ELECTRONICS AND TELEVISION & SHORT-WAVE WORLD

OCTOBER, 1939

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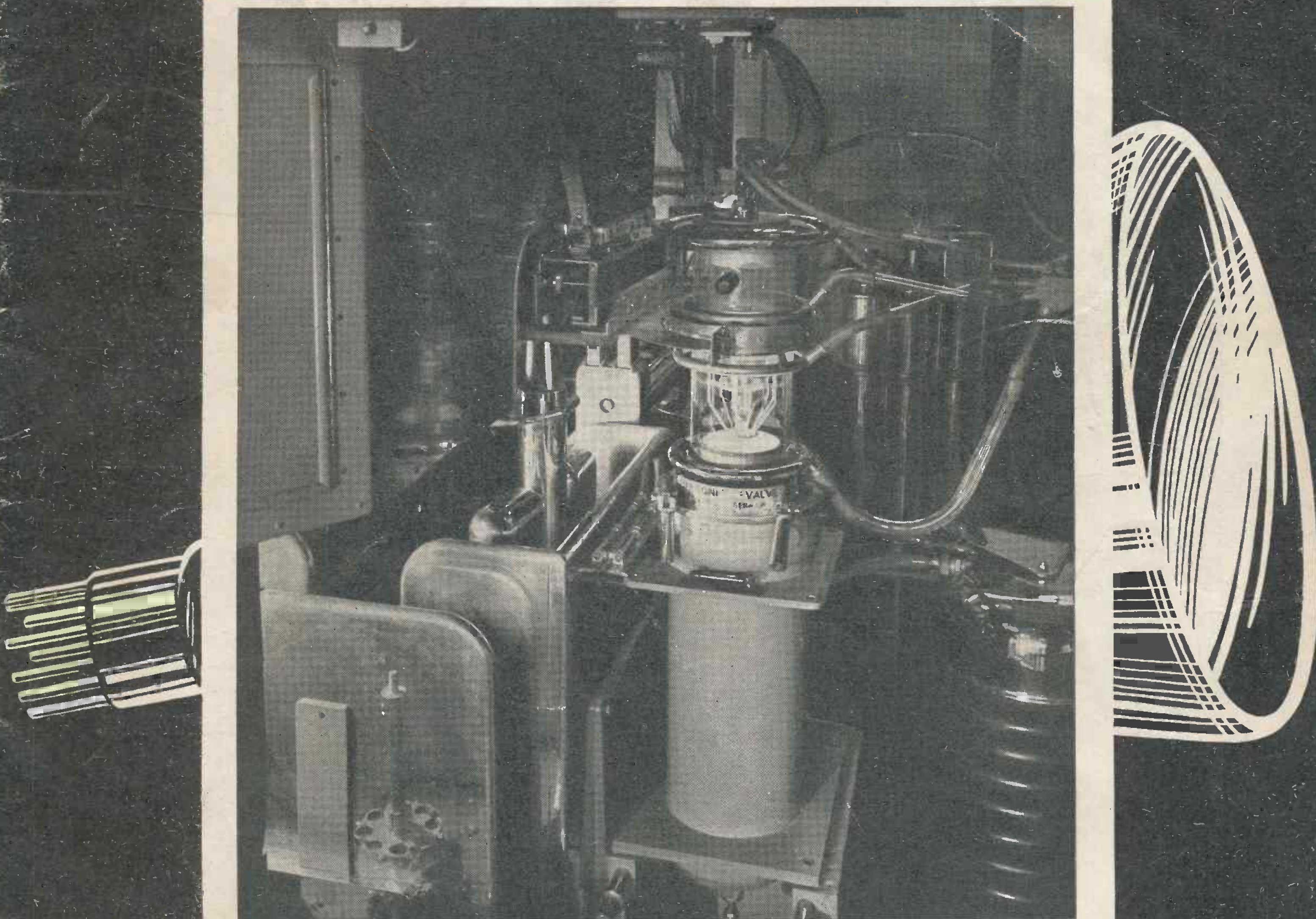

SOUND AMPLIFIER SYSTEMS FOR RAID WARNINGS

(SEE PAGE 583)

THE FIRST TELEVISION JOURNAL IN THE WORLD

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Our New Scope: Our New Price

FOR some long time we have been considering the question of enlarging the scope of this journal, it having become abundantly evident that television is only the most ocular development of a remarkable new industry—that of Electron Engineering, which is increasing in importance every day. It is quite impossible to forecast the ultimate development of this industry, but from the outline of its scope given in the article overleaf, readers will gain some idea of the remarkable possibilities. The desirability, and almost the necessity, of enlarging our scope has been pressing upon us, but if we hesitated to make a decisive change in the policy of this journal, it was because we had pioneered television from its earliest days when, in spite of the resolution and enthusiasm of John Logie Baird and a few others, it was regarded as a mere dream; and we take a very natural pride in having played our part—a greater part than is generally known—in its development.

However, with the coming of war, special considerations have compelled the closing down of the only British television transmitter and have brought to a close " for the duration " any popular development, although it would be quite wrong to assume that there is not considerable activity behind the scenes; this activity, however, is not likely to be given an opportunity of interesting the public yet awhile. On the other hand, there is at the moment, and will continue to be, intensive research into a dozen or more other branches of the electronic science. Such research may well bring about, and will almost certainly do so, an immense number of practical applications the importance of which can hardly be exaggerated.

Everybody knows that during the last war there was a remarkable development in wireless; remember, for example, the electronic valve, known practically at the time only to a relative few who were able, once hostilities had ceased, to take advantage of their knowledge and in a brief time give the world the then astonishing radio broadcast.

There will be similar, and possibly as important, although not necessarily such spectacular, developments in the near future in the immensely wide and evergrowing field of applied electronics in modern engineering, and it does not need any special argument on our part to demonstrate that there is sound sense in our change of title and enlargement of scope. We shall continue to chronicle as before all important development in television and in short-wave reception, although we should not be serving the public interest in drawing marked attention to war-time development in short-wave transmission.

