PICTORIAL OUTLINE OF TRANSMISSION & RECEPTION

# Television and SHORT-WAVE WORLD

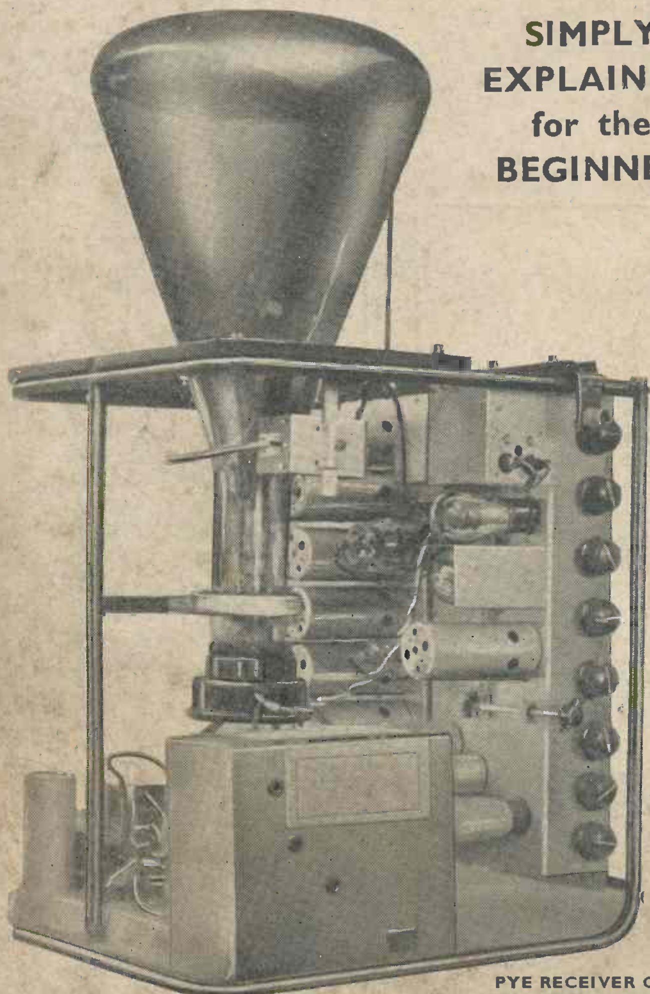
1/- MONTHLY

FEBRUARY, 1937

No. 108. Vol. x.

## THE CATHODE-RAY TUBE

SIMPLY EXPLAINED for the BEGINNER



PYE RECEIVER CHASSIS

**CATHODE-RAY TUBE :—**

*Articles*
*Diagrams*
*Pictures*
*Data*

**SHORT-WAVE**
*Experimenters' Test Equipment*

*£2-2-0 for an Idea*

(page 88)

BERNARD JONES PUBLICATIONS LTD.
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THE FIRST TELEVISION JOURNAL IN THE WORLD

No. 108 VOL. X FEBRUARY, 1937.

# TELEVISION and SHORT-WAVE WORLD

## Special Features




TELEVISION
AND
SHORT-WAVE WORLD

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# COMMENT OF THE MONTH

## *A Suggestion to the B.B.C.*

THE B.B.C. in their questionnaire (reproduced on another page in this issue) ask a number of questions and state that the answers provided by viewers will materially help in developing the television service. It is difficult to appreciate the relevancy of these questions, unless their objective is some form of census of viewers, for we can assure the B.B.C. that with any properly installed receiver there is no difficulty whatever in receiving the transmissions excellently anywhere within the service area of Alexandra Palace. Neither is there any difficulty in adjusting the receiver either for vision or sound, nor is car ignition interference of any serious consequence provided that in some cases steps are taken to minimise it. Every television receiver manufacturer takes care that the receiver is properly installed, and it can be assumed, therefore, that the most suitable type of aerial forms part of the equipment. It would appear that the only information of any value that will result is the location of receivers, and even this will not be conclusive proof of extended service range for, of course, conditions differ in different districts.

Comparisons of identical transmissions, however, that we have made with viewers in various districts indicate that there is a considerable amount of variation in the transmissions, and we venture to suggest that the B.B.C. would be doing viewers a real service and obtaining valuable information if they were to secure the co-operation of viewers in different parts who, immediately the programme was concluded, would report by telephone very concisely the results, the information received then to be broadcast either aurally or visually. Matters such as picture brightness, contrast, synchronising and definition would be important items of the reports.

Probably about half a dozen checking posts would suffice, and the procedure need only occupy a few minutes, particularly if the information was given in semi-coded form. This information would at once serve the purpose of removing any doubt from the minds of viewers regarding the correct functioning of their receivers, assist them in the proper operation and provide the transmission engineers with valuable data.

There is one further suggestion which we should like to make, and that is that when repetitions of programme matter are essential—and at this juncture this seems inevitable—that the repeated items are given in sequence. With this arrangement viewers would be saved the annoyance of switching on and off or waiting for the duration of the whole of the programme in order to see only a part.

# LARGE-SCREEN TELEVISION

## SCOPHONY PROSPECTS : : GERMAN TECHNICAL VIEWS

BY THE EDITOR.

GERMANY was one of the first countries to experiment successfully in large screen high-definition television pictures. In August, 1928, Professor Karolus, of the Telefunken Company, the chief German radio and television concern in Germany, demonstrated at the Berlin Radio Exhibition a 100-line picture 1 m. square. In 1935 he showed another 100-line picture, this time the size was 4 m. square, and the brightness was very good indeed.

Professor Karolus has continued to concentrate on the large screen aspect of television and therefore his views about the future prospects in that direction are of considerable importance.

It is a matter of great pride to this country to know that Professor Karolus is of the opinion that certain methods for large screen pictures developed in this country, i.e., *the Scophony methods, are most promising for commercial and practical ends.*

Professor Karolus and Professor Schröter (director-in-chief of the Telefunken research laboratories and one of the leading German authorities on the subject of television) have recently delivered a series of lectures to the German Electrical Engineers at the Charlottenburg Technische Hochschule, Berlin, on various aspects of television, and the tributes paid by them to Scophony, the British television system, coming as it does from persons associated with one of the most important competitive concerns, are very significant, the more so if one bears in mind the existing ramifications of Telefunken in the field of radio. As far as we know Telefunken, Radio Corporation of America, Marconi-E.M.I. have an interchange of patents in the field of radio, and possibly also in the field of television.

It will be of interest to quote some extracts from the lectures referred to above.

*Extract from the Condensed Synopsis of the Lecture by Professor Dr. F. Schröter, entitled "Physical Rules, Possibilities and Limits of Television" given on November 2, 1936.*

(translation from the German)

"... By exciting supersonic waves with a piezo quartz in a cell containing liquid, the Debye-Sears optical effect can be produced. By modulating the vibration of the quartz with an input of 0.05 to 0.2 watt the changes of the diffraction grating can be used as a television light-relay.

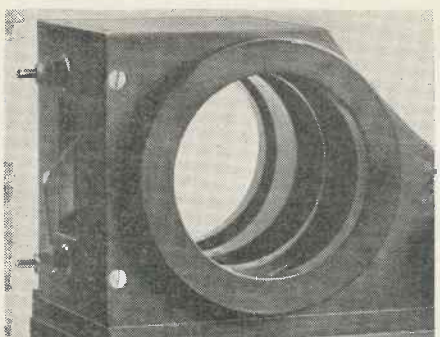
The brightness of the pictures can be considerably increased by the Scophony method. This method consists of focusing the plane of the liquid waves on to the screen and in the compensation of the traversing motion with a scanner-drum.

*With the aid of the Scophony system a high number of picture elements is simultaneously active, giving a storage or integration of light, similar to the working of the human eye. A good illumination (over 5 lux) is achieved on a large screen with 240 lines (100,000 picture elements).*"

(the italics are ours).

*Extract from the Condensed Synopsis of the Lecture by Professor Dr. A. Karolus, entitled "The Problem of Large Pictures in Television" given on December 14, 1936. (translation from the German)*

".... We have heard the fundamental principles of the Scophony system in the lecture by Professor Schröter. A characteristic is to preserve or store the modulations along the full length of a line. The piezo-electric crystal, which is modulated by the transmitted signals produces in the liquid a compression wave train, which travels and persists in time.



*The Scophony light cell for medium-screen pictures*

### *Alexanderson's Method*

"The 'electrical focusing' of E. F. W. Alexanderson is in a sense related to the preceding method. In this case there are several light control cells at equal distances apart arranged in the scanning direction and not at right angles to it, and they are connected to one another by electrical time delay circuits. The signal corresponding to a definite picture element excites the cells in the order of their arrangement successively. The propogation speed in the cell is chosen in relation to the opposing scanning speed so that the consecutive flashes emanating from the same picture element coincide on the reception screen. According to this process each picture element could flash, instead of once per picture, several times rapidly in succession and the brightness could be correspondingly increased. This process would, however, require for a reasonable amplification degree an expense hardly permissible in practice, and is therefore greatly inferior to the Scophony method."

### *The Cathode-ray Tube and Projection*

Professor Karolus further dealt in his lecture with the prospects of the cathode-ray tube for projected pictures, and pointed out, on strength of practical experiences to date in the various television laboratories, that projection by means of cathode-ray tubes presented great difficulties in achieving the desired results.

He then goes on to say in the synopsis:

"The principles of the cathode-ray oscillograph appear to be *hopeless* (our italics) for the creation of cinema-size television, even with the highest possible specific output in the luminous surface which could be achieved by electron-optical methods, more so as the experiments made in the laboratories of the General Electric Company, U.S.A., to use instead of fluorescent masses, thermal radiating materials (such as Auer masses or the like) failed completely."

# U.S.A. AND THE PROBLEMS OF TELEVISION

## PROSPECTS FOR 1937—BY OUR AMERICAN CORRESPONDENT

A VERY large amount of interest in television in the United States now centres round the work of the Philco Radio & Television Corporation. For the past year this company has been making field tests from its experimental station in Philadelphia, using 345 lines interlaced and obtaining high definition pictures of an excellent quality ten miles from the transmitter. The tests have been temporarily discontinued, while improvements are being made in the apparatus, but in a short time the station will reopen using 441 lines interlaced. When the Philco station reopens, it is expected that it will be the first television station in the U.S.A. operating on the television standards proposed to the Federal Communications Commission by the Radio Manufacturers Association. In short, Philco will present the television that is proposed as the future standard for the United States.

Mr. Albert F. Murray, chief television engineer of the Philco Radio & Television Corporation, in an interview with our correspondent, outlined five essential points that must be cleared up and settled before commercial television will be possible in the United States:

(1) Technical standards for television transmission will have to be approved by the Federal Communications Commission so that any receiver will receive any transmitter within range. The Radio Manufacturers' Association has drawn up a set of these standards which have been offered to the F.C.C. for its approval.

(2) The present limited range of television, averaging about 25 miles, will have to be increased. Key cities, such as New York, San Francisco, Philadelphia, Washington, Boston, etc., will have television first.

(3) Before there can be commercial television in the United States, the Government will have to issue commercial licences suitable for television, that is, in the 42-90 megacycle band.

(4) A source of programmes will have to be developed. In putting on a short sketch by television more is required in the way of costumes, rehearsal and stage properties than for any other known entertainment field. Actors can no longer read their scripts. Both appearance and voice will be necessary for the television star. The problem of giving the American people television programmes 365 days a year assumes staggering proportions.

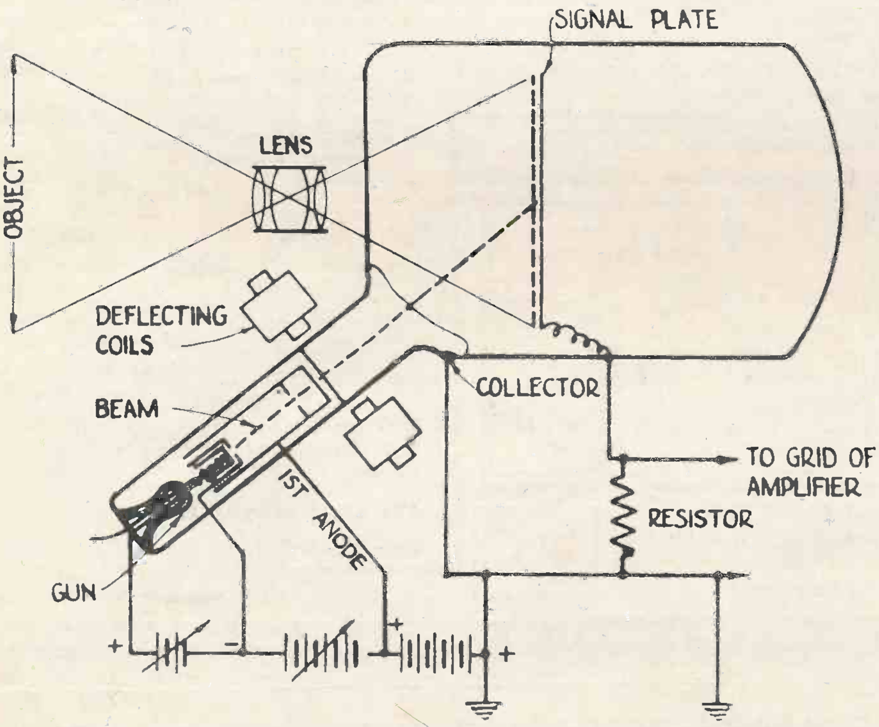
(5) Reduction in the cost of television receivers.

Mr. David Sarnoff, president of R.C.A., said: "In co-operation with the industry, we have recommended to the Fedral Communications Commission the adoption of 441-line definition as a standard for commercial operation. Our New York transmitter will be rebuilt to conform to the recommended standards. That also means building receivers to conform to the new standards of the transmitter. The necessity of synchronising transmitting and receiving equipment carries with it serious responsibilities. On the one hand, standards cannot be frozen prematurely or progress would be prevented; on the other hand, frequently changing standards would mean rapid obsolescence of television equipment."

The Farnsworth Station, in Philadelphia, will "go on the air" some time during the spring of 1937, and will open using 441 lines definition. Thus it will be seen that the United States is assured a standard television, one in which any receiver will receive any programme from any transmitter within range.

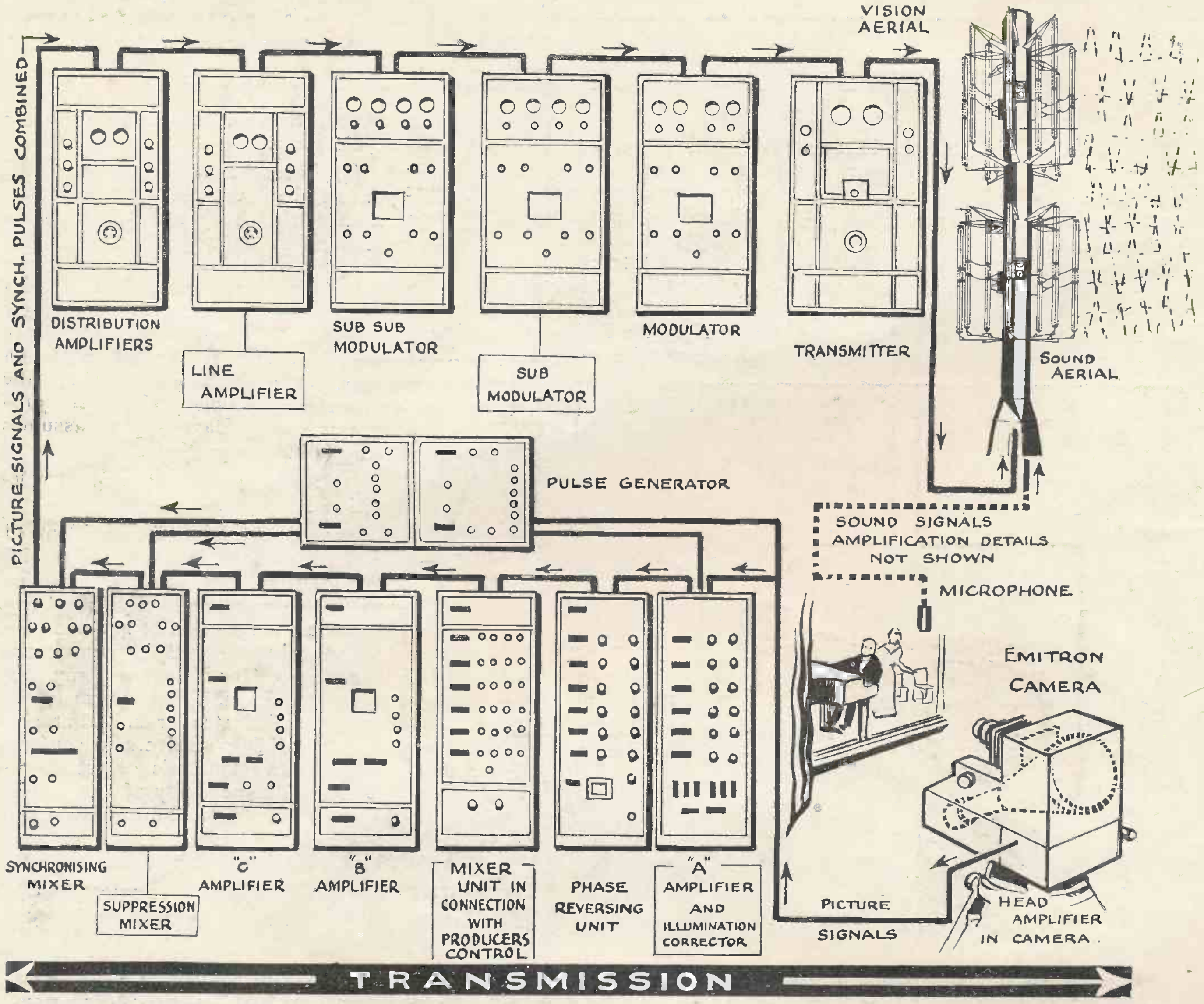
Probably one of the most interesting developments in television in the United States is the perfection of the image-dissector-tube in the Farnsworth pick-up camera to a sensitivity where powerful lights are no longer necessary in a studio. A new Farnsworth image dissector tube operates very well with only four 100-watt electric light bulbs as illumination for a picture of the head and shoulders of a subject, such as an announcer.

### FIRST DETAILS OF THE PHILCO CAMERA




*This drawing is the first published of the camera used by the Philco Radio and Television Corporation which has been so successful in the U.S.A.*

# FROM STUDIO TO PICTURE—A PICTORIAL OUTLINE




## A SIMPLE EXPLANATION

### *The Camera*

THE scene to be transmitted is focused through a lens system on to the sensitive plate of the Emitron Transmitting Camera in exactly the same way as the image is projected in a photographic camera. The camera converts what it sees into electric signals at once.

The camera has an electric memory, that is it will store up and retain a scene after that scene has ceased to be presented to it. If, for instance, after a momentary exposure to a scene, the lens is capped and the camera left for a period, it will, when switched on, faithfully transmit what it saw before the lens was capped.

