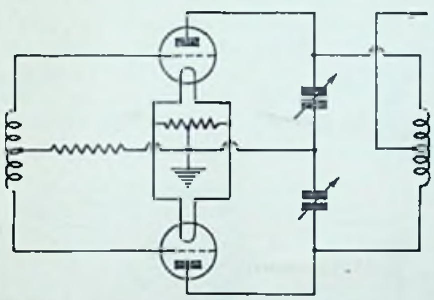


Fig. 4.—Untuned grid push-pull oscillator.

200 and 300 can be carried with less radio-frequency current through the crystal than with triodes operating at lower voltages. The screen voltage should be between 90 and 125 volts for best operation, while the screen is by-passed to earth through a condenser of .01-mfd. The grid leak is a 2-watt carbon resistor of 10,000 to 25,000 ohms. The plate tank circuit is low-C, a 100-mfd condenser being quite satisfactory.

Valves can be used in push-pull as oscillators, as shown in Fig. 4. The regular tuned-plate tuned-grid circuit is used, but instead of tuning the grid circuit with a condenser, the coil is designed to resonate at the desired frequency. For crystal control the electrodes of the crystal holder are connected to the two grids, and in place of the grid coil, a centre-tapped radio-frequency choke is used. The grid coil can be adjusted so that the oscillator can be tuned over quite a band by means of the split-section condenser in the plate circuit.

The Tri-Tet

The tri-tet is the latest development in oscillator circuits and is gaining wide popularity because of its stability and high harmonic output. Fig. 5 shows the electron-coupled circuit and Fig. 6 the crystal-controlled circuit. The grid tank circuit is high-C and the plate tank circuit low-C. In operation the plate circuit is tuned to a harmonic of the grid circuit for maximum stability.

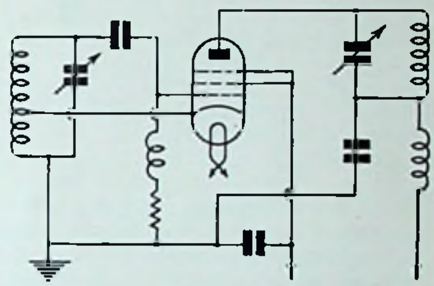


Fig. 5.—Electron-coupled tri-tet.

Amplifiers

To prevent variations in load on the amplifier from affecting the oscillator frequency, as in keying or modulation, it is modern practice to use buffer

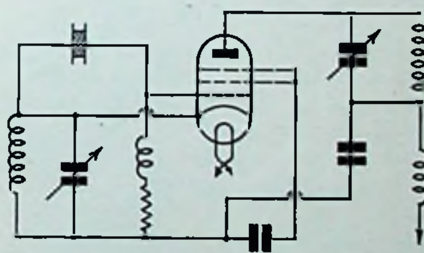


Fig. 6.—Crystal controlled tri-tet.

stages between the oscillator and the amplifier stage feeding the antenna. The buffer amplifiers also furnish the additional r.f. gain needed properly to

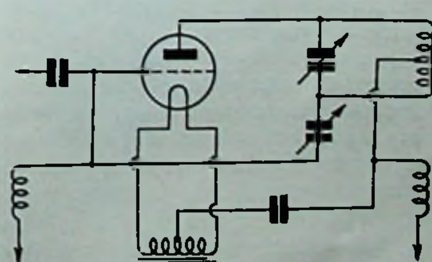


Fig. 7.—The neutralised sub-amplifier.

excite the highly biased Class-C amplifier valves.

Fig. 7 shows the conventional neutralised buffer amplifier stage. Fig. 8 shows the screen-grid amplifier. Both are coupled through condensers to the preceding stage. Fig. 9 shows the buffer amplifier with link coupling

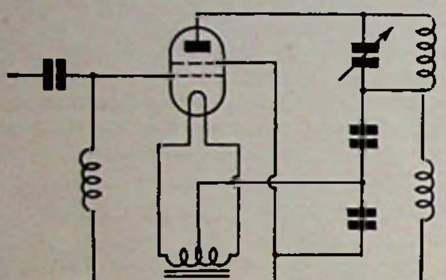


Fig. 8.—Screened-grid sub-amplifier, self-neutralised.

to the preceding stage. In this circuit the grid is tuned and a coupling line is used to carry the energy from the exciting stage. From an efficiency standpoint it is far superior to the condenser system of coupling. The value of the grid choke is not critical. The main disadvantage of this circuit is

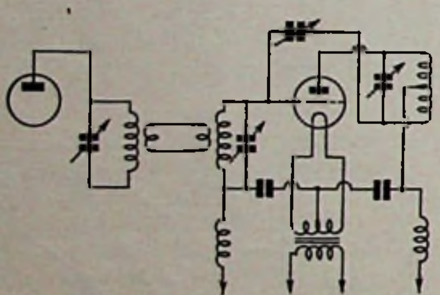


Fig. 9.—Link-coupling to sub-amplifier.

that an additional tuning condenser is required. This condenser, however, can be eliminated by interwinding the grid and plate coils, as shown in Fig. 10.

Fig. 11 shows the method of coupling a single stage to a push-pull amplifier stage. Split-section condensers are used, and the rotors are grounded. Fig. 12 shows a single-stage capacitively coupled to a push-pull amplifier stage.

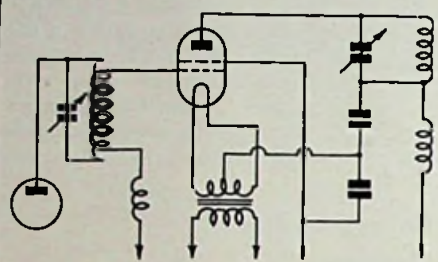


Fig. 10.—This buffer amplifier is coupled by having inter-wound grid and plate coils.

Frequency Doublers

The circuit for a frequency doubler is the same as that of the buffer amplifier, the difference being in the bias voltage. In the popular distortion type of doubler the bias is from 3 to 7 times cut off. Naturally, consider-

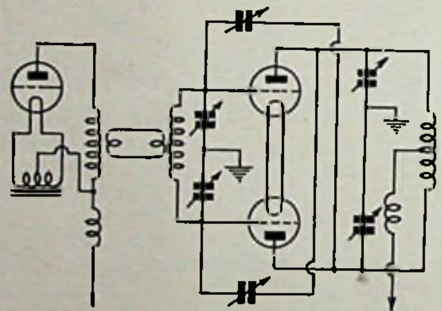


Fig. 11.—Push-pull amplifier link-coupled to a single oscillator

able r.f. voltage is needed to drive this type of doubler, and efficiency is quite low. The push-pull, or push-push doubler—which is becoming quite popular—is shown in Fig. 13. The grids are in push-pull, but the plates are in parallel. In operation the grids receive excitations on each half of the cycle, and, as the plates are in parallel, the impulses delivered to the plate tank are all in one direction, or double the frequency of the grid circuit. The

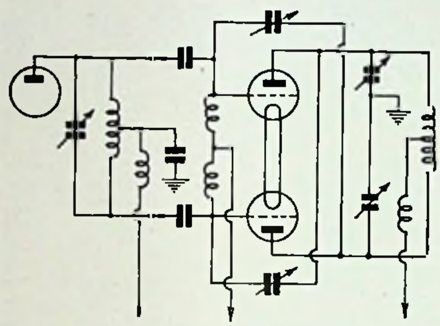


Fig. 12—Capacity-coupled push-pull amplifier.

efficiency is better than the distortion type doubler, the output being about the same as a straight amplifier. When it is desired to operate the stage as a straight amplifier it is only necessary to change the plate coil and open the filament circuit of one of the valves.

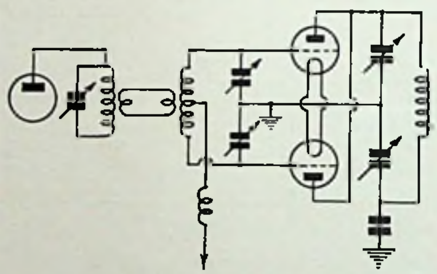


Fig. 13—Push-pull frequency doubler

This valve then neutralises the other, assuming, of course, that the two valves have about the same characteristics.

"First Steps in High-definition Reception" (*Continued from page 730*)

grey so that our black will tail off into grey in the old manner despite the periodic interruptions due to the synchronising signal, and if we are to prevent this we must make the condenser take a long time to discharge, which again means a long time constant. It is not a difficult matter to calculate the time constant required to maintain a black over, say, one-third of the picture. With 25 pictures per second, two amplifier stages and an allowance of ten per cent. loss of voltage we arrive at a time constant of roughly 0.25 megohm-microfarad, so that if we use a 1 mfd. condenser we need a ¼ megohm leak and so on. With the 50 pictures per second of the E.M.I. transmissions a time constant of half this value will suffice since the duration of the black is halved.

(To be continued.)

For Battery Set Users.

Home constructors who have been held up with their new super-het will be glad to know that the Mullard Co. have recently released their battery-operated Octode type FC2.

The filament consumption of this new valve is 0.125 amp. at 2 volts and under optimum working conditions consume 3.0 mA. This low current consumption will be a great help when large battery-operated supers are under consideration.

In addition to filament and anode there are six grids one within the other. Price has been fixed at 18s. 6d.

A British 75-watt R.F. Pentode

We are pleased to be able to publish the first details of the British RK20 type of valve. Four other new valves are also dealt with in this article.

READERS have heard quite a lot about the wonderful capabilities of the RK2O radio-frequency pentode. Stations equipped with this valve have been putting out fine phone signals using suppressor grid modulation. The actual advantage of an R.F. pentode as a P.A. is not so much for the extra gain in R.F. obtained, but for the comparatively negligible audio input required to give high-percentage modulation.

A 75-watt carrier needs between 25 and 30 watts of audio to give true 100 per cent. modulation if the Heising method is used. Grid modulation does, of course, reduce the amount of audio required, but at the same time quality does noticeably deteriorate.

Suppressor-grid modulation combines the advantages of anode and grid bias modulation. Quality remains at a high order while the input is comparable to a grid-modulated P.A.

The 362 Valve Co. have now introduced a 75-watt pentode designated the RFP-362. The list price is £3, and characteristics are as follows:

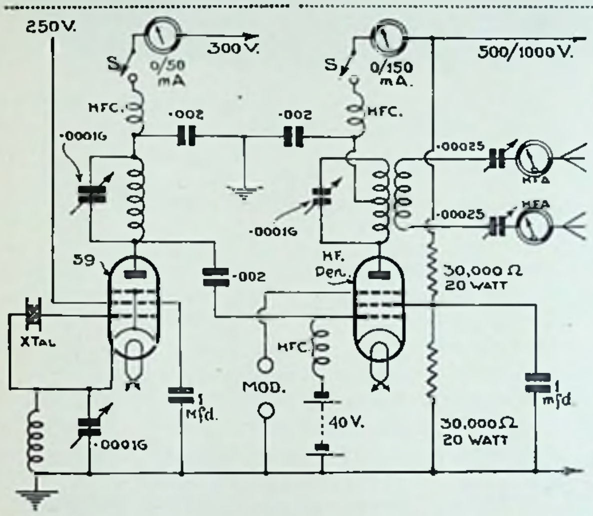
Filament voltage, 6 volts.
Filament current, 2 amperes.
Maximum anode voltage, 1,000 volts.
Maximum screen voltage, 500 volts.
Anode dissipation, 75 watts.
Screen dissipation, 20 watts.
Slope, 8 milliamps. per volt.

It can be seen from the static characteristics that this valve closely resembles the RK20, so that in view of the price being low, it should prove invaluable to British amateurs. Construction as regards filament and grids is conventional, but the anode is in ten distinct sections in the usual 362 style. It is claimed that a box anode for this valve would be difficult to construct and very hard to de-gas. It is perhaps this unique anode which allows the valve to be overrun without causing damage or loss of vacuum. The filament, consisting of four V loops, is designed to withstand a very heavy maximum emission.