We are not blind to some imperfections in the present issue but readers will realise that we have had our share of the troubles with which all businesses are afflicted at the present time. From our editorial and business staffs we have lost key-men, and there are all the minor difficulties associated with the sudden coming of war. Thus, while our first number of " Electronics and Television " is consequently not quite typical, we hope to make it more so as the months go by, and, in the meantime, judged by war-time standards, we hope readers will agree that there is not much to grumble at.

Finally, our price! With deep regret we are compelled by circumstances to raise our price or—frankly—to join the host of publications that have been suspended or put out of existence during the past few week. We beg readers to accept our word that in raising our price to 1s. 6d. we have not sought in the very least to take advantage of them, the position being simply that the war-time difficulties relating both to cost and revenue have left us no alternative. We shall hope to carry the great majority of our readers with us, and they may be sure that we shall strive month by month to give them excellent value in up-to-date news and information on all the subjects within our new scope.

NEW ELECTRONIC APPARATUS FOR DIAGNOSIS OF MENTAL DISEASES

ELECTRICAL ACTIVITY IN THE HUMAN BRAIN

This article describes an important application of the high-gain amplifier to electro-physiological research, and is reprinted from the "A.E.I. News," the Journal of Associated Electrical Industries, Ltd., by permission.

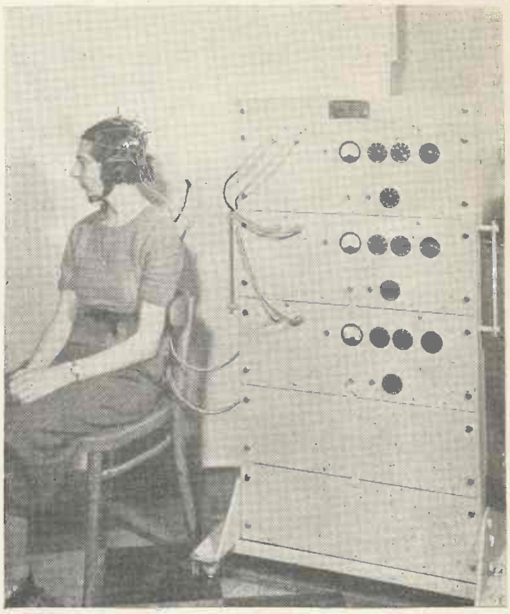


Fig. 1. The amplifier connected to the scalp by small pad electrodes. There is no discomfort to the patient.

THE intimate relationship between electricity and the functions of the human body has been known for a long time—in fact since the time that Galvani demonstrated his classical experiment on a frog's leg. From this demonstration has arisen the whole investigation into the forces which control our "living and being," and as new discoveries are made the similarity between the human organism and modern electrical communication systems becomes more and more apparent.

Every movement is undertaken in response to a signal received or transmitted from the brain, the nature and characteristics of the signal being as distinct as those of a telegraph code. These code messages, transmitted by means of the nerves, serve to actuate the various muscles and co-ordinate our movements to the finest degree of precision. Damage to the nervous network inevitably results in loss of efficiency, although it may not be immediately apparent, but damage to the main transmitting centre, the brain, has such disastrous results that an increasing amount of time and money is being spent on the endeavour to find out the cause and cure of such defects.

The latest aid to the diagnosis of brain disease is an instrument which goes by the name of the "electro-encephalograph"—roughly speaking an electrical brain-writer. Its development followed on a discovery by the German physiologist Berger, in 1929, that the cells composing the brain were capable of developing an electrical potential in a similar manner to the potential developed in muscular and nervous tissue.

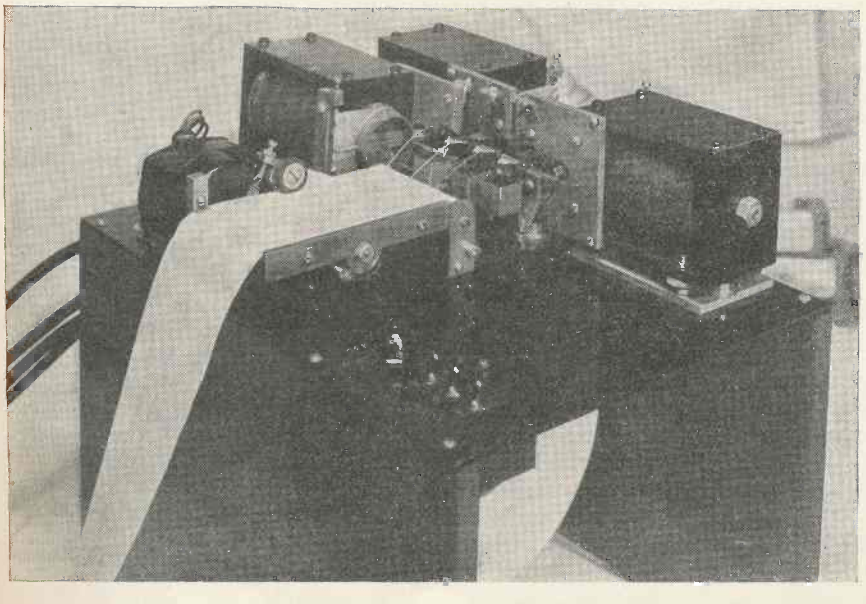


Fig. 2. Recording pens on a paper chart give a continuous indication of cell activity in the brain.

Brain Waves

Berger's "brain-waves" were looked on in the nature of a curiosity for some time, mainly owing to the lack of suitable precision apparatus with which to record results; and it was not until the work of Adrian, Matthews, and other physiological experts showed that muscle and nerve potential could be recorded accurately that attention was turned to Berger's work.

W. Grey Walter, a Cambridge physiologist, has devoted several years to the development of a suitable apparatus for recording the electrical activity of the brain, and the results of his work are now embodied in the Ediswan electro-encephalograph made under his direction.

To understand the results obtainable, it is necessary to remember that the brain in a normal condition is the seat of various minute electrical impulses, almost in the nature of random discharges between cells. These potentials are only of the order of 10-50 microvolts, but can be detected by means of electrodes placed on the surface of the scalp.