### *The Head Amplifier*

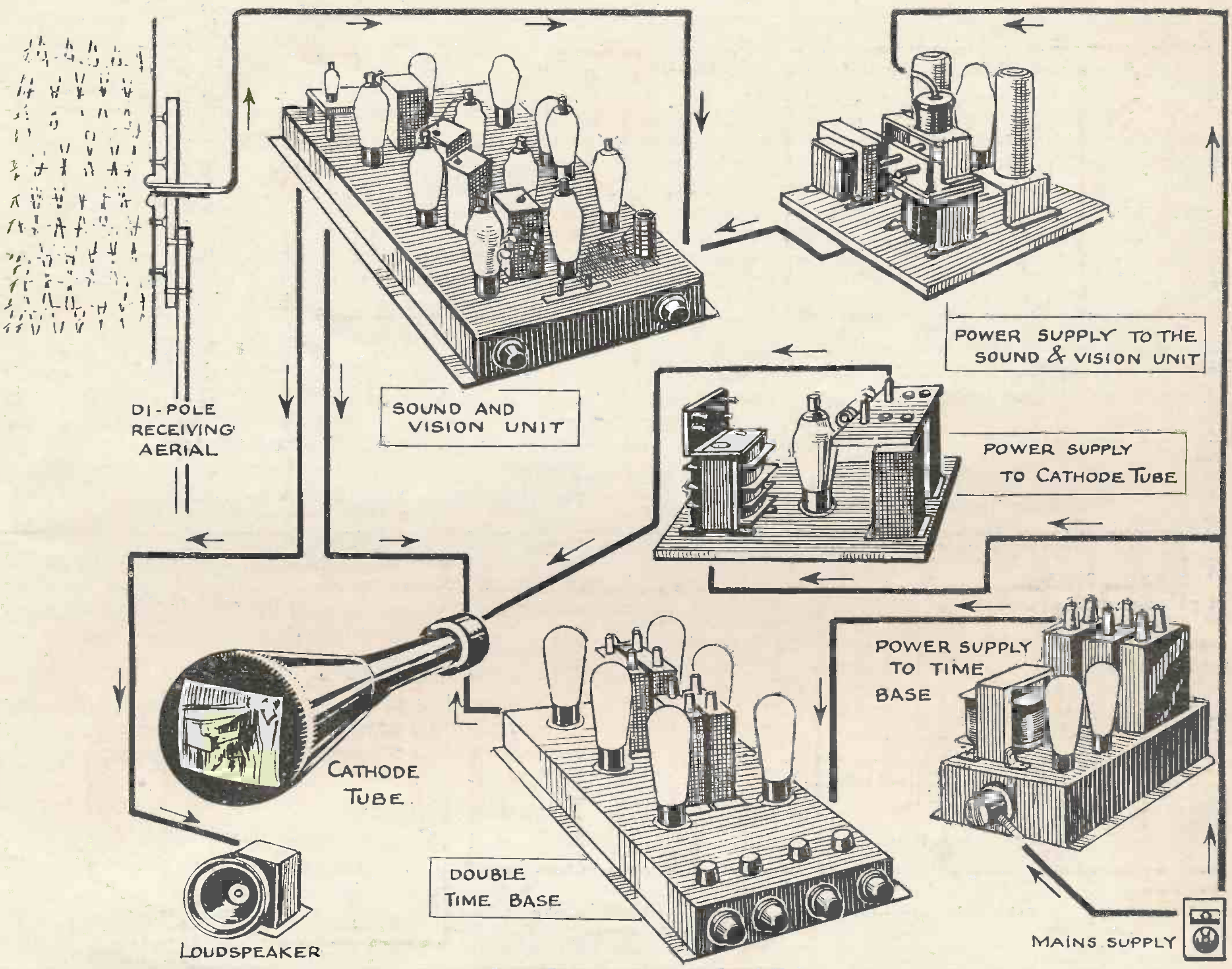
The picture signals from the camera plates are fed straight into the head amplifier. This amplifier strengthens the minute signal from the photo-sensitive plate of the camera sufficiently for them to pass down as much as 1,000 ft. of cable until they reach the main valve amplifying equipment.

After passing through the multi-core connecting cable from the head amplifier in the camera, the picture signals enter the picture illumination corrector unit (one for each of six cameras). This unit arranges that any inequalities which may have developed in the picture signals, are corrected. By this means a faithful reproduction of the light and shade over the whole picture is ensured.

### *The Phase Reverse Unit*

After this the signals enter the phase reverse unit. This unit has been provided because it is sometimes

# OF ELECTRONIC TRANSMISSION AND RECEPTION




RECEPTION

necessary to use either positive prints or negatives of films at will

## The Mixer Unit

The foregoing description has dealt with one camera channel only. Six cameras can, however, be used and the mixer unit sorts out the picture signals from the six cameras by means of electric remote control from the programme producer's control desk. A producer can fade out from a close-up to a long-shot or other scene.

## B Amplifier

Further amplification of the picture signals from the particular camera selected by the producer occurs in the B amplifier unit.

## C Amplifiers

The partially cleansed and amplified picture signals are fed into the duplicate C amplifiers. In the C amplifiers further extraction of unwanted interference, due possibly to the situation of the camera, is effected in addition to further amplification of the picture signal.

## Suppression Mixer Units

The camera signal, which has now passed through two preliminary stages of interference reduction, passes into the duplicate suppression mixer units. Final removal of any interference from the picture signals is effected in the suppression mixer units (a five-stage amplifier).

## Syn. Mixer Unit

The picture signals from the Emitron camera have now been amplified and cleared of any unwanted interference. It is now necessary to add to these picture signals the synchronising impulses which are to be transmitted with the picture signal. This is done in the synchronising mixer unit. As the picture signals pass through the synchronising mixer unit synchronising pulses from the pulse generator (see over) are added. The signal going forward to the transmitter is now a combination of picture signal and synchronising pulses.

### The Pulse Generator

The function of the pulse generator is to produce all necessary pulses and frequencies for picture synchronisation and the operation of the cameras throughout the system. The pulse generator is in two bays. In the first of these the basic frequencies are generated by multiplying the frequency of the supply mains or of a generator which can be independent of the supply mains. The second bay further amplifies and selects the correct pulses (which are multiples of those generated in the first bay) and amplifies, corrects and diverts them to whatever part of the system requires them.

### Distribution Amplifier

The complete signals to be radiated are now fed to the distribution amplifier. Each of these duplicate amplifiers feeds a channel to the transmitter and in addition channels for monitor picture receivers wherever they are required.

### Line Amplifier

From this point we are concerned only with the picture signals to be radiated as they pass into the amplifier. A number of these amplifiers may be used for accepting picture signals from mobile vans or outside broadcast points.

### Modulator Units

Three modulator units follow. These three units raise the picture signals to high power, and consist of eight valves passing a high-power modulating signal to the vision transmitter.

## THE RECEIVER

### The Receiving Aerial

This consists of two copper tubes generally one half wavelength long and used as a di-pole with two feeder lines coming from the centre. This aerial picks up both sound and vision signals and passes them on to the receivers.

### Sound and Vision Receivers

The vision signals are fed into the high-frequency stage of a multi-valve receiver which is capable of reproducing up to two million cycles. As a rule 9-10 valves are needed, which includes four intermediate frequency stages. Sound signals are at the same time fed into the first valve of a simple 4- or 5-valve superhet receiver which rectifies and amplifies before passing the signals into the loud-speaker.

### Power Supply

A common unit provides high- and low-tension for both the sound and vision receivers. As the power pack is energised from A.C. mains the receivers are independent of batteries as grid bias is obtained automatically by means of cathode bias resistors.

### The Cathode-ray Tube

The output from the vision receiver is fed into the cathode-ray tube on the end of which the picture is seen. The electrical impulses from the vision receiver are converted into light in the cathode-ray tube and are controlled by a double time base.

### Double Time Base

The time base controls the formation of the picture both horizontally and vertically and synchronises the receiver with the transmitter. High-tension and low-tension for the energising of the time base are obtained from a special power pack.

### The Time Base Power Pack

This pack is a simple unit giving high voltage at low current and is made up of two half-wave rectifying valves, a small transformer and three or so high voltage condensers.

### Tube Power Pack

The final unit in the chain is the power pack for the cathode-ray tube. It supplies up to 5,000 volts according to the type of tube, but at a low current of about 2-3 ma. A half-wave mercury vapour valve is used in this circuit.

## Television on Suppressed Side-bands

At the last 1936 meeting of the Institute of Radio Engineers (U.S.A.) D. W. Epstein, of the R.C.A. Manufacturing Co., presented the paper "Sideband Suppression in Television Reception." Experience showed, the author said, that a better image often resulted if the circuit was tuned to one side or the other of the carrier, resulting in a partial suppression of one of the sidebands.

The increased detail obtainable under this condition was explained in this manner: The bandwidth passed by the receiver was narrower than that transmitted. By detuning, more "highs" were accepted by the receiver, at the expense of signal strength, resulting in a more detailed image with a lower signal-to-noise ratio. Such detuning retained double side-band reception on the low (over-all scanning line) frequencies, which were proportionately stronger than the highs.

If the receiver band-width is widened in the attempt to accept both transmitted side-bands fully, the gain per stage decreases in direct proportion to the band-width, necessitating more stages. Hence to make the most economical use of the band-width available at the receiver, single side-band transmission is highly desirable.

The effect of single side-band reception on frequency (fidelity) and phase response was examined theoretically and experimentallyy. The transmitter and receiver in the experimental set-up were equipped with rejector circuits which lowered the energy transfer in the lower frequency side-band. Among other things it was found that distortion in the second (linear) detector circuit under these conditions did not become serious up to the maximum modulation level of the transmitter (about 80 per cent.). Wave-form distortion in a television image due to the presence of second and third harmonics seemed, in fact, to be less serious than it is in audible reproduction.

Further research along these lines, it is thought, may materially alter the present concepts now current on television-band dimensions, since in the ideal case a given picture could be sent in half the band-width used for the usual double-side-band method.

# Scannings and Reflections

## STANDARD OF TRANSMISSION

THE decision of the Television Committee to employ two standards of transmission has been the subject of criticism from the very start. The two systems use different picture or signal standards, a point which this journal in common with all those who wish for the rapid progress of television deplore. It is now understood that a decision to use one standard is imminent and likely to be announced shortly after these notes are in print.

It has been obvious that both standards have their particular advantages and it would seem desirable that some compromise should be arrived at, though whether this is what the Television Committee have in mind we are not at present in a position to state. Certainly a picture frequency of 50 per second is desirable on account of flicker. As to the number of lines, the results given by 240 or 405 lines appear identical when transmitting films, which provide a good comparison as the subject matter in all news reels are of the same type. This points to the idea, which seems pretty common, that when electronic devices are used for scanning at both ends (transmitting and receiving) a higher number of lines is better than when the transmitting end is mechanically scanned. We would also hazard a guess that manufacturers would prefer sequential scanning as against interlaced. There is also the matter of mechanical receivers. Although an odd number of lines does not present an insuperable obstacle in the development of these—and they are being developed—matters would be simplified if a figure were used which would provide a more convenient multiple.

## THE PROGRAMMES

There has been a noticeable improvement in the programmes and their presentation of late. The long periods of a picture of a clock, which rarely showed the correct time, are now gone and the blank screens never take more than one of the sixty minutes. Unfortunately those who criticise rarely make any suggestions as to what will improve the subject of their criticism. Television is always compared with the cinema and comparison at the present time is most unfair. The programmes have, however, most definitely been very poor; we have yet to come across anyone who is interested in seeing muffin men, flower sellers, shrimpers and the like. There is also far too much repetition both in the case of artists and fifth-rate films. The "Picture Page," although all right in its conception, would bear revision in its presentation. The constant repetition with the very dummy-looking switchboard begins to jar.

## "EFFECTS"

How many lookers realised that in the recent programme entitled "Paleface" an attempt was made, which was fairly successful, to superimpose the pictures from two sources. The scene was a Gainsborough picture, but unfortunately, the lady in the picture did not quite register in the frame and a short or double exposure effect resulted. Incidentally, in the same programme the artist's model scene was considered most daring—for the B.B.C.

## FILM OF REALITY?

There is much controversy in television circles as to whether viewers prefer to look at a television image reproducing "live" artists in the studio or film. Actually, as both are just shadow images via television it seems that provided it entertains the origin does not matter. There is little doubt that the average film is superior to the average television studio fare from live artists, though, unfortunately, the majority of the films shown so far have been most uninteresting. It was possible, however, to make a comparison in the recent programme in which Sir Malcolm Campbell and his famous Bluebird were featured. One first saw the actual car with Sir Malcolm at Alexandra Palace and then a film during its record-breaking runs at Daytona and Salt Lake. Similar scenes such as close-ups of the car and Sir Malcolm were in no way comparable, the film being vastly superior in every way.

## FARNSWORTH TO COME ON THE AIR

The Farnsworth Television Corporation have announced that a studio has now been equipped with two electron cameras and transmitting gear erected with the object of putting out programmes in the near future.

Mr. A. H. Brolly, chief engineer of the Farnsworth Company, in his announcement for the company, said: "In our experimental broadcasting from the Philadelphia station, we plan to meet in every respect the requirements for television broadcasting, recommended to the F.C.C. by the Radio Manufacturers' Association Committee on television standards. This means that the picture that we will broadcast will have 441 lines and use interlaced scanning.

"The Farnsworth transmitter is located on one of the highest points in the Philadelphia area, and the studio has been located on the outskirts of the city purposely to try out the use of directional broadcasting to cover a populated area from the outskirts of a city rather than for the broadcast from a transmitter located in the centre of the city."

## THE SERVICE AREA

The service area of the Alexandra Palace has proved to be greater than was anticipated. The G.E.C., for example, have already installed standard home sets in ten counties within an area embracing about a quarter of the population of the United Kingdom and covering more than 3,000 square miles. At each point reception is well up to standard.

Outside the 25-mile radius these installations include not only such places as Luton, Camberley, Dorking and Woking, but towns nearly 40 miles away, such as Reading (Berks.), East Grinstead (Sussex), Tunbridge Well (Kent), and the environs of Southend-on-Sea (Essex). In these fringe towns alone the popu-

## MORE SCANNINGS . . . . . .

lation is more than 300,000. Exceptionally good results are being obtained in all these places. It will be remembered that at the inauguration of the first official television service ten weeks ago, Lord Selsdon said he would be unwilling to lay heavy odds against a Hindhead resident, 42 miles from London, viewing the Coronation.

### MORE APPOINTMENTS AT THE PALACE

Mr. R. A. Rendall has been appointed Assistant Director of Television. Mr. Rendall joined the B.B.C. in 1928. He served for a short time as an announcer before entering the Talks Department, in which he worked in various capacities, including that of talks executive until 1934. In September of that year he became West Regional programme director, at Bristol. A year later he was seconded to the Palestine Government as adviser in broadcast programme organisation, and on the opening of the Palestine broadcasting service at Jerusalem, last March, he became action programme director. Mr. Rendall returned from Palestine recently, and has now taken up his new duties at Alexandra Palace.

Another appointment is that Mr. Reginald Smith, who has been appointed Assistant Stage Manager. Mr. Smith was educated at Clifton College and at Merton College, Oxford. On leaving the University in 1923 he joined the Oxford Repertory Theatre and has been in the theatrical profession ever since. He has also been associated with films and broadcasting.

An assistant has also been given to Mary Allan, the television make-up expert.

### PROGRAMME TIME

The question is being discussed whether the present time of 9 till 10 for the evening programme is the most suitable. The consensus of opinion appears to be that it is not, and that an earlier time would be better. This hour breaks into the evening rather and upsets any other occupation. Obviously the time should be such that the city worker will have returned home and a suggested time is 7.30 to 8.30 or at the latest 8 to 9. These times, it is contended, in addition to not causing a dislocation of the evening, would allow many to see part of the programme and also go out if they wished. An earlier hour would also be welcomed by demonstrators—and, we believe, the Alexandra Palace staff. There is, of course, the point to take into consideration whether an earlier hour would fit in with artists' appointments in other spheres.

### 5-METRE TRANSMISSIONS TO AMERICA

Now that the British amateur H. L. O'Heffernan, G5BY, has succeeded in spanning the Atlantic on 5 metres is seems possible that these very short waves may ultimately be used for interference-free long-distance transmission and reception.

G5BY's record-making transmission to America was first sent out on December 27, 1936, when it was picked up by W2HXD in New York. This record has now been confirmed, so once more amateur radio has proved its worth.

Although ultra-short waves are supposed to have a limited range, this theory will have to be revised for British amateurs have been heard in Morocco, France and other parts of the world when using the 5-metre waveband.

### MODERN PIRATES

The modern definition of a pirate is a person who uses a radio transmitter without a Post Office licence to do so. With the increasing interest in short waves it is becoming more evident that there are many of these pirates at work.

The call sign G8WW is being used regularly, although this call sign has not been officially issued to an amateur. Readers hearing this call at great strength, indicating that the station is a local one, should immediately inform the local Post Office.

### CAR RADIOS

There appears to be a subtle difference between a radio fixed to the car and a portable receiver permanently carried around on the back seat. For a car radio an additional licence must be obtained and to make sure one is purchased a policeman can now ask to see it along with all the other licences.

If a radio is not fixed, but is left on the seat it becomes a portable for which no additional licence is needed. This fine point makes a difference of 10s. a year.

### TELEVISION RECEPTIONS FROM MOSCOW

The television department of the All Union Radio Committee, Moscow, has received a letter from a radio fan living in Birmingham, confirming reception of Moscow television broadcasts transmitted from Radio Station, RZS. This is a low-definition transmission.

### TELEVISION RECEPTION AT 55 MILES

A particularly interesting case of long-distance vision reception is that of Mr. W. R. Westhead, Junior, Avenue Lodge, Dyke Road Avenue, Brighton. As a Christmas surprise item, Mr. Westhead took down by train a standard "Televisor" receiving set, model T.5, of Baird Television, Ltd.

A standard aerial was erected on a bamboo pole on the roof of Mr. Westhead's house, and it is interesting to learn that the picture seen on this set is most satisfactory. No trouble is experienced in synchronising, the signal strength being quite adequate for modulating the cathode-ray tube over its full range. Traces of car interference are, however, noticed, and to overcome this, Mr. Westhead, who is very interested in radio as a hobby, is carrying out a number of aerial experiments, including the fitting of a parabolic reflector in order to see what difference this will make to his results. The outstanding point to notice, however, is the enormous increase in the number of potential viewers which can be embraced with a service area of 50 miles' radius as against the original estimated one of 25 miles.

### TELEVISING A PUBLIC EVENT

Elaborate preparations are being made at the Alexandra Palace for televising the boxing tournament of the Alexandra Amateur Boxing Club on February 4. This may be regarded as the first public event to be televised and particular interest attaches to it on this account. Also it is the first public event which has been advertised to be televised.

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The Corpatact Manufacturing Company of Iver, Bucks, wish to advise all agents and clients who are interested in Corpatact devices that these can now be obtained direct from the manufacturer and patentee who is the owner of the registered trade mark "CORPATACT." All inquiries will have immediate attention.

## . . . . AND MORE REFLECTIONS

### A BLUE RIBBON FOR 5-METRE WORK

In France a "Blue Ribbon" is to be awarded to the amateur making the most headway in 5-metre research. So far four transmitting amateurs have held the trophy, all for covering long distances on low power.

The maximum distance covered to date is a little over 170 miles, from France to Corsica, with a power of 6-watts.

### THE PYE TELEVISION RECEIVERS

The photograph on the cover of this issue of TELEVISION AND SHORT-WAVE WORLD shows the chassis of the Pye television receiver. Two models are made, one a de luxe instrument incorporating television, all-wave radio, and a radiogramophone with automatic record changer. The other model is for vision and sound only. The cathode-ray tube is placed vertically in the cabinet, the picture (size 10 ins. by 8 ins.) being reflected in a mirror in the lid. In order to handle adequately the unusually wide band of frequencies a "duode" speaker is incorporated giving life-like reproduction of both speech and music.

A demonstration of these instruments was given recently and the results left nothing to be desired, the picture being a very pleasing colour with remarkably good definition. It is hoped to give full technical details of the Pye receivers in an early issue.

### BAIRD LARGE-SCREEN TELEVISION

It will be remembered that last month a complete description was given of the Baird super-screen system. A public demonstration of this was given for the first time on January 4 at the Dominion Theatre to a very large audience. It was, of course, inevitable that this should suffer to some extent by comparison with the cinema pictures which proceded it, but even so it was evident that the audience were very much impressed with the show.

As explained last month, the system is primarily intended for visual public address with head-and-shoulders close-ups of speakers, but the manner in which the demonstration was staged proved its suitability for entertainment purposes. Although the programme was transmitted from a studio in the upper part of the Dominion Theatre it could equally well have been via radio. From a technical point of view the remarkable things about the system are the absence of flicker with very low picture speed and the amount of light on such a large screen.

## GRAPHITE COATING IN CATHODE-RAY TUBES

THE coating given to the inside walls of cathode-ray tubes in the earlier days of television used to be, for the most part, silver. This possessed certain disadvantages, notably its bright appearance, causing internal light reflection, which interfered with the image on the screen. A number of materials which could be used to provide this second anode and earthing screen were examined. After much research graphite coatings were selected by tube manufacturers, as for instance, Messrs. Ferranti, as conforming best to the requirements in mind. Such requirements are electrical conductivity, absence of light reflection properties, chemical inertness and the ability to adhere well to the glass walls of the tube.

Graphite in its ordinary form was for many reasons unsuitable. It was necessary to use colloidal graphite, known to the electrical industry as "Aquadag," a colloidal dispersion of the material in distilled water. Films could then be obtained which were homogeneous and had a maximum electrical conductivity. If one used ordinary finely powdered graphite, the particles might be too coarse to form a film which was internally homogeneous, or continuous. The flat particles of graphite should lie on one another like tiles, providing electrical continuity and minimum resistance to the passage of the current.

### *Properties*

Such coatings have a black, matt appearance, which eliminates internal light reflection in the tube. Because the particles of graphite are extremely fine they adhere to the glass tenaciously and to one another. Being almost black and without lustre the coatings radiate heat well, and they are also chemically inert.

### *Formation*

The method of forming the coating varies. One of the commoner methods is to close the end of the tube, which is fixed in a vertical position, with a stopper, and admit from a reservoir at a slightly higher level a solution of "Aquadag" in distilled water. The solution rises up the tube to the level which marks the end of the coating, and this might be from the neck right up to the fluorescent screen or short of that if desired. After the solution is withdrawn by lowering the reservoir the tube is dried and then heated to about 500° C. Another method of application is to brush on the solution.