A typical circuit for this valve is shown in Fig. 1. In this circuit a type 59 pentode is used as a tri-tet oscillator, the crystal being ground to a frequency 7 mc. The cathode is also tuned to 7 mc., while the anode doubles down to 14 mc. The R.F. pentode acts as a perfectly conventional 14 mc. P.A. with modulation in the suppressor grid. During our tests double cut-off was obtained with a grid bias of 20 volts negative. Of course, no neutralising is required for this type of valve while the only precaution necessary is to make sure that the screen dissipation is kept down to 20 watts. Two 30,000-ohm resistances forming a fixed potentiometer across the 1,000 volts supply will give the correct screen potential.

During our tests we deliberately overran this valve to 150 watts anode dissipation, but with a permanent screen dissipation of 20 watts. This did not impair the emission in any way and from our subsequent life tests we feel quite sure that amateurs will be able to treat the 75-watt rating as being very conservative.

The R.F. output is considerably



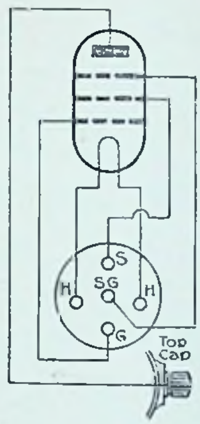
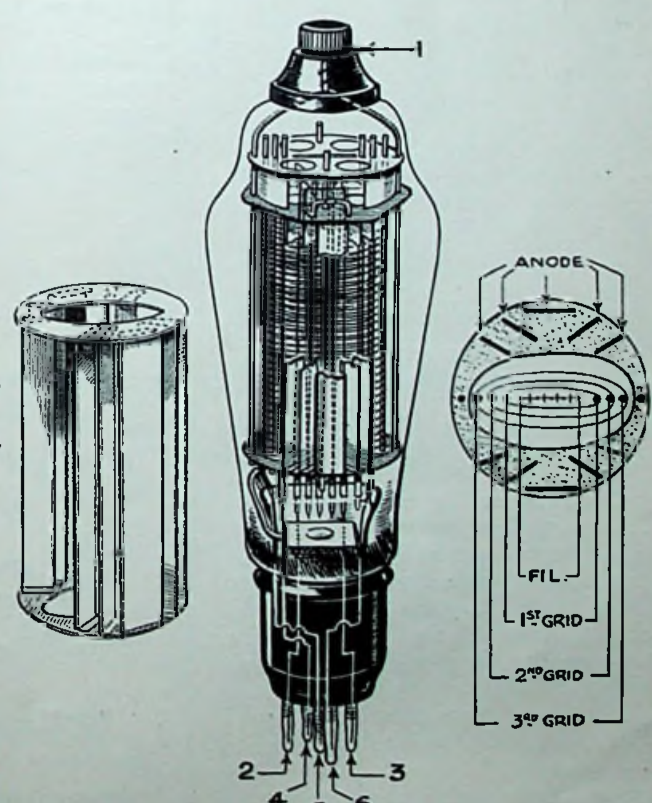


Fig. 1.—A simple two valve transmitter can be built with the aid of the R.F. pentode.
Fig. 2.—The standard four pin base is used, the suppressor grid going to the centre contact.



Notice how the anode is built up with 10 small plates. This is a new departure from normal valve practice.

greater for a given input even at low wattage, while some special experimental tests were made on 160 metres with an input of 10 watts. Although the valve was being rather wasted at this low power 25 per cent. increase in radiation was obtained.

One of the main advantages of the RFP-362 is that a 100-watt carrier can be fully modulated at good quality with an audio input to the suppressor grid of under 3 watts. In practice this means that the modulator can be of the PX4 type of valve. Biasing and anode connections are shown in Fig. 2.

A second valve of interest is the new PX50. Many readers have already heard our tests with this valve as a modulator and have commented on the increased depth of modulation and improved quality. This valve, operating with an anode voltage of 500 and with a dissipation of 50 watts, gives 13 watts of audio with less than 5 per cent. second harmonic distortion. The internal resistance is 800 ohms with a mutual conductance of 6 milliamps. per volt. At a list price of £2 10s. it represents excellent value and should prove useful in phone stations.

The Cossor DD/Pen.

The new Cossor DD/Pen, a double-diode-pentode, can be used in a circuit to give automatic tone control. Fig. 3 is almost self-explanatory. It gives the actual connections.

When using this circuit the following advantages are obtained—direct automatic volume control action by the use of A.V.C. on audio as well as radio frequency amplifiers, automatic tone control, wide range for local stations, restricted range for distant stations, and reduced inter-station noise.

The automatic tone-control circuit shown can be applied to any receiver with five or more valves if A.V.C. is used, while construction will mean no more difficulty than obtained with A.V.C.

The automatic tone control functions in the following way: a manual tone control is usually arranged with a condenser and a variable resistance in the anode circuit of an amplifier. Of course, it is necessary that the receiver should be of the high-fidelity type with ample top-note response. This same requirement holds for automatic tone control except that instead of having to adjust the manual control there is an automatic arrangement whereby the DD/Pen controls the tone. Wide range is given for local stations and restricted range for distant stations, which is generally required.

In between stations when a receiver with A.V.C. causes inter-station noise, a receiver with A.V.C. is quietened, but is still not dead as with a muting switch or Q.A.V.C. This action takes place with a small condenser connected between grid and plate of the DD/Pen. On strong signals this has a negligible effect, but on weak signals it is equivalent to a capacity about 50 times its actual value by reason of the "Miller" effect.

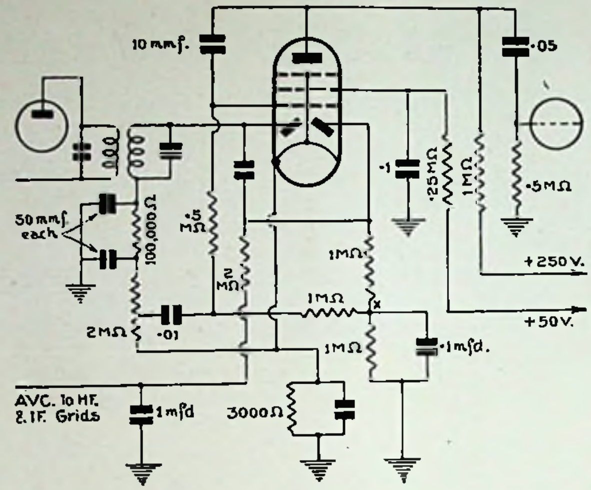


Fig. 3.—A double-diode pentode valve can be used in this circuit. Although a great number of resistances are required the connections are simple and should be easily followed by the constructor.

The Tunsgram APP4c.

Tunsgram have introduced a new valve which will be sure to interest the A.A. experimenter and the genuine QRP transmitter. This is a triple grid output valve designated the APP4c. The following characteristics will give some idea of the usefulness of this valve:

- Filament volts, 4.0.
- Filament current, 1.9 amps.
- Anode voltage, 250.
- Screen voltage, 250.
- Negative bias, 6 volts.
- Suppressor grid volts, −6.
- Mean anode current, 36 milliamps.
- Mean screen current, 4 milliamps.
- Slope, 10 milliamps. per volt.
- U.P.O., 3.6 watts.

As the suppressor grid is at chassis level this valve can be used in the same way as a conventional R.F. pentode for suppressor-grid modulation. The output is approximately 4-5 watts under normal conditions as a modulated oscillator. When used as a speech amplifier it is less prone to parasitic oscillation than the conventional steep-slope pentode where the suppressor grid is connected to cathode. A counterpart with a 35-volt .2 amp. heater is also available and designated type PP36. The list price of the APP4c is 14s. 9d.

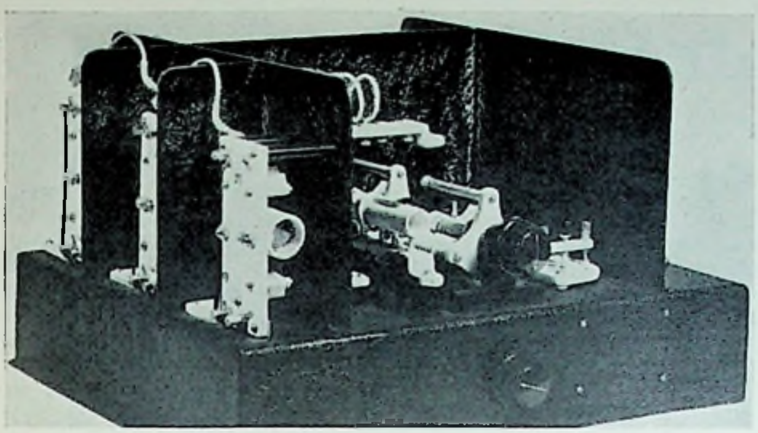
Five Meters Across the Altantic

The radio section of the Municipal College at Portsmouth are to make special tests in an endeavour to bridge the Atlantic on a frequency of 60 megacycles. Reports will be appreciated. The call sign is G6PU. The transmission times will be as follows:

Friday, December 13-December 14, 10 p.m. to 10 a.m. G.M.T.

Saturday, December 14, 10 a.m. to 11 a.m.

Saturday, December 14-15, 10 a.m. to 1 a.m.



A RECEIVER FOR HIGH-DEFINITION SIGNALS

Details of the B.T.S. ultra-short wave receiver

THIS ultra-short-wave receiver, covering 5-80 metres, is primarily intended for high-definition television reception; it has a 2½ megacycles response. Two items of importance connected with a receiver of this type is employment throughout of Megacite, a special low-loss high-power factor material, and all metal parts are silver plated.

The receiver consists of one signal frequency amplifier, frequency changer, two I.F. stages, second detector and pentode output. Universal AC/DC valves are employed.

The signal amplifier is grid tuned and loosely coupled to the aerial. Fixed grid bias is shown in the circuit, but, of course, automatic volume control may be applied if desired. This should only be necessary, however, if the transmitting station is in close proximity, as the range obtained on the ultra-short-waves is very limited; moreover fading is not experienced to any extent on these frequencies.

This R.F. amplifier is decoupled by means of a 20,000-ohm fixed resistance and a 0.1 mfd. condenser. It is most important that the latter be non-inductive, as at the frequencies covered by this receiver a mere trace of inductance will offer quite an appreciable impedance to the R.F. currents. The valve for this stage is the Mazda V.P. 1321.

Coupling between the amplifier and the frequency changer is accomplished by means of a tuned anode circuit which is matched within very fine limits to the input grid circuit. The signals are fed to the frequency changer by means of a small low-loss variable condenser and an ultra-short-wave H.F. choke. The coupling condenser is variable in order that any difference in feed-back capacity produced by individual valves may be compensated.

The frequency changing is done by cathode injection; that is, feeding the incoming signal through the coupling coil of the oscillator circuit. The tuned winding of the reaction coil is wound with very heavy gauge wire with the reaction winding well spaced on either side: coupling is, therefore, very tight and at the same time the throw-back capacity is kept down to a minimum. With this arrangement it is possible to obtain very smooth oscillation, without any trace of blind-spots.