In order to render these small

Brain Wave Activity

changes in potential easily visible on a record, enormous amplification is required, and amplifiers having a gain of 5-10 million have been constructed. The output from the amplifier is recorded by means of a cathode-ray tube and photographic paper, or by ink writing mechanism using a continuous roll of paper.

The apparatus has three identical high gain amplifiers connected to three cathode-ray tubes. The reason for the triple combination will be seen later in the explanation of the principle of the diagnosis. A common time sweep circuit deflects the beams of the tubes simultaneously across the screen at a speed of 1-2 traverses per second, and the long afterglow of the screen enables the movement of the beam to be easily followed. The amplifiers are connected to the patient by special silver electrodes which are pressed on to the scalp and held in place by rubber bands. A valuable point about the apparatus is that it is perfectly safe in use and there is no danger nor discomfort to the patient.

Interference Precautions

With such high amplification, careful precautions have to be taken against electrical interference, and it is sometimes necessary to use a shielded room. Even the electric light mains are a source of considerable trouble, and in old buildings complete re-wiring has had to be carried out in some cases.

To minimise hum picked up from the apparatus, high-tension batteries are used for the amplifier supply, and these also enable stable operation to be obtained even at the maximum gain.

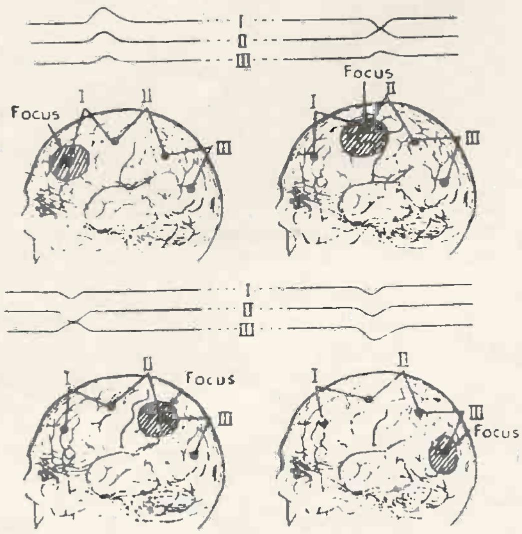
Nature of Records

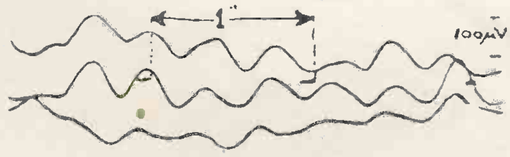
The electrical phenomena first discovered by Berger, to which the name "Berger rhythm" is sometimes applied, consist of slow rhythmic changes in potential between two points on the scalp, the changes occurring at the rate of approximately ten per second. This phenomenon is only noticed when the patient has the eyes closed, as mental activity associated with seeing objects upset the rhythm altogether.

A second type of wave activity is associated with depressed or nervous subjects and is slightly quicker in rhythm (18-25 per sec.), and occasionally even quicker waves have been observed.

These rhythms are all obtained in normal subjects, but it is in abnormal cases or in those under the influence of drugs that the most remarkable differences are observed. Under ether anæsthesia, the electrical effects take the form of slow waves of much greater amplitude which appear to spread over the whole area of the brain, and these are easily distinguished from the normal variations referred to above.

The slow abnormal waves are also present in cases of brain disturbance, whether due to incipient tumours or well-established growths, and it is this fact which makes the instrument so valuable for the diagnosis of disease. Another important point is that the seat of disturbance is usually clearly defined, almost as though there were a definite source of electromotive force in the brain. This source is referred to in clinical work as the "focus" of the disturbance.





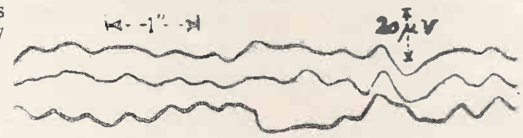


Fig. 4 (top) and Fig. 5 (bottom). Records taken from an anaesthetised patient and from an unconscious patient with brain trouble.

Fig. 3 (left). How the focus of abnormality is located by the apparatus.

Exploring

The object of the surgeon is to explore the surface of the scalp and narrow down the field of search until he locates the focus with accuracy. In the great majority of cases this enables him to operate on the seat of the trouble immediately, without the necessity of exploring further.

To locate the focus accurately three pairs of electrodes are necessary, and their action is shown in the diagrams of Fig. 3.

In the diagram in the left upper corner, the focus is assumed to be under one of the electrodes marked "I." The other electrode of the pair is connected to one of the "II" pair, and so on to form a series "chain" of exploring points.

If we assume that the focus gives rise to an impulse of negative polarity, this will appear on the recording screen as a peak in the upward direction, shown above the diagram.

As each of the other electrode pairs is in series with No. 1 pair, this peak will be repeated on each of the records in the same direction.

Now, in the diagram on the right, assume that the focus is moved to the point shown under the junction of Nos. 1 and 2 electrodes. The direction of potential impulse will then be in the opposite direction in No. 1 pair, and in the original direction in Nos. 2 and 3. The peak on No. 1 record will thus be reversed, while those on the other two will be unchanged.

A similar change will be seen in the lower left-hand diagram, while in the lower right-hand diagram the focus is at the other end of the chain and the polarity of all the potential peaks is reversed.

The position of the focus in relation to the electrodes is thus seen by observing the phase relationship between the three records while the electrodes are moved to different positions on the scalp.

Fig. 4 shows a typical record obtained from the apparatus. In this case the patient was under ether anæsthetic, and it will be seen from the time marked on the chart that the frequency is about 2-3 per second. Fig. 5 was taken from an unconscious patient suffering from brain trouble and the similarity in the record will be apparent.

Both the records are quite easily distinguished from the higher frequency and smaller amplitude of trace obtained on a normal subject.