The thickness of the coating is governed by the concentration of the "Aquadag" solution used. Messrs. Ferranti use more than one coating. A concentration sometimes used by manufacturers of tubes is one part of "Aquadag," which is in paste form, to two parts of distilled water. Certain refinements in the process are necessary, which have not been mentioned, such as the thorough cleansing of the glass walls before forming the coatings, but these are details which are left to individual users.

### Loan Service of Accurate Measuring Instruments

The work of amateurs and experimenters is frequently handicapped because reliable measuring instruments are not available and their cost does not warrant purchase for temporary or occasional use. We learn that H. E. Sanders & Co., of 4 Grays Inn Road, have now a very comprehensive range of high-class instruments which they are prepared to let out on hire for short or long periods at extremely low rates. These comprise Wheatstone bridges, ohmmeters, meggers, standard resistance boxes, milliammeters, microammeters, etc., all of which are accurate and reliable. The fees charged for loan depend on the value of the instrument, and will be quoted on application, but they are much lower than the usual rates.

# ELECTRON APPARATUS AT THE PHYSICAL SOCIETY'S EXHIBITION

THE 27th Exhibition of the Physical Society, which closed on January 7, had little to distinguish it from the previous exhibition of 1936 unless it was the greater proportion of new apparatus and exhibits. The space restriction compelled many manufacturers to omit much of their standard apparatus and overcrowding was noticeable in the Trade Section on the top floor of the Imperial College.

The first floor was also devoted to trade exhibits while on the ground floor there were some twenty stands devoted to research. Of these the most interesting to the television experimenter were the electron microscope of the General Electric Co., and the electron focusing demonstrations of the B.T.H. and Edison Swan Companies.

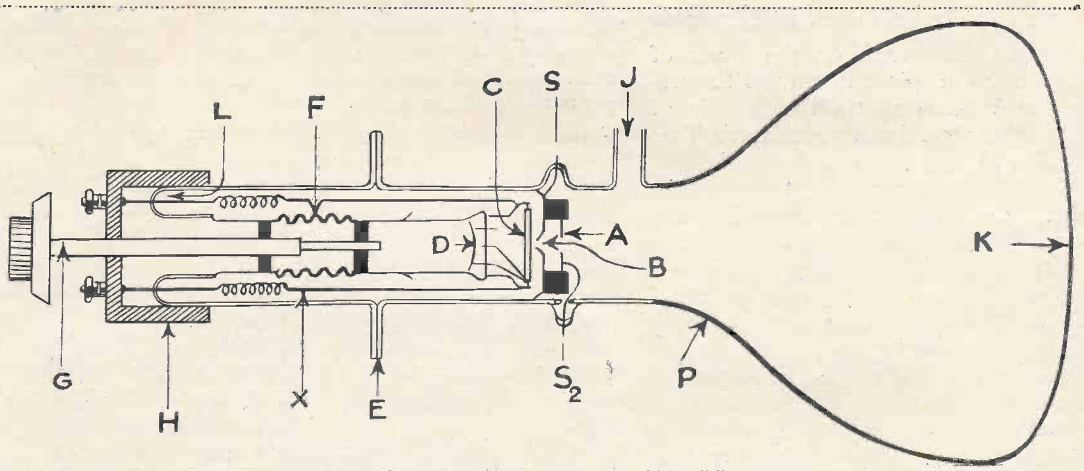
The G.E.C. demountable Electron Microscope is shown diagrammatically in Fig. 1. This demonstrates how the electrons from a suitable source can be focused so that an electron image of the object is thrown on to a fluorescent screen. The lens system consists of two circular cupro-nickel diaphragms set 1 mm. apart, and having 1 mm. apertures. The system acts as an immersion objective, whose focal length is controlled by the ratio of the potentials on the diaphragms. The magnification is altered by varying the distance of the object from the first diaphragm. This is accomplished by means of Tombak bellows attached to the object. The tube is continuously evacuated, and a large ground glass joint permits specimens to be rapidly interchanged, and also enables the object to be moved across the aperture of the lens. The microscope has been used for obtaining electron images of different oxide-coated nickel surfaces, and also for studying the crystal structure of metals.

On the Ediswan stand a long tube illustrated the principles of magnetic focusing. Opposite the "gun" of the tube a small screen is mounted on a tube attached to a soft iron core. By means of an external solenoid the core, and hence the screen, can be moved to any distance from the focusing coil. The effect of varying the current through the latter can then be observed and the focal length of the system demonstrated.

The B.T.-H. Co.'s Electron Trajectory apparatus aroused a good deal of interest. This apparatus enables the potential lines in cathode-

*Fig. 1.—The G.E.C. Electron Microscope.*

A Main lens, circular diaphragm with 1
B mm. aperture. (A and B set 1 mm. apart)
C Cathode
D Glass Pinch
E Ground Glass Joint
F Metal Bellows
G Differential Screw for Bellows Adjustment.
H Ebonite Cap
I Heater and Cathode Leads
J Pumping Tube
K Fluorescent Screen
L Circular Seal
P Carbon Film on inside of bulb
S1 Potential Lead to B
S2 Potential Lead to A



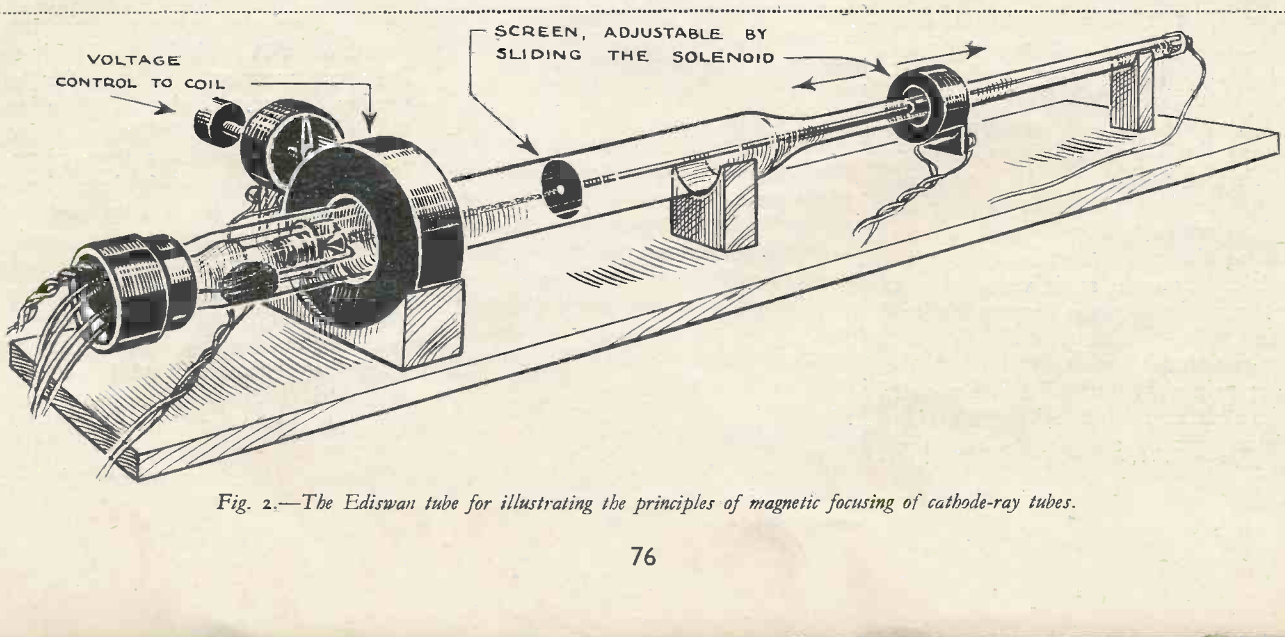




*Fig. 2.—The Ediswan tube for illustrating the principles of magnetic focusing of cathode-ray tubes.*

ray tubes to be accurately plotted by the use of a large scale model of the electrode system immersed in a conducting liquid. By means of a special probe electrode the paths of the electrons are plotted on a drawing board, the probe being coupled to the

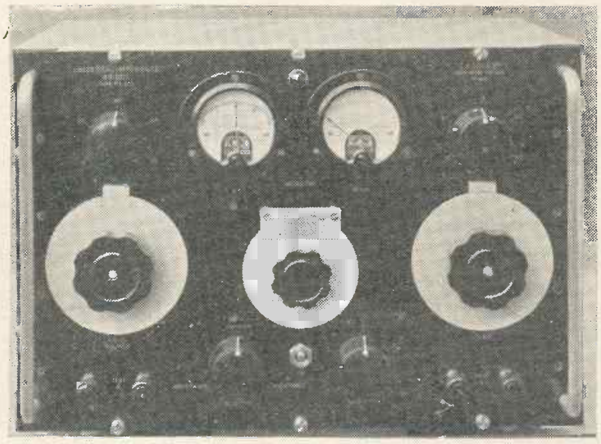


*Fig. 3.—The universal impedance bridge of the Marconi-Ekco Co.*

pencil by a pantograph. The use of such a device enables the behaviour of the electron beam in a cathode-ray tube to be predicted with ease and accuracy.

In the trade section both the Cossor Co. and the Ediswan Co. showed their 10 in. and 12 in. television tubes, particulars of which will be found on another page. On this floor the outstanding exhibit was that of Marconi-Ekco, who are now manufacturing a complete range of research instruments for general and special radio use. A typical example is the Universal Impedance Bridge, shown in the photograph of Fig. 3. This is intended for measuring impedance of both condensers and inductances from .0001 to 20 $\mu$F., and 0.1 mH to 200 H. In addition resistances of 1-200,000 ohms can be measured.

To give examples of other test instruments shown by firms, we may note the Model E.665 " Selective Analyser " made by the Weston Instrument Co., and the new Valve Tester of the Automatic Coil Winder Co. The former is shown in Fig. 4 and comprises a universal test meter and a circuit selector. The two items are fitted in a neat carrying case and provide all that is necessary for fault finding (or " trouble-shooting," as our U.S. friends have it) in radio receivers. The remarkably wide range of the meter can be seen from the markings on the selector switch below the meter. At the top of the panel is a multi-contact valveholder for direct testing of valves in the receiver. Considering the capabilities of the instrument, the price of £11 16s. 3d. appears very reasonable.

Among the valve exhibits were noted the new short-wave transmitters of the Standard Telephones and Cables Company. The one shown in Fig. 5 is the 30-watt triode for use on frequencies up to 750 mc., and has the following characteristics:

Filament Volts, 2.0.
Filament Current, 3.6 a.
Max. Anode Volts, 450.
Magnification, 6.5.
Impedance, 2,700.

The anode-grid capacity is as low as 1.6 $\mu\mu$F. In addition to the above there are two new screen-grid tetrodes, Types 4278A and 4282B, with dissipations of 1 kW and 70 W, respectively.

Turning from the transmitting to the receiving side, the new Mazda Acorns were on view, with the high mutual conductance of 2.5 ma./V. These valves are similar in appearance to the American ones with a slight difference in pin spacing. Two applications of the acorns were demonstrated—a short-wave oscillator having a wavelength of 70 cm. and a probe voltmeter for use in receiver tests. In the latter, the acorn is mounted at the end of a long flexible lead which enables the grid pin to be placed directly on to the oscillatory circuit. The conventional slide-back

(*Continued at foot of next page*)

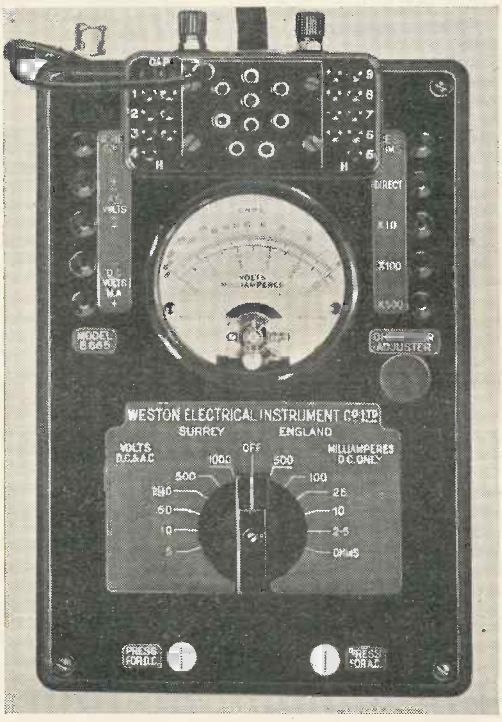
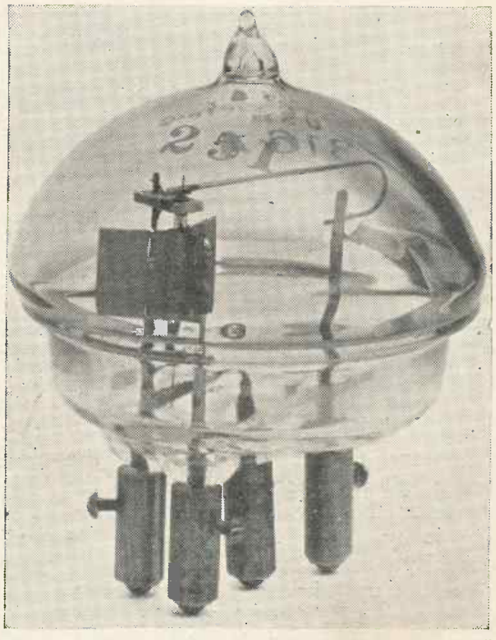



*Fig. 4.—(Left). The Weston selective analyzer.*

*Fig. 5.—(Right). The Standard Telephones & Cables ultra high-frequency triode.*



# THE B.B.C.'s QUESTIONNAIRE

*The B.B.C. have issued an appeal to viewers to report on various aspects of television reception and an invitation for suggestions for the programmes. For the information of our readers who are not in possession of receivers we publish below a copy of the letter which accompanies the report form and also a copy of the latter. In order to enable those who are only able to see the programmes occasionally we ourselves make a special request for opinions and suggestions on another page in this issue.*

**Dear Sir,**

**We much appreciate your response to the appeal made by the B.B.C. in a recent television programme, that those who possess television receivers should make themselves known to the B.B.C.**

**The successful development of the Television Service depends a good deal at this stage on the voluntary help of viewers; and in the hope that you may be willing to help us in this way, we venture to enclose a short set of preliminary questions to which it would be useful to us to know the answers.**

**More generally, we should be interested to know, if you could spare the time to tell us, what items in recent television programmes you or your friends have thought (a) the most successful, and (b) the least successful. You will, we know, understand that there are at present many practical limitations upon the planning, arrangement and quality of television programmes. We should, however, be glad to have any impressions which you have so far formed of the new Service. We should also welcome any suggestions that you cared to make for future programme items, and would consider if they were feasible.**

**If you are able and willing to help us in this way, would you be so good as to fill in your answers to the questions on the enclosed form, adding, either on the back of it or on a separate sheet, any views you may care to express on the more general points mentioned above. An envelope, which requires no stamp, is enclosed for your reply, which will be treated as confidential.**

**Other points are likely to come up from time to time, on which we should appreciate information from viewers. If you answer this present enquiry we should propose, unless you ask us not to do so, to let you know of them as they arise.**

**Yours faithfully,**

**THE BRITISH BROADCASTING CORPORATION**

## B.B.C. TELEVISION SERVICE

VIEWER'S REPORT.

Viewers can materially help the B.B.C. in developing the Television Service by completing this form and returning it to Broadcasting House in the accompanying envelope.

| | |
|---|---|
| 1. What is the make of your television receiver? | |
| 2. How long have you had it in use? | |
| 3. Have you a special television aerial? | |
| 4. Please state:<br>(*a*) the height of your aerial above the ground;<br>(*b*) the approximate height of your aerial above sea-level, if you know it. | feet<br>feet |
| 5. Are you experiencing any difficulty in adjusting your receiver<br>(*a*) for vision?<br>(*b*) for sound? | |
| 6. Do you find that reception is upset when motor-cars pass your house? | |
| 7. Are you experiencing interference from any other source? | |

"Electron Apparatus at the Physical Society's Exhibition"

(*Continued from preceding page.*)

voltmeter circuit attached to the acorn allows measurements to be made on the circuit without disturbing it by the introduction of extra capacity.

In the upstairs section the resistances of the British Electrical Resistance Co. were noted. These are wound on a toroidal former and have a substantial travelling contact. With a rating of 50 and 100 watts they are suitable for use as mains potential dividers. Details can be obtained from the firm at Queensway, Ponders End.

Space does not permit of more detailed reference to the remainder of the exhibits. Readers are strongly recommended to apply for tickets of admission to the next exhibition, which takes place at the same period in 1938. It affords a valuable means of judging the quality of British instruments and the strides which have been made in the development of laboratory and commercial apparatus. The success of the exhibition is largely due to Dr. Laing, the organiser, and the Council of the Physical Society are to be congratulated on their stimulus to the work of the British instrument trade.—G.P.

# TABLE OF CATHODE-RAY TUBES FOR TELEVISION

| Manufacturer. | Type No. | Screen. Dia. | Screen. Colour. | Focusing. | Deflection. | Filament. Volts. | Filament. Amps. | Operating Conditions. $A_1$ | Operating Conditions. $A_2$ | Operating Conditions. $A_3$ | Operating Conditions. G.B. | Modul. Volts. | Sensitivity † |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ‡ Baird Television .. | 15 W.M.I. | 375 | White | Magnetic | Magnetic | 1.7 | 2.4 | 6500 | — | — | 90 | 30 | 2 mm/A.T. |
| A. C. Cossor, Ltd. .. | 3274 | (mm.) 256 | White | Electron Optical | Electrostatic | 0.6* | 1.4 | $\frac{1}{2}A_2$ | $\frac{1}{4}A_3$ | 1-4,500 | A1 | $\frac{1}{4}V_g$ | 650/V |
| | 3272 | 305 | White | do. | do. | 0.6* | 1.4 | do. | do. | 1-5,000 | do. | do. | 820/V |
| Edison Swan Electric Co., Ltd. .. .. | 10H | 250 | White | Electron Optical | Electrostatic | 2.0 | 1.5 | 150/400 | 900/1,500 | 3,500 | 100/250 | 20 | 800/V |
| | 12H | 300 | White | do. | do. | 2.0 | 1.5 | do. | do. | 4,000 | do. | 20 | 950/V |
| Mullard Wireless Service Co., Ltd. .. | E46-G10 | 250 | Green/Blue | Electron Optical | Electrostatic | 4.0 | 1.0 | 250 | 800 | 4,000 | 60 | | 550/V |
| | E46-12 | 300 | White | do. | do. | 4.0 | 1.0 | 250 | 800 | 4,000 | 60 | 25 | 550/V |
| | EM46-12 | 300 | White | Electron Optical | Electrostatic/ Magnetic | 4.0 | 1.0 | 250 | 800 | 4,000 | 60 | 25 | 1,500/V |
| | E46-15 | | | As EM46-12, but with 15-in. (375 mm.) screen diameter | | | | | | | | | |
| Ferranti .. .. | — | 350 | White | Magnetic | Magnetic | 2.0 | 1.5 | 5000 | — | — | — | 10/50 | — |

* Directly Heated. † Sensitivity is expressed as K/V mm. per volt where V is the final anode voltage. ‡ Only available in receivers.

# INTERELECTRODE CAPACITIES

| Type No. (*see above*). | Final Anode-Grid. | Plates-Electrodes. | Inter-Plate. |
|---|---|---|---|
| 3274 | 17 mmfd. | 11 mmfd. | 1 mmfd. |
| 3272 | do. | do. | do. |
| 10H | 15 mmfd. | 15 mmfd. | 4 mmfd. |
| 12H | do. | do | do |
| E46-15 | 15 mmfd. | | 4 mmfd. |

## "A New Method of Transmitting High Frequencies"

(*Continued from preceding page*)

the small circles show the "return" lines moving vertically upwards.

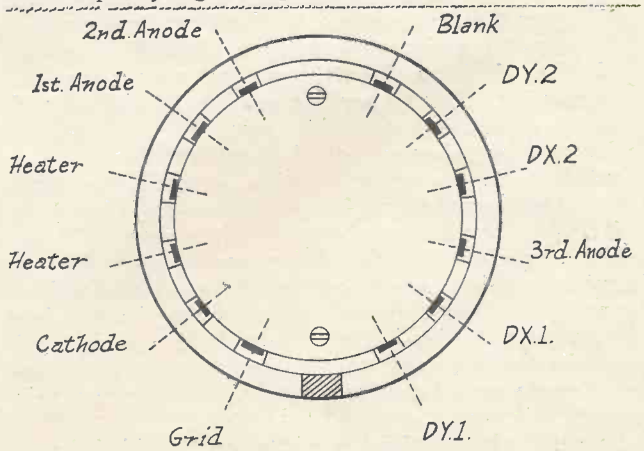
Several different kinds of wave can be generated inside a dielectric guide. In Figs. 1a and b the electric fields are aligned along the length of the guide. This is called an electric wave.