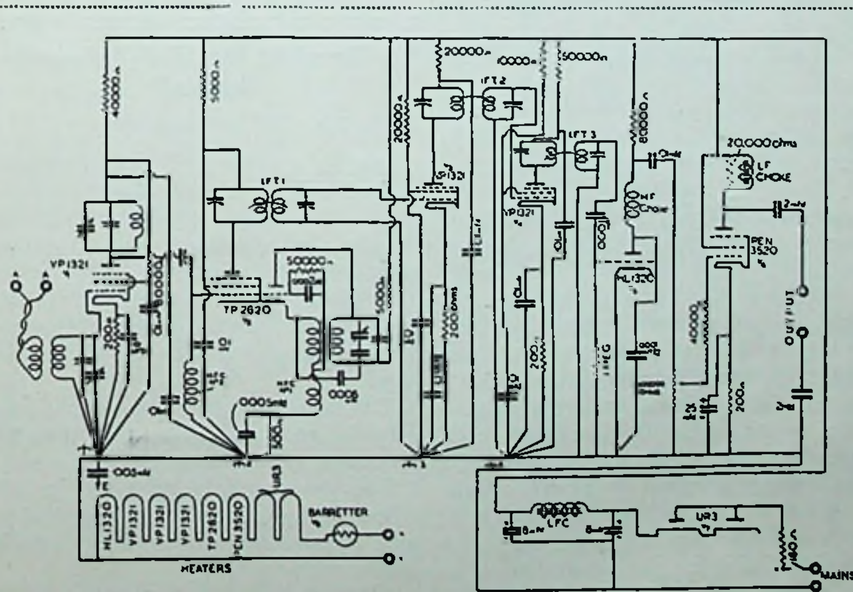
Losses are also reduced across this circuit by the inclusion of an ultra-short-wave H.F. choke in the cathode circuit. This has the effect of isolating the losses inherent in the metal chassis from the tuned winding.

A standard ultra-short-wave condenser is used for tuning the oscillator section, and ganging to the signal amplifying circuits is obtained by means of a padding condenser.

The most suitable valve for frequency changing has been found to be the Mazda T.P. 2620, which consists of a pentode and triode valve screened one from the other, and therefore completely independent except for a common cathode. The great advantage of this arrangement lies in the fact that the oscillation produced in the triode section is not affected in any way by the input signal or the conditions under which the pentode is operated. Moreover the pentode section has variable-mu characteristics enabling automatic volume control to be applied if so desired. Both sections are de-coupled.

Two I.F. stages are employed, using special intermediate transformers, tuned to a frequency of twelve megacycles. Coupling between the primary and secondary windings of these transformers may be varied in order to obtain any degree of band-

(*Continued in column 2 on next page.*)



The circuit of the B.T.S. ultra short-wave receiver.

Our Readers' Views

Correspondence is invited. The Editor does not necessarily agree with views expressed by readers which are published on this page.

Interlaced Scanning

SIR,

There is a lot of discussion at the moment in England on the system of interlaced scanning used by Marconi-E.M.I.

For your information, I must point out that I studied a system of this kind in 1932, a system for which I obtained a Belgian patent in the first months of 1933.

A description of this system, applied to the analysis and the reception by a mechanical process, appeared on December 3, 1933, in No. 23 of *Radio Vision*, a supplement to *L'Antenne*, No. 558.

This process of analysis has besides been written up at a conference of the French Cinematography Society, which took place at the same time.

MARC. CHAUVIERRE
(Boulevard Excelmans, Paris).

Performing Animals

SIR,

At first one would hardly see the connection between television and the question of performing animals. In fact the probability is that before you read another word of this letter you will consign it to the waste paper basket with the trite remark that the man who can see the connection is endowed with a vision so telling as to render needless all scientific aid.

Yet it is quite certain that television will be exploited for cruel ends unless steps are taken to prevent it, since the trade in performing animals has made use of practically every known institution to keep it alive.

It is extraordinary how some people will believe in the unsubstantiated word of those who make money out of this traffic that it's " all done by kindness." Yet on reading the evidence before the Select Committee of the House of Commons, *The Times* demanded immediate legislation in 1922—thirteen long years ago. They were naturally horrified and angry at the public being deceived into being amused by turns which involved a lion being kept for five days without food or drink between trainings with trident and whip or a whip used for training dogs, which had a spike on the end like a sail needle and was disguised and decorated with ribbons.

EDMUND T. MACMICHAEL.
(Hon. Director, The Performing and Captive Animals' Defence League, London, W.C.2).

Eiffel Tower Transmissions

SIR,

As a television amateur since 1930 and reader of TELEVISION AND SHORT-WAVE WORLD, I have often regretted the slowness of France in this field.

For two years I received London with a mirror-drum receiver so the termination of the 30-line service was a disappointment to me.

Now it seems that in Paris we are going to have a transmission at 180 lines.

A 7-metre transmitter is being constructed on the north pylon of the Eiffel Tower and ought to be ready in November, with a power of 1 kW at first and 10 to 20 kW by March, 1936. The feeder connecting the transmitter to the summit will be 300 metres long and is nearing completion. I enclose a photograph showing the beginning of the feeder (not reproduced).

The studio will be at the P.T.T. Ministry, situated about one kilometre away.

A. BOUQUIN
(Rue de la Federation, Paris).

"A Receiver for High-definition Signals."

(*Continued from preceding page*)

width up to two and a half megacycles. This wide band will prevent attenuation on any of the modulating frequencies obtained with 240-line high-definition television. The valve used in each stage is the Mazda V.P. 1321, which has variable-mu characteristics, enabling A.V.C. to be applied.

The anode of the first amplifying valve is decoupled. It was also found necessary to decouple the screens.

The intermediate amplifer is followed by a straightforward leaky-grid second detector and a pentode output valve.

All leads must be kept as short as possible in a design of this nature, especially in the signal frequency and intermediate frequency stages. It is also essential that screening shall be effective and for this purpose thick gauge metal is recommended. Decoupling must, of course, be thoroughly carried out in each stage.

All heaters are connected in series and applied to the mains voltage through a Phillips C.1 barretter. A resistance could be used instead of the latter but this has the disadvantages that it takes up far more room, and has to be re-adjusted to suit different mains voltages.

The valves used are: I.F. amplifiers, V.P. 1321 Mazda; frequency changer, T.P. 2620 Mazda; detector, H.L.1320 Mazda; output pentode, Mullard Pen 3520.

The receiver is supplied in kit form by British Television Supplies, Ltd., at the price of £11 11s. 0d.

Wireless and Gramophone Trader Year Book and Diary.

The 12th annual edition of *The Wireless and Gramophone Trader Year Book and Diary*, *just published*, contains so much information and reference data appertaining to radio and gramophone trading that it seems to be indispensable to every radio and gramophone trader.

New features included in this edition give a summary of the Television Report and an article describing the principles of television. The popular valve reference tables have been revised completely and are right up to date. Diagrams are also given of British and American valve base connections; 1935/6 receiver specifications (with valve types and resistance values for extra speakers) list 400 sets by 54 British manufacturers—a complete guide to the current market. Technical, legal and general commercial information has been revised and includes every up-to-the-minute item of value in everyday trading.

A very practical diary for 1936 (one week at opening) is provided.

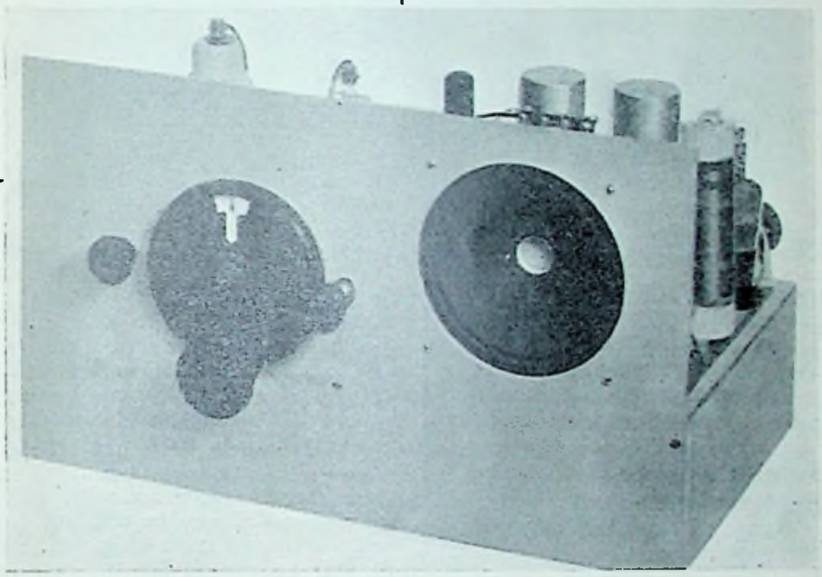
" The Year Book " is priced at 5s. 6d. The book is obtainable from the publishers—The Trader Publishing Co., Ltd., Dorset House, Stamford Street, London, S.E.1.

A Universal Mains S.W. Three

Here are the constructional details of a new general-purpose short-wave receiver designed by KENNETH JOWERS. *It is intended primarily for reception of short-wave broadcast programmes but covers all amateur wavebands.*

MANY readers have asked for a simple short-wave receiver to listen to American and other short-wave programmes. Several points have always been stressed and these segregated, show the following features have to be embodied in a family short-wave set. Single-dial tuning irrespective of a number of tuned circuits is most important. No ganging is required while, at the same time, coils must match up without difficulty. Mains operation for A.C. or D.C. is essential, while sensitivity must be such that long-distance programmes can be received with reasonable regularity.

It may seem rather a tall order to embody all these features in one receiver, as many of them are conflicting. Ganged tuning and no coil trouble is not the usual experience of amateur constructors. However, these features have been embodied in quite a simple way without putting up cost to any appreciable extent.



Only three controls. Trimmer, master tuner and reaction.

The Circuit

The circuit finally chosen consisted of a high-frequency pentode, tuned-grid coupled to a steep-slope triode leaky-grid detector, in turn resistance-capacity coupled to a pentode output valve. On A.C. mains a half-wave rectifier comes into operation, which on D.C. mains is a passenger. Readers on D.C. mains will readily see that if there is no possibility of ever wanting to use the receiver on A.C. the rectifying valve can be omitted. This will entail very slight modification. The anode and cathode connections on the rectifying valve will have to be shorted together while the filament voltage dropping resistance must be of a type suitable for three 13-volt valves at .3 ampere instead of four 13-volt valves.

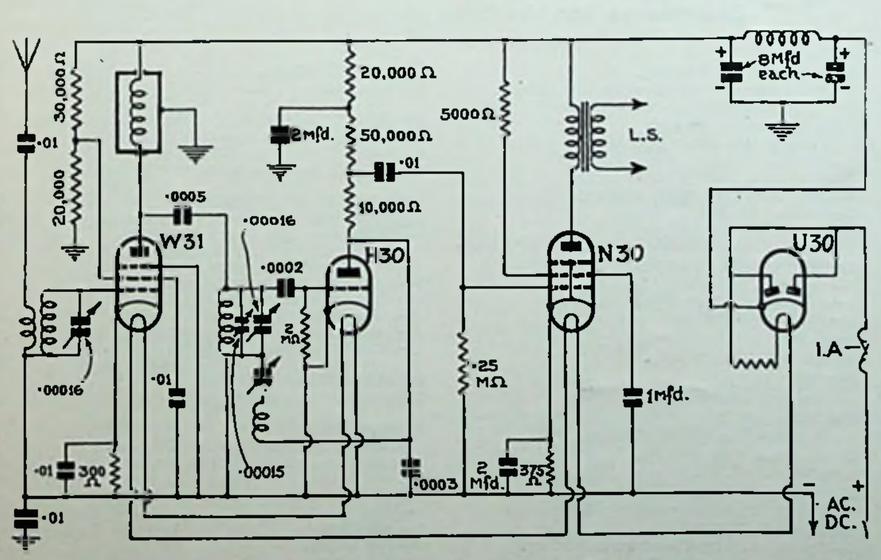
So that any type of aerial can be used without causing dead spots or lack of reaction the input circuit is loosely coupled so as to minimise damping. At the same time selectivity is kept reasonably good. It may seem rather extraordinary emphasising the need for selectivity with a short-wave receiver, but now that there are so many stations on the air high selectivity is very necessary.

In the anode of the high-frequency pentode is a screened all-wave choke which is free from peaks, so the receiver can be used on all wavelengths providing the correct type of plug-in coils are used.