Although the equipment is primarily intended for use in the diagnosis of brain disorders, the fact that it consists of a high gain amplifier and cathode-ray tube allows it to be used for any physiological research in which minute potentials have to be studied or recorded. For example, one tube may be used to record an electrocardiogram (heart action potential) while the second and third record the brain potentials. Heart sound potentials may be picked up by a microphone and amplified, the record being compared with the electrocardiogram.

The apparatus was shown at the Ediswan stand at Radiolympia, where diagrams and explanatory labels showed the lay visitor how this important apparatus is helping to add to medical knowledge and assist workers in the field of mental science.

QRT

By R. W. H. Bloxam, XGM6LS

IN August, 1914, a red van drawn by a dapple grey horse called at my house and collected my large loose-coupled aerial tuning inductance, several other loading inductances (all with their brass rods and sliders), three crystal detectors, headphones, and the antenna, complete with spreaders. This antenna was the only one in the town of 50,000 inhabitants, and had always been to 49,999 of them a local object of wonder and great speculation, as its huge shell insulators gave it a very imposing appearance—nothing like it graced the landscape for many miles.

Once again the clouds of war have broken, and so the last " test " call has gone out, and as far as British ham stations are concerned our cherished bands are silent.

Let us hope that it will not be long before we have the right to use them again.

Somehow that last QSO had a great kick in it. Rumours of an imminent QRT were current, on the 7 mc. band anyway, for a considerable time before the gong sounded, indeed it was amusing to hear some of the comments and conjectures which passed between stations. One optimist was heard to remark that he understood the QRT was not going to be general, but merely that the G.P.O. was not going to issue any *new* licences!

Of course, there are many good reasons why a general cessation of private experimental transmissions is necessary in time of war. Apart from the possibility of QRM on such bands as are useful to the Services, there are other important reasons, some of them not being obvious at first sight.

At the time of writing, information is to hand that the G.P.O. are collecting transmitting apparatus once again, but obviously the task is somewhat more formidable this time, amounting as it must to over 2,000 stations.

Apart from the cost, the amount of storage space required may be imagined by multiplying one's own junk pile by the approximate number of stations, plus a wide margin for fellows like Jones who built a new transmitter each month!

It all seems rather purposeless anyway, because that mythical spy fellow wanting to tell the enemy why they are not winning the war is hardly likely to be found among the ranks of the *licensed* transmitting fraternity, whose credentials have all been inquired into before licences were granted to them.

No, that fellow's QRA will not be found in any Call Book.

Many of the younger members of our fraternity will now be " brass-pounding " in one or other of the Services, and those of us who by reason of age or engagement on other duties are compelled to relinquish our keys, wish them vy 73, Good Luck, and a speedy return to ham radio.

We shall look forward to hearing the old familiar call signs over the air once more.

It seems a pity that no form of emergency network or other communications system has been evolved from the very good material and skilled operators that would have given willing service to help at home.

However, help can be given in other directions, and in spare moments as are left one may dream and plan that new modulator, on paper at any rate, and maybe, who knows, the XYL may even get that cupboard door fixed that has waited a couple of years.

Influence of Cathode Rays on Luminescent Screens

Experiments have recently been made on the effect of continuous luminescence produced by a cathode ray on an insulated screen in a high vacuum cathode-ray tube. These experiments show that:—

1. The charge imported by the ray to the screen leaks off at the same rate.

2. The screen potential is always positive with regard to that of the cathode.

The areas of the screen impinged by the cathode ray shows a decrease of brightness as a function of the time of impingement according to a logarithmic law. This effect can be attributed to two reasons:—

1. The primary electrons liberate metal atoms out of the screens substance, producing a blackening of the fluorescent layer, and therefore a weakening of the produced light.

2. Some of the liberated metal atoms move in front of or into the luminescent centres of the substance and prevent the transfer of the energy required for the production of light. It can be shown that at the same time a regeneration process is present. This regeneration is due to the partial retransfer of the metal atoms into their original positions in the crystal grid whereby the affected luminescent centres regain their luminosity.

Experiments with intermittent electron impingement show that regeneration can be increased thereby.

ASPECTS OF TELEVISION
DISCUSSED AT THE TELEVISION CONVENTION — OLYMPIA, 1939

As announced last month a Television Convention which was open to the public was held at Olympia during the last week of the exhibition. The chairman was Mr. H. J. Barton-Chapple.

The first speaker was Mr. R. G. Clark, of Mullards, who spoke of the value of intelligent observation by the public, and said that it must be realised that those engaged in television were creating a new system.

Mr. Clark emphasised that the design of transmitter and receiver were closely interlinked, and that the most important matter was the question of definition. The standard was determined largely by the carrier frequency and the range of frequencies was limited. The use of a lower frequency would lead to trouble from interference and multiple images, and the definition would be lower. A higher frequency would still present the multiple image problem and would give less range, while the generation of the necessary power would be very difficult, if not impossible. The present standard, he said, represented the middle course between prudence and rashness.

Mr. Clark said that many transmitters would be needed even for a limited national coverage, and that the provision of separate studios was not favoured on account of their cost. This left the possibility of linking the transmitters to a single studio either by H.F. cable or by U.H.F. radio links. The former was not simple, and its cost was high, while the latter were liable to interference.

The past year had shown real engineering development. The production of special types of valves had simplified receivers and gave them greater reliability. The C.R. tube, too, had been improved in every way —it was more compact, had a smaller and more uniform spot, had greater sensitivity, and a better screen of improved colour and higher luminosity. Controls on receivers had been reduced to a minimum.

Mr. T. C. Macnamara, of the B.B.C., dealt with transmitting problems. Considerable improvement had been made in details in the last year, and the most important was the introduction of a second studio. The provision of a central control room was also important.

Cameras had been improved; the Marconi-E.M.I. tubes gave better definition and contrast than a year ago, and their colour response was more consistent. Studio lighting was better; much knowledge had been gained from the practice of film studios, but television had its own problems. The reason for bad lighting, which he admitted did occur at times, was inadequate time for full-dress rehearsals. It was generally agreed that outside broadcasts were the most important, for there was no other visual medium with a completely topical flavour.