Figs. 2a and 2b show a magnetic type of wave by way of contrast. In cross-section, Fig. 2a, the magnetic fields are shown as dotted radial lines, and the electric fields are full-line circles. In Fig. 2b the magnetic fields are seen as closed circles which move along the length of the guide. In this case the "dots" and small circles show how the electric lines of force are interlinked with the magnetic lines.

The existence of these types of wave, and the relative distribution of the lines of force, can be verified experimentally by using a small "probe" of wire to explore the inside of the guide. The energy picked up by the wire—which acts as a small aerial—is first rectified by a crystal detector and then applied to a sensitive meter, which shows how the field strength varies from point to point.

The last few years have been marked by a growing use of the ultra-short waves. The increasing number of broadcast stations operating between 30 and 70 metres is one sign of the times, whilst the new television service between 6 and 7 metres is another. In addition, commercial interests are now beginning to exploit the use of the so-called micro-waves which are measured in centimetres instead of metres. It is here that the new dielectric guide is expected to play a big part, when these "hyper-frequencies"—as they are sometimes called—come into their own.

Finally, there are distinct possibilities in its use as a trunk line for multiplex telephony. For instance, it could be made to transmit as many as four hundred different carrier-waves simultaneously, each modulated with telephony signals up to 5,000 cycles.




*The G.E.C. tube base as used by Ediswan, G.E.C. and Standard Telephones and Cables*

# SOME TELEVISION AERIAL EXPERIMENTS

## AN ACCOUNT OF PRACTICAL RECEPTION TESTS

THE B.B.C. in their television questionnaire ask among other things: "Have you a special television aerial? Please state the height of your aerial above ground, and the approximate height above sea level."

The matter of the aerial in television reception is an important one and we have therefore carried out a number of practical tests with different arrangements, and also obtained information from other users of television receivers in different districts. This latter was necessary because it is, of course, quite impracticable to move a receiver from one situation to another.

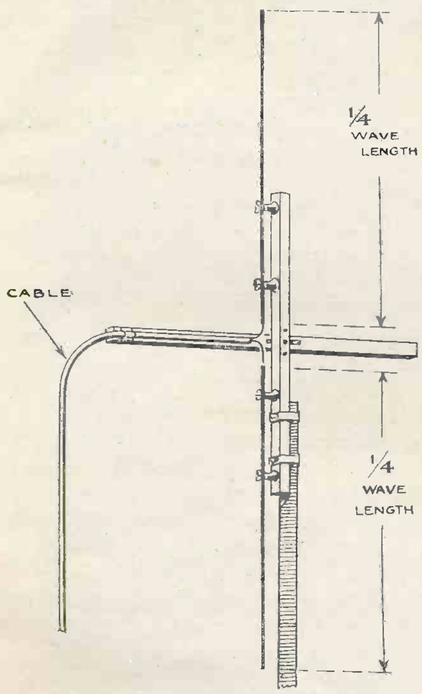



*Fig. 1. The usual type of dipole aerial.*

The first test was made with a dipole erected on the chimney stack of the house at a situation about eighteen miles from the Alexandra Palace. So far as actual reception was concerned this gave excellent results, but the height, which was roughly 30 ft. above ground level, was insufficient to be clear of interference from passing cars. It was also concluded that owing to the smoke from the chimney and consequent deposit of soot on the insulators, which support the copper tubes of which the aerial proper consists, it would not be long before the aerial lost a great deal of its effectiveness. The aerial was not kept in this position for a sufficient length of time to determine what effect this would really have, but it would appear to be a factor which it is desirable to take into account.

Fig. 1 shows the type of dipole used and it will be seen that it consists of two pieces of wood of ⊣ formation with the two aerial units mounted on the vertical member and the lead brought off horizontally for a distance of about four feet. Each member of the aerial is approximately 5 ft. 4 ins. long with a gap of 2 ins. between them.

### *A Series of Experiments*

It was known that at a distance of roughly four miles from the Alexandra Palace aerial height was of no importance and that quite good reception was obtainable with the aerial on the ground. It was decided, therefore, to make a series of experiments with the aerial at various heights and as a preliminary a test was made with it one foot above ground. Results with the aerial in this position and at a distance of 18 miles from the transmitter were practically negative. Only the faintest modulation was observable and the sound transmission could barely be heard with the volume control fully on.

The aerial was next raised to a height of 10 ft. and a very decided improvement was noticeable, though the picture was by no means fully modulated; it could be clearly seen, but it was entirely lacking in contrast and no adjustment of the contrast or brightness controls of the receiver had any effect whatever in improving the picture. Sound was roughly half normal volume with the control fully on.

During these tests a concentric feeder was used for the lead-in and it was thought desirable at this stage to try the effect of a twisted feeder, as any decrease in efficiency would be more apparent with a low signal value. With a twisted feeder, which consisted of ordinary lighting cable twisted together there was a falling off of 20 to 30 per cent., and though the picture was discernible it was so faint and so lacking in detail as to be quite useless. There was also such a diminution in the volume of sound as to make it almost inaudible.

It was clear that with either type of feeder an aerial position such as this was useless, so it was decided to raise it another 10 feet, still retaining the twisted feeder. The total height to the centre of the aerial was then 20 feet, and a marked improvement was at once apparent, though the results fell far short of the original arrangement with the aerial on the top of the chimney stack. The pictures were, however, moderately good and the volume of sound was ample, provided that the volume control was in the full position.

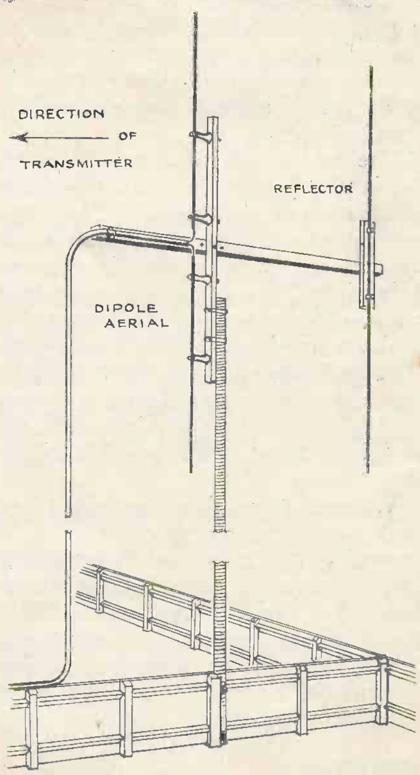



*Fig. 2. Dipole with reflector.*

Tests were next made to ascertain the exact direction of the location of the Alexandra Palace, and it was found that even at a height of 20 feet the aerial was entirely screened by the house. As it was desirable to know what effect this screening had on reception, the aerial was moved bodily to one side so that there was no screening in the immediate vicinity, and once more a considerable improvement was noted. When the concentric feeder was substituted for the twisted type the results left little to be desired, though it was appreciated when operating the receiver that it was working with very little margin—that it was necessary to operate with the volume control nearly at maximum and rather critical tuning was essential.

It was now quite clear that the desiderata were height and freedom from screening, but it was decided to try whether a reflector would effect any further improvement before increasing the height still farther. Accordingly another ⊣ shaped frame was attached to the existing aerial framework and on this was mounted a copper tube of the same length as the aerial, its position being .25 of the wavelength behind the latter—in other words at a distance from the aerial of 2 ft. 8 ins.

The aerial was now moved to its original position in which it was screened by the house. Care was taken that the plane of the aerial and the reflector was in the direction of Alexandra Palace and a comparison made with the results obtained in this position previously. There was very little noticeable improvement and the conclusion was reached that if advantage is to be taken of a reflector, the aerial must be as free as possible from screening.

When the position was altered so that there was comparatively little screening it became evident that the use of a reflector gave decided advantages, but it was found that the directional effects were rather critical and that if particular attention is not given to this point the aerial is more effective without a reflector.

### *Importance of Height*

Finally the aerial was raised to a height of approximately 35 feet so that it was entirely clear of the house, and in this position there was ample input, which enabled the receiver to be operated with the volume control only one-third on even without the use of the reflector.

Some further observations with other receivers in different districts have been made and in every case it was evident that height is a very important factor, in fact in one instance with a receiver situated at the top of a large block of flats and about two hundred feet above street level it was possible to operate it without any aerial at all, though, of course, the results were rather indifferent. At another situation six miles from the Alexandra Palace and in the heart of London excellent results are being obtained with an ordinary dipole situated on a comparatively low roof, which is surrounded by very high buildings. Also at a distance of ten miles good reception is being obtained with an indoor dipole aerial which is on the first floor and therefore only about twelve feet above ground level. Attenuation appears to take place very suddenly and it is probable that at a distance of a mile farther away such an aerial location would be utterly useless. In another case thirty-two miles from the Palace ample signal strength is being obtained with an aerial thirty-five feet above ground level and without the use of a reflector; the addition of a reflector would almost certainly give an increase of ten per cent.

### *The Aerial and Synchronising*

The opinion was formed that one of the most serious disadvantages of an inefficient aerial concerned the synchronising of the picture. In all cases where the aerial was not efficient trouble was experienced in this respect which necessitated frequent attention to the synchronising controls and particularly the line, even though the picture itself was reasonably good. With improved efficiency of the aerial this trouble entirely disappeared.

It is well known that the transmissions vary to some extent and therefore it is possible that apart from aerial alteration variations in reception would have taken place, but it appears that the tests may be taken as providing a rough guide.

It appears very desirable to prevent corrosion of any of the joints in the aerial system and these should therefore be covered with insulating tape over which Chatterton's compound is run in a molten state. With a joint made in this manner and ample metal-to-metal contact there is no necessity to solder.

The concentric feeder can be run in any manner; for instance, it can be secured to the side of the building or fence, but it should be fastened in such a way that it does not sway about with the wind. If it is in the open, preferably it should be as close to the ground as possible, in fact the best situation would be a few inches underground, though this would necessitate employing some sort of conduit. This situation will prevent pick-up on the feeder. A test for whether interference is being picked up on the feeder may be made by earthing it at intervals with wires not longer than six feet. If no reduction in noise results it may be concluded that the noise is being picked up on the aerial.

## Summary of the U.S.A. Television Committee's Recommended Standards.

1. Frequency allocation:
   Lower limit, 42 mc.
   Upper limit, 90 mc.
   An experimental band starting at 120 mc.
2. Channel width, 6 mc.
3. Spacing between television and sound carriers, 3.25 mc. (approximately).
4. Relation of sound carrier to television carrier, sound carrier higher in frequency.
5. Polarity of transmission, negative.
6. Number of lines, 440-450.
7. Frame frequency, 30 per second. Field frequency, 60 per second, interlaced.
8. Aspect ratio, 4:3.
9. Percentage of television signal devoted to synchronising signals, not less than 20 per cent.
10. Synchronising signal, No recommendation. ("Serrated" vertical signal favoured by R.C.A. "Narrow" vertical signal favoured by Philco, Hazeltine, Farnsworth, General Electric Co.)

TELEVISION—THE IDEAL HOBBY FOR THE EXPERIMENTER

# THE HISTORY OF THE CATHODE-RAY TUBE

## AN ACCOUNT OF HOW IT WAS DEVELOPED

*By G. Parr*

To many who are marking its acquaintance for the first time in television the cathode-ray tube appears to be something quite new, and they would probably be surprised to know that the name itself was used as far back as 1876. It is true that the modern high vacuum tube that is used in television is the result of intensive research over a period of a few years, but commercial tubes were available at the beginning of the century and the Cossor Co. can claim to have been making tubes for the past thirty years.

To find the origin of the name "cathode-ray" we have to go back to 1859 when investigations were being made in this country and Germany on the behaviour of gases under strong electric fields.

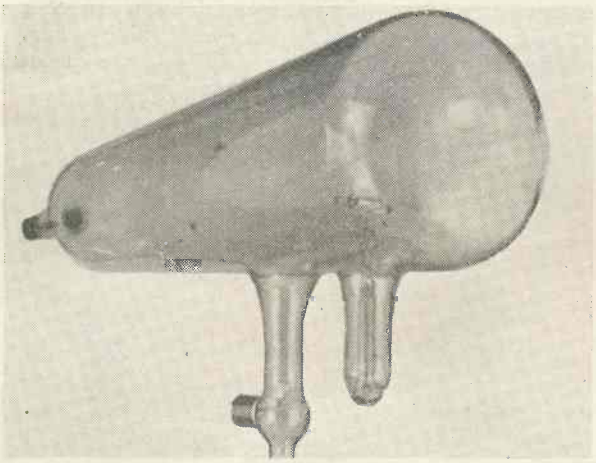


*Fig. 1.—Crookes' tube with Maltese Cross to show the shadow cast by rays on the end of the bulb.*

The effects which occurred when a glass tube was connected to a high potential and gradually exhausted of air had been observed by Faraday and even earlier by Coulomb, and the familiar "Geissler tube" with its ornamental glasswork and colour effects was the practical outcome of the early work on electric discharges at low pressures.

As vacuum technique improved and new types of pump enabled a higher degree of vacuum to be attained, new phenomena became visible which had hitherto been absent at lower degrees of exhaustion, and among these were the effects noted by Plücker and called by him "cathode rays."

When the discharge passed between two electrodes in an exhausted glass tube it was noted that the glass in the neighbourhood of the cathode (negative electrode) fluoresced with a greenish colour. This effect was ascribed to a form of ray which proceeded from the cathode and struck the glass with sufficient energy to produce luminescence* and even heat. From this discovery the investigation into the nature and properties of these cathode rays proceeded rapidly, and it was Crookes (1879) who showed that they were not rays in the sense that we speak of light rays, but were actual particles projected at right angles to the surface of the cathode.

The tube which he used to show this had been copied many hundreds of times and can be bought at any scientific instrument makers.

A photograph of a modern copy of Crookes' tube, bought a few weeks ago, is shown in Fig. 1. The cathode is in the form of a concave disc, the anode being sealed in at the side of the tube, the side limb serving also for a support. At the end of the tube is a tiny Maltese cross cut from sheet metal and hinged so that it can be tilted into a vertical plane or dropped flat. When a discharge from an induction coil is passed through the tube the glass domed end fluoresces with a vivid green under the bombardment of the "rays," and if the Maltese cross is tilted up into the path of the rays a sharply cut shadow of the cross appears on the glass. It was this effect that demonstrated that the rays proceeded normally (i.e., at right angles to the surface) from the cathode and did not disperse in a manner similar to light in all directions. Incidentally, it is interesting to note that it was on a Crookes' tube that Professor MacGregor-Morris carried out the first experiments of focusing the rays with a magnetic field.

The fact that the rays were not only particles but carried a negative charge and hence gave rise to a current of negative electricity was shown by Perrin (1895) who caught them in a bucket at the end of a long tube (Fig. 2). The whitish ring round the edge of the hole is a coating of fluorescent material, presum-

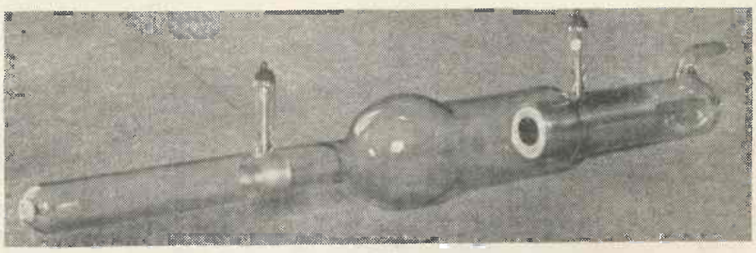


*Fig. 2.—Perrin's tube which demonstrated the negative charge associated with the electron.*

* The words 'luminescence' and 'fluorescence' are sometimes used loosely to describe the same effect. Actually luminescence is the generic term covering fluorescence and phosphorescence.

# COLD AND HOT CATHODE TUBES

ably to show whether all the particles have gone inside! A short distance from the cathode will be noticed a cup-shaped electrode with a small hole pierced in the centre to act as an aperture to concentrate the

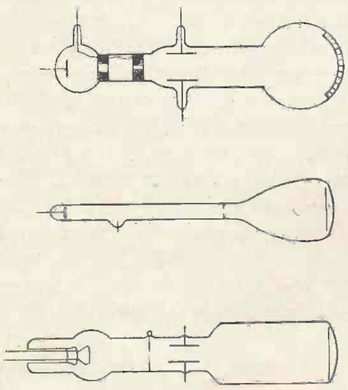


*Fig. 3.—Three stages in the development of the tube. Top: Thomson's tube of* 1897. *Centre: Braun tube of the same period. Bottom: Wehnelt tube of about* 1902.

rays into a thin pencil. In this we have the foreshadowing of a focusing action, although the true focusing devices were added at a much later date.

From then onwards a great deal of research was carried out by various workers, notably Sir J. J. Thomson (who celebrated his 80th birthday some weeks ago), and the first " cathode-ray tube " was produced for the purpose of carrying out accurate measurements on the properties of the cathode rays and their behaviour in magnetic and electrostatic fields. The term coined by Plücker survived the later discoveries of the true nature of the rays, and we still refer to them easily as " cathode rays " although " electron beam " would be more accurate. The word " electron " did not come into use until after 1890 when it was applied to these negatively charged particles by Dr. Johnstone Stoney.

In Fig. 3 we have outline drawings of three stages in the development of the primitive cathode-ray tube from the Thomson tube to the Wehnelt tube. In the Thomson tube two slotted apertures will be seen, mak-

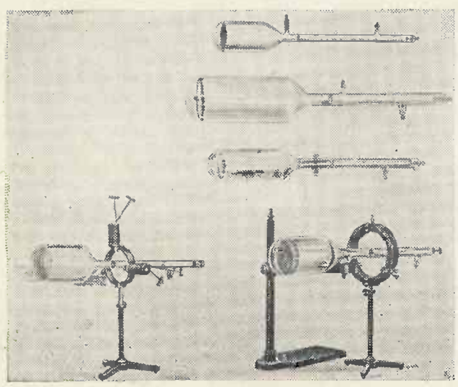


*Fig. 4.—A page from a scientific catalogue of* 1905 *showing types of tubes available.*

ing the beam in the form of a flat strip which passed between two electrodes in the middle of the tube. The glass domed end of the tube was not coated with any fluorescent material and the position of the beam was shown by the green glow on the glass itself. A potential was applied to the two deflecting plates and the movement of the strip on the glass recorded on a rough scale marked on the surface.

The Braun tube shown in the middle of the diagram can be said to be the first laboratory form of cathode-ray tube for measurement purposes. It had the great improvement of the sheet of mica at the domed end which was coated with fluorescent material. In this tube an aperture of a simpler type was inserted just before the bulb portion.

At this time fluorescent materials were limited and the only experience in the use was gained through investigations on X-ray fluorescent substances. Willemite, the natural form of zinc silicate, was one of the earliest used and persisted up to the most recent times, although it is now being displaced by more efficient substances giving a better colour of luminescence.

A great many of the early materials were quite unsuitable for later types of tube as they would not with-

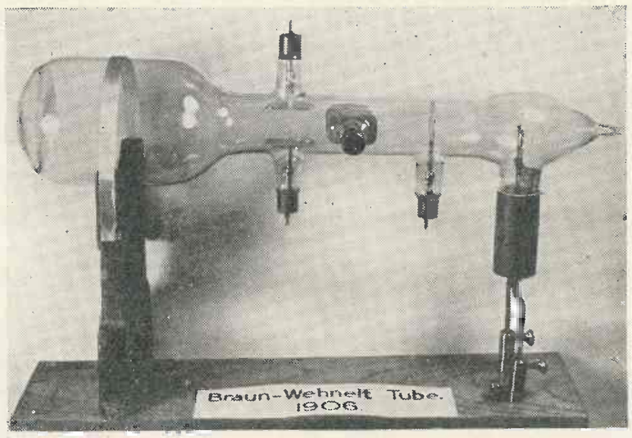



*Fig. 5.—A Braun-Wehnelt tube of* 1906 *using a hot cathode.*

stand the heating which is a vital part of modern high vacuum technique.

The photograph of Fig. 4 is a reproduction from a page in a scientific instrument maker's catalogue of 1906 and shows types of Braun tubes with stands and magnetic coils for deflecting the beam.

The fact that a magnetic field from a coil placed round the tube could improve the sharpness of the fluorescent spot was demonstrated about 1898 and this method of focusing was in common use about the beginning of this century.