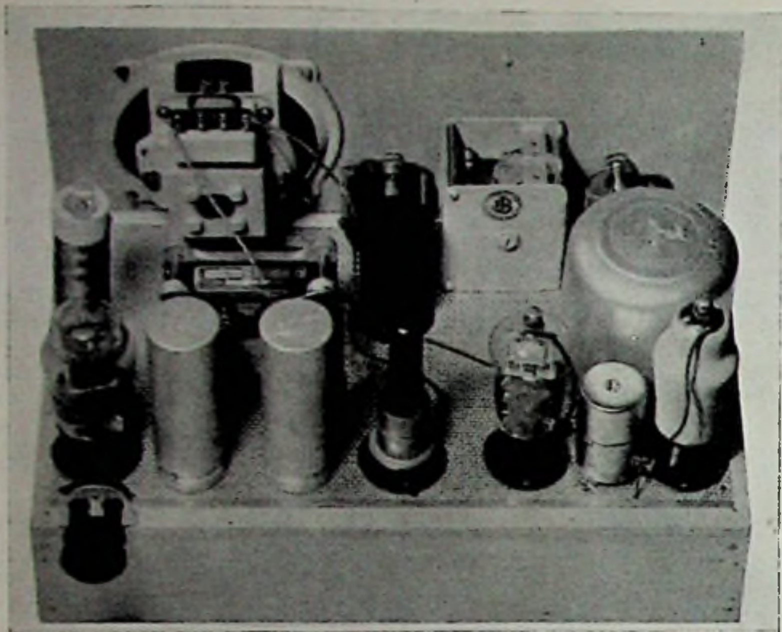
The second detector stage is quite conventional, the tuning coil being a four-pin Eddystone, on which are wound both grid and reaction coils.

Leaky-grid detection gave most satisfactory results, but in the anode circuit a 10,000-ohm resistance appeared preferable to a high-frequency choke. The actual anode impedance in the detector stage is a 50,000-ohm resistance, while the de-coupling circuit consists of a 20,000-ohm resistance and a 2-mfd. condenser.

Ample input to the N30 pentode valve was obtained with R.C. coupling and this materially assisted in reducing the hum so that on the loud-speaker background was negligible. By fixing the loud-speaker on the same chassis as the receiver, the primary of the built-in transformer is connected in the anode



Although four valves are used, the rectifier is a passenger on D.C. mains. Note the position of the trimmer.



From left to right the valves are, rectifier, pentode, triode detector and pentode H.F. amplifier.

circuit of the output pentode so saving unnecessary wires and terminals.

Smoothing is by means of a Sound-Sales 30-henry choke plus 16-mfds. capacity. This will be found adequate providing the same layout is adopted.

Single-knob Tuning

Tuning is by means of a special .00016-mfd. Jackson two-gang condenser fitted with a B.T.S. slow motion drive. As no two coils are ever alike a balancing condenser of 15-micro-microfarad capacity is connected across the grid section of the two-gang condenser. When the coils are changed it is simply a matter of balancing them up with this small condenser, after which the receiver is tuned by a single knob.

For reaction a .00015-mfd. condenser with one side automatically earthed is in series with one side of the reaction coil and the anode of the H30. This, of course, is the normal Reinartz system.

Bias is obtained automatically throughout. In the H.F. pentode circuit a resistance of 300 ohms in the cathode reduces anode current and keeps the H.F. stage completely stable. The cathode of the detector valve is connected directly to earth as this does not require bias, but the N30 must have bias and it is obtained by means of a resistance of 375 ohms in the cathode.

If increased gain is required in the high-frequency stage the 300-ohm bias resistance can be omitted, but this depends entirely on the valve used. If one is obtained with a slightly lower amplification factor than normal it is sometimes a good idea to omit this resistance.

Construction

As regards construction this will not present any difficulty. The chassis is made of five-ply wood and is 16 ins. wide, 9 ins. deep, with a sub-baseboard of 3 ins. The panel is 16 ins. wide and 9 ins. high, made from 14-gauge aluminium.

The chassis is covered with perforated zinc, which can be obtained from Woolworth's and costs 6d. a roll. One roll will be enough for two receivers of this size. It is far preferable to aluminium foil for no holes have to be drilled for wood screws, while connections can be soldered directly to it.

Holes for the valve holders can be cut out with a carpenter's centre bit, but it is advisable before cutting the hole to cut a slightly larger hole out of the zinc foil and then to complete the smaller hole for the valve holder. The valve holders, H.F. choke, L.F. choke, electrolytic condensers, fuse, filament-dropping resistance and two-ganged tuning condenser can all be mounted on the chassis. The positions for the three condensers on the panel should then be marked as well as the hole for the loud-speaker. A 4½-in. hole will be ample for the W.B. midget speaker, but if this is going to be cut with a fret-saw make a slightly smaller hole and then file it out with a half-round file to make quite sure it is perfectly smooth and circular. Four holes should then be drilled around the large hole and the loud-speaker bolted on. The balancing and reaction condensers should also be mounted. These are one-hole fixing. Six small holes, two at each end and two at the middle then have to be drilled to take the wood screws for fixing the panel to the chassis. When this has been done simply bolt on the B.T.S. tuning drive.

Underneath the chassis two 2-mfd. condensers have to be screwed down near to their associated components. Wiring can be carried out with 20-gauge tinned copper covered with systoflex, although it is an advantage to wire up the valve heaters with 1-mm. flex.

Simple Tuning

The receiver when first switched on will take about 1½ minutes to give maximum emission. Tuning is quite simple, simply adjust the main drive until a station is heard, then adjust the balancing condenser on the left-hand side of the panel to give maximum volume.

Components for Universal Mains Short-wave Three.

CHASSIS AND PANEL.
1—Wood chassis to specification (Peto-Scott).
1—Aluminium panel 15 × 9 (Peto Scott).

CONDENSERS, FIXED.
5—.01-mfd. type PC101 (Bulgin).
1—.0002-mfd. type PC302 (Bulgin).
1—.0003-mfd. type PC303 (Bulgin).
1—.0005-mfd. type PC305 (Bulgin).
2—2-mfd. type SC20 (Bulgin).
1—1-mfd. type SC10 (Bulgin).
2—8-mfd. electrolytic 500-volt working (Dubilier).

CONDENSERS, VARIABLE.
1—2-gange .00016-mfd. (J.B.).
1—.000015-mfd. type 1053 (J.B.).
1—00015-mfd. type 2140 (J.B).

COILS.
2—sets 4-pin (Eddystone).

CHOKE, H.F.
1—type 982 (Eddystone).

CHOKE, L.F.
1—30-henry 60-m/a (Sound Sales).

DIAL, SLOW-MOTION.
1—Standard (B.T.S.).

HOLDER, FUSE.
1—¼-amp. fuse holder and fuse (Microfuses).

HOLDERS, VALVE.
4—7-pin chassis type less terminals (Clix).
2—4-pin chassis type (Clix).

LOUD SPEAKER.
1—type Midget (W.B.).

PLUGS, TERMINALS, ETC.
2—Insulated sockets type II (Clix).
2—insulated plugs type 12 (Clix).
1—mains plug and socket type P12 (Bulgin).

RESISTANCES, FIXED.
1—30,000-ohm type 1-watt (Amplion).
2—20,000-ohm type 1-watt (Amplion).
1—50,000-ohm type 1-watt (Amplion).
1—10,000-ohm type 1-watt (Amplion).
1—5,000-ohm type 1-watt (Amplion).
1—300-ohm type 1-watt (Amplion).
1—.25-megohm type 1-watt (Amplion).
1—2-megohm type 1-watt (Amplion).
1—375-megohm type 1-watt (Amplion).

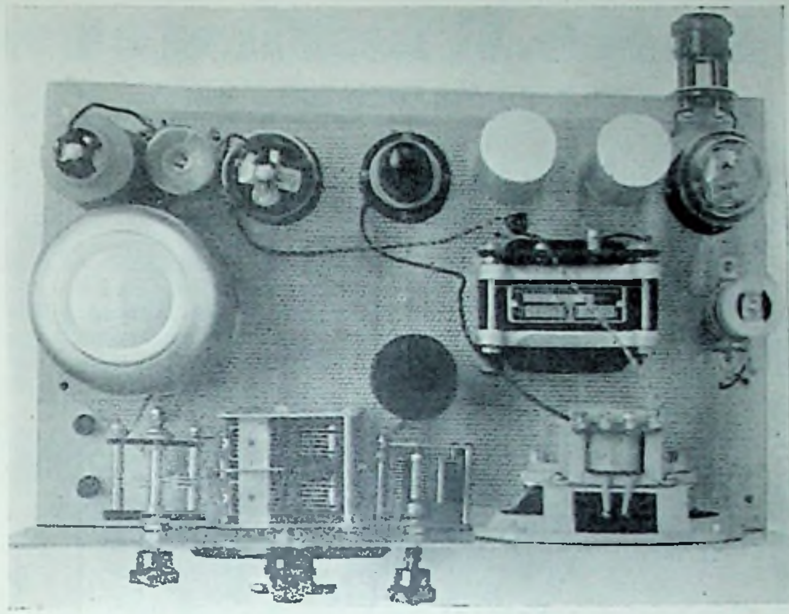
RESISTANCES, MAINS.
1—type MR46 (Bulgin).

SUNDRIES.
Connecting wire and sleeving (Goltone).
3—plug top anode connectors (Bulgin).

VALVES.
1—W31 Osram.
1—H30 Osram.
1—N30 Osram.
1—U30 Osram.

Reaction should be adjusted still further to increase the volume, after which tuning is carried out with the main drive plus reaction. The first pair of coils tune between 12 and 26 metres and are suitable for daylight reception, the second coil covers 22 to 47 metres, the third 41 to 94 metres, and the fourth 76 and 170 metres. Broadcast band coils are also available, tuning up to 2,000 metres, but selectivity will not be of a sufficiently high order unless a small preset of .00005-mfd. capacity is connected in series with the lead-in. This receiver will meet a big demand for it is capable, even in the hands of a novice, of bringing in a large number of short-wave programmes.

The circuit, although it is more or less conventional, is reliable, while amateurs who wish to use the receiver for the amateur bands only, can dispense with the balancing and two-gang .00016-mfd. condenser, and use instead one of the new Jackson two-gang 15-mmfd. condenser units so giving permanent band-spread.



The aerial coil is screened from the rest of the circuit but the grid coil is unscreened. It can be seen beside the reaction condenser.

TELEVISION IN NATURAL COLOURS

By B. Bennett.

TELEVISION in natural colours would appear to be possible by a combination of Kerr cell and prisms with photo-cells of various spectrum sensitivity. In other words there would be a relation between the colour of the televised subject and the various spectrum-sensitive photo-cells which would govern the signal voltage applied to a second Kerr cell.

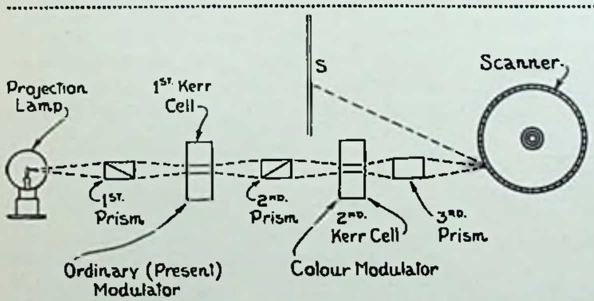


Fig. 1.—A suggested scheme for colour television employing a mechanical transmitter and Kerr cell light valves.

It would be necessary to use two Kerr cells with three prisms, Kerr cell No. 1 is used for shade modulation and Kerr cell No. 2 for colour modulation in conjunction with the third prism which allows only one colour to pass at a time.

The amount of turning of the plane of polarisation is different fo- different colours and Kerr's constant is inversely proportional to the wavelength of the light. Using the same voltage there is less turning of the plane of polarisation for red than for blue light, for example, and a predominating colour can be observed when the light emerges from the second prism.

