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Television and SHORT-WAVE WORLD

JANUARY 1939
No. 131. Vol. XII.

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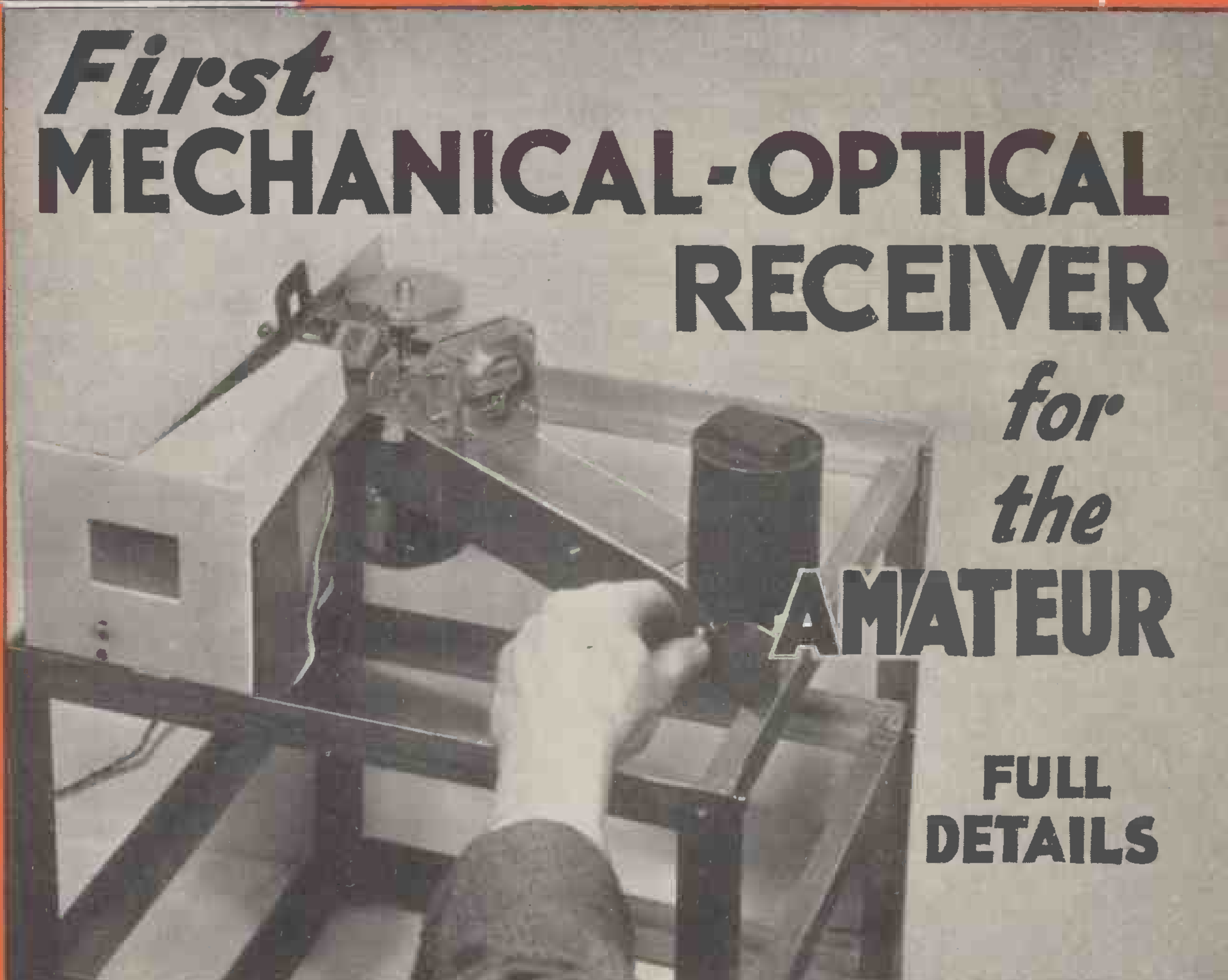

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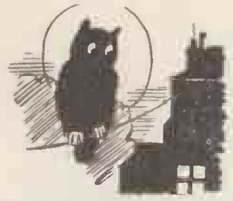

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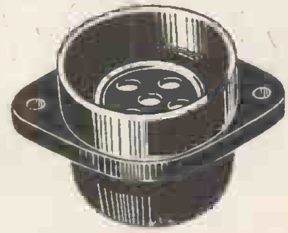

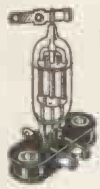

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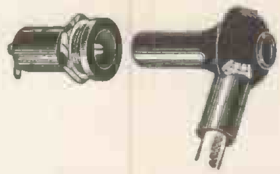

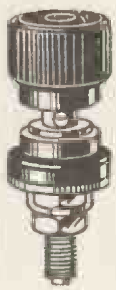

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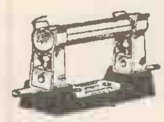

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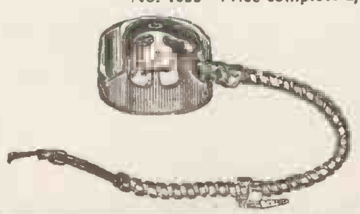

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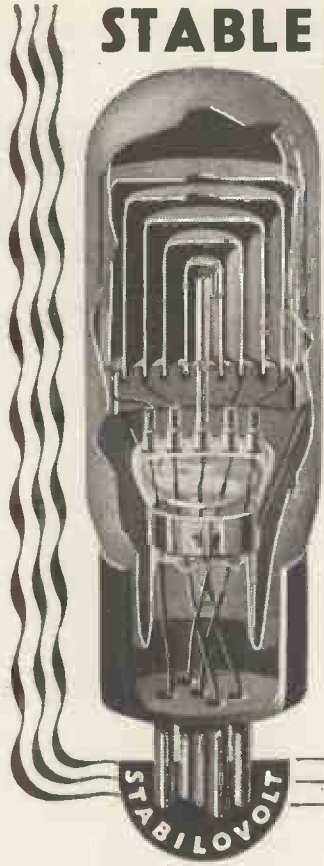

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TELEVISION and SHORT-WAVE WORLD

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COMMENT OF THE MONTH

Another Achievement.