A most important improvement in the tube was made in 1905 by the use of a hot cathode for emitting the electrons. This was introduced by Wehnelt, who also gave his name to the cylinder surrounding the cathode in the modern tube. The cold cathode tubes of Braun were quickly displaced by Wehnelt's hot cathode tubes, although they were crude compared with later forms of emitter and had an exceedingly short life. A flat platinum ribbon was mounted at one end of the tube and a spot of lime deposited at the centre. The whole platinum strip glowed red hot and the electrons emitted from the lime spot were attracted to a flat disc pierced

# ELECTRON OPTICS AND THE C-R. TUBE

with a central hole to which the positive potential was applied. The imperfect vacuum in these early tubes gave rise to a great deal of trouble due to ionisation of the residual gas by bombardment from the electron stream. The ions formed would return to the cathode with considerable velocity and their impact caused pitting on the surface of the cold cathode discs and premature burnouts in the hot cathodes. The present-day manufacturer with the improved vacuum pumps at his disposal is still anxious about damage to the cathode

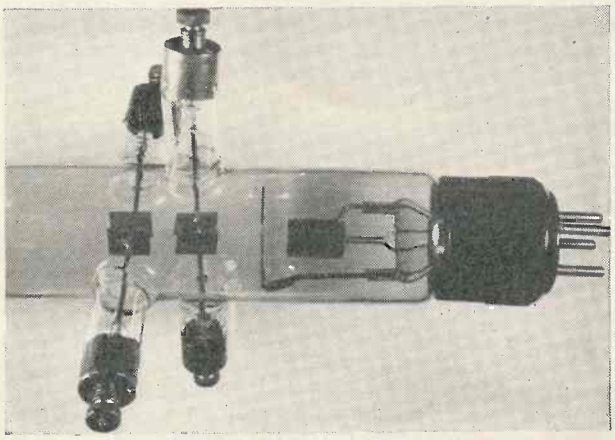


*Fig. 6.—An early gas-focused tube showing the Wehnelt cylinder.*

by positive ions and takes care to reduce the velocity of such as remain in the tube to a safe value by keeping the potentials low.

The photograph, Fig. 5, shows a Braun-Wehnelt tube of 1906 with its smart-looking stand and terminals for the filament supply.

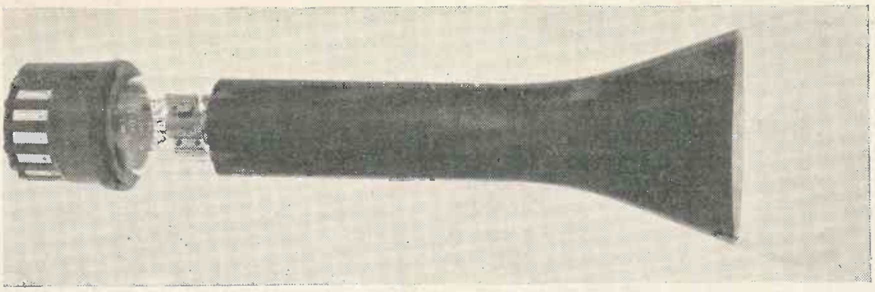
In 1931 von Ardenne made the important improvement of surrounding the cathode with a negatively charged cylinder which served to pre-concentrate the electron beam before it passed through the hole in the anode, or accelerating electrode. This greatly improved the focusing properties and the "efficiency" of the beam, since before that time the simple apertures inserted in the path of the beam did no more than cut off part of the electrons travelling up the tube. With the introduction of the Wehnelt cylinder these waste electrons were guided into the main stream and contributed to the intensity of the spot. The focusing effect of the gas was controlled by the cathode emission and by the potential applied to the negative cylinder, and the von Ardenne tube made external photography of the fluorescent trace a practical success for the first time. In a book on the Cathode-ray Tube in Radio Research the authors state that "such advances as were made in recent years . . . owe much to the ingenuity, resource and unfailing friendliness of Baron Manfred von Ardenne."

The few years after 1932 saw the gas-focused tube firmly established as a laboratory instrument and its uses as a television reproducer were also being recognised. In 1933 the Ediswan Co. were giving regular demonstrations of 30-line reception with a small tube and commercial cathode-ray receivers were seen at the German television exhibition.

The whole of the theory and practice of focusing of electron beams was given a fresh outlook about this time by the researches of Brüche, Knoll and Ruska.

The theory involved in this branch of the science is outside the scope of this review of development and it is sufficient to say that the success of the modern high-vacuum tube is founded on the principle that the elec-

*Fig. 7.—A modern high-vacuum tube with a 6-in screen (Standard Telephones and Cables).*



The next noteworthy improvement did not take place until fifteen years later when Van der Bijl and Johnson discovered the properties of a trace of gas in the tube in its improvement of the focusing. The earliest gas-focused tube was the Western Electric Type 4224, which may be considered the first successful laboratory tube having a reasonable life and with a sharply defined spot. The cathode was protected from ionic bombardment by enclosing it in a form of tube, extended to include a tubular anode. This electrode arrangement was responsible for the use of the word "gun" to denote the electron producing electrode system and it is only lately that the word shows signs of being dropped in favour of the more common valve terms, grid and anode.

tron beam can be focused by electrostatic fields in the same manner that a beam of light can be focused by glass lenses. At the same time the efficiency of the magnetic field for producing the same effects has not been overlooked and present-day practice seems evenly divided between the two methods.

This account of the development of the cathode-ray tube cannot be concluded without reference to the foresight of Campbell Swinton who, when the tube was in its state of early development in 1908, predicted the use of "cathode rays" for scanning and for reproducing pictures on a fluorescent screen, and in fact laid the foundations of the modern high-definition television practice.

The photographs illustrating this article were kindly supplied by Mr. R. M. Weston, M.A.

# WE ASK FOR . . .

# PROGRAMME IDEAS AND CRITICISM

## TWO GUINEAS FOR THE BEST LETTER

The B.B.C. is spending a considerable sum on television, and doubts arise in their minds as to whether the whole of the money is being spent wisely. Their difficulties are considerable. Just as they had to build up their broadcasting service without any precedent to guide them, now they are trying to build up a television service, again without a precedent. And their experience in sound broadcasting does not avail them over much.

Even the casual viewer finds in the B.B.C. television programmes much to criticise. There is as yet an amateurishness which shows itself chiefly in a lack of finish and in the failure to observe what would appear to the ordinary person to be obviously elementary things. But that, perhaps, is where the ordinary person has to beware. Things are not always what they seem and you can be sure that the practical and technical difficulties in the television studio are considerable. But it does not follow that the public appreciates or understands those difficulties and we are prepared to believe that the B.B.C., faced on the one hand with considerable expense and on the other with a body of criticism (much of it unfavourable), are wondering whether they are getting value for their money.

### The B.B.C.'s Questionnaire

In an attempt to get direct information on this matter, they are inviting everybody who has a television receiver to inform them of the make of the receiver, its date, type and height of aerial, whether there are any difficulties in adjusting either sound or vision, whether reception is upset by motor cars or interference from any other source, and what they regard among recent televised items as the most—and on the other hand the least—successful! Details of this questionnaire are given on another page of this issue.

The B.B.C.'s questionnaire necessarily is addressed to the actual owners of receivers—a relatively small public most or all of which is embodied in the circulation of this magazine. It must be remembered, however, that in addition there is a large body of readers, apart from those who have the privilege of owning a set, who yet have facilities as viewers and who are accustomed to seeing television demonstrations, and who frequently have opportunities of forming their own opinions on matters in which the B.B.C. now show themselves to be highly curious. We ourselves would be glad if the information that is being sent by our readers to the B.B.C. were sent to us as well. We should find it invaluable in adjusting ourselves to readers' requirements. But, in addition, we should like all our readers, whether replying to the B.B.C. questionnaire or not, to let us know their opinions of the programmes, not only the items that compose them, but the respective lengths of those items and of the programmes and the times at which they are transmitted.

### Cinema Comparisons

Of course, the reader will have to bear many things in mind, and we are sure he will avoid drawing the easy but misleading comparison that might occur to the man-in-the-street—that between the cinematograph and television. It is quite useless at the present time to compare these two.

The cinematograph industry has forty years of experience behind it. It has immense wealth. It is able to employ the services of the most highly-paid people in the world and can do this simply because it can distribute its films over the face of the world and draw profits from thousands of different localities—all with one original although considerable expenditure. It can afford to build up the most costly temporary settings and to rehearse its actors for weeks and even months. It can afford to take and re-take and yet again re-take scene after scene until its highly qualified directors are thoroughly satisfied with the result. One prominent British studio is satisfied if, with a day's camera work on the set, it can produce enough film for a few minutes on the screen. Should an accidental blemish show itself, that part of the film can be cut out, perhaps with no loss to the rest of the picture, or, if necessary, can be replaced. The original film is subject to cutting and editing, and there is absolutely no reason why the finished picture should be marred by a casual or accidental trouble of any kind.

But how very different with television. In the first case, the service is being paid for by the B.B.C. The B.B.C. is not "selling" anything to bring the money back. It cannot in any sense, at the present time, rival the methods of the cinematograph industry. It rehearses its programmes under the handicap of many limitations. Except within slight limits the television camera cannot go to the subject; the subject must be brought to the television studio. There is, of course much, rehearsal, but on severely economic lines, and should, during the actual studio transmission, the slightest thing go wrong in the presentation, it will be extremely difficult or perhaps impossible to put it right without drawing attention to it and thus making it worse.

The presentation is bound to owe something to the B.B.C.'s experience with sound broadcasting, but that itself is a doubtful advantage, inasmuch as sound broadcasting is for people who might as well be blind so far as the reception of the programme is concerned. Whilst the technique of television has gone forward amazingly recently, there has been very little opportunity for studio technique to perfect itself, and it is not unfair to say that at this moment programme presentation and programme material are a long way behind actual transmission technique.

### Our Invitation to Readers

In spite of what we have said above, it is undoubtedly true that much can be done to improve the television programme and its presentation, and this is where we want our readers to help. Ideas are the things that count. Included in the readership of this magazine is the most competent body of television advisers in the world, and we should highly appreciate their going to the trouble of telling us what, after having considered all the known factors, they would do to improve the B.B.C.'s television programme. We should like their comments on the times of transmission, the length of programmes, the length of items as at present shown, on the question of repetition of pictures—chiefly of news and other feature films—and we should like them to indicate their ideal programme.

This is not work that we can pay for in the ordinary way, but merely to mark our appreciation of our readers' kindness, we offer Two Guineas for what we consider the most useful letter that reaches us. It is our intention to publish in "Television" selections of the letters received. May we ask that letters should be posted to us as soon as possible. They should be of any length, but, in general, we suggest they should not exceed a few hundred words. This is not a readers' competition, but rather an effort by which readers can further the development of television. Please see that letters are addressed to The Editor, "Television," 37, Chancery Lane, London, W.C.2.

# RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

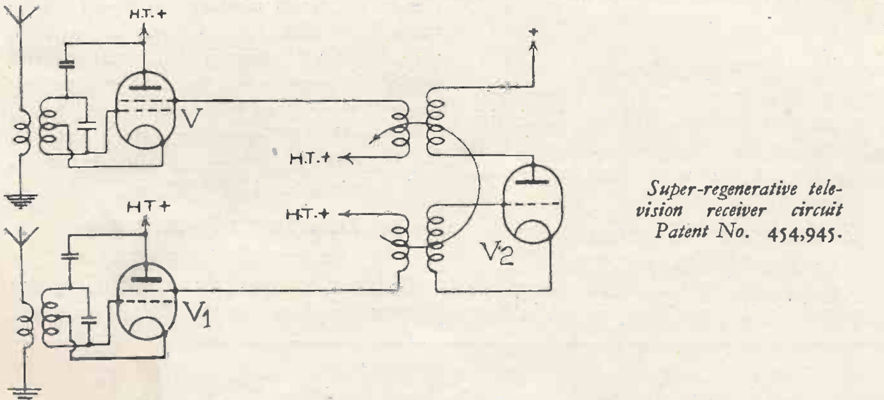
*Specially Compiled for this Journal*

*Patentees :—L. R. Merdler and Baird Television Ltd. :: Marconi's Wireless Telegraph Co. Ltd. H. M. Dowsett and L. E. Q. Walker :: J. C. Wilson and Baird Television Ltd. :: D. M. Johnstone and Baird Television Ltd. :: Fernseh Akt. :: J. E. Keystone and L. F. Broadway A. D. Blumlein*

### Television Receivers

(Patent No. 454,945.)

Picture signals transmitted on one carrier-wave are received by the valve V, whilst the corresponding sound signals, transmitted on a different carrier, are applied to the valve V1. Both these valves are back-coupled to act as super-regenerative amplifiers, and both are "quenched" by the same set of oscillations from the back-coupled valve V2. The quenching oscillations are fed from the plate circuit of V2 to the amplifier V and from the grid circuit of V2 to the valve V1, the two leads being preferably decoupled so as to keep the system stable. The use of one common frequency to quench both amplifiers effects a useful economy.




*Super-regenerative television receiver circuit Patent No. 454,945.*

If one of the valves V, V1 is used to amplify the signals before frequency-changing, whilst the other valve amplifies them after frequency-changing, the system will remain stable even if no decoupling is used. —*L. R. Merdler* and *Baird Television, Ltd.*

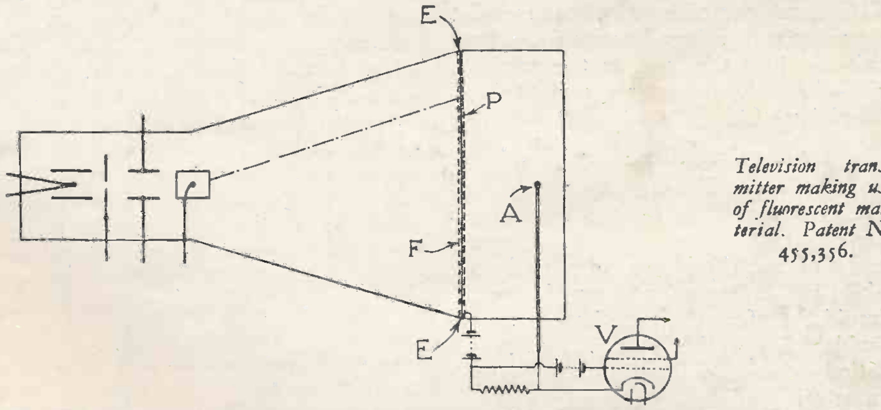
### Television Transmitters

(Patent No. 455,356.)

One of the difficulties in transmitting television signals is to keep pace not only with the rapidly varying light value of each particular " point " of a picture, but also with the more slowly changing alterations which occur in the general illumination, or what may be called the "background brilliance" of the picture.

The cathode-ray transmitter shown in the figure is designed to meet this difficulty. The screen-electrode E consists of a glass plate which is coated on the side facing the "gun" of the tube with a fluorescent material F, and on the opposite or outer face with a layer of photo-sensitive material P.

The picture to be transmitted is focused on the sensitive layer P, and simultaneously the fluorescent layer F is scanned by the electron stream from the gun. The anode A collects the electrons emitted from the photo-sensitive layer P, and these go to form the signal components. But in addition there will be an extra emission due to the fluorescent light produced by the electron scanning beam, and this extra component is used to vary the amplification factor of a variable-mu valve. The latter in turn keeps the amplitude of the radiated carrier-wave in step with any slow changes in the background illumination of the picture.—*Marconi's Wireless Telegraph Co., Ltd., H. M. Dowsett* and *L. E. Q. Walker.*




*Television transmitter making use of fluorescent material. Patent No 455,356.*

### Intensity Modulation

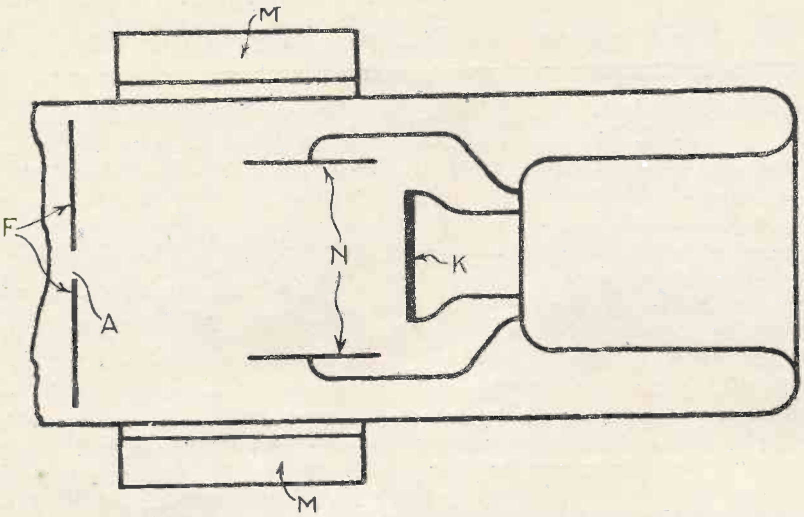
(Patent No. 455,237.)

In order to reproduce a televised picture, the incoming signals are usually applied to a control grid so as to vary the number of electrons which can reach the fluorescent screen, and therefore the brightness of the spot produced.

Instead of using a control grid to produce this result, the cathode K of the tube is first constructed in such a way that its emissivity varies from a maximum at one end of its length to a minimum at the other. An electron image of the cathode is then focused by means of an external magnet M on to an electrode F provided with a central aperture A.

The incoming television signals are applied to a pair of plates N and swing the stream to and fro, so that at one time more electrons pass through than at another, according to whether the electron image of the cathode corresponds to maximum or minimum emission.—*J. C. Wilson* and *Baird Television, Ltd.*

to one or both of the saw-toothed oscillators, so that in the event of a breakdown in the time-base circuit, the electron stream is at once automatically "scattered" over a wide




*Electron camera employing intensity modulation. Patent No. 455,237.*

### Super-regenerative Receiver

(Patent No. 455,298.)

A pentode valve is used to "quench" the tuned circuit in a super-regenerative receiver. The pentode is shunted across the circuit to be damped, and local oscillations are applied either to its grid or anode, so as to swing the valve between two conditions. In one condition, it has a very high impedance, of the order of a megohm, whilst in the other the impedance sinks to 100 ohms. During the latter period, the valve operates to "quench" the super-regenerative circuits.

The same pentode may also be used to generate the local oscillations by back-coupling the grid to the screen grid.—*D. M. Johnstone* and *Baird Television, Ltd.*

### Protecting the Screen

(Patent No. 455,479.)

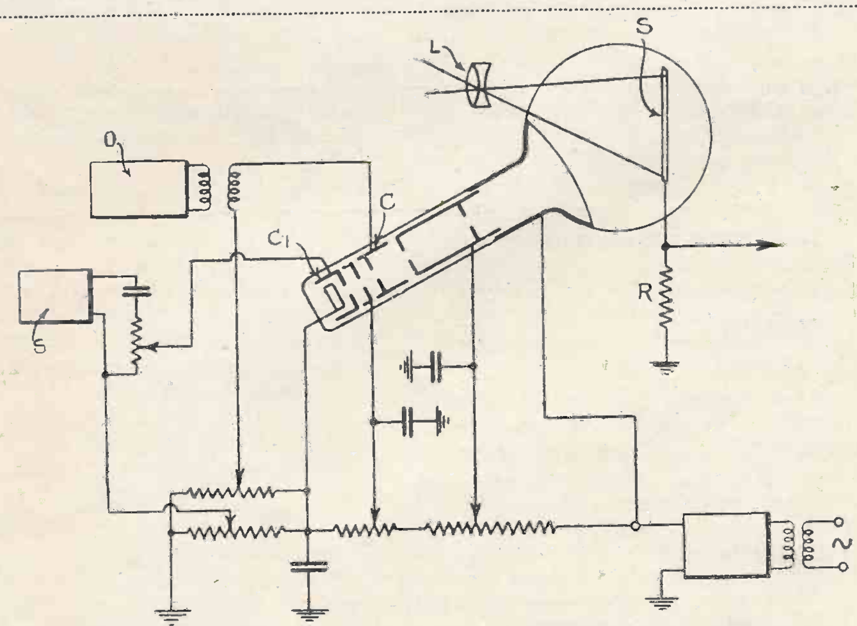
It is not safe to let the scanning beam "rest" on the fluorescent screen of a cathode-ray tube, as it is liable to damage or burn it out. Should therefore the time-base circuit —which keeps the spot in constant motion—cease to function, for any reason, it becomes necessary either at once to throw the spot off the screen, or to take other measures to render it harmless.

According to the invention one of the magnetic coils used for focusing the electron stream is connected, in series with the high-tension supply, to one or both of the saw-toothed oscillators, so that in the event of a breakdown in the time-base circuit, the electron stream is at once automatically "scattered" over a wide area of the screen and its intensity reduced below the point at which it is likely to damage the screen.—*Fernseh Akt.*

### Cathode-ray Transmitters

(Patent No. 455,555.)