A suggested scheme is shown by Fig. 1. The third prism is necessary to allow the passage of only one colour at a time, this colour being selected by the signal intensity applied to the second Kerr cell. A control would be needed between the colour of the televised subject and the intensity of the signal voltage applied to the second Kerr cell, so that a weak signal allows blue to predominate and a stronger signal red because, as already mentioned, the amount of rotation of the plane is different for different wavelengths of light.

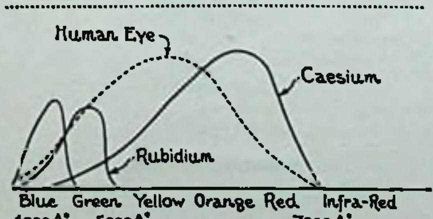


Fig. 2.—Curves showing the colour response of different types of photo-electric cells.

Different types of photo-electric cells are differently sensitive to a particular part of the light spectrum according to whether the cell is a caesium, potassium, or rubidium, etc.

The caesium photo-cell is most sensitive in the red part of the spectrum towards 7,000 A°, potassium in the blue, and rubidium for the green (see Fig. 2). Here then are three cells for colour controllers at the transmitting end to affect the second Kerr cell at the receiving end.

By feeding the impulses generated by the different photo-cells according to colour variation being televised, to the second Kerr cell, the plane of polarisation would be turned and according to the amount of this produce a different predominating colour.

Only a very small percentage of light would be lost in the second Kerr cell and although the third prism will also tend to absorb some of the light sufficient brilliance should be possible for home television screens.

What S.W. Amateurs are Doing

Here are some further ideas used by amateurs which our Short-wave Editor has obtained after contact with amateur operators.

IN a past issue details were given of a V-doublet aerial designed by a well-known American concern. This has been used to a very great extent by several G stations. For example, GI5MZ mentioned that with the V-doublet aerial in use interference from a mercury-vapour rectifier was completely eliminated.

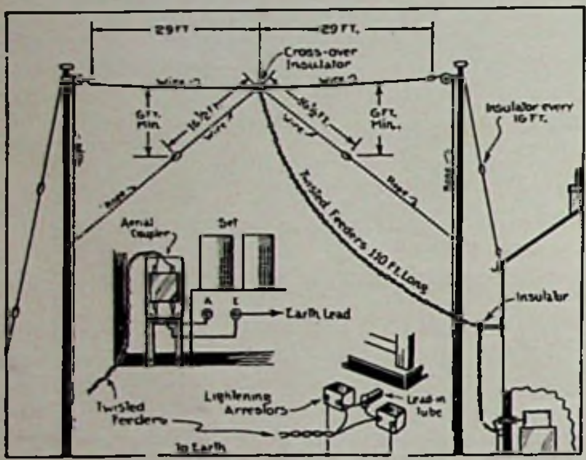


Fig. 1 (left).—This is an evolution of the doublet aerial designed by the R.C.A. Co. It is effective without causing a big drop in signal strength.

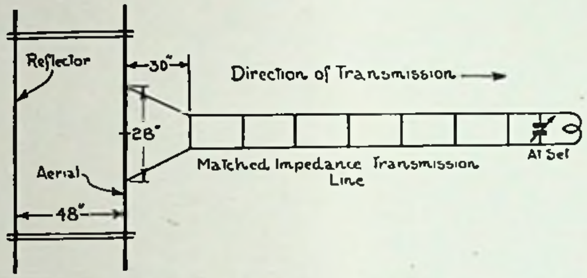


Fig. 2.—Directive aerials make a big difference to the field strength at 5 metres. Try this arrangement which is easy to erect.

I noticed that one station was using an improvement on this V aerial; actually a double-doublet. The circuit arrangement is shown in Fig. 1. Although cut for 20-metres the total length was only 58 feet and this was found to resonate perfectly. An inverted V from the centre spread to 16½ feet, while twisted lamp flex for the feeders were made 110 feet in length, but this was only as a matter of convenience. The stay wires were broken every 16 feet by insulators otherwise loss in radiation or pick-up as the case may be was experienced.

It looks as if this aerial may have distinct possibilities either for transmission or reception so we shall be glad to hear from any readers who have gained any further experience with it.

Directive Aerials

Aerials seem to interest amateurs for at another station I saw rather an interesting arrangement for directive transmission. The aerial that appeared to give more than average radiation is shown in Fig. 2. This is a conventional radiator for 56 mc. with a directive reflector, coupled to the transmitter or receiver through a matched-impedance transmission line.

The method employed is quite simple, the only critical feature being the design of the double feed line, the points at which these lines connect to the aerial, and the length of the fan or the distance it takes for the two feed wires to come down from 28 ins. apart to only 3 ins. apart.

The transmission line is constructed of 18-gauge enamel-covered wire spaced 3 ins. with wooden dowels boiled in paraffin. These spacers must not be more than 12 ins. apart, so when the line does sway in the wind it sways altogether, spacing remaining constant.

Both feeders terminate at a point 30 ins. from the aerial itself and at right angles to it. From this point the lines spread fanwise until they can be joined to the aerial at a point 14 ins. each side of the centre, that is, 28 ins. apart. Such a transmission line has an impedance of 600 ohms, and this is also the approximate impedance of that section of the aerial between the two points where the line is connected.

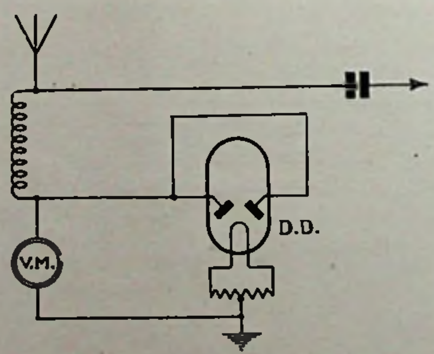


Fig. 3.—Some means of R.F. measurement is a great help in obtaining the most from the transmitter.

Any length can be used for the transmission line providing the 3-in. spacing is preserved. At the transmitting end the coupling consists of a coil of a single 3-in. turn parallel-tuned by a midget condenser. If used for reception a small coil of about five turns ½-in. diameter will be found more convenient, while the grid of the first valve is connected to one side of this coil through a capacity of about 10 micro-microfarads.

R.F. Measuring Instruments

Very few amateurs have any radio-frequency measuring instruments available. Neon tubes seem to foot the bill in many cases but are hardly suitable for even comparative measurement. It is all very well using a neon tube to tell whether or not there is any R.F. in the aerial circuit and for just checking the amount of R.F. in the buffer stages, for example.

A neon tube is almost useless when it comes to obtaining differences in R.F. output for two different settings of a tuning condenser. It is difficult to remember the amount of light when making these tests, and secondly, the amount of change is inclined to be small.

W8HXR, in Dayton, Ohio, uses a very simple R.F. meter for obtaining peak settings of an aerial circuit with only a low-voltage meter, a double diode for a valve, and a home-built H.F. choke. The only voltage to be measured is the leakage of the R.F. choke, and in the circuit shown on Fig. 3 this is approximately a 7-volt peak.

By substituting a 100,000-ohms resistance for the choke, the voltage rises to approximately 400. This naturally puts a slight drain on the aerial and affects tuning, so it is better to keep to the choke.

The meter can be read accurately so that direct comparison between two settings of a tuning condenser can be noted. It is essential that the unit be coupled to the aerial as indicated in Fig. 3 so that D.C. anode voltage will not get to the meter. Incidentally this is an excellent test meter for the effectiveness of R.F. chokes at transmitter frequency.

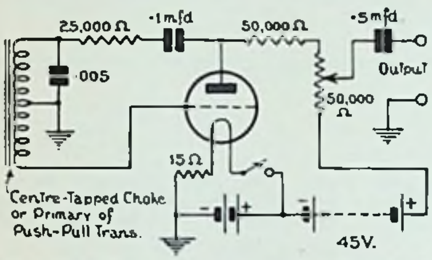
The Short-wave Radio World

A Review of the most Important Features of the World's Short-wave Literature.

A Single-note Oscillator

A 500-CYCLE note oscillator having an output relatively free from harmonics is very useful in a phone station or in a laboratory for oscillograph measurements. A sine-wave oscillator is often necessary accurately to find the distortion characteristics of an L.F. amplifier.

Most amateur phone stations suffer from amplitude distortion, perhaps rather more than from frequency distortion, so making a single-frequency oscillator a necessity. In a recent



A push-pull transformer primary will make a good choke for this oscillator circuit

issue of *Radio* appeared a note oscillator which is very simple in design. Actually it is fundamentally similar to the oscillator used by the Bell Telephone Co. in their measuring equipment oscillators. It is a resistance stabilised circuit giving excellent wave-form.

The resistance between the anode and the L.C. circuit is larger than the A.C. resistance of the valve so the total effective anode resistance becomes nearly a constant value. This means good frequency stability, and if the resistance is high enough just to allow oscillation, wave-form remains pure.

Simple attenuation of output is obtained by means of a 50,000-ohm potentiometer and this allows the output to be varied from practically zero to about 3 volts peak, as measured by means of a peak valve voltmeter.

The unit is built in a metal case with portable type H.T. battery, a non-spill accumulator and an L-type battery valve. All of the components are mounted on a wooden baseboard, the actual lay-out being of little importance. The anode resistance of 25,000 ohms depends to some extent on the type of tapped choke used. We noticed that the primary of a push-pull output transformer was entirely satisfactory. The .005-mfd. condenser across the anode section is, of course, variable, being determined by the frequency of note required.

In using this oscillator the output terminals may be connected to the input of the speech amplifier either directly or through a simple resistance network, while the valve voltmeter can be used to check the gain from one or several stages.

One use is a very good guide to the amount of bias required while another is the provision of a pure tone source for Wheatstone Bridge measurements of conductance capacity, or resistance.

A Simple Transmitter

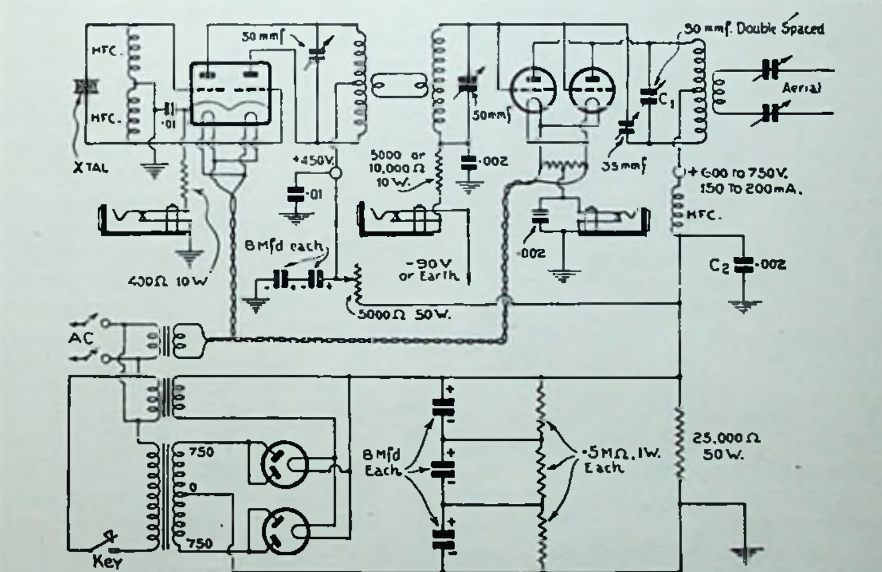
Considerable interest has been created in America by the design of a three-valve transmitter for the beginner. It consists of a class-B valve used as an oscillator-amplifier followed by a pair of 210's in parallel.

210's, certain types of which can be obtained for 4s. 6d. each, will work satisfactorily at 10 watts and equally as well at 100 watts a pair, so that it immediately reduces valve costs to a low level.