Much work has been done in the installation of O.B. gear, and several methods of linking it up with Alexandra Palace were available—U.S.W. radio, balanced cable and balanced cable plus telephone line. It was possible to use 1 to 4 miles of ordinary telephone line with a repeater every mile.

Referring to the range of Alexandra Palace, Mr. Macnamara said that it had been expected to be about 25 miles, but it had turned out to have a safe range of nearer 35 miles. Good reception had been obtained up to 70 miles. The range was limited by car-ignition interference. If all cars were fitted with suppressors the range would be very greatly increased.

Ultra-high Frequencies

The next speaker was Mr. Owen Harries, who dealt with the possibility of using wavelengths below two metres. He stressed the need for new research on such wavelengths, both on their production and on their propagation. He was of the opinion that there would be no abrupt change of field strength at the horizon, and he did not think that with high power the range would prove unduly limited. The difficulty was to generate high power, and up to the present only a few watts had been produced.

In America a method had been developed in which a beam of electrons in an applied field had a natural frequency and a negative resistance. The difficulty was that the wavelength depended on the voltage and current, and no one had yet shown a way of amplifying or modulating with such systems.

It was practicable to transmit very short waves down a metal tube with conductive walls, and by placing a horn at the end, reflections could be avoided. The system was reminiscent of a speaking tube and was highly directional.

Mr. Harries also referred to the possibilities of micro-waves in medical practice. They had been tried in Germany for anæsthesia, and were said to have no after-effects. A U.H.F. field applied to the head resulted in unconsciousness which lasted as long as the field was applied.

During the discussion which followed Mr. Davis expressed his conviction that the British television system was sound. The adoption of 405 lines was originally a bold decision which had been justified by events, and he did not think a change would be necessary for years to come. In the case of cinema television a greater number of lines would be desirable because of the direct comparison with films.

Mr. Lance expressed the view that more elaborate aerials and new circuits for ignition interference suppression would be the next developments. Dipoles had been used for years, but he hoped that something better might be found.

Mr. Barton-Chapple asked if it were possible to screen micro-waves adequately so that they would not prove dangerous to the engineers, and he also referred to the possibility of using vertically and horizontally polarised waves of the same frequency without mutual interference.

In reply Messrs. Clark, Macnamara and Harries agreed that the screening of micro-waves was difficult. They did not feel that it would be possible to avoid interference between stations on the same wavelength by using vertical polarisation for one and horizontal for the other on account of the tilting of the wavefront. Tilts of 20 degrees had been measured on the Alexandra Palace signals.

contributed much to the improved performance of the receiver. Characteristics of the valve are given below.

Mullard EE50 secondary emitter valve
Mutual conductance 14 mA per volt
Input capacity 7.7 mmfd.
Output capacity 7.7 mmfd.
Grid damping 9,000 ohms at 45 Mc.

This receiver illustrated the fact, often met in high frequency work, that the most effective design from the point of view of performance is that which leads to the simplest and most compact construction.

This trend in the receivers generally is illustrated in the drawing, Fig. 5, which shows the move towards compactness of design, while the graphs of performance show how the receivers at the same time have improved both as regards picture quality and signal sensitivity.

In conclusion, the writer would like to thank Messrs. Baird Television, Ltd., for permission to publish this article.

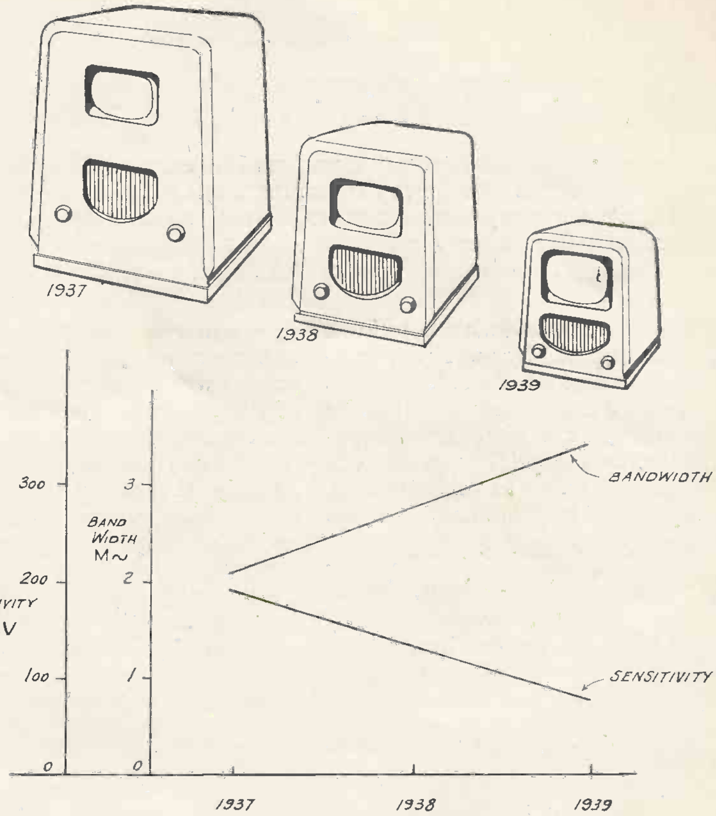


Fig. 5. Relative receiver sizes and relative performances in the last three years.

Television in Italian War Planes

Squadron Already Equipped

MAJOR C. C. TURNER, writing in the *Daily Telegraph and Morning Post,* says that according to a New York newspaper Italy has an air squadron equipped with radio television sets.

It is claimed that difficulties due to the weight of the ordinary television installation, and to the need for very strong light, have been overcome. The installation, it is stated, has been reduced to "flying" weight, and daylight, even without direct sunlight, is sufficiently strong.

At first the application of this discovery was limited to transmission of pictures of cloud formations to a ground station, or similar pictures from the ground to the 'plane, but it is now claimed that from a 'plane at a height of 6,000 ft. a motor car on a road can be seen clearly enough to recognise its make. A television range of 100 miles is said to be attained.