THIS Journal was the first in the world to give constructional details of a cathode-ray television receiver and, moreover, they were given at a time when the utmost secrecy prevailed in the various laboratories in which receiver design was being developed. Additional to this we provided a design for a receiver which probably holds the record for consistent long-distance reception and with each we gave a guarantee of performance ordinarily accepted as standard. Although large numbers of these receivers have been built, we have not received a single complaint regarding their performance or of any difficulty in construction.

During the period that these receivers have been before our readers we have constantly had in mind the desirability of providing a design for a mechanical-optical type of receiver. From the home-constructor point of view this would appear to have many advantages—no high voltages are necessary, components are comparatively cheap and the construction is simple. A long series of experiments have been made to this end and in this issue we present the first of a series of articles on a simple design for a receiver of the mechanical-optical type which we guarantee will give pictures from the Alexandra Palace transmissions. The author is Mr. J. H. Jeffree, who is well known as one of the foremost experts in mechanical-optical television.

The definition is low in this elementary type, but we can promise that we shall be able to show how it can be doubled by a simple modification, and later when further experiments are concluded, we hope to attain the full degree of definition. Although we make no extravagant claims for this receiver, either as regards definition or quality, we guarantee that if constructed according to the instructions it will provide definite entertainment from the Alexandra Palace transmissions, and serve as a useful introduction to mechanical-optical television. It is placed before our readers as a basic design of experimental apparatus which, in addition to providing entertainment, will open up a most engrossing field of experiment.

A Suggestion for Provincial Experimenters

We should particularly like to draw the attention of experimenters who reside in the provinces outside the present service area to this receiver. Although, of course, at the present time it will not be possible to produce pictures, basic experiments can be made and modulation obtained from an ordinary broadcast receiver on the sound programmes. It should, therefore, provide a most interesting field of experiment and be of ultimate practical use when the service is extended.

TELEVISION'S MECHANICAL-OPTICAL RECEIVER FOR HOME CONSTRUCTION

By J. H. Jeffree

THE FIRST MECHANICAL MODEL FOR RECEIVING THE ALEXANDRA PALACE TRANSMISSIONS EVER PRESENTED TO THE AMATEUR CONSTRUCTOR

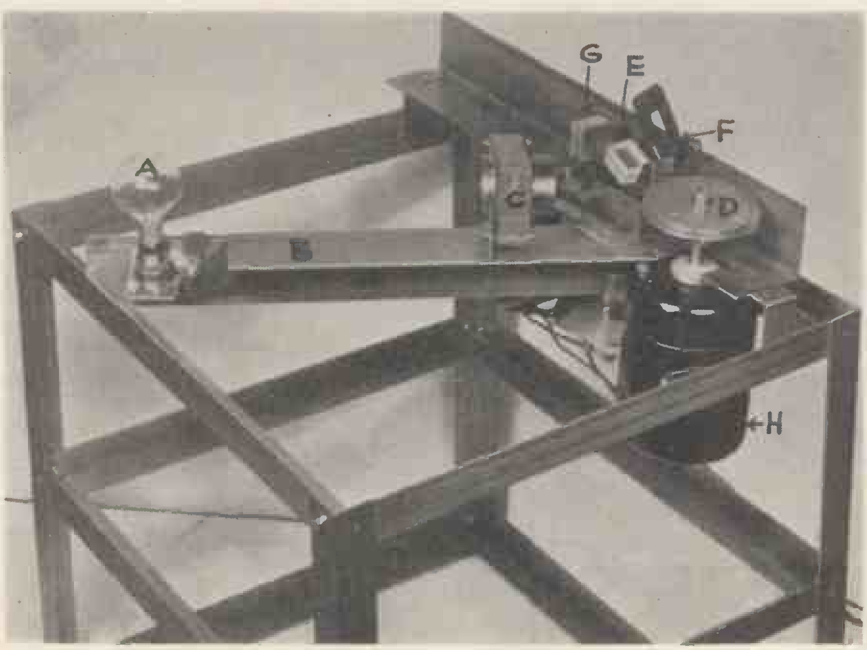
EASY TO BUILD :: LOW COST :: LOW VOLTAGES

As reported in last month's issue, it has proved possible to receive pictures with the steel ball scanning arrangements described in the June issue of last year. While the full resolution present in the transmissions is not reproduced by this system, the definition is sufficient to put the programmes across, and permit reading of captions, etc. The simplest arrangement, previously described, gives a 67-line picture, and the resolution along the lines can be of the order of 100 picture elements, so that it is about twice as good as the old 30-line pictures; but it can also be increased to 135 lines. This receiver may be regarded as the simplest and cheapest possible.

Our preliminary experiments were purposely begun with the simplest arrangement; moreover, to begin with, they were done with the crudest and most makeshift forms of mountings and radio hook-ups, to test out the system under awkward conditions. An additional, unintentional handicap was that the place chosen for the experiments, in Surrey, proved exceptionally unsuitable for reception of Alexandra Palace, although only about 20 miles away. The site is screened, in the direction of A.P., not only by a wood of tall trees reaching up to 50 yards from the aerial, but also by hills about half a mile further on in the same direction. As a result, the signal strength from a 40-ft. high centre-fed aerial with reflector is only a small fraction of a millivolt. Fortunately there are no main roads for a considerable distance in any direction, and the interference level is also low, permitting good reception.