The circuit shown by Fig. 2 is rather an interesting one even though it is more or less conventional. A crystal ground to the required frequency is in the grid circuits of the class-B valve which operates in push-pull. The anode is tuned by an inductance and capacity circuit to the same frequency as that of the crystal. This anode coil is then link-coupled to the tuned grid circuit of the 210's.

These 210's are neutralised in the usual way, the neutralising condenser being 35 mmfd.., such as the Eddystone type 900. The anode circuit of the 210's is tuned by a double-spaced .00005 condenser capable of withstanding the voltage applied to the P.A. stage. The power pack is rather ambitious for a simple transmitter of this kind, so instead of using two rectifiers in parallel a single rectifying valve and a transformer giving 250, 350 or 500 volts, as required, will be more satisfactory. The filament transformer must be separate so as to allow for primary keying.

The beginner will find that a pair of 210's running from 250 volts will supply a very smooth 10-watt carrier and standard components can be used throughout without fear of breakdown. The bleeder resistance across the power pack are most important for discharging the fixed condensers.



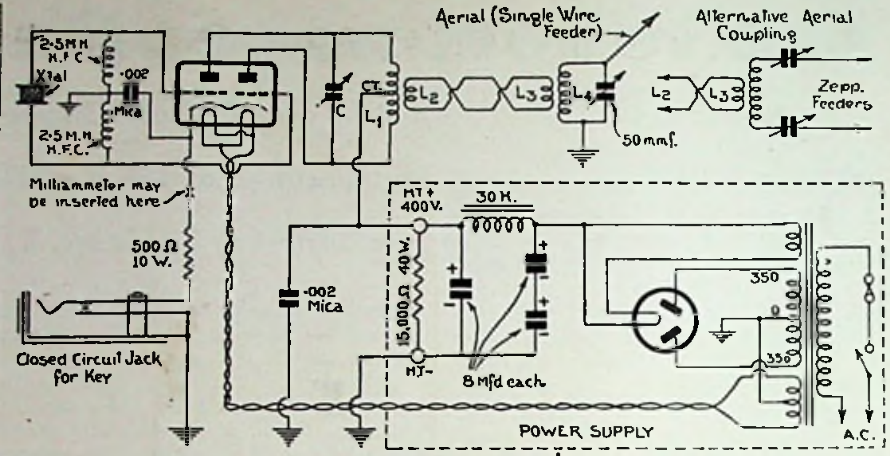
The class B input valve should be of the mains driven type. Both output valves are 210's.

One-valve Transmitter

Yet another transmitting circuit which will appeal to the amateur is shown by Fig. 4. This novel circuit was introduced by *Radiocraft* and will prove popular amongst B.C.L.'s who are taking up transmission. The transmitting valve is an A.C.-operated class B, or if this is not available a pair of AC/HL's connected in the usual way. The crystal for the waveband required is connected across the grids of the two valves with two chokes in series having their centre points earthed. The anodes of the valve are connected to the tuning coil to match the frequency of the crystal used. It is rather important that this coil be carefully wound so as not to lose any radiation; a suitable coil would be about 4 ins. diameter of 18 gauge bare copper wire. This coil can then be coupled to a conventional Zepp-feeder or to a single wire feeder as required.

Keying is carried out in the common cathodes and as a general rule little interference would be caused without a filter. The power pack of a conventional type should be fitted with a transformer and valve to give the required potential. It is advisable to can the power pack to prevent any pick-up of hum in the transmitter, but this, of course, is a matter for experiment. Primary keying is not possible as a combined mains transformer is used. The 15,000-ohm 40-watt bleeder resistance is again used to discharge the smoothing condensers.

The circuit is perhaps the most simple we can advise for the beginner and will give perfectly satisfactory results.



Long range is possible with this simple transmitter. It can be adapted for battery operation by using a Cossor 240B valve.

RECENT HISTORY OF GERMAN TELEVISION DEVELOPMENTS

THE attempt to transmit visible happenings by electrical means occupied German inventors in the middle of last century. Nevertheless at the start it was considered a fantasy which could not be carried out. The first person to propose a suitable solution according to present-day ideas, and to have patented it in 1885, was the Berlin engineer Paul Nipkow, who lives in Berlin-Pankow and is now 75 years old. His invention could not be turned to account at that time because the necessary technical auxiliary materials were not available. It was the development of amplifiers which first opened new possibilities for the realisation of television. In Germany, it was Mihaly Karolus and the German Post Office in the first place, who recognised this, and undertook practical experiments.

Phantasists

The experiments had, at that time, to be carried out in all secrecy, for television was generally regarded as a Utopia and those who busied themselves with this problem were held to be phantasists, not to be taken seriously. These views were represented even up to a short time ago by a large number of well-known scientists and technicians. To-day, with television in an essentially serviceable form, all these doubters must see their error. The work which has been carried on on behalf of television in the last eight years by German inventors and German firms under the direction and with the liveliest co-operation of the German Post Office, has been a hard struggle, which demanded unusual perseverance and a strong optimism.

The First Pictures

The first pictures led the way in 1929 with 30 lines. In the course of its further development, in addition to other improvements, the number of lines and hence the quality of the picture was continuously increased. To-day 180 lines have been reached. The pictures, which are given over the Witzleben transmitter have this number of lines. For a long time experimental transmissions were carried out daily by the German Post Office, and took place from 9-11 a.m., 3-5 p.m., and 8.30-10 p.m. These experimental transmissions had latterly reached such excellence that the transmitter could, without any qualms, be placed at the disposal of the National Radio Society several times in the week for programme transmissions, and these have been taking place regularly ever since.

The experimental transmissions of the German Post Office are continued in the same way as formerly on the remaining week-days.

Meanwhile the German Post Office has taken a considerable step forward in the work of development, and that is the construction of a light ray scanning apparatus, built by Fernseh A.G. The scanning apparatus is set up in the Television House of the German Post Office in Rognitzstrasse, and is now incorporated in the regular experimental work of the German Post Office. It permits of giving pictures of individual persons and also little scenes.

Only a few of the public will be in a position at present to acquire a television receiver. But in order to give the public an opportunity of seeing the results achieved the German Post Office has now set up the first public television station in the Post Office Museum. The visitors to the Museum can see and hear the presentations free of charge.

These demonstrations have been very popular and it is especially gratifying that the work of the German Post Office, not only as a pioneer of television, but also as the most powerful factor in its further development, is appreciated.

As it is assumed that the keen interest in the television transmissions will continue, the German Post Office intends to arrange further public television stations in the various Berlin suburbs.

Our Policy
"The Development of Television."

A 3-Valve S.W. Super-het Circuit

A Development in Amateur S.W. Receivers

By J. H. Crewe

ONE of the most controversial topics amongst short-wave amateurs is the best set for general reception. It has been more or less agreed that an o-V-1 or 1-V-1 receiver is ideal for headphone work, real DX, and for when conditions are bad as regards noise level.

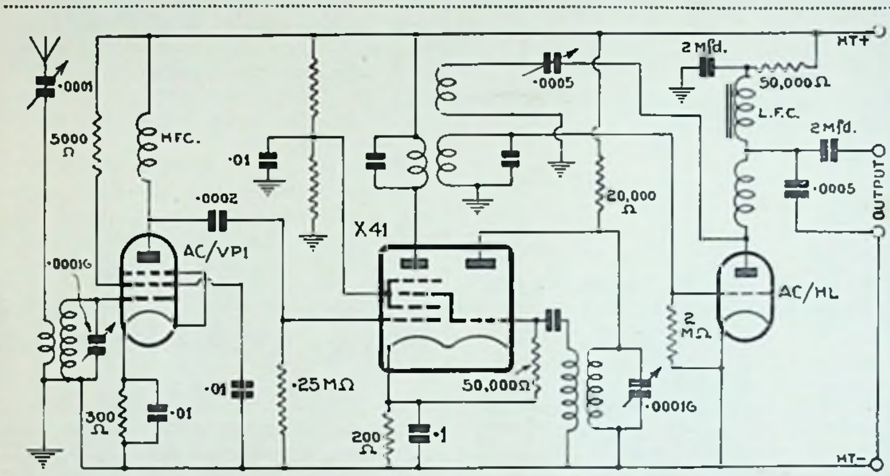
The super-het wins hands down when conditions are good or when the stations to be received are of reasonable field strength. An R.F. stage in front of a super, particularly with regeneration, makes almost an ideal set.

Unfortunately as conditions are usually on the poor side for a great period of the year, users of 1-V-1's and other straight sets score more points as regards long-distance reception owing to the extremely low noise level. Selectivity, however, prevents the most being made of this type of set so that those amateurs who can afford it generally have two receivers.

As so many amateurs cannot afford very much after having purchased gear for the transmitter, some reliable substitute has to be found. What is really wanted is a straight set with super-het selectivity or a super-het with straight set noise level.

I have been interested in this problem for many years, even though two and sometimes three sets were always available. With the introduction of the triode-hexode and other multiple valves, many of the supposedly insurmountable problems were overcome.

The original circuit evolved from purely an experimental basis was triode-hexode detector-oscillator, pentode-I.F. amplifier and triode second detector. This circuit naturally was not much improvement as regards noise level although selectivity was up to a high level. No modifications to the I.F. amplifier or to the first detector made any improvement. It was then realised that some totally different method had to be employed, first to increase the gain, and secondly to wipe out the noise level.



The H.F. stage gives increased gain without background noise. Image suppression is another feature.

The second circuit was then tried with an untuned H.F. amplifier, triode-hexode detector-oscillator, and the remainder of the circuit as before. This increased the gain enormously but the noise level was only decreased if the gain was kept well down.

After experimenting with all kinds of arrangements, different I.F. frequencies, different methods of coupling and by splitting the gain so as to be reasonably level in all stages, a circuit was arrived at which should prove of great interest to all DX enthusiasts.

First of all an H.F. pentode with a tuned grid circuit was coupled to a triode-hexode with an untuned grid, but a tuned oscillator circuit on the anode side. The anode of the hexode was then coupled via a band-pass I.F. coil directly to the grid of a triode second detector.

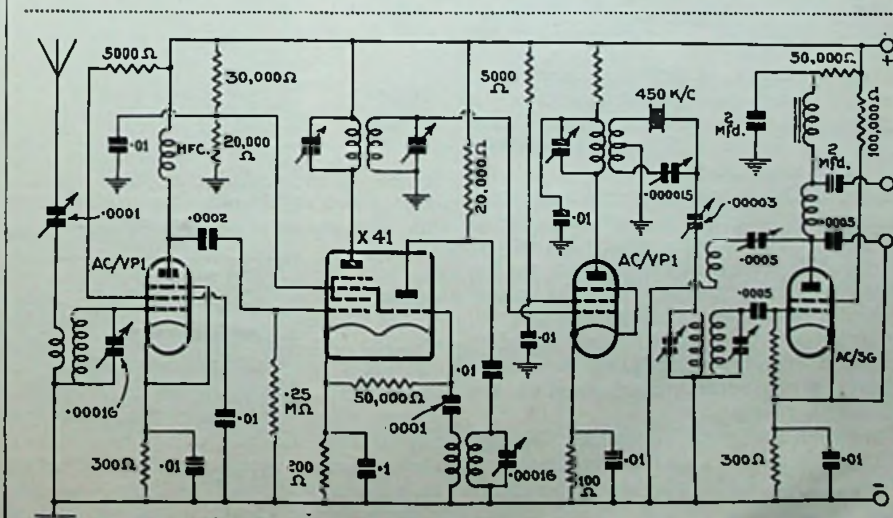
The overall gain of this circuit was slightly more than from a 1-V-1 with normal selectivity. The advantage was, however, that the noise level was also of the order experienced with a straight receiver, but with inherent selectivity.