The application of this discovery to "spotting" for the artillery is foreshadowed, and may even now be practicable.

Experiments have been in progress in several countries for some time.

The televising of actual scenes from the air should not be confused with the employment of the infra-red ray for "seeing" objects, such as 'planes or ships, hidden in fog. As long ago as August 23, 1935, *The Daily Telegraph* reported on an invention which revealed to the observer a 'plane four miles away in cloud and a ship 12 miles distant.

Air Ministry Research

Four years ago the Air Ministry financed television research undertaken by the National Physical Laboratory. This had in view the installation in a 'plane of a screen on which the pilot could see a spot, representing his 'plane, moving over a map of the aerodrome, and enabling him to approach and land in fog.

This was a very different method from that of the Lorenz, or other "blind" landing system, which guide a pilot during his approach, and inform him automatically of his height from the ground as he comes in.

In August, 1935, a decree by Hitler directed that television in Germany should be placed under the Air Ministry. All television apparatus came under regulations relating to military equipment. The fact that television can be used in war was at that time new to the general public.

Luminescent Afterglow

The afterglow of luminescent substances excited by cathode rays can be represented by two exponential curves giving a satisfactory approximation of the initial part and the end of the curve showing afterglow as a function of time. The curve shape of the afterglow depends on the excitation intensity.

If interrupted excitation is used the measurements show a strong decrease of the degree of modulation for high frequencies, for instance, of a few per cent. for 105 cycles per second. Different luminescent substances give different steepness of curves, showing degree of modulation as a function of frequency. The degree of modulation is calculated on the basis that the afterglow curve consists of one and of two e-functions.

R_1 = value, approximately 20,000 ohms, to make M read 0-20 volts. Bias battery, standard 0-16½ volts.

Fig. 5b.—
V_1 = Mullard PM202 or similar.
C_1 = value, as for Fig. 5a.
P_1 = ,, ,, ,, ,, ,,
R_1 = ,, ,, ,, ,, ,,
Bias battery, standard 0-16½ volts. Anode battery, standard 0-16½ volts.

Fig. 6.—
V_1 = as for Fig. 5b.
C_1 = value, 0.01 mfd., mica dielectric, T.C.C. type M, Dubilier type 670, or similar.
R_1 = value, 5-10 megohms.
C_2 = value, 0.1 mfd., mica dielectric (Dubilier type 577 or similar).
P_1 = as for previous circuits.
R_2 = value, 1,000 ohms (approx.) 1 watt type.
R_3 = value, approx. 20,000 ohms, to make M read 0-20 volts.
R_4 = 10-30 ohms (not critical, see text). Anode battery voltage, 16-20 volts approx.

Fig. 7.
All values as for Fig. 6, except the following:—
R_1 = value, not less than 10 megohms.
C_3 = as for C_2 in this and previous circuits.
P_2 = as for P_1 in this and previous circuits.
R_2 = value, 5,000 ohms, ¼ watt type.
R_3 = value, approximately 50,000 ohms, to make M read 0-50 volts.
Grid bias battery, 0-9 volts standard. Anode battery voltage, 30-50 volts.

Fig. 8.
R_1 and R_2 = value, 0.200 ohms each (see text).

Fig. 9.—All values as for Fig. 7 except:
R_1 = value, 0.5 megohm max.
R_2 = value, 250 ohms, 1 watt type.
Grid bias battery, 0-4½ volts standard.

Fig. 10.
R_1 and R_2 as for Fig. 8.
V_1 = Mazda AC/HL, AC/P or similar. Owing to the "cathode load" type of circuit, the factor is not important.
C_1 = 32 mfd. electrolytic, 100-volt working (T.C.C.).
C_2 = 500 mfd. electrolytic, 12-volt working (T.C.C.).
C_3 = 500 mfd. electrolytic, 12-volt working (T.C.C.).
R_3 = 500 ohms, 1 watt type.
R_4 = to suit input impedance required. For general purposes, 100,000 ohms.
The Westectors are both type H1. Anode battery voltage 60-120-volt (according to valve).

Fig. 11.
V_1 = Mazda AC/HL or similar.
(Note: Any good make of intervalve transformer of low ratio, say, 1:3, will serve for T.)
V_2 = Marconi-Osram D42 or similar.
V_3 = Mazda AC/P or similar.
R_3 = 500 ohms, 1 watt type.
R_4 = as for Fig. 10.
R_5 = 10,000 ohms, 1 watt type.
R_6 = 1 megohm.
R_7 = ½ megohm max.
R_8 = 500 ohms (potentiometer).
R_9 = optional, according to voltage of anode supply.
R_{10} = 20,000 ohms, 3 watt type.
C_4 = 50 mfd., 12-volt working.
C_7 = 50 mfd., 12-volt working.
C_5 = 8 mfd., 200-volt working.
C_6 = 0.25 mfd. paper.
P_1 = 500 ohms.
Anode battery voltage 150-200 volts.

Fig. 12.
V_1 = Mullard P.M.202 or similar.
C_2 = 0.1 mfd. mica dielectric (Dubilier type 577).
C_3 = 0.1 mfd. mica dielectric (Dubilier type 577).
P_1 = 400 ohms.
P_2 = 400 ohms.
R_3 = 100,000 ohms.
Anode battery voltage 30-36 volts.
Grid bias 0-9-volt standard.

Fig. 13.
V_1 = Marconi-Osram L.210 or similar.
V_2 = Marconi-Osram H.2 or similar.
C_3 = as for Fig. 12.
C_2 = as for Fig. 12.
P_1 = as for Fig. 12.
P_2 = as for Fig. 12.
R_1 = 250 ohms, 1 watt type.
R_2 = 250 ohms, 1 watt type.
Anode and grid battery voltages as for Fig. 12.

Fig. 14—All values as for Fig. 7, except for the following:—
R_3 = 50,000 ohms.
M to read 0-100 microamps.
Anode battery voltage to be adjusted to give best value of standing current. Suggest 30 volts for first trial.