In view of the success obtained under these handicaps it seems that reception with this system should not ordinarily be difficult. The system has many advantages to commend it to the experimenter, in that it needs no high voltages, no synchronisation other than the controlled 50-cycle mains, and therefore less expensive equipment than a C.R. tube. On the other hand, the unsynchronised picture drifts about a little sideways; sometimes for several seconds it will be almost stationary.

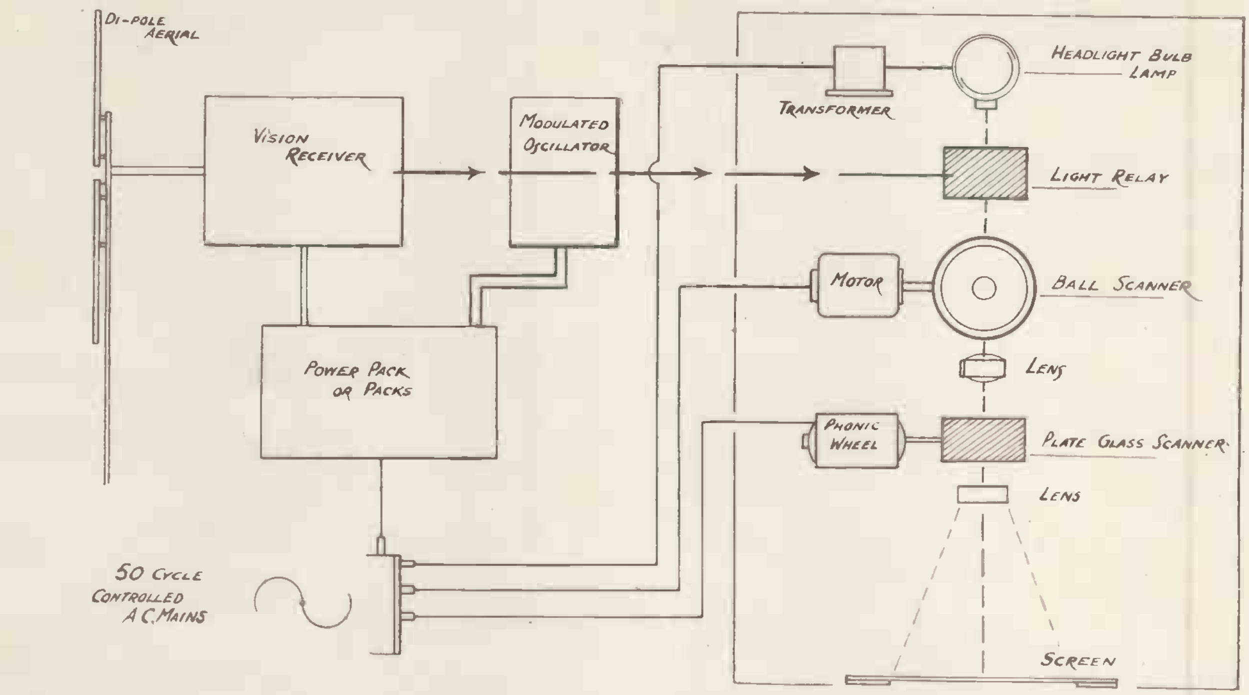
It is quite entertaining to watch the programme



Photograph showing chassis with optical bench in position. The letter references are as follows :—
- **(A) Light source.**
- **(B) Optical frame.**
- **(C) Light valve with lenses.**
- **(D) Line scanner.**
- **(E) Frame scanner.**
- **(F) Phonic wheel motor.**
- **(G) Lens.**
- **(H) Synchronous motor.**

It should be noted that Scophony Ltd., are the owners of the patent for the supersonic light relay employed and it is only permissible to employ it for experimental purposes.

THE COMPLETE VISION RECEIVER



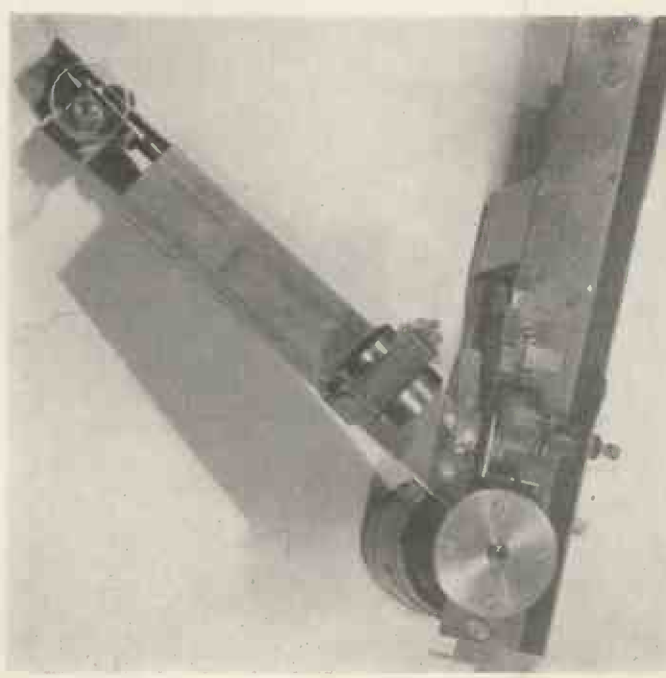
Schematic diagram of the complete receiver showing the units that are used for reception of the vision transmissions.

with this arrangement, and the experimenter can gain useful experience of mechanical reception with it and can, with practice, control the drift of the picture by finger pressure on the rotating steel ball scanner. Doubtless, however, he will soon want to have proper synchronisation also, and this is being developed. It will necessitate, of course, some extra equipment, but the constructional details now to be given have been so worked out that, while assuming mains control to start with, they permit the introduction of proper synchronisation and other improvements without extensive alteration.