Headphones were used throughout so making tests even more stringent. On all wavebands very weak CW and phone stations were QSA5, while tuning was quite simple for a two-gang band-spread type of unit was employed. Of course, it is immaterial what type of condenser is used for tuning, so that listeners interested in commercial broadcast programmes should use a .00016 double-gang condenser of conventional type.

An improvement added after a month or so's test was regeneration on the second detector by means of a coil coupled to the I.F. coil. This increased the gain still further. 110 or 126 kc. I.F. coils can be used to advantage for a further increase in gain will be noticed. The stage of tuned R.F. appears to eliminate second channel readings, while the untuned grid circuit in the hexode makes very little difference, whereas the third condenser would greatly increase ganging difficulties.

Several fans then made some suggestions about adding a crystal filter. This was tried but was found impracticable owing to the loss in stage gain. An I.F. amplifier was introduced which

(*Continued in third column of next page*)



A crystal filter makes the receiver selective enough for all amateur requirements.

Receiver Monitoring

THOSE who have a spare milliammeter of a low-reading variety will be interested in this article showing how it can be made to fulfil a useful purpose in the anode circuit of the detector valve. Meters can be very useful for determining different factors providing the full significance of various readings are realised.

There are several positions in the receiver where a meter can be connected to fulfil the purpose of being a visual tuning indicator or a signal strength measuring instrument.

One of the most favourite positions for a milliammeter is in the anode circuit of an I.F. or H.F. amplifier where the reading will increase according to signal strength.

The Americans have found an ingenious idea of using a galvanometer and a simple variable resistance network in the anode of the second I.F. valve. The standing anode current is side-tracked in the usual slide-back method and an incoming signal causes the galvanometer to read.

Judging Signal Strength

Perhaps the most popular English method of judging signal strength is with a galvanometer in the diode circuit where accurate indications of R strength can be obtained. As a signal strength indicator and a visual tuner are fundamentally the same thing, we will refer to it as a visual tuner for this at the moment enjoys most popularity. The rectified current meter connected in the detector circuit is more useful than the ordinary D.C. meter measuring the current of an audio amplifier. The meter in the detector anode gives a reading depending on the strength of the signal applied to the grid of the detector valve, in addition to giving an idea of the voltage and efficiency of the detector stage.

Tuning by ear is rather a complicated business on a powerful multi-valve receiver, but with a milliammeter connected as shown in Fig. 1 this problem is once and for all overcome. An anode-bend detector, for example, consumes 1 milliamp., without any signal being applied to the grid. Directly a station is tuned in the correct tuning position is obtained when the meter gives a maximum reading. What actually happens is that the current rises from a mean or say 1 milliamp. to about 3 milliamps., depending on the strength of signal.

With a leaky-grid detector, although the connection to the milliammeter is the same as for anode bend, the standing current will be very much higher, but the best tuning point is obtained when the meter reads minimum current.

It is a matter of personal preference as to whether an anode-bend or leaky-grid rectifier is used. Of course, the anode-bend rectifier has only a low current reading so that the meter has to be more sensitive and consquently more expensive.

With leaky-grid the milliammeter will have to cope with currents between 3 and 10 milliamps. according to the type of valve, and meters for such a purpose are comparatively cheap.

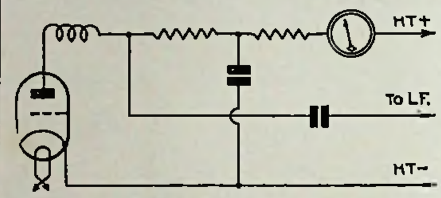


Fig. 1.—This is a typical circuit showing how a meter can be used to read current or for tuning purposes.

A more accurate means of measuring the rectified current, that is the current which actually gives the indication of signal strength, is shown in Fig. 2. This arrangement reads only the increase in current so that it can be calibrated in actual units of R strength.

This type of meter is easy to read, for instead of the standing current being two or three times greater than the rectified current, the standing current is by-passed so the only current to be read is the actual rectified signal current.

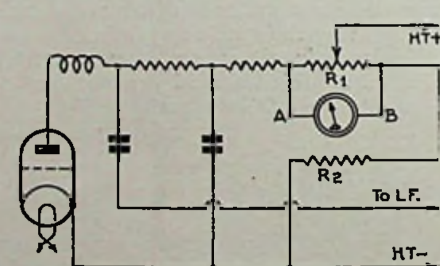


Fig. 2.—To obtain actual values of R strength this system is more useful for the actual rectified current can be determined quite accurately.

The rectified current can be made to read on the meter-scale by balancing out. A convenient method for use in an amateur receiver is shown in Fig. 2, where, although it entails the loss of one or two milliamps., the loss is not very serious. Resistance R1 is adjusted to give any desired reading on the meter when current is flowing, owing to the effect of current flowing through both halves of R1, that is on both sides of the slider. When the slider is adjusted, the voltages developed across the resistances on each side of the slider are equal. There will be no current flowing through the meter so a zero reading is obtained even though the valve is still taking its normal current.

When a signal is applied to the grid of the valve, reduction in anode current, in the case of a grid-leak detector, will cause an increase in voltage at A with a result that current will flow from A through the meter, so a reading based on actual rectified current will be obtained.

This idea can be fitted to almost any amateur receiver and if it was in general use would once and for all overcome the problem of accurately gauging the strength of a station.

A 3-Valve S.W. Super-het Circuit

(*Continued from preceding page*)

increased the noise level and the gain, of course, without the crystal, but with the crystal switched into circuit the gain and the noise was equal to the previous arrangement, but with crystal selectivity.

Some intermediate frequency coils were obtained from Wright & Weaire with a tapped secondary so as to make a proper balanced bridge crystal circuit. The input was then split and a certain percentage was then fed to the grid of the following valve through either the crystal or balancing condenser. The greater the input via the crystal the greater the input and vice versa. A small midget condenser in series with the bridge circuit was then brought into play so as to obtain perfect balance. This circuit then gave results equal to the original three-valve super and it was a matter of doubt as to whether the extra selectivity was worth while in view of the extra expense of the crystal, valve, condensers, and I.F. transformer.

For normal amateur and commercial broadcast reception the three-valve super is ideal, particularly if an I.F. coil is used which has a variable primary-to-secondary coupling. It does seem in view of further experiments and tests, that the three-valve super with tuned R.F. should meet the requirements of a very large percentage of transmitting and receiving stations.

A point to bear in mind is that this three-valve super does have the gain of a 1-V-1 with the selectivity of the super. For loud-speaker working an additional amplifier has to be added after the second detector. This is perfectly conventional and does not need any explanation.

CALLS HEARD

***W9DXX, Alice R. Bourke, Chicago, Ill.* (*20-metre CW.*)**

Period September 1 to November 1, signal strength following call signs.

CE7AA-5, CO2AN-5, 2HY-7, 2LL-8, 8RQ-7, 8YB-9, CM2FA-7, 2DO-7, 2XF-7, 7AB-6, 7JP-5, CX2AK-7, D4ARR-6, 4GAD-4, 4QET-5, EA3AM-4, EI5F-5, 8G-5, F8DR-8, 8EO-5, 8TQ-5, G2AO-5, 2DC-5, 2IM-5, 2IN-5, 2MR-6, 2NM-6, 2XQ-5, 2YB-5, 5GQ-6, 5LI-5, 5NI-5, 5ZJ-7, 5RI-5, 5SR-5, 6CL-6, 6LD-7, 6MJ-5, 6NJ-6, 6OY-5, GI6XS-6, HC2CH-6, HH2W-6, HJ3AJ-3, HP1A-8, K4SA-6, K5AA-5, 5AD-5, K6AUZ-4, 6PHL-6, 6COG-5, LU1CA-5, 6AP-8, 8BAJ-6, OA4N-5, ON4AU-7, 4CSL-5, 4RX-6, PAOXA-5, SM6UA-5, TI2RC-8, 5MR-5, VE1AQ-5, 1CD-7, 1DL-6, 1DM-5, 1EA-6, 1EP-6, 1HG-8, 2BT-6, 2DG-7, 2GA-5, 2GO-7, 2HT-6, 2JK-7, 2JT-8, 3ADM-6, 4GD-9, 4HA-5, 4HM-7, 4OG-6, 4JV-6, 4PH-7, 4RO-7, 4YL-6, 4YO-6, 5EC-6, 5HR-5, 5LG-5, 5LJ-5, VK2EO-6, 2XU-5, 3EG-5, 5HLY-5, VO1IXP-5, VP1JR-8, 4TC-4, 5PZ-6, X1AM-8, 1AY-6, 1DA-6, 1G-5, 2C-5, 2C-5, 2GC-5, 2L-5, 2N-6, 2U-6, YN1AA-4, ZL2KK-5, ZS6T-6.

***Eric J. Wills, Exeter, Devon.* (*20-metre Phone.*)**

ZL4BQ, 1FE, 2BZ, VK3MR, 2TF, 2BQ, 2ZC, 2CY, 5YK, 5FM, 3ES, 2HY, SU5NK, ZL1GX, 2CI, W8CJG, 1AJZ, PY9AH, VS6AQ, LU1AV, VE2GZ, 4DU.

***BRS 1,847, J. A. Jagger, Guildford, Surrey.* (*10-metre Phone.*)**

—Mid-west Imperial.

VK2LZ, 4BB, ZT6K, W2GBJ.

(*28-Mc. CW.*) 1-*V*-1.

ZL4BQ, VK2LZ, 2AS, 2HY, 2HZ, 4EI, 4GK, 4BI, 5GL, 6FG, 6SA, VE3WU, 3RM, PX1CG, X1CZ, LU3DD, VU2CQ, VU2LJ, PK1DF, VS6AH, ZU6P, ZU1C, ZT6K, ZS1H, SU1SG, FA8CR, OH5NQ, HB9T, D4ARR, ON4AC, EA4AO, YR5II, HAF2D, PAOFX, YN4ZO, W1DF, 2DZA, 3BWB, 4AJX, 5WG, 6WOB, 8IXS, 9GBJ.

(*14-mc. Phone.*)

VP2CW, VK4BB, W9KTC, W7DHF, CX2AK, 2KM, W6BWE, K4DDH, W5EEV, W6AZL, 5EDX, K4SA, HJ5ABE.

***BRS 1,784, M. G. Bourke, Jersey, Channel Islands.* (*1.7-mc. Phone.*)**

G6GO, 5CJ, 5NW, 5MM, 5OP, 5KJ, 5ZJ, 5OC, 5CW, 6UU, 6KV, 6SR.

(*7-mc. Phone*)

YV5AM, HI7G, CO8YB, HB9T, GI5MZ.

(*14-mc. Phone.*)

VP2KM, VE2FZ, CO8YB, VE4DU, HH2W, K4GDH, 4SA, VK4BB, HB9J, CX2AK, VP2CD, PY2BA, LU9EA, 7AZ, 4BL, 1EX, 5CZ, 6AP.

***B. McDougall, Stornoway, Isle of Lewis, Scotland.* (*40-metre Phone.*)**

G2HT, 2LU, 2FC, 2PK, 5CJ, 5JW, 5ZJ, 5KF, 5GF, 5GC, 5HL, 5VM, 6YU, 6XQ, 6IF, 6LS, 6PK, 6OS, 6WU, 6FC, 6DH, 6AH, ON4WHL, 4US, PAORT.

***J. G. Barnes, Liverpool, 9.* (*20-metre Phone.*)**

W3BFH, 3EOZ, 3BL, 3XC, 3HF, 3EHY, 4PW, 4CJ, LY1AA, 1AG, CM8YB, HI7G, 60, VP90, 9R, HH2W, VE5CR.

***B.R.S. 1,353, S. Bradbury, Bradford, York.* (*80-metre Phone.*)**

W1LI, VE1EI, PAOEO, HB9AJ, 9B.

(*40-metre Phone.*

HI7G, GI5MZ, 6WG, EI7G, 8G, LX1AI, CT2AV, 1AH, 1JW, 1JC, plus 130 40-metre G phones.