Figs. 15 and 16.—See text.

Mercury-arc Lamps for Studio Lighting

USE is now made in the General Electric (U.S.A.) television studios for illumination purposes of water-cooled mercury-arc lamps. A battery of four units containing 12 lamps is employed having the light output equivalent to that provided by nearly 30,000 watts of incandescent light and at the same time giving off no appreciable amount of heat.

The lamps are about the size of a cigarette and have an exterior of quartz. Surrounding the tube is another quartz jacket through which water passes at the rate of three quarts a minute, to prevent destruction of the lamp by intense heat. The water, in passing around the tube, transmits 90 per cent. of the heat away from the light source, and as a result, little heat is dissipated into the studio.

This new mercury lamp radiates more than two and one-third times the light given off by an incandescent lamp of the same wattage. The twelve 1,000-watt lamps used in the G.E. television studio have a total light output of 780,000 lumens, while the same wattage of incandescent lamps would give only 330,000 lumens. Also in the new lamps more than 90 per cent. of the infra-red radiation is absorbed in the circulating water and there is no risk of burn.

The cooling system of the lamps is equipped with a pressure-operated switch and magnetic valve because the water in the jacket must be moving before the lamp is lighted and because the lamp must be turned off automatically in the event of failure or reduction of the water supply. The lamp is filled with argon gas and, when lighted, a pressure of more than 1,000 pounds per square inch is developed within the quartz jacket. Two rubber hoses connect to each of the lamp units, one leading from a tap at one of the studio walls to allow water to pass into the lamps, and another carrying the warmed water from the lamps to waste.

It is announced that Los Angeles will soon have the highest television aerial in the United States. Plans for the new site of station W6XAO call for an aerial at least 100 ft. above the transmitter building overlooking Hollywood. Since a nearby mountain is 17,000 ft. high, W6XAO's stream lined aerial will surpass the altitude of New York's Empire State Building by one and a half times.

Other eastern stations hampered by the lack of suitable sites have established their transmitters many miles from the populated centres. The Don Lee station is only 2½ miles from the centre of Hollywood.

A RECORD OF PATENTS AND PROGRESS

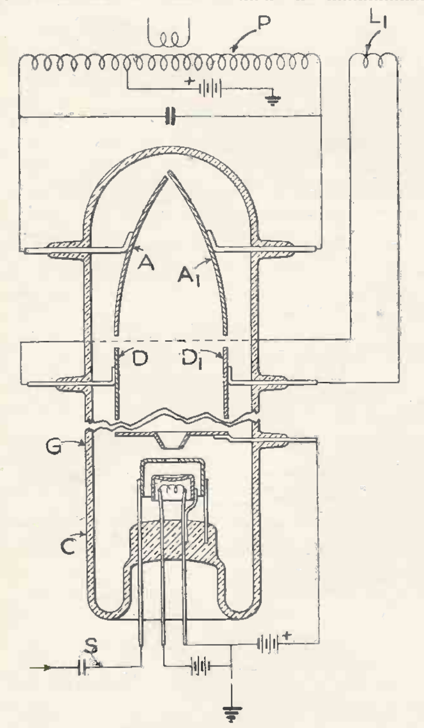
RECENT DEVELOPMENTS

PATENTEES
Farnsworth Television Inc. :: Marconi's Wireless Telegraph Co. Ltd., and D. L. Plaistowe :: Hazeltine Corporation :: Radio Akt., D. S. Loewe :: Ferranti Ltd. :: F. Ring :: Scophony Ltd., G. Wikkenhauser, and J. Sieger

Cathode-ray Tubes

(Patent No. 506,454.)

The figure shows a cathode-ray tube designed to generate oscillations of a sharply-peaked character. The electrons from the cathode C are first focused into a narrow beam, which is then deflected from side to side by the plates D, D1 so that it strikes first against one and then the other of a pair of anodes A and A1.



Transmitting tube with sharply peaked output. Patent No. 506454.

These are curved to the shape shown, with the end of plate A1 overlapping, but not touching the plate A. They are connected by external leads to the primary winding P of an output transformer, which is also coupled to a coil L1 which feeds back deflecting-voltages to the plates D, D1, so that the oscillations are self-sustained.

The curvature of the anodes A, A1 is such that all the electrons in the deflected beam strike simultaneously, so as to produce the maximum voltage across the output coil P in the minimum time. In other words they produce a large peak of current of relatively short duration, which can be modulated by signals applied to the control grid G through a lead S.—*Farnsworth Television Inc.*

Adaptors for Producing Colour Pictures

(Patent No. 505,912.)

In the standard B.B.C. television transmission, four-fifths of the time between one frame and the next is occupied by the train of picture signals plus the associated line synchronising impulses. The remaining one-fifth is occupied by the framing impulses only, and contains no picture signals.

Advantage is taken of this fact to convert a black-and-white picture into one in natural colours.

An adaptor box is inserted before the camera at the transmitting end. It contains three coloured glasses one red, one yellow, and one green. The glasses are carried on an endless band which is driven at constant speed so that during the time-interval occupied by one frame the red filter is operative, during the next the yellow, and so on. The filters are changed-over during the idle "fifth" of each framing period, when no picture signals are being transmitted. A similar adaptor, controlled to run at synchronous speed, is used at the receiving end. —*Marconi's Wireless Telegraph Co., Ltd.,* and *D. L. Plaistowe.*

Iconoscope Tubes

(Patent No. 506,237.)

The usual method of generating television signals in a transmitting tube of the Iconoscope type is to project the picture on to a mosaic screen of photo-sensitive cells, so as to form an "electrical image" on the screen, which is then discharged by a scanning stream of electrons from the gun of the tube. As each of the mosaic cells is discharged, a pulse of current flows to a metal plate at the back of the screen, and then through a load resistance to form the signalling current.

According to the invention, the signal currents are collected by a second anode, mounted near to but separate from the mosaic screen, and coupled to an output resistance. As the scanning-stream moves across the mosaic cells, electrons are liberated partly by photo-electric action and partly by secondary emission, and both streams are utilised to build-up a stronger signal.—*Hazeltine Corporation.*

Scanning Discs

(Patent No. 506,691.)