The picture conveniently obtainable with the simplest arrangement is about 1½ by 2 inches, and at this size a dark room is not needed for viewing. It could be "stretched" for experimental viewing in a dark room, but would then be rather faint. By various modifications, however (involving only slight additions to the present arrangements) it can be given more light and at the same time enlarged, making it 3 in. wide or more without loss of brightness. This can be done without scrapping anything of importance.

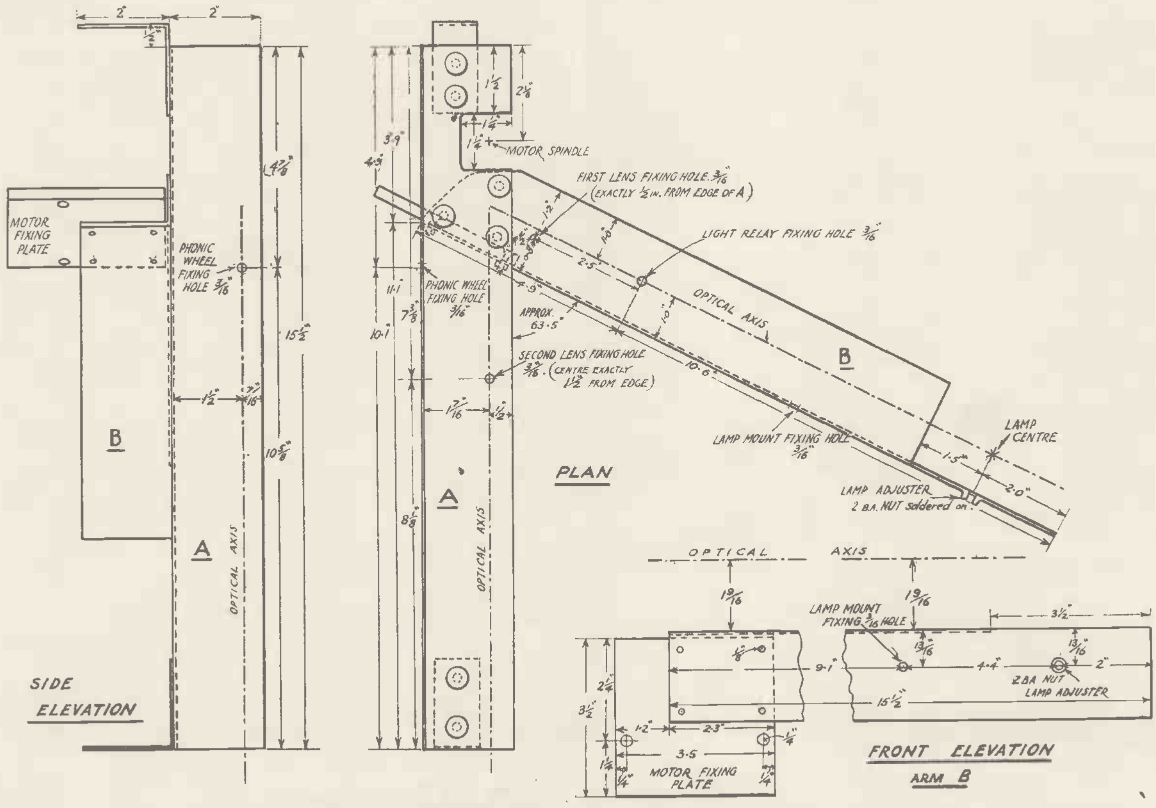
Outline of Complete System

Above is shown diagrammatically what is needed for mechanical television reception. The *aerial* and *vision receiver* can be quite standard for television; naturally, a sound receiver is no use! Mr. S. West has kindly lent for our experiments a model of the vision receiver of his "Simplest" televisor described last spring, and this proved very suitable, though in our badly screened locality some further V.F. amplification was needed before the modulated oscillator. In normal situations within the service area, however, this receiver should give sufficient signal to drive the oscillator unit directly. Alternatively it is possible, as mentioned last month, to build a special receiver, and as in this case full frequency response need not be aimed at, some simplification and consequent reduction



Photograph of bench showing optical unit.

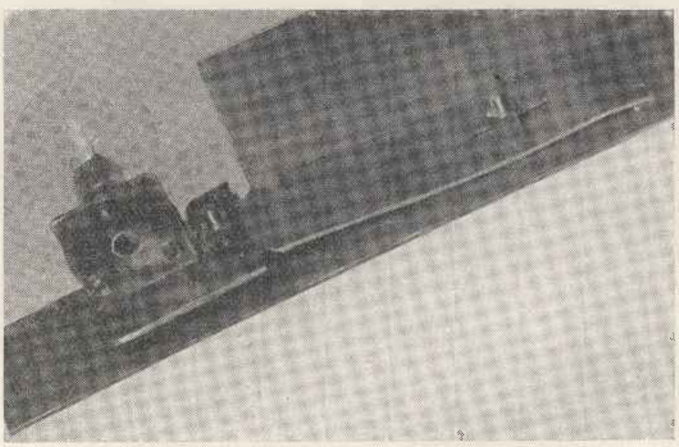
THE OPTICAL ARRANGEMENTS



Dimensioned diagram showing construction of optical bench.

of cost is possible over a standard type. Constructional details of this will be given in due course.

The modulated oscillator unit will normally consist of two valves, and can be of various types. When, as is recommended, a 10-megacycle crystal is used in the light relay, it will have to modulate a 10-megacycle carrier to frequencies approaching one megacycle (for our reduced resolution) and to a fair depth of modulation, though for the present arrangement 100 per cent. modulation is not necessary. Some care is needed in the design if good results are to be secured, but quite simple and cheap designs, which work satisfactorily, are possible and will be described.



Photograph showing adjustment provided for light source.