In a transmitter of the Iconoscope or mosaic-cell type, the picture is first




*Modified Ionoscope transmitter. Patent No. 455,555*

projected through a lens L on to the photo-sensitive screen S, where it is scanned by the electron stream to produce signal currents across a resistance R.

The electron stream is first modulated at carrier-frequency by voltages applied from a generator O to a control electrode C. It is simultaneously modulated by synchronising-signals supplied from a source S to a second control electrode C1. A slowly-varying voltage, corresponding to the overall changes in average "brightness" of the picture, may also be supplied to the second control electrode. —*J. E. Keyston* and *L. F. Broadway.*

### Time-base Circuits

(Patent No. 455,858.)

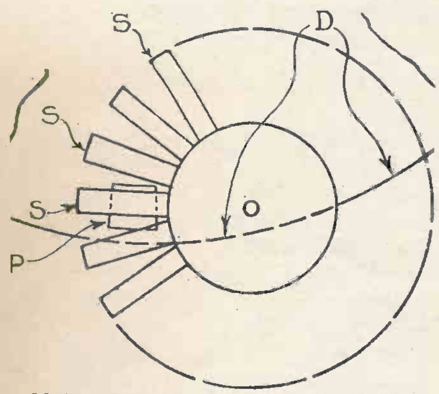
Line synchronising signals are applied to the fourth grid of a heptode valve, at the same time as impulses of twice the line frequency are applied to the similar grid of a second heptode valve.

Longer impulses at framing frequency are simultaneously applied to the first grids of both the valves in parallel. The two valves constitute an electric "switch" arrangement, which is prevented from "changing over" except at the proper intervals, so that the different impulses are fed in correct sequence to the cathode-ray receiver.—*A. D. Blumlein.*

### Interleaved Scanning

Patent No. 455,972.)

Relates to means for ensuring the proper displacement between one set of scanning lines and the next, which is necessary to ensure that both sets of lines sandwich together, without overlap, on the viewing screen. In one arrangement a plate of glass, which is slightly tilted so as to throw the rays slightly to one side, is interposed between the scanning spot and the picture during one scanning operation. During the next scanning operation, a second plate of glass, tilted in the opposite direction, replaces the first, and so on, in rotation.




*Mechanical interleaved scanning. Patent No. 455,972.*

Or, as shown in the figure, a number of glass plates in the form of spokes S are rotated in front of the aperture P in the larger scanning disc D, so that for one set of scanning lines the light passes through one of the spokes and is therefore deflected slightly to one side, whilst during the second set of scanning lines the light passes without deflection through the open space between two of the spokes.—*J. C. Wilson* and *Baird Television, Ltd.*

**Summary of Other Television Patents**

(Patent No. 455,085.)

Scanning system suitable for a cathode-ray television transmitter of the "mosaic-cell" type.—*H. G. Lubszynski* and *S. Rodda.*

(Patent No. 455,233.)

Method of producing a double-sided photo-sensitive electrode of the mosaic-cell type for use in a cathode-ray television transmitter.—*H. E. Holman.*

(Patent No. 455,267.)

Mains-supply unit, with ripple-balancing arrangement, for use with cathode-ray tubes.—*Radio-Akt. D. S. Loewe.*

(Patent No. 454,383.)

Method of deriving a television signal representing the average or overall brightness of the image to be transmitted.—*T. M. C. Lance* and *Baird Television, Ltd.*

(Patent No. 454,588.)

Method of subdivided scanning, designed to produce signals having a wave-form which is both rectangular and saw-toothed.—*J. L. Baird* and *Baird Television, Ltd.*

(Patent No. 454,589.)

Scanning system in which an electron stream is used to "open" in succession a series of bi-refringent light-cells.—*J. L. Baird* and *Baird Television, Ltd.*

(Patent No. 454,937.)

Method of preparing light-sensitive "mosaic cell" screens, as used in a cathode-ray tube television transmitter.—*C. J. Whilems.*

(Patent No. 454,956.)

Shaping circuit used for correcting the "bottom-bend" effect in television transmitters.—*Marconi's Wireless Telegraph Co., Ltd.*, and *W. S. L. Tringham.*

(Patent No. 455,375.)

Method of synchronising the frame and line scanning frequencies in a television receiver.—*E. C. Cork, M. Bowman-Manifold,* and *C. L. Faudel.*

(Patent No. 455,497.)

Multigrid generator of saw-toothed and flat-topped oscillations.—*E. L. C. White.*

(Patent No. 455,736.)

Focusing system of electrodes for increasing the sensitivity of a cathode-ray tube.—*N. V. Philips Gloeilampenfabrieken.*

(Patent No. 455,785.)

Scanning the background separately from the foreground of a scene to be televised, in order to make more effective use of the available range of signal frequencies.—*T. Vrabely.*

(Patent No. 455,797.)

Method of altering the size of the scanning spot, whilst still keeping it in focus, so as to be able to change-over from high to low definition in a cathode-ray receiver.—*The General Electric Co., Ltd.,* and *L. C. Jesty.*

(Patent No. 455,899.)

Preparing light-sensitive electrodes, particularly those of the mosaic-cell type, as used in Iconoscope television transmitters.—*H. Heimann.*

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Mr. W. H. Copeman, of 28 Henrys Avenue, Woodford Green, Essex, is desirous of obtaining copies of March, 1935, October, 1935, and January, 1936, issues. Will any reader who can oblige kindly send a postcard to the above address.

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## Television's Guaranteed Receiver for use in America

A NUMBER of inquiries have been received asking if it is possible to adapt the Guaranteed Receiver so that it is suitable for use in America with the different standards employed there.

Actually there should be no difficulty in adapting this receiver for U.S.A. standards, and the following is an outline of the necessary modifications. The first point is the excitation and control of the tube, and this data will be provided by the manufacturers of the tube.

American valves should be checked and the nearest types employed. The following details will be of assistance in this respect.

X41 Triode pentode. H.F. pentode and separate triode can be used.
MSP4 H.F. pentode, anode top cap.
TSP4 H.F. pentode high-slope grid top cap.
D42 low capacity diode (dispense with capacity across load resistance).
Rectifier normal "80" tube.
AC2/Pen output pentode (3 watts undistorted).

Mains transformers should be ordered to suit 110-volt mains and U.S.A. tube heaters.

The polarity of the pictures radiated in England is positive, therefore earth coil end of load resistance and connect diode cathode to grid of MSP4 output tube. This takes care of U.S.A. negative picture radiation and produces a positive picture on the C.R. tube screen.

Adopt the time base described in our January issue. Omit resistances R2 and R5 together with shorting switches. The circuit will then be satisfactory for U.S.A. standards. Difficulty may be experienced with the triode amplifier tubes. Consult R.C.A. for equivalents to the British Mazda AC/P type. The R.C.A. gas-discharge relays are satisfactory.

Interlacing takes place automatically. It means that 60 pictures per second are transmitted and the resulting picture with a repetition of 30 per second are superimposed so that the scanning lines of one picture interlace with the scanning lines of the next. No special receiving apparatus or "sweep" circuits are necessary.

Coils to take care of the radio carrier frequency should be employed for the inputs and oscillator section. Exact data cannot be given, but as a guide remove two turns from the tuning circuit and one from the grid of the oscillator.

# THE CATHODE-RAY TUBE FOR THE BEGINNER

*Twelve months ago we published a series of diagrams explaining the working principle of the cathode-ray tube. Since that time certain modifications have been made in its construction and on account of this fact and for the benefit of new readers we are again publishing a set of diagrams which will provide uninformed readers with the necessary knowledge to understand this essential television component*

THE electrode assembly of the cathode-ray tube resembles in many respects that of the ordinary valve: that is, there is a glass pinch which carries the filament, which is the source of electron supply; a cylindrical electrode called the grid, which has a similar function to the grid of a valve; and an anode to which the electrons are attracted. Actually in most modern tubes there are three anodes, one serving to accelerate and the other two to focus the beam to a fine point on the end of the tube. In order that the electrons can reach the end of the tube, each anode is provided with a hole through which they can pass.

It will be clear, therefore, that the purpose of the electrodes so far described is to provide a beam of electrons and give these sufficient velocity so that they will strike the end of the tube where their presence is made visible by causing the specially coated surface to fluoresce.

For television purposes it is necessary to be able to vary the density of this stream of electrons so that the amount of light caused by their impact on the prepared screen will vary accordingly. This is the function of the grid, or Wehnelt cylinder as it is sometimes called, and it acts in the same way as does the grid of a valve.

Additionally, there are two pairs of plates called deflectors placed beyond the final anode, and if suitable potentials are applied to these it is possible to cause the electron beam to swing about in any direction and at any speed.

The important and elementary points to remember are (1) that electrons are produced by means of a filament which may be either directly or indirectly heated;

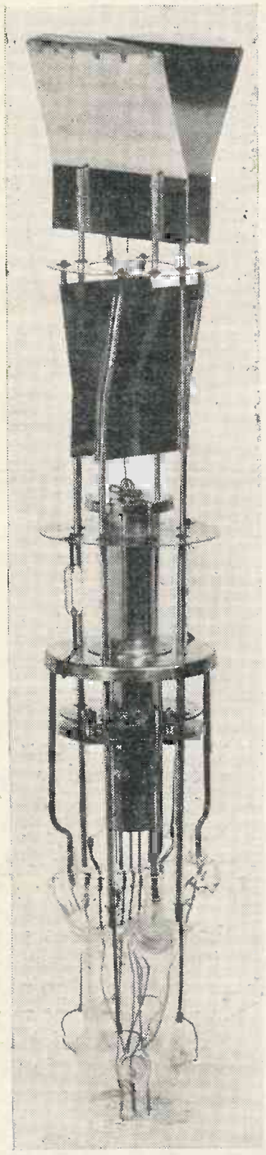


Fig. 1.—*This is a photograph of the latest Ediswan cathode-ray tube electrode assembly. It is constructed as a complete unit before insertion in the neck of the glass bulb.*

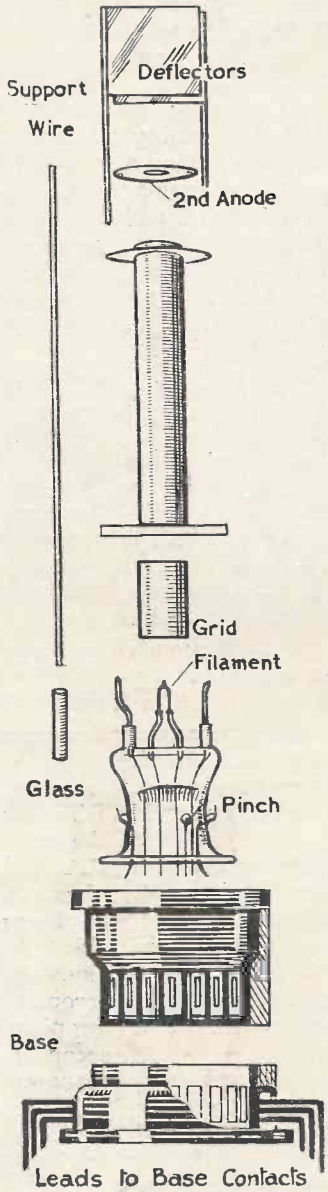



Fig. 2.—*This drawing shows the various parts which constitute the electrode assembly. Leads from the several electrodes are brought down to the base which fits into a special holder.*

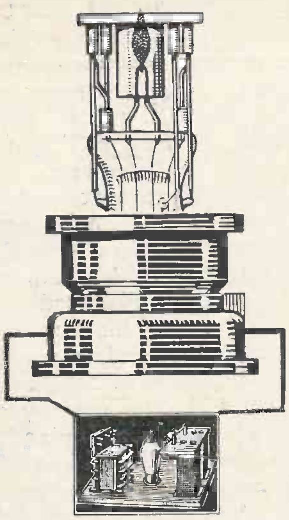


Fig. 3.—*The low and high-tension supplies are provided by a power pack. When current is supplied to the filament and a positive potential to the first anode, electrons leave the filament and pass to the anode.*

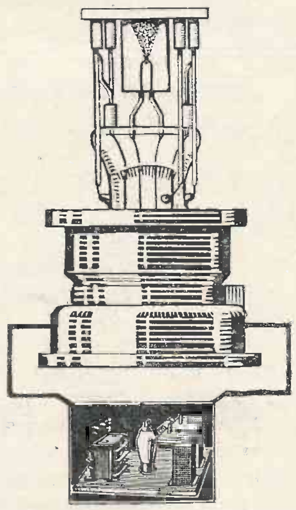


Fig. 4.—*A negative bias applied to the grid has the effect of compressing the electron stream so that more electrons pass through the anode. Increased bias will have the effect of reducing or cutting off the beam entirely.*

(2) that these electrons can be made to take a beam form; (3) that the density of the beam can be varied within very wide limits; (4) that the electrons composing the beam can be accelerated by using successive anodes to which high electric potentials are applied; (5) that the beam can be swung about at high speeds by applying potentials to suitably disposed deflector plates.

The photograph, Fig. 1, shows the complete electrode assembly of a modern cathode-ray tube, and Fig. 2 is a drawing of the various parts of which it consists. For the sake of clarity only two anodes are shown, but as mentioned before it is now customary to use three for tubes employed for television.

The successive diagrams show the stage-by-stage operation of the tube; it must, however, be appreciated that these operations take place practically instantaneously. Fig. 3 shows the electrons leaving the filament and passing to the first anode, some of which, owing to their high speed, pass through, though the majority pass to the metal of the anode and form an anode current as in the ordinary valve. If, however, a negative bias is applied to the cylindrical grid or control electrode, this will have the effect of compressing the stream of electrons and therefore more will pass through the hole in the anode and very few remain on the metal (Fig. 4). If the grid bias is increased considerably, the stream will be cut off altogether and it is this property of the grid which is used to vary the intensity of the electron stream and so produce varying light on the screen.

After the electrons have passed through the hole in the first anode there is a tendency for the beam to diverge (Fig. 5) instead of remaining in a compact jet and it is necessary, therefore, to bring them together

(*Continued in 3rd col. of page 96*)

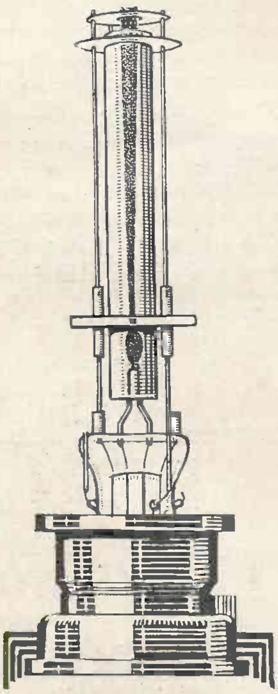


*Fig. 5.—This drawing shows how the electrons having passed through the first anode tend to diverge and how the second anode has the effect of bringing them again into a compact jet.*

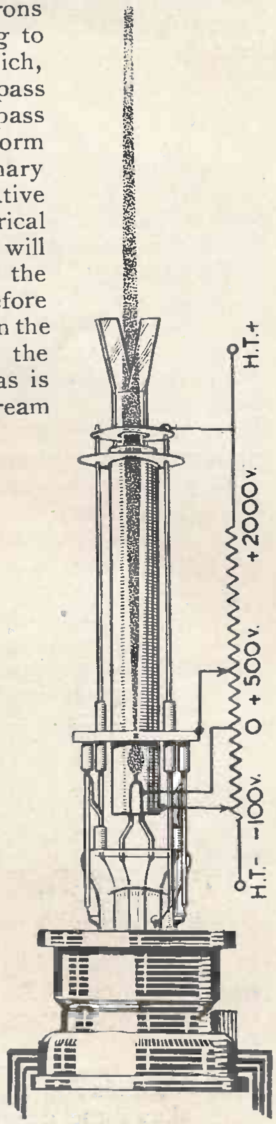



*Fig. 6.—A chain of resistances are connected across the high-tension supply and tappings are taken to the various electrodes to provide the suitable potentials. These values vary according to the type of tube.*

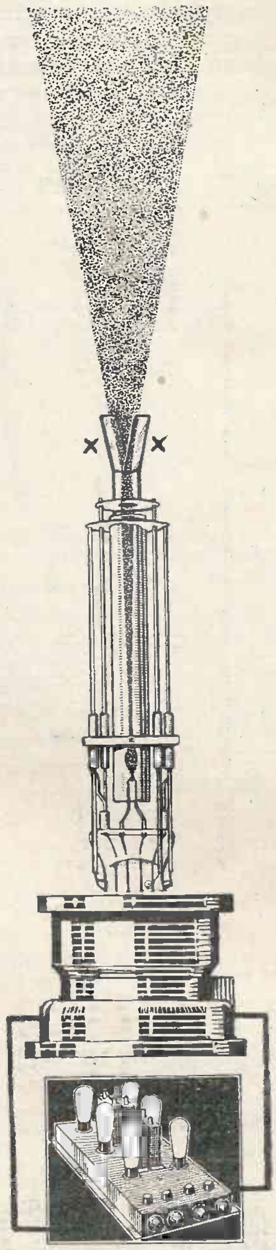



*Fig. 7.—Here the beam is being acted upon by one pair of deflector plates X because of alternating potentials applied to the plates. The result is that the beam is caused to swing rapidly backwards and forwards in one plane.*

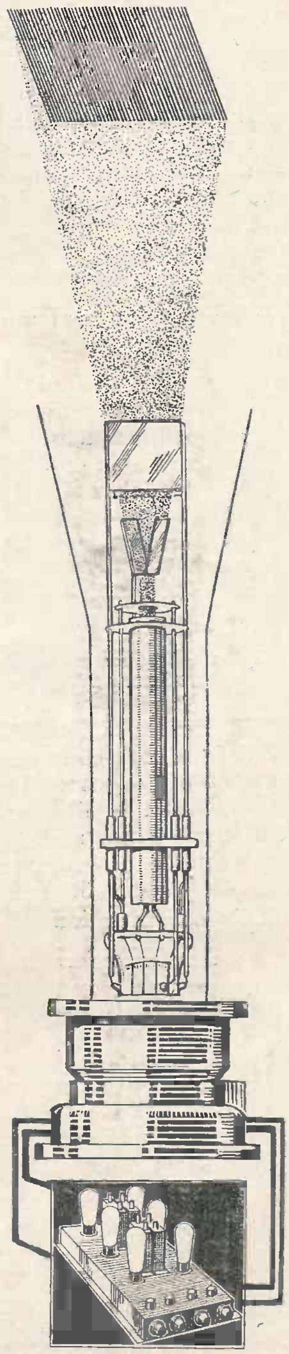


*Fig. 8.—This drawing shows the beam being acted upon by both pairs of plates in such sequence that the screen is covered at regularly recurring intervals. The compound on the end of the tube fluoresces as the electron spot strikes it; owing to persistence of vision the effect is an evenly illuminated screen.*

# THE MAGNETIC FOCUSING OF CATHODE-RAY TUBES

By H. Wood, B.A., (Oxon.), Ferranti Television Research Laboratories.

*Very little information has up to the present been published on the magnetic focusing of cathode-ray tubes, and this article, which is by an authority on the subject is therefore of considerable importance.*

IN the three-electrode cathode-ray tube, the electron emission from the cathode is accelerated by a gun or anode at a potential of several thousands of volts and controlled by the Wehnelt cylinder at a small negative potential. The beam of electrons emerging from the final aperture of the anode is in the form of a narrow angled cone with its vertex within the anode. The axis of the cone coincides with the axis of the cylindrical neck of the tube. The object of magnetic focusing is to collect this divergent beam magnetically in order that it may show as a very small intense light spot at the centre of the fluorescent screen. The spot can then be made to scan the screen by magnetic deflection.

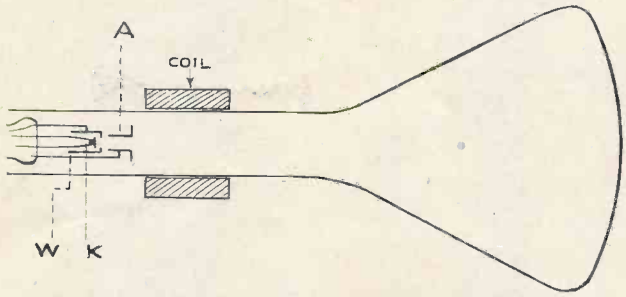



*Fig. 1.—Diagram showing arrangements for magnetic focusing, A Anode. W Wehnelt Cylinder. K Cathode.*

This concentration of electrons is effected by surrounding the neck of the tube in front of the anode system with a solenoidal coil (usually of about 200-300 ampere-turns) of suitable design (see Fig. 1).