***2BTQ, L. B. Thomas, West Norwood, S.E.27.* (*14-mc. C.W.*) 1-*V*-1.**

75 VK's, 45 ZL's, 35 W's, 6 K6's, 8 J's, 7 CM's, 4 KAL's, 25 LU's. All these stations were received during October.

***2BDN, J. Lucas Letchworth, Herts.* (*1.7-mc Phone.*)**

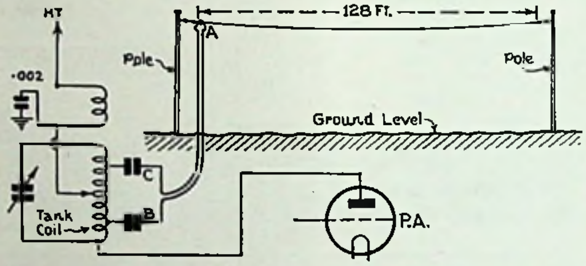
G5WW, 5IL, 5RD, 5VT, 6GO, 2DQ, 5KJ, 6SR, 5CJ, 6NU, 6KD, 5BC, 5BO, 5VS, 6UU, 2OV, 6PA, 5WL, 2KT, 3HO, 5OD, 5AR.

Heard on the Short Waves

By Kenneth Jowers.

MOST amateurs will by now have heard W1ZD on 20 metres, who is putting over amazingly strong signals from his new Collins transmitter. I had hoped to be able to publish details of the new Collins aerial which is being used by W1ZD, but unfortunately the final details will not be ready for another month. However, here are some brief figures which give an idea of the lines on which this aerial was designed.

The arrangement is to use a *resonant* transmission line with a 300-ohm characteristic impedance to fasten directly on to the tank coil of the transmitter. The impedance of this line must be 300 ohms and be of low-loss construction. At the aerial end the line is terminated in either a centre-fed doublet, or as an end-on Hertz as shown in the diagram.



The latest Collins universal coupler is a great improvement on the original arrangement. No special coupling coils are required as the feeders are tapped on to the tank coil.

W1ZD uses a flat top of 128 ft. with twin feeders of the same length. This makes the aerial and feeder each a half-wavelength long on 80 metres, wavelength long on 40 metres and two wavelengths long at 20 metres. The important feature is the line which consists of ¼-in. copper tubing spaced 1½ ins. apart, so giving the correct 300-ohm characteristic impedance.

10-metre Work

Interest on 10 metres is certainly growing apace. G5BY has sent me a very interesting log of stations worked between October 13 and November 10, operating on five Sundays and four Saturdays only. Amongst the stations heard and worked were four W1's, three W2's, four W3's, four W4's, two W5's, three W8's, four W9's, CX1CG, Su1SG, VU2LJ, VK4WB, VK6SA, ZS1H, Zt6K.

W8MWL was worked two-way phone at R7, W9BHT two-way phone and several other stations were worked several times. G5BY obtained WAC on ten metres less than one hour after G2YL. I understand that the contacts with CX1CG, in Uruguay, and VK6SA, in Western Australia, are the first from this country.

It looks from this as if readers will be well advised to spend a little time on the 10-metre band. Most short-wave sets will go down to this wavelength with the correct coil, so listen during the daylight hours.

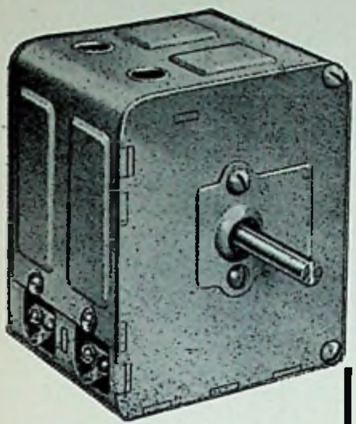
Those who are really interested in the technical side of radio and are within a reasonable distance of Portsmouth should get into touch with the new South Hants Radio Transmitting Society. All members must be scientifically interested in radio, preferably members of the R.S.G.B. and not mere knob-twiddlers. Several field days have been held, and during the winter months meetings will take place on the first Wednesday at the School Room, 13 Outram Road, Southsea, at 7.30 p.m. At the November meeting the president, Mr. L. E. Newnham, B.Sc., A.M.I.R.E., G6NZ, lectured to the Society on "Aerial and Feeder Systems." G2XC will lecture in December on electron-coupling.

John H. Preston must surely be one of the most well-known listening stations in this country. In his last letter to me he points out the bad interference to top band stations from Radio Strasbourg, who has now increased power to 120 kilowatts. He also mentions some new stations that are on the air, such as 6HH, 6ZQ and 5OD. Further reports on these stations will be appreciated.

The monthly meeting of the Westcliff amateurs was held at G5VQ, and a further meeting was held at G6CT a week later to discuss the possibilities of joining the Southend Radio Society. It was finally agreed that the Westcliff amateurs would link up with the S.R.S.

G5VQ is still rebuilding, while 6IF is now on 10 metres but without much success. The next meeting will be held on November 25 when G6UT, the District 14 D.R., will be present.

(*Continued on page 750*)



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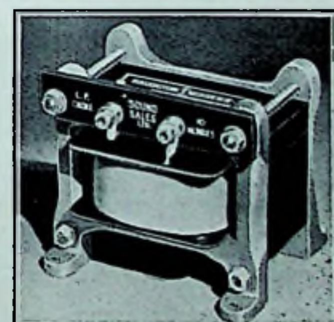

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Heard on the Short Waves

(*Continued from page* 748)

A Novel Transmission

How many heard the transmission from the American stratosphere balloon which was relayed through the short-wave stations on the 19-metre band? Actually I believe the balloon was using an ultra-short wave transmitter on a wavelength of about five metres, which was being picked up by the ground station and relayed to New York. I listened in during the early part of the evening when the balloon was about 60,000 ft. up, and heard most of the remarks, at least until it reached a height of 70,000 ft.

Rocky Point, which has always been known for its short-wave trans-Atlantic telephone stations, has been chosen as the sight for the new R.C.A 200-kilowatt station. The wavelength used will be approximately 28 metres and it is hoped that 100 per cent. service will be possible for the transmission of telegraphy and pictures.

A New Superhet

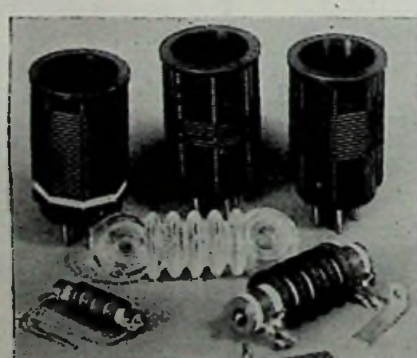
I notice in America that they are using a new kind of 5-metre superhet. The input is fed into a detector oscillator at a frequency of 1,500 kilocycles. This is then fed into a low-frequency I.F. stage at about 1½ megacycles followed by a second converter feeding into an I.F. at 21 megacycles. The third detector is of the super-regenerative type, the output of which is coupled to a conventional L.F. amplifier. The idea certainly gives good overall stage-gain, while noise level is claimed to be of a low order.

Talking about five-metre work those who have seen the British efforts at long-line oscillators will very much like the new American idea of having horse-shoe shaped grid and anode lines. It does not affect performance to any great extent, but it certainly makes a long-line transmitter more compact and suitable for the average radio shack.

On November 27 Ray Noble and his Orchestra re-broadcast from W2XAF on 31 metres. The time is 10.30 p.m. G.M.T. Similarly on November 29 Jesse Crawford, the well-known organist who plays from Radio City, is radiating at the same time. These two programmes will be well worth hearing. On Saturday, November 30, at 11.45 p.m., there is to be a special world's Press review from this same station, which will criticise all sorts of political anges and should be well worth hearing as it gives an idea of what the American really thinks about Europe.

Radio Mart Short-wave Components

THERE are so many cheap short-wave components available at the present time that one is inclined to be a little dubious of components that are apparently high-grade at a very low price. All short-wave fans known G5NI and the Birmingham Radio Mart, but their components are not so well known as they should be.



For example, glass insulators, the general price of which is about 9d., can be obtained for 4d. These insulators are really of very high quality and suitable for all frequencies, including ultra high. There is no reason whatsoever for any amateur using the old-type of china insulators with these available so cheaply.

Perhaps the most interesting component in the range is the model CXT transmitting R.F. choke listed at 4s. 6d. This is wound in five sections in honeycomb formation on a ceramic tubular former. It is provided with neat mounting brackets and is suitable for transmission use at all frequencies. It is without question one of the best R.F. chokes available to British amateurs at the moment.

A choke of similar construction, but, of course, considerably smaller, is priced at 2s. It is designated CHN and is suitable for all short-wave receiving sets. A faulty H.F. choke in a receiver causes poor reaction, dead spots and generally unsatisfactory results. We recommend this choke to any reader who is in doubt as to the efficiency of that component in his own receiver.

Transposition blocks for doublet aerials cost 4s. 6d. for a set of ten. These, of course, are again made from a high-quality insulator and are cheap at this price.

A poor coil will ruin the best receiver. Radio Mart coils of the four-pin plug-in type cost 2s. 6d. for 20 and 40 metres, and 2s. 9d. for 80 metres. These have standard connections, are wound on high-grade moulded formers and can be thoroughly recommended.

G5NI will help any amateur with problems about components or valves. His stock of American valves is very extensive.

"A New Method of Phototransmission"

(*Continued from page 702*).

disc revolving behind it. This light is caught by a second photo-electric cell, and is then transmitted as an interrupted beam of periods of longer or shorter duration. This variation in time may be between 1/200 and 1/1,600 second.

The interrupted current in which the variations in amplitude have been replaced by variations in time can be sent out by wireless.

The Receiving End

At the receiving end, the light used is of constant intensity and is caused to fall on the paper for the length of time the current is emitted, being shut off when the current is turned off.

The pictures obtained by this method have an appearance similar to that obtained from a screen when making blocks, being composed of a series of dashes which are wider or narrower as the variation in the picture is from darker to lighter.

In the reproduction of these pictures, therefore, no screen is necessary, the pictures being photographed directly on to the zinc plate, and the spots in the picture taking the place of those produced by the screen in ordinary pictures.

When to Listen for Short-wave Stations during DECEMBER

By C. J. Greenaway,—2BWP.

G.M.T.	3.5 mc.	7 mc.	14 mc.
0100	VE1 ; W1	W1, 2, 3, 4	
0200	VE1 ; W1, 2	W1, 2, 4	
0300	W1, 2, 4	W1, 2 ; PY	
0500	W4, 5	PY	
0600	W4, 5		
0700		CN ; FA8 ; LU ; ZL	
0800		W4 ; ZL	
0900			ZL ; LU ; PY
1000			ZL
1200			W1, 2, 3
1300			W1, 2, 3
1400			W1, 2
1500		KA ; VK	W1, 2, 4 ; FA8
1600		FA8 ; VU ; VK	W1, 6, 7 ; FA8
1700		FA8 ; SU ; Y1	W1
1800		CN ; FA8 ; FT4 ; SU ; Y1	
1900		VK	
2000		FA8 ; SU ; VK	
2100		CN ; FA8 ; SU ; VK ; Y1	
2200		FA8 ; FF8 ; LU ; W1, 4	
2300	VE1	CE ; CN ; FA8 ; W4	
2400	VE1 ; VO ; W1	FA8 ; W4	

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December, 1935

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Printed in Great Britain for the Proprietors and Publishers, BERNARD JONES PUBLICATIONS, LTD., Chansitor House, Chancery Lane, London, W.C.2, by THE PRESS AT COOMBELANDS LTD., Addlestone, Surrey. Sole Agents for South Africa: CENTRAL NEWS AGENCY, LTD. Sole Agents for Australia and New Zealand: GORDON AND GOTCH (AUSTRALASIA), LTD.