Assuming that we omit special synchronisation arrangements, to start with, the next link is the light relay. This has been described already in some detail in this Journal, and is a liquid cell operated by a 10 mc. quartz crystal from the oscillator unit. Then comes the ball scanner and the rest of the mechanical receiver which consists altogether of the following parts:—

- Headlamp bulb with transformer or accumulator.
- Crystal-operated light relay with simple lenses.
- Steel ball scanner with 3,000 r.p.m. synchronous motor.
- Glass rod or other equivalent first cylindrical lens.
- Plate glass or equivalent second scanner, driven by phonic wheel.
- Second cylindrical lens.
- Ground glass screen.

In addition to the above, power packs will be needed, giving, for the mains synchronised arrangement, about 80 to 100 mA. at 250 volts, and rather more if special synchronisation is added. It is possible to use two standard 60 mA. packs instead of one bigger one, and this facilitates decoupling.

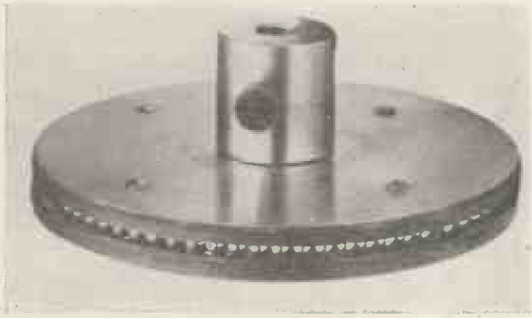
Construction of Mechanical Unit

On page 4 is shown the complete mechanical receiver unit, mounted on the top tier of a rack adapted to carry the vision receiver and oscillator units on the

THE RECEIVER CHASSIS

middle tier and the power packs at the bottom. This is a convenient arrangement, and even if it is not desired to go to the trouble of making such a rack at first, it is advisable to arrange for the mechanical receiver to be raised up sufficiently to allow the oscillator unit to go in underneath it, as this permits short leads to the crystal.

It is not desirable that these leads should be long, as that causes undue radiation of harmonics of the oscillator frequency, which may disturb reception if they fall near to 45 megacycles. Fortunately, it is



Photograph of the high-speed scanner, which consists of a series of steel balls held between two brass discs.

always possible to detune the crystal a little, so that they need never fall near enough to prevent reception entirely; but one reason for recommending a crystal working at about 10 megacycles is to avoid this trouble as far as possible from the start.

With this crystal frequency and reasonably short leads it is not troublesome and no special precautions are needed. In cases of difficulty, of course, screening would have to be adopted, but that may necessitate higher oscillator power to compensate for capacity losses.

The rack shown is of 1 in. by 1/16 in. right-angle brass or iron, the three trays, each 15 in. wide by 16 in. deep, being made first and secured by a 3/16 in. copper rivet at each corner, and then bolted to the uprights (16 in. high) with 2 B.A. bolts. Aluminium or wood could naturally be used instead, if desired. The writer prefers to mark out and drill all the holes before fixing together, since, if a bench drill or lathe is available, this facilitates rapid completion of the job, and with care sufficient accuracy is easily obtainable.

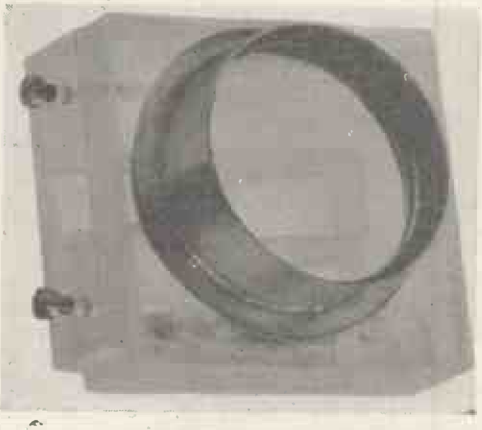
The mechanical unit proper has a frame made of two lengths of 2 in. by 1/16 in. angle brass, cut and riveted together to the dimensions and angles shown on page 6. In riveting this frame, care should be taken to avoid buckling the metal; should this occur, it should be carefully trued up again afterwards. If aluminium be used for this frame it should preferably be more than 1/16 in. thick; better 3/32 in.

Two short pieces of the same angle section are cut off to make legs at the two ends of strip A; these are riveted on as shown, so that the unit stands, in the tray, on these and the edge of strip B. By this arrangement the minimum amount of vibration is transmitted from the moving parts to the amplifying gear below, and no large surfaces are present to radiate noise transmitted from them. This is an advantage, among others, possessed by this frame over the board mounting shown in the original descriptions of this system, though it will function quite well also on such a mounting. A proper frame saves trouble in the long run, however.

Instead of being riveted, the brass frame could well be sweated together. Bolts are not convenient as they get in the way of some of the parts.

On the arm marked B are mounted the lamp and light relay, and the necessary adjustments to these parts are provided in the mountings, as shown in the photographs. It is necessary to be able to focus the lamp, more or less once for all, at the right distance from the relay, and the slotted holes in its mounting provide for this; but in actual running it may sometimes be necessary to move it sideways, to correct for distortions of the filament, and this is possible by the adjusting screw and spring as shown, which function by bending the flexible portion of the mounting. The light relay is fixed without adjustment at the calculated distance from the operating point of the ball scanner, but will have to be set, by rotation, to allow the light to traverse it nearly parallel to the supersonic wave fronts. Hence it has a one-hole fixing with a spring washer and nut underneath the strip B, so that it can be turned to give the best black and then tightened up.