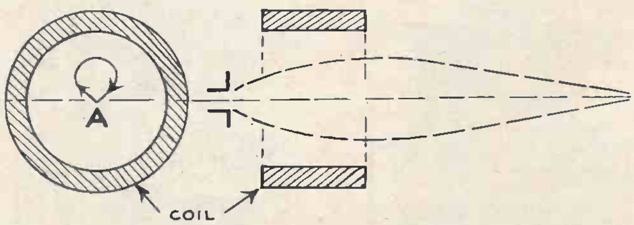



*Fig. 3.—Spiral field along axis of coil.*

The beam diverging from the anode is rotated by the action of the field of this coil and at the same time is made to converge. Adjustment of the coil current is made until the narrowest part of the beam. i.e., the part of greatest concentration is just upon the fluorescent screen.

A consideration of the field of the solenoidal coil (Fig. 2) shows us how this focusing is effected.

In the region within the coil the field is almost uniform and parallel to the axis. Outside the coil, the axial field gets weaker, but there is a radial component due to the curving of the lines of force away from the axis.

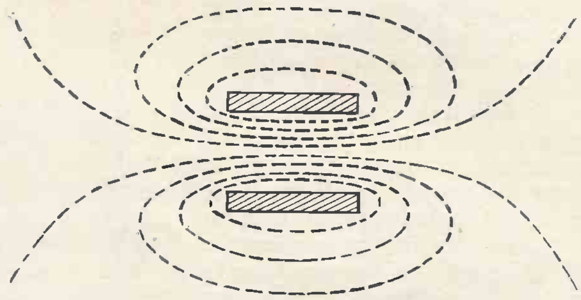


*Fig. 2.—Magnetic field of solenoidal coil.*

Let us now see what happens to an electron which is diverging from the anode A at a small angle to the axis. Due to its axial velocity in the radial field outside the coil, there is a magnetic force acting upon it, which causes it to move in a spiral.

Within the coil it still spirals because here it has a *radial* velocity in the uniform *axial* field. A complete mathematical investigation shows that when the electron has emerged from the field of the coil it is travelling towards the axis and will meet it at the image position. Fig. 3 shows the complete spiral as seen along the axis of the coil.

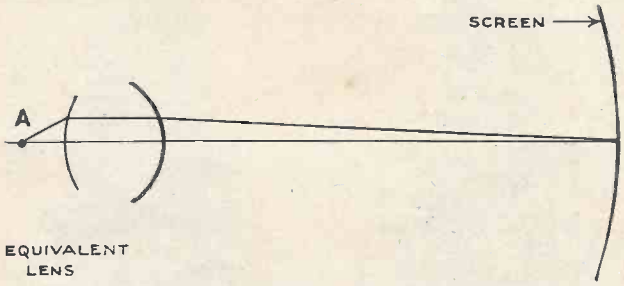



*Fig. 4.—Simplified optical equivalent.*

It can also be shown that all electrons from the anode within a small angled cone meet the axis at the same point after they have passed through the field of the coil. The whole twist of the spiral executed by the electron in the field of the coil is less than one complete turn. If the field is considerably increased, the

# ADVANTAGES OF MAGNETIC FOCUSING

electrons can again be made to focus at the same point. In this case, the spiral has one extra complete turn.

It should be noted that the scales in Figs. 2 and 3 are exaggerated in order to show the electron paths more clearly. The average practical values are:

Anode to coil, 3 cms.
Width of electron beam in coil, ½ cm.
Length of coil, 8 cms.
Coil to screen, 40 cms.

In this working condition, the anode, though outside

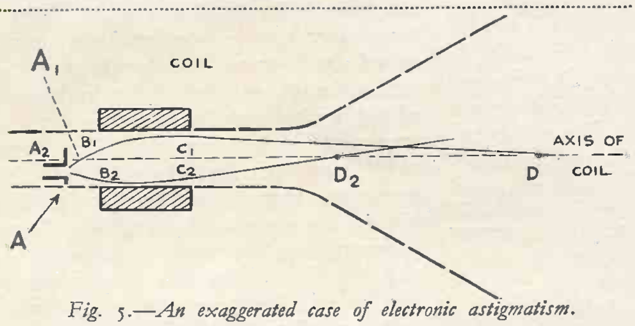



*Fig. 5.—An exaggerated case of electronic astigmatism.*

the focusing coil, is within its field. This is a lens system which gives extremely good electron concentration as a small spot on the screen. Its optical equivalent is a double convex lens with the surface nearer to the anode almost plane (see Fig. 4).

There are two major defects which may occur, both of which can be avoided by careful design and adjustment. The first is pure astigmatism and manifests itself in the same way that optical astigmatism does with glass lenses. With the magnetically focused C.R.

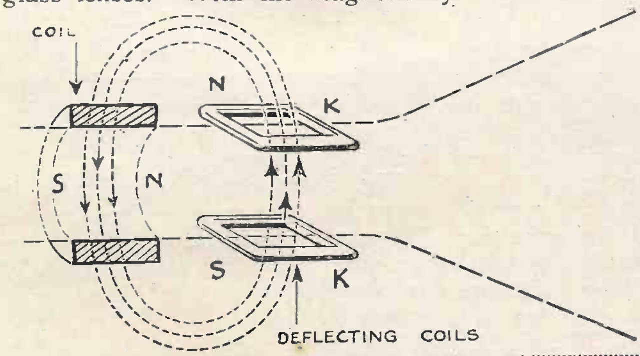



*Fig. 6.—Arrangement of coils for horizontal deflection.*

tube this defect can occur if the anode aperture is situated off the axis of the focusing coil. An exaggerated case is shown in Fig. 5.

The electron following the path $AA_1$, $B_1$, $C_1$, $D_1$ focuses as though it had come from an anode at $A_1$ on the coil axis and the one following path A, $B_2$, $C_2$, $D_2$ focuses as though it had come from an anode $A_2$. The image on the screen changes shape as the focusing current is altered and there are two slightly different values of current giving maximum electron concentration. The appearance on the screen in each case is of a thin short line instead of a circular spot, the two lines being approximately perpendicular.

This astigmatism may result from either or both of two defects:

(1) The anode is not situated centrally in the neck of the tube.

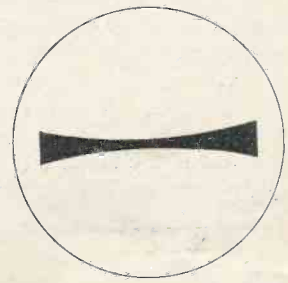
(2) The axis of the coil does not coincide with that of the neck of the tube.

Fortunately (1) can be corrected by having a slight angular adjustment on the coil. It is extremely important that this defect be absent in tubes used for television receivers, as it causes loss of picture detail.

There is another type of astigmatism which occurs if a badly designed magnetic deflection system is used.

In Fig. 6 the coils KK are used for horizontal deflection and their return field is vertical in the region of the focusing coil. This causes a modification of the field of the focusing coil, making it no longer symmetrical about its geometrical axis. This effect is clearly at a maximum when the deflection is greatest, i.e., the spot is astigmatic at the ends of the scanning

*Fig. 7.—Effect of using a coil of which the field is not symmetrical about its geometrical axis.*



line though anastigmatic at the centre. The appearance of a scanning line under these circumstances is shown in Fig. 7. This defect is absent if the deflector coils are suitably designed and positioned in order to have only a very weak field in the region of the focusing coil.

As an example of a magnetically focused tube there is the Ferranti which has been specially designed for magnetic focusing and scanning. It has a long cylindrical neck which can accommodate a focusing coil and deflecting coils. This neck is made with the smallest possible diameter, consistent with tube strength, in order that the smallest focusing and deflecting currents may be used. The electrode system comprises indirectly-heated cathode, Wehnelt cylinder and single anode. The anode has effectively three apertures and is specially designed to give a wide-angle beam suitable for magnetic focusing.

### *Advantages of Magnetic Focusing*

(1) The electrode system of the tube is very simple, thus making the tube less expensive.

(2) The focusing coil is a simple solenoidal coil and can be made adjustable to prevent astigmatism—a very important factor in television tubes. In an electrostatically focused tube astigmatism, if it occurs, is a permanent fault as the focusing electrodes cannot be adjusted after assembly in the tube.

(3) If magnetic focusing is used with magnetic scanning a considerable economy results as the scanning oscillators are much simpler and cheaper than those used for electrostatic deflection.

(4) Altering the brightness of the spot does not cause such serious defocusing as in most types of electrostatic tubes.

# Our Readers' Views

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

### *90-mile Reception of A.P.*

SIR,

I hope the following will be of interest to you. Since the beginning of October to the week ending November 14, I have received the Alexandra Palace programme daily. I have kept a log of signal variations during the time of listening, and on comparing them, the reception by night is of a higher level than in daylight. R7 was the average by daylight and R9 by night, with very slight fadings. The receiver in use is a straight three-valve covering 2-10 metres to which is capacity coupled an indoor aerial fixed round three sides of the window frame. I have had reports verified from the B.B.C. This report is in regard to sound only, the vision C.W. being of about the same strength.

J. TAYLOR (Isle of Wight).

### *Extended Views*

SIR,

I was interested to read under "Scannings and Reflections" in this month's magazine, of the chance use of a reflector to obtain extended scenes during an Alexandra Palace transmission.

If you will remember, this was suggested by Sir Ambrose Fleming in a lecture on television at the Imperial College of Science in January, 1930, and reported in that month's TELEVISION Magazine.

Personally, I have had no opportunity of experimenting in this line, but would like to hear other reader's opinions on this matter.

At present I am working on a radial scanning system using rotating prisms which could, I think, be used with advantage with the above.

B. WHATMORE (London, N.).

### *5-metre Activity*

SIR,

I have noticed that amateur stations are again active on 5 metres, but it seems that little new is being discovered. The net results of most of the experiments seems to be interference to local broadcast listeners.

This is quite understandable in view of the obsolete methods employed in transmitting, such as shock excited circuits and hit-and-miss aerial arrangements. In many cases, principles adopted 12 years ago have revived, so I fail to see how any useful progress can be expected.

Transmissions from such apparatus are quickly lost and in any case can only be picked up with super-regenerative receivers, which are in themselves extremely noisy and are, therefore, quite useless for the reception of weak signals.

It is possible to construct a superhet receiver to cover the 5-metre band, so it seems a waste of time still to use pre-historic shock-excited transmitters. Why do not the Post Office insist on some orthodox frequency control such as crystal, electron coupling or master oscillator which would give stability, greater range of reception and, at the same time, eliminate any chances of interference to broadcast listeners.

How can anything but local reception be expected by simply coupling the transmitter to any old aerial and hoping for the best, which usually results in a maximum range of 2-3 miles.

In my opinion the only satisfactory aerial system for the ultra-high frequencies is one carefully thought out and mathematically correct. I suggest an aerial with four ½-waves in phase with reflectors. The whole system should be supported as high as possible above ground level on a wooden frame with means to alter its directional properties. This aerial must be fed by properly designed matched impedance feeders.

If the serious experimenter would work on these lines I feel sure that there would be considerable progress in 5-metre long distance reception.

J. E. NICKLESS, A.M.I.E.E., G2KT.

### *Trend of Invention*

SIR,

During the year 1936, 35,900 Patents were applied for.

As regards the trend of invention, the Comptroller's report for 1935 refers to considerable activity in connection with the dyeing of leather, artificial resins, chemicals for treating textiles, photographic chemicals and drugs, and the development of synthetic methods of preparing sex-hormones. There was activity also in connection with devices for the detection of, and protection against, noxious and explosive gases. Development also took place in technical applications of modern discoveries in physics, including transmutation of elements by bombardment with high-speed electric particles and short-wave radiation, the mercury discharge lamp, in which a relatively minute lamp gives an intrinsic brightness hitherto unknown in practice, and powders and other substances, stimulated to luminosity by radiation from an electric discharge. Trolley-bus control and telephone and railway-signalling relays also received attention. Television accounts for a large increase in applications, particularly as regards the development of cathode-ray receivers, the reduction of flicker by interlaced scanning, the transmission of cinema films, and short-wave wireless transmitting and receiving apparatus for use in television. In aeronautics marked development took place in gyroplanes.

In road vehicles the imposition of the speed limit resulted in a large number of applications relating to devices for limiting the speed or for providing indications and warnings for drivers and pedestrians.

GEE AND CO.,
Patent Agents (London, W.C.2.).

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### "The Cathode-ray Tube for the Beginner"

(*Continued from page 93*)

again, and this is accomplished by applying a high potential to the second anode, the compression actually being brought about by the electric field which is produced between the first and second anodes.

Fig. 6 shows the application of the potentials necessary for focusing the beam, and it will be seen that these are obtained by means of a chain of resistances across the high-tension supply.

The beam is caused to swing from side to side by applying a rapidly changing potential to one pair of deflector plates, as shown in Fig. 7. The scanning circuit, or time base as it is termed, to provide this changing potential is designed to produce the deflection regularly and uniformly in one direction whilst a second scanning circuit moves the beam in a direction at right angles. In Fig. 8 the beam is shown being acted upon by both pairs of deflector plates.

In operation for television purposes the signal from the receiver is applied to the grid of the tube whilst the beam is tracing the screen, and this modulates the intensity of the beam which is revealed as a varying intensity of light on the screen.

# STUDIO & SCREEN

## A MONTHLY CAUSERIE on Television Personalities and Topics

*by K. P. HUNT*
**Editor of "Radio Pictorial"**

INTRIGUING rumours of romance in the B.B.C.'s television studios at Alexandra Palace gained currency during the month. It was whispered that an engagement between Mr. Leslie Mitchell, the television announcer, and Miss Elizabeth Cowell, his colleague and hostess-announcer, might shortly be expected; and as this was the first hint that Cupid was at work in television surroundings, the story was, of course, embroidered rather freely.

I am assured that there is no truth whatever in these rumours. Elizabeth Cowell herself says that the idea is without any foundation.

"Everyone who looks-in to the B.B.C.'s television programmes, of course, sees me and Leslie Mitchell together quite a lot on the screen," she said, "and from this I suppose it is easily imagined we are always together. But as a matter of fact I don't see much of Leslie apart from work at the Palace. Whatever impression has got abroad is due simply to this association on the screen."

"Leslie and I are just good friends," she repeated emphatically.

* * *

I have had little opportunity during the month of enjoying much looking-in, but I saw several programmes a few days ago after a lapse of more than a fortnight. My impression was that the whole routine and presentation of the programmes at Alexandra Palace is, for want of a better word, definitely "slicker" than it was in the beginning of the new service. It is only natural that we should now begin to see the effect of the experience gained by the productions staff who, without shouting it from the housetops, have been learning by their mistakes all the time.

Perhaps the most significant development on the studio side is the rapid growth of multi-camera technique. This was brought out very well in "Anthony and Anna," in which no fewer than four cameras were used on the one set and the fading effects were extraordinarily impressive.

The use of scenery in television production, which I mentioned in these notes last month, is evidently an aspect of the studio work which holds great possibilities, and already we have seen further striking examples of what can be done. One case which comes to mind was Dallas Bower's production of "Burnt Sepia" in which there was a background of palm trees, and so on, forming a sort of scenic frame in front of which characters appeared. This scenery was taken care of by one camera, while a second camera was used for shooting the characters.

*Judy Shirley.*

The scenery looked most magnificent, but few lookers could have guessed that actually it was clevery cut out in cardboard and probably cost no more than a few pence!

The man behind this development of scenery in television productions is Peter Bax, one of the stage-managers at the Palace, who, it will be remembered, made a preliminary but extremely successful attempt in this direction with the Canterbury Cathedral scenery. Following hard on the heels of this innovation he was also responsible for that particularly effective scene in the Armistice Day programme in which a great degree of realism was introduced in this manner, even to the smoke of the guns floating over a Flanders cemetery. We can look forward to many more interesting developments of this scenery idea in television production.

* * *

Mary Allan, television make-up expert, is still one of the busiest people at the Palace, and after hearing a story I was told last week I am quite ready to believe she is equal to anything. Mary was asked to make up a motorcar for television!

It was Campbell's "Bluebird," and although to ordinary sight this 30-foot long blue-coloured mechanical wonder makes a beautiful picture, when it was first tried out via television it was found that certain shiny metal parts on the car reflected the studio light and caused halation, in the same way that, when taking night pictures with a camera, a blur of light may occur if a source of light is included in the view. So to get over these difficulties, the make-up expert, Mary Allan, was called upon to demonstrate her art upon the car. She arrived complete with powder and paint, and, I understand, powdered all the light parts of the car.

* * *

Gerald Cock is already giving a good deal of thought to the possibility of televising the Coronation in May. He was one of a company including Sir John Reith and the Archbishop of Canterbury who recently made a tour of Westminster Abbey, and it is known that television plans in connection with the Coronation were the subject of the inspection. As far as I can gather, however, this visit was only with the object of going into the possibilities, and nothing definite has yet been decided as to whether the Coronation will be televised or not.

* * *

Mr. D. H. Munro, Productions Manager at the Palace, still seems to be the hub round which the actual programmes are turning, and it must be said to his credit that he has de-

# A TELEVISION DANCE BAND

vised a marvellous system of team work in the studios. The whole thing works like clockwork, and there has been no hitch in the routine since it started, which is the greatest tribute one can pay to an organisation which is always growing and which presents fresh problems every day.

* * *

Cecil Lewis has sojourned to Italy prior to his Hollywood trip. I hear there was a touching little farewell party in his honour. Cocktails, and all that, and Cecil shook hands with everybody—about 60 people in all.

* * *

A programme which I was too late to say much about in these notes last month, because of the early Press day, was Harry Pringle's Christmas Eve Old Veterans' programme which was one of the most successful yet produced. It brought the greatest number of telephone congratulations so far received at the Palace for any one programme. Harry deserves special commendation for his clever experiment in which he showed the audience clapping. This audience, by the way, was got together at the last moment, and included all sorts of people, who donned paper hats and were soon lost in the party spirit. "We quite forgot we were at a television show," one of them told me afterwards.

* * *

Sidonie Goossens, the famous harpist, made an exceedingly pretty picture on the television screen. To get the right effect they put her on a platform four feet high and, by using two cameras, got some remarkably fine effects, some of which were upward shots.

Another performer whose television appearance during the month was notable was Yvonne Arnaud who, by the way, is booked again for an appearance early in February. Her success as a television artist can be attributed not only to her undoubted cleverness and somewhat whimsical character, but to the wealth of stage and screen experience which stands her in such great stead, and which in fact was quite noticeable in her television performance at the Palace. Here is a little story I was told which illustrates what a tremendous asset this background of stage and film experience can be.

Yvonne ended her act about three or four minutes earlier than was expected, and on coming to the end she thought it was quite over. Resourceful Elizabeth Cowell stepped forward and in a wonderfully natural manner started talking to Yvonne—asking her if she would give another song, and discussing with her what it should be.

Now a newcomer to the show business, in these circumstances, would probably have been flabbergasted, and no doubt would have betrayed the fact to lookers. But not so Yvonne. In a flash she understood the purpose of the conversation, and acted up to it with superb aplomb.

Among other acts that deserve mention is Eric Wild and his Tea-Timers. Eric is a cornet player in the television orchestra, under Hyam ("Bumps") Greenbaum, but has scored a notable success with his 6-piece combination billed as "Eric Wild and his Tea-Timers." The other five players also are drawn from the television orchestra, the combination of instruments being rather unusual, and consisting of xylophone, bass, guitar, cornet, trombone and clarionet. The unusual feature is that the combination contains no drums nor piano.

Eric himself is a Canadian who came over here last May with Billy Bissett. He is a Bachelor of Music of the University of Michigan, and does all his own orchestrations.

The Tea-Timers have appeared three times for televiewers, with Judy Shirley and Anne Lenner as vocalists. These two girls are sisters. Both have attained prominence in sound broadcasting as crooners with dance bands, Judy mostly with Maurice Winnick and his band, while her sister is at present a main attraction in most of Carroll Gibbons' broadcasts.

* * *

*Eric Wild and his Tea Timers—the first television dance band—all the members of which are also members of the Television Orchestra.*

Here is a spot of interesting news. A little bird has whispered in my ear that we shall soon see a regular television dance band, and that this is now being organised as a 10-piece outfit, with Eric Wild as leader. I also hear, by the way, that the television Tea-Timers will shortly be heard in one of Brian Michie's programmes.

As a popular television feature, "Picture Page" still seems to be in the ascendant. With the February 3 performance it will reach its 25th edition.