One method of reducing the effect known as "keystone distortion" in mechanical scanning-systems is to project the light at an angle to the plane of the scanning-disc instead of at right-angles to it. This naturally reduces the effective cross-section of the emerging ray of light by a factor proportional to the sine of the angle of incidence of the light. It is also found to increase the loss of light due to reflection and dissipation by some fifty per cent.

According to the invention, these disadvantages are avoided by first punching out from the scanning-disc holes of a comparatively-large diameter, and then "backing" them by a thin sheet of copper in which holes of the right diameter have been made. The latter are preferably made slightly longer in one direction than the other, i.e., rectangular or oval, instead of square or circular, so as to reduce the "shuttering" effect on the inclined ray of light.—Radio-*Akt. D. S. Loewe.*

Time-base Circuit

(Patent No. 506,856.)

The figure shows a back-coupled saw-toothed oscillation-generator in which the amplitude of the currents fed to the deflecting coils can be regulated, without any falling-off in linearity.

The valve V is a low-frequency power pentode, back-coupled at T and feeding saw-toothed currents to

Frequency Modulation for Broadcasting

EQUIPMENT is now being built for the construction of a new broadcast station in Schenectady that will operate on the recently announced frequency modulation system developed by Major Edwin H. Armstrong.

The transmitter for the new station will be located in the building now housing General Electric's television transmitter on the Helderberg Mountain, 12 miles from Schenectady. It is expected that the new station will go on the air in about two months time.

General Electric has been conducting frequency modulation tests for some time on its 150-watt ultra short-wave station W2XOY. These tests and subsequent ones have shown that at least 96 per cent. of all natural and man-made static is eliminated in the new system. Coverage is limited to approximately twice the distance between the transmitting aerial and the horizon, which should provide good reception for about 100 miles from the Helderberg transmitter.

Standard broadcast receivers are unable to receive programmes transmitted on the new system and General Electric recently announced regular production of a full line of sets built to receive the staticless programmes, one of which also makes available standard American broadcasts, foreign and domestic short-wave stations, as well as television sound programmes and which can be used in conjunction with a television picture receiver.

THE ELECTRON

The ELECTRON is a minute particle with a negative charge equal to 4.77×10^{-10} electrostatic units.

Its mass is a hypothetical quantity which is expressed as the ratio of the force applied to the acceleration produced, and is equivalent to 8.96×10^{-23} gms.

Because of the charge on the electron the apparent mass increases as the velocity increases.

The ratio of the charge to the mass of the electron is 5.32×10^{-17} electrostatic units per gm. This ratio is usually written e/m.

The velocity imparted to an electron by an accelerating potential is given by the equation :

$$5.32 \times 10^{7}\sqrt{V} \text{ cms. per sec.}$$

where V is the accelerating potential. This is only true for slow moving electrons.

The radio stations familiar to everyone to-day employ what is known as the amplitude method in broadcasting programmes. This system projects a constant carrier stream of waves which produces the humming sound that is heard when a station is quiet.

Sounds striking a microphone produce waves which mix with the carrier wave, and they leave the studio together. Unfortunately, static also mixes easily with this carrier wave.

With the frequency modulation system, the carrier wave is juggled so that it vibrates at the same frequency as the sounds in the studio. Because the carrier wave is constantly shifting, static has no opportunity to mix with the carrier wave. All who have heard programmes broadcast by the new system praise its improved fidelity. The frequency modulation system operates on an ultra short-wave band.

Besides its sound qualities, the new system makes room for many new stations, since many stations may operate on the same channel. In standard broadcasting in U.S.A. some 730 stations now occupy 105 channels. Under frequency modulation it will be practicable to assign frequencies to as many or more stations by using only the five channels already established, since the characteristics of the new system result in the elimination of interference between stations. It is impossible for one station to interfere with another, since no two stations can be heard at the same time even though both may be broadcasting on the same wavelength. In tests conducted from a station in Albany and another experimental station in Schenectady, both broadcasting on the same wavelength, it was found that a receiver installed in a motor car travelling between Schenectady and Albany would first receive the Schenectady programme and when half-way to Albany would suddenly receive the programme from Albany. At no time was there interference between the two stations, and it was even found that at a certain point between the two cities it was possible to alternate reception from the two stations simply by bending the horse-whip-type aerial used on the car.

Multiple Interlaced Scanning

Attention has been directed to a particular type of multiple interlaced transmission with an interlace ratio of 4 to 1 adapted to be received either with an interlace ratio of 4 to 1 or 2 to 1. This system may be briefly described as interlacing two consecutive complete images, each of which consists of two interlaced groups of lines. It is suggested to combine the usual form of 2 to 1 interlace, having an odd number of lines per frame with an interlace produced by additionally shifting the whole group of lines.

The combination of interlaced scanning with single channel colour television transmission has been considered. Each form of interlace in combination with a periodic change of three colours requires a definite number of lines per frame in order to give correct repetition. For obtaining a higher rate of colour repetition resort may be made to overlapping of lines. The colour sequence of the first line of each frame of a 4 to 1 interlace should correspond to the location of these lines as defined by a characteristic number.

World's Largest Speaker

The enormous perisphere which in conjunction with the 700 ft. Trylon has become the symbol of the New York World's Fair, has been utilised by R.C.A. sound engineers to form the horn of the largest loudspeaker ever constructed—a sound reproducer so vast that thousands of persons are able to stand at one time at its periphery. The huge speaker is used to produce music at the Theme Centre.

A battery of 36 high and low frequency sound reproducers is installed in a concrete chamber below ground level at the base of the perisphere. This chamber, which is entirely concealed from view, effectively couples the reproducers to the horn created by the perisphere and and the surrounding ground surface forming a horizontal 360-degree circular speaker. The massive unit is designed to cover the audible range of sound from 20 to 10,000 cycles. It reproduces sounds so low in the lower register that they are felt rather than heard.