The optical axes of the system are placed at a level of 1½ in. above strip A, or 1 9/16 in. above B, and run centrally on B, and ½ in. from the inner edge of A, as shown. Mountings and parts adjusted to this height are obtainable from H. E. Sanders & Co. To bring the lamp filament to the right height the mount has to extend below the level of strip B; hence this strip is cut away at the top for a length of 3½ in., leaving only



Photograph of supersonic light relay. Scophony Ltd. are owners of the patent on this light-modulating device and it must be clearly understood that it is permissible only to use it experimentally.

the vertical side at the end, as shown. A simple lamphouse is desirable, to avoid flooding the receiver with stray light.

Light Source

The light source is a 6-volt, 36 c.p. headlight bulb over-run at about 8 or 9 volts from a transformer or accumulator. A ¼-ohm rheostat or fixed resistor, to carry 8 amps., can be included in the circuit to save the lamp while making adjustments, and this is cut out for actual reception. This and the transformer can be mounted under strip A as shown.

Cheap 6d. bulbs can be used, but some of these show a tendency to fail when overrun, not at the filament but at the connecting leads to the cap; similarly, some cheap lamp-holders tend to give trouble at the springs holding up the contact pins, which become hot owing to carrying too heavy a current. It saves trouble, therefore, to obtain good ones.

The bulb filament *must* be a single straight coil, about ¼ in. high by 1/40 in. thick, and the bulb is to be mounted so that this is vertical, with its centre in the optical axis of strip B as previously defined. No reflector may be used with the lamp; the whole operation of the light relay depends on its drawing light from such a single, bar-shaped source. The inside of the lamp house should be blackened to prevent reflections.

The Scanner

Next comes the steel ball scanner, that designed for mains synchronisation having 67 balls, as suggested in the original proposal for this system, and carried on the spindle of the 3,000 r.p.m. synchronous motor. This motor is fastened to a plate, ¼ in. thick, screwed or riveted to the vertical edge of strip B, as shown on page 4. This should be so set that the centre of the vertical spindle is in the A optical axis and 1.40 in. behind the intersection of this with the centre line optical axis of B. The latter distance should come automatically if the other measurements are right, but if it does not, packings should be inserted or the mounting plate replaced by a thinner one, to bring it right.

The 1.40 in. is more important than the exact position of the spindle in the optical axis of A. The edge of the ring of balls will then receive the focused light from the relay at the point of intersection of the optical axes and reflect it along that of strip A. The ball scanner is set on the spindle at such a height that the ball centres are 1½ in. above this strip. The further adjustments of the scanner to get correct framing will be dealt with later.

Optical System

There follows a ¼ in. focus cylindrical lens, either the previously specified glass rod or the plano-convex type now obtainable, which has the advantage of including simple focusing and of permitting additions later to enlarge the picture. The glass rod works fairly well, especially if it be turned to find the part which gives best definition. This may not be necessary, but it has been found that some glass rod has variations of homogeneity around its circumference, so the best part may as well be selected.

The photograph shows this lens (the new form) and also the second scanner with its phonic wheel motor, which is fixed by one hole in the vertical side of A. On a baseboard set up a bracket would be needed. A spring washer under the locked fixing nuts enables this unit to be rotated, by the handle *h*, to frame the picture vertically. If an 8-pole phonic wheel be used this will often be necessary, since one tooth of the wheel corresponds to half a picture; with a 4-pole, permanent-magnet type, as now available, it can be set once for all, or at least so long as no changes occur in the transmissions.

The second cylindrical lens of 2 in. focus forms the lines, and is mounted so as to be capable of being set at the right distance from the scanner to define them sharply. Its position is about 2½ in. away from the balls. From this lens to the screen is a shade of thin metal, or even card, to exclude stray light. The screen if of fine ground glass, and should be masked to the correct picture size of 2 by 1½ in. (for the present arrangement). Normally the arrangements here given will be found sufficient to keep unwanted light from the screen.

Along the underside of strip A can be mounted the condensers for the synchronous motor as well as the lamp transformer. They then intrude on the space below only along one side and are not in the way. Switches can be provided, if desired, along the outer vertical edge of strip A.

(*To be continued.*)

General Electric (U.S.A.) Television Activities

THE General Electric Company, of New York, has now under construction at Schenectady a large experimental television plant. Engineers are continuing research and development on all phases of the new science, are designing transmitters and receivers, are studying the progress of other companies in foreign countries, and will have a large television exhibit at the New York World's Fair.

The technical developments and field tests on television, the company states, have progressed to a point where the next step in the development is in rendering an experimental television service to the public. This new service, which will be on an experimental and limited service basis, will be an addition to existing radio broadcast service and can be accomplished only through the installation and operation of television transmitters and the sale of television receivers.

The view is held that two major technical limitations still act as a deterrent to the rapid establishment of television on a national basis, First, how to economically "pipe" programmes from city to city. Hence television networks are not yet practicable. While it is true that television transmitters can be piped by very special wire circuits and by relays of special radio transmitters, neither of these methods is to existence to-day nor do they appear to be economically possible in the near future.

The second technical problem is the limitation of range or distance. A fairly high power television transmitter is now limited to a radius of not much more than 40 or 50 miles. This immediately indicates that a great many transmitters will be required to provide a national service. It also means that, considering the probable cost of television transmitters, the economics of the situation will at first tend to limit transmitters to urban areas where the population is dense. Extension of service to remote suburban rural areas will necessarily be slow.

There can be no question of the ultimate service of television to mankind. It will unquestionably have a far greater influence than radio when it has been brought to an equal state of perfection, for in this new art we add sight to sound and thus appeal to the two most powerful senses.