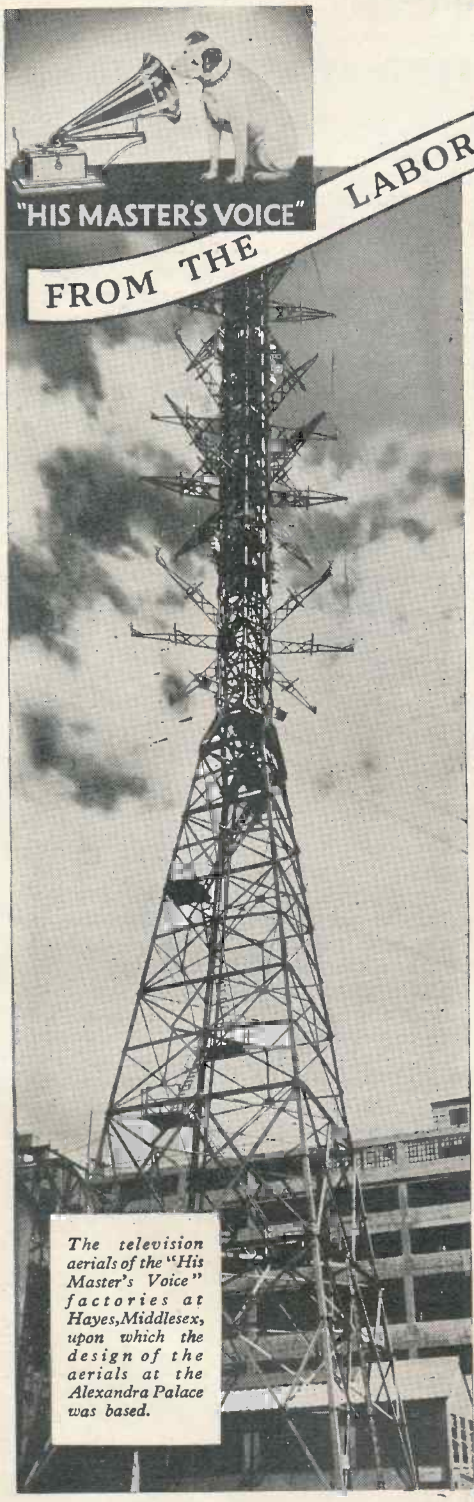
Cecil Madden, the producer, has been amusing himself by working out some statistics as to bulk artistic endeavour and dressing room turnover in the first 20 editions of "Picture Page" already televised.

He tells me there have been 162 programme items in the course of which Leslie Mitchell has interviewed 168 men, 90 women, 12 boys, 12 choir-boys, one elephant boy, six girls, one fairy, three accompanists, one Siamese cat, one Alsatian dog, one string of onions, one monkey, one Bond Street model, one tray of muffins, one box of herrings, one Guy Fawkes, and a silkworm!

* * *

On February 2, the League of Health and Beauty are to give another show which, if it is anything like the last one, will make good looking.

FROM THE LABORATORY IN 1931 TO THE HOME IN 1937




*The television aerials of the "His Master's Voice" factories at Hayes, Middlesex, upon which the design of the aerials at the Alexandra Palace was based.*

# "HIS MASTER'S VOICE"

*The Pioneers of High Definition*

# TELEVISION

IN 1931 "His Master's Voice" gave the first demonstration of High Definition Television, and by High Definition is meant pictures with great detail.

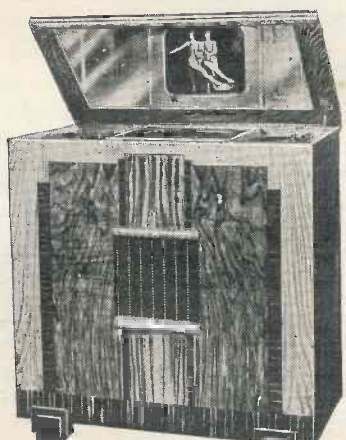
"Television is only in the laboratory stage" said the "His Master's Voice" engineers, and for five years they worked in secrecy at Hayes, Middlesex, to bring Television to entertainment value for the home.

Now, with the installation at the Alexandra Palace of the Marconi-EMI system of Television, with its wonderful Emitron Camera, and absence of flicker, "His Master's Voice" engineers have reached their objective. At the same time they have designed the receivers illustrated on this page.

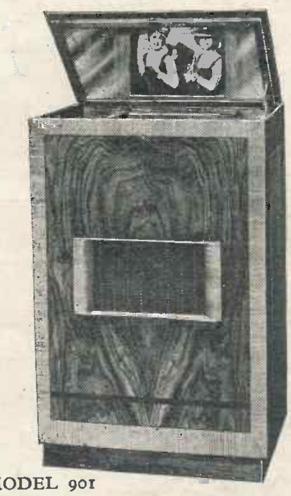
The "His Master's Voice" television receivers, Model 900 and Model 901, cost 120 gns. and 95 gns. respectively.

The circuits employed in both instruments for vision reception are electrically the same. Different sound receivers are incorporated. Model 901 has twenty-two valves in all, and has a receiver for the television sound transmissions only. Model 900 has twenty-three valves, including a five wave band all-wave receiver which enables the television sound programmes, or other broadcast programmes on the medium, long and short wave bands to be heard.

Both instruments have wide angle vision, that is, the pictures are seen in a mirror, and can thus be viewed by a number of people over a wide angle. No lens or other magnifying device is employed. 12″ Cathode Ray receiving tubes are fitted which give a size of picture visually equivalent to that seen from the back seats of the average cinema.



MODEL 900



MODEL 901

**The "His Master's Voice" engineers who have designed these Television Receivers have devoted the same skill to the design of the new "His Master's Voice" All-Wave Radio Receivers and Radiograms. These instruments give you the best reception of radio programmes from all parts of the world and cost from 9½ gns.**

**FREE DETAILS OF 'H.M.V.' TELEVISION RECEIVERS AND NON TECHNICAL EXPLANATION OF TELEVISION**

To "His Master's Voice," Television, 108T Clerkenwell Road, London, E.C.1.

I would like to receive your illustrated folder in colour, giving brief non-technical explanation of television and particulars of "His Master's Voice" television receivers.

NAME ........................................................................................................

ADDRESS ....................................................................................................

# PREMIER SUPPLY STORES

## — THE LARGEST RADIO MAIL ORDER HOUSE IN EUROPE —

*GET OUR QUOTATION FOR YOUR SHORT WAVE AND TELEVISION GEAR*

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

*All Post Orders to—* **Jubilee Works, 167, Lower Clapton Rd., London, E.5**

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

**Have you had our Giant Illustrated Catalogue and Valve List ? Send 4d. in stamps for this amazing list of Bargains.**

### AMERICAN VALVES

**HIGH-GRADE TRIAD** for which we are sole British Distributors. The following types all **5/6** each : 2E5, 6E5, 2G5, 6G5, 6D7, 6E7, 6B6, 1A6, 1C6, 2A3, 2A5, 2A6, 2A7, 2B7, 6A4, 6A7, 6B7, 6C6, 6D6, 6F7, 00A, 01A, 11, 12, 15, 18, 19, 20, 22, 24A, 26, 27, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39/44, 40, 41, 42, 43, 45, 46, 47, 51, 53, 55, 56, 57, 58, 59, 71A, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 89, V99, X99, 112A, 1V0, 5Z3, 12Z3, 25Y5, 25Z5, 6A6, 185R.

Also **6B5**, High Gain Triode, will give 15 watts per pair in Push-Pull with only 300 anode volts, **5/6** each.

All the new Metal-Glass Octal Base tubes : 6N7, 6L7, 6N6, 6A8, 6K7, 6J7, 6C5, 6Q7, 6F5, 524, 6D5, 6B6, 6H6, 6Z6 (at **6/6** each) 210 and 250, **8/6** each. 4-, 5-, 6- and 7-pin U.S.A. chassis mounting **valveholders, 6d.** each. **Octal** Bases, **9d.** each.

### EUROPA MAINS VALVES

Famous Europa 4 v. A.C. types, H.L., L., S.G., Var.-Mu-S.G., H.F.-Pens., Var.-Mu-H.F. Pens., 1, 3 and 4-watt A.C. directly-heated output Pentodes. Full-wave rectifiers, 250 v. 60 m.a. A.C./D.C. types. 20-volt .18 amp. S.G., Var.-Mu-S.G., H., HL., Power, and Pentode. All **4/6** each. **Following Types.** Full-wave rectifiers, 350 v. 120 m.a. and 500 v. 120 m.a. 2½ watt indirectly-heated Pentodes. Frequency Changers, Octodes and Heptodes.
Double Diode Triodes, all **5/6** each.
2½ watt Directly Heated Triodes, **6/6** each.

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

### PREMIER'S FAMOUS MAINS TRANSFORMERS

**PREMIER** wire-end type with screened primaries, tapped 200-250 v. Centre-tapped Filaments. Guaranteed one year. **H.T. 8 & 9** or **H.T. 10** with 4 v. 4 a. C.T. and 4 v. 1 a. C.T., **8/6. 250-250 v. 60 m.a.** or **300-300 v.,** 4 v. 1 a., 4 v. 2 a. and 4v. 4 a., all C.T., **8/6. 350-350 v. 120 m.a.,** 4 v. 1 a., 4 v. 2 a. and 4 v. 4 a., all C.T. **10/6.** Any of these transformers with engraved panel and N.P. terminals, **1/6** extra. **500-500 v. 150 m.a.,** 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., **17/6.**

Super-shrouded model, **21/-.** 500-500 v. 200 m.a., 5 v. 3 a., 4 v. 2 a., 4 v. 2 a., 4 v. 3-5 a., all C.T., **25/-** (for use with 83 or 523 rectifier, cost only **5/6** to obtain 500 v. 200 m.a. smoothed).

500-500 v. 150 m.a., no L.T.'s, **12/6.** 1,000-1,000 v. 150 m.a. no L.T.'s, **19/6.**

**SPECIAL OFFER.** 350-350 v. 120 m.a. wire-end transformers with 4 v. 2 a. 4 v. 3-5 a., all C.T., **9/6** each.

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

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

**SMOOTHING CHOKES,** 25 m.a. **2/9** ; 40 m.a., **4/-** ; 60 m.a., **5/6** ; 150 m.a., **10/6.** 2 500 ohms, 60 m.a. Speaker Replacement Chokes, **5/6.** 250 m.a. Chokes, **21/-.**

**GIANT MULTI-RATIO OUTPUT TRANSFORMERS.** 5 ratios—1 : 1, 1.5 : 1, 2 : 1, 2.5 : 1 and 3 : 1, **5/6** each. **COSSOR NEON TUNING INDICATORS, 3/6** each. **.05 MICA CONDENSERS,** 500 v. working **1/-** each. **.0015 MICA,** 1,000 v. working, **1/-** each. **.1 PAPER TUBULAR** Condensers, 750 v. working, **1/-** each.

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

**TELSEN** iron-cored screened coils, W.349. **4/-** each. Electric **SOLDERING IRONS,** 200-250 v. A.C./D.C., **2/3.**

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

**U.S.A. MIDGET 2-GANG** (2 × .0005) **CONDENSER** with trimmers 3½ in. wide, 2½ in. long, ¼ in. spindle, ⅜ in. long. **3/6** each.

### SHORT-WAVE KITS

**NEW 1937 1-VALVE SHORT-WAVE RECEIVER OR ADAPTOR KIT** 13 to 86 metres without coil changing. Complete Kit and Circuit, **12/6. VALVE GIVEN FREE!**

**DE LUXE MODEL** 14 to 150 metres, complete Kit with Chassis, 4 Coils and all parts, **17/6. VALVE GIVEN FREE !**

**SUPERHET CONVERTER KIT, 13/6.**

**S.W. SUPERHET CONVERTER,** for A.C. Mains Receivers, **20/-.** A.C. Valve given **FREE !**

**NEW 1937 2-VALVE S.W. KIT,** 13 to 86 metres without coil changing. Complete Kit and Circuit, **19/6. VALVES GIVEN FREE! DE LUXE MODEL,** 14 to 150 metres, complete Kit and Chassis, 4 Coils and all parts, **25/-. VALVES GIVEN FREE!**

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

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

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

**LISSEN ALL-WAVE COILS,** 12-2,000 metres, complete with switching and wiring diagram. **Special Offer, 6/11. 1936 TELSEN** 3-gang iron-cored Band-Pass coils with integral switching, 200-2,000 metres, **12/6** set.

**HIGH-GRADE** Litz-wound I.F. Transformers with dual ceramic trimmers, 465 kc., **5/6** each.

### PREMIER HIGH-FIDELITY P.A. AMPLIFIER KITS

**3-WATT A.C.** 2-stage **AMPLIFIER** for Mike or Pick-up. Complete Kit of Parts with 3 valves, **40/-.**

**7-WATT A.C./D.C.** 3-stage **AMPLIFIER.** High-Gain, Push-Pull output. Complete Kit of Parts with 5 matched valves, **£4 4s.**

**10-WATT A.C.** 3-stage **AMPLIFIER** incorporating Phase-Inversion and Push-Pull Triodes. Enormous gain and straight line reproduction. Complete Kit of Parts, including 5 matched valves, **£5 5s.**

**20-WATT A.C.** 3-stage **AMPLIFIER,** suitable for largest dance hall. Employs new Giant Speech Transformer to ensure perfect reproduction. Complete Kit of Parts with 5 matched valves, **£8 8s.**

### PREMIER TRANSVERSE-CURRENT MICROPHONE

**Reisz pattern. Large output, exceptionally fine frequency response with low hiss level. Frequency range, 45-7,500 cycles, plus or minus 2DB, 30/-. Transformer, 5/- ; Table Stand, 7/6 ; Adjustable Floor Stand, 22/6.**

**ELECTROLYTICS.** U.S.A., 4, 8 or 16 mfd. 530 v. peak, **1/9** each. **Dubilier,** 4 or 8 mfd. 500 v., **3/-** ; 50 mfd. 50 v., **1/9** ; 10 mfd. 50 v., **6d.** ; 25 mfd. 25 v., **1/-.** T.C.C. 4 or 8 mfd. 650 v., **4/-** ; 15 mfd. 50 or 100 v., **1/-** ; 50 mfd. 12 v., **1/-. Paper Condensers.** W. E. 250 v. working 4 mf., **2/-** ; 2 mf., **1/-** ; 1 mf., **6d.** ; 350 v. working 4 mf., **2/6** ; 2 mf., **1/6.** Dubilier 500 v. working 4 mf., **4/-** ; 800 v. 4 mf. **6/-.**

Wego 450 v. working, 2 mf., **1/9,** 4 mf., **3/-**; 700 v. working 2 mf., **2/-,** 4 mf., **3/6.**

**Dubilier Oil-filled Condensers.** Complete range in stock up to 3,000 volts working.

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

**Potentiometers** by well-known makers. All values up to 1 meg., **2/-** ; with switch **2/6.**

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

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

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

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

### SHORT-WAVE COMPONENTS

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

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

**SUPER CERAMIC CONDENSERS,** S.L.F. .00016, .0001, **2/9** each ; double-spaced, .00005, .000025 .000015, **3/-** each. All brass with integral slow motion, .00015 tuning, **3/9** ; .00015 reaction, **2/9.** British Radiophone 2-gang .00016, **5/6.**

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

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

**GLASS AERIAL INSULATORS, 4d.** each.

**BEEHIVE STAND-OFF, 6d.** each.

**SCREENED FLEX,** single, **3d.** yd. Twin, **4d.** yd.

### METERS

**MOVING-IRON** flush type milliamp meters in 2¼-in. Bakelite Case, to read A.C. or D.C. Ranges, 10, 20, 30, 50, 100, 150, 250 and 500 m.a., also 1, 3, 5 and 10 amps., 6, 16 volts, all **5/9** each. 0-250 v., **8/6.**

**MOVING COIL METERS,** 0-1 m.a., 2⅝-in. flush Bakelite Case, resistance, 100 ohms, **18/6.** Super model, 3½-in. case, **22/6.**

**VOLTAGE MULTIPLIERS,** any value, **1/-** each. Tapped milliamp shunts for 10, 50, 100 and 200 m.a., **4/-** each.

**TELSEN MULTIMETERS.** An extremely useful multi-range meter reading A.C. and D.C. Ranges, 8 v., 16 v., 240 v., 30 m.a. and 300 m.a., **8/6** each.

### MOVING COIL SPEAKERS

**MAGNAVOX.** Mains energised. "154," 7-in. cone 2,500 ohms 4 watts, **12/6** ; "152," 9-in. cone, 2,500 ohms **17/6** ; "152 Magna," 9-in. cone, 2,500 ohms 6 watts **37/6. Magnavox** P.M.'s—"254," 7-in. cone, **16/6** ; "252," 9-in. cone, **22/6.**

**ROLA** latest type P.M.'s, **18/6. GOODMANS'** 8-in. mains energised, 1,000 ohms field, **10/6** each.

**JENSEN** P.M. Speakers, **10/6. R. and A.** energised Speaker, 7½-in. diameter, 2,500 -Ω- field. Pentode Transformer, strongly recommended, **11/6.**

**ENERGISING UNIT** for any above energised speakers, **10/-.**

**MAGNAVOX** "33," "33 Duodes" and "66" Speakers can always be supplied from stock.

### GRAMOPHONE MOTORS

**COLLARO** Gramophone Unit, consisting of A.C. motor, 100-250 v. high-quality pick-up and volume control, **45/-** ; Collaro motor only, **30/-** ; Collaro Universal Gramophone Motor, 100-250 v. A.C./D.C., with high quality pick-up and volume control, **67/6** ; Collaro Universal Motor only, **49/6** ; **EDISON BELL** double-spring motors including turntable and all fittings, **15/-** ; **COSMOCORD** Gramo. unit, comprising A.C. motor pick-up and volume control (list 55/-), **35/9.**

**COSMOCORD PICK-UPS,** with tonearm and volume control, **10/6** each.

**PICK-UP HEADS** only, **4/6** each.

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

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

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

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

Super Quality lightweight **HEADPHONES, 3/9** pair.

**TELSEN BINOCULAR H.F. CHOKES,** Bakelite case, 200-2,000 metres, **1/3** each.

"Operating the Alternative Time Base"

(*Continued from page* 102)

be exercised to see that there is always at least 1 meg. fixed resistance in series at all times, otherwise there will be a danger of applying too high a voltage to the relays with consequent damage to them.

Self bias to the grids of the gas discharge relays may be obtained as follows.

A 500-ohm 1-watt resistance with a 50-mfd. 12-volt condenser across it should be taken one side to −H.T. and earth on the circuit diagram and the other side to *−H.T. on the power unit.* Thus the 500-ohm resistance is in series with the H.T. on the negative end. The condenser across this resistance is for smoothing and is *necessary.* The earth must be kept as shown in the circuit diagram.

The minus bias leads previously connected to the grid bias battery common to both sides should now be taken to −H.T. of the power unit and the battery dispensed with. It is advisable to conduct initial experiments with the bias battery.

Those who are on the same circuit A.C. mains as the transmission can experiment with mains synchronising for the frame frequency. Remove the usual synchronising feed and connect about 3 ft. of single lead to the grid of the frame relay. Hold the bare end between the fingers (there is no danger) and slightly adjust the bias control and the picture will usually jerk into synchronism. This is because A.C. mains hum is deliberately introduced to the grid of the relay. If the phases are correct it will only be necessary to bring the lead from the relay close to a mains transformer. Even though not on the same A.C. mains as the transmitter it is worth experimenting for the experience gained.

### *Explanation of "Negative" Synchronism*

As is usual, a positive pulse is required to be applied to the relay grid to provide efficient synchronism, and although the scheme outlined does apply a positive pulse, it does so in what might be termed a negative manner, as follows:—

As the relay approaches its "firing" point the relay grid is driven more negative by the arrival of a negative pulse (black in the picture) which is the synchronising signal. This prevents the relay firing, but immediately the synchronising pulse has passed the picture detail is being transmitted which, at its lowest value, is 30 per cent. of the carrier strength. Thus a strong positive pulse is applied to the relay, while it is in a critical state—a state we have automatically created. The relay then fires and any picture content will have no effect on the scanning.

It is, of course, necessary to apply just sufficient voltage to keep the grid in a more negative condition at the arrival of the synchronising pulse.

The value of the instantaneous picture signal immediately following the synchronising signal will not have any bearing on the relay firing point, as it will be clear that practically any positive signal immediately following the synchronising pulse will fire the relay. An advantage is that less strength is required and a valve can be dispensed with.



### Transformers for the Guaranteed Receiver

Will readers kindly note that all transformers for "Television's" Guaranteed Receiver can be obtained from W. Bryan Savage, Ltd., Westmorland Road, London, N.W.9.

### Rotary Converters for Television

A.C. current is, of course, essential for the operation of television receivers, but in cases where A.C. mains are not available the difficulty can be overcome quite easily by the use of a rotary converter. Many installations of this nature are in operation in various districts where the mains supply is D.C. The Janette converter is an excellent instrument of this type and being equipped with a filter of exclusive design it is quite silent in operation and the results obtained are equal to those of mains supply. These converters can, of course, be used for a variety of purposes as, for example, radio, public address, gramophone amplifiers and neon signs. The Janette converter is marketed by Charles F. Ward, 46 Farringdon Street, E.C.4, who will furnish particulars of outputs and prices on request.

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