TELEVISION AND THE KINEMA —THE TRUE FACTS

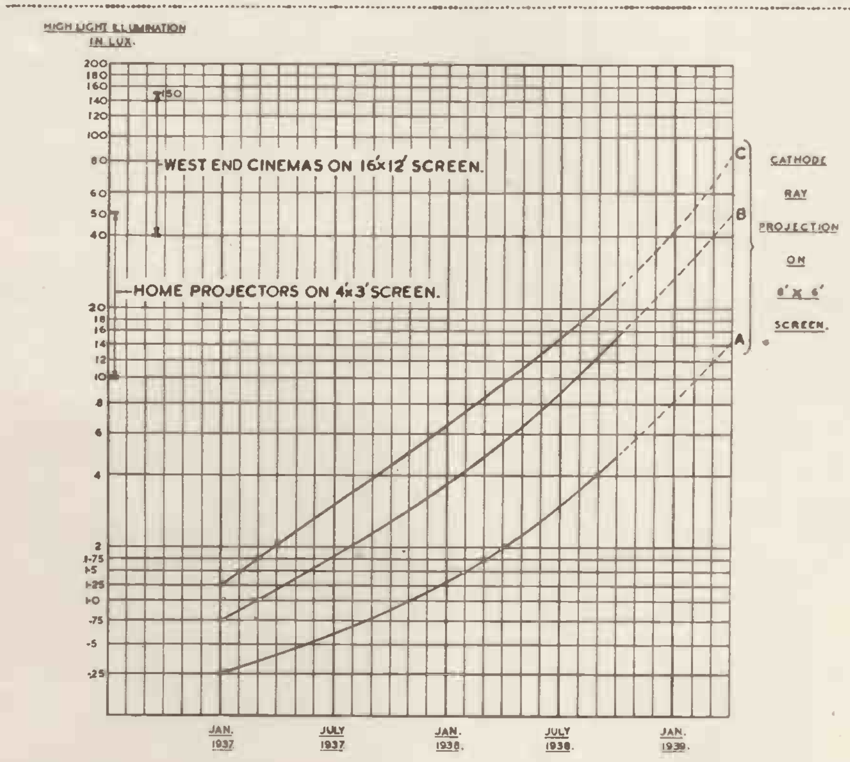
AN AUTHORITATIVE ARTICLE BY A WELL-KNOWN KINEMATOGRAPH ENGINEER

This Article is by R. Howard Cricks, F.R.P.S., the well-known kinematograph engineer and Secretary of the British Kinema Society. It is an impartial review and summary of the position of television in public entertainment.

TO-DAY, three West End theatres are equipped with Baird projection type cathode-ray apparatus. At the Tatler, Charing Cross Road, I have seen a number of programmes, including the Lord Mayor's Show and the Armistice ceremony. I can only describe the results as an amazing advance; admittedly the screen is only 8 ft. in width, but definition and quality of image possible are in many instances actually ahead of the transmission standards.

In the latest equipment, installed only a few weeks ago, a new cathode-ray tube is used, 16 in. over-all diameter, utilising a screen measuring over 5 in. by 4 in., instead of the size of 4 in. by 3 in. used six months ago, so obtaining a 50 per cent. increase in screen area. The front face of the tube consists of a ¼ in. thick optical flat. With this tube is used a Taylor-Hobson lens of 14 in. focus, working at the enormous aperture of $f/1.8$.

With this equipment, a light intensity of something over 2 foot-candles is obtained, not less, in fact, than that found in many older kinemas. Since this intensity has already increased threefold within a few months, it holds big probabilities of still further increases, permitting of the use of a still larger screen. The curves reproduced show the progress made by Baird equipment during the past two years and, by extrapolation forecast, the likely future progress of the next few months; from this it will be seen that the Baird Company hopes on an 8 ft. screen, to equal the illumination of the average West End kinema screen, or alternatively to give the present results—which in my opinion are perfectly acceptable to the average audience for news items—on a larger screen.



Recent history of large-screen illumination. (A) Illumination falling on screen; (B) Equivalent illumination when using glass beaded screen; (C) Equivalent illumination when using special screen which reflects light only into the area occupied by seats.

One advantage of the larger screen, given of course a sufficient light intensity, is that for a given focal length of lens the projector can be placed farther back in the hall, and eventually, as I prophesied about twelve months ago, placed actually in the projection room, alongside the film projectors. Furthermore, rear projection, with its apparently unavoidable flare-spot and loss of contrast, is avoided.

German Systems

I have, too, heard excellent accounts of large-screen results obtained in Germany. Fernseh, for instance, have evolved a new type of screen based on true optical principles, in which a specular reflection is obtained by means of an enormous number of tiny lenses of scientifically calculated curvature backed by mirrors. The idea is that the reflection is kept within the actual seating area, and, unlike our present screens, is not distributed throughout the whole auditorium. This is the type of screen indicated by the curve *C* (from which fact one may assume that Baird's also are not blind to the advantages of this principle). Personally I should have expected the increase over *B* to be greater than shown.

In both these systems the source of the image is a cathode-ray tube which, except that it works at much higher potentials and light intensities, is identical in principle with the tube of the ordinary home receiver. As a kinematograph engineer, I must confess that I have a hankering after a high-intensity arc as the source of light, the electronic tube serving

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merely as a control system or relay. Indications of possible methods of achieving this were made by Mr. A. G. D. West, in his paper to the British Kinematograph Society (reported last month).

I can state, however, that no one has yet succeeded in producing results from such systems, but this fact has not prevented the Cinematograph Exhibitors' Association, in a recently published report, from agreeing with me in regarding this as the most promising line of research for the kinema.

The fact that it permits of the employment of an arc or high-pressure mercury lamp is a certain recommendation for the Scophony principle. Back in the summer we saw some excellent results, again on an 8 ft. screen, by the Scophony system.

We must, then, conclude that here and now, public television is an accomplished fact, as far as technical factors are concerned. Further advances in cathode-ray systems are to be expected in the direction of electron multiplication, and, of course, by improvements in screen materials, which at present set a limit to the intrinsic brightness of the image. I would add that, inevitably, public television must be associated with the kinema.

Public Programmes

But before any of these public-view equipments can be used for their proper purpose, a programme must be provided. For the first time, on the occasion of the Armistice ceremony, the customary ban on public demonstrations was lifted. In connection with this, I have heard the remark: "Ah, the B.B.C. is climbing down at last—they'll have to let us have all their programmes soon for the public!" As I shall shortly point out, this remark represents an altogether erroneous view of the matter.

From one quarter I am told that the reason for the B.B.C. ban is, first, that if performances were to be public, Alexandra Palace would have to pay more for its artists; and, secondly, that since the film industry opposes the use of its films and its artists for television, the B.B.C. in retaliation won't allow the use of its programmes.

The actual truth is that the B.B.C. is governed solely by the recommendations of the Television Advisory Committee; from Mr. Brebner, Public Relations Officer of that Committee, I have gleaned the following rather important information.

The Committee has for some time past been considering very seriously the whole question of public television shows, with particular reference to kinema installations. A few weeks ago members of the Committee watched a programme at the Tatler Theatre. Although they preserved a discreet reticence, I gather from Mr. Blebner that a decision on the matter may be expected within about two months.

Some of the factors to be considered, additional to those I have mentioned, are the probability of withholding of facilities for televising sporting events, and of not only having to pay more for artists, but of being actually unable to get sufficient of the first grade.

Then, too, how is the kinema to pay for its programmes? No exhibitor could reasonably expect to get hours of programme time weekly (and charge his patrons for it) all for 10s. a year. On what basis is he to be charged? How are fees to be collected? Another important factor with both technical and commercial implications must be taken into account. At present programmes could only reach London kinemas.

The fact that the B.B.C. and the Post Office have not yet given any public demonstrations of television in the provinces may be regarded as showing either a lack of salesmanship, or a spirit of undue caution. The television industry—which is naturally anxious to find wider markets for its products—is firmly of the opinion that the underlying reason is that the coaxial cable between London and Birmingham has proved unsuitable for the transmission of high-definition images. An emphatic denial of this suggestion was given to me by Mr. Brebner, who assured me that many transmissions had been made of signals from Alexandra Palace to receivers in Birmingham.

Distribution

This statement does indicate that, provided financial arrangements satisfactory to all parties can be made, there is no technical reason why installations of kinema receivers, tapped directly off the cable, without the interposition of another radio link, should not be made in many provincial towns. One can visualise hundreds of theatres—chiefly perhaps news-theatres—being equipped within the comparatively near future.

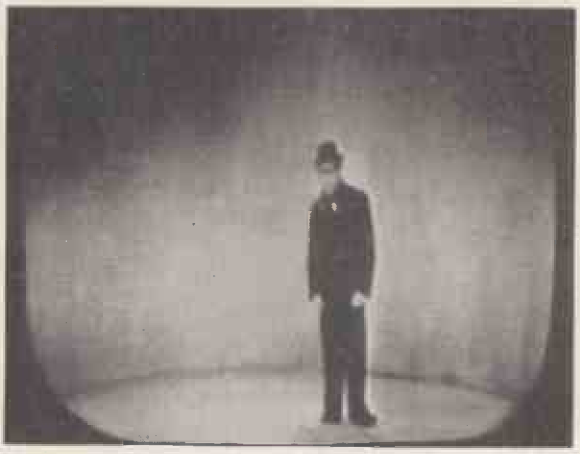
It is difficult to consider an alternative suggestion, that the kinemas should get together and provide their own programmes. In the first place, getting together is the one thing the film trade just can't do. Secondly, the provision of such facilities would be very costly—after all, Alexandra Palace runs away with £1,000 a day.

Technical Faults

I hesitate to criticise the technicians of Alexandra Palace, because I have had some insight into the difficulties with which they have to contend. But I feel I must include some observations connected with technical matters.

There is a strong feeling in the film industry that nobody with film-trade experience need apply for any technical post at A.P. Men who have spent their lives making films, and who appreciate some of the differences between film and television technique, have pointed out to me innumerable faults on the practical side of transmissions. Faults such as the strange flare seen on many exterior transmissions on dull days (an outstanding example was the Lord Mayor's Show) may be difficult to eradicate; its cause is apparently a wandering of the very small charge on the mosaic of the Emitron. But when the same fault is manifested on film transmissions, as it invariably seems to be, one is entitled to ask why. The Baird Company demonstrated, back in the old 240-line days, a perfectly clear and well graded picture free from these shadow effects. To any technically-minded person it seems obvious that film is actually far easier to transmit than direct views, if only because the available light is unlimited.

A description was given in the November, 1938, issue of this journal of a new film transmitter recently installed at Alexandra Palace. All I can say is that of the films I have so far seen transmitted by it, none shows much improvement over those from the previous equipment. Cossor's too have shown that it is perfectly possible to transmit films with interlaced scanning without these faults. Why is not some different type of apparatus installed, since films must, in my opinion, provide an increasing proportion of the programme time? (Incidentally, why not also a 16 mm. film transmitter? It would enormously increase the number of films available; suggestions that the detail of a 16 mm. film frame is inadequate can be ignored—it will enlarge admirably up to a 10 ft. screen or larger.)



These two photographs show the flare effect often noticeable in film transmissions and due apparently to the wandering of a small charge on the mozaic of the Emitron camera.

Another criticism which the large-screen viewer can appreciate more than the home viewer is lack of critical focus. Trucking shots are quite rightly widely used in studio transmissions, but one notices that, almost invariably, they start right out of focus, and then come into focus as the camera finishes its travel—in other words, there is no "follow focus." In the film studio, this is carried out as a matter of course by an assistant cameraman; the longer focus and greater aperture of the television lens makes it all the more necessary.

In outdoor transmissions, trucking shots are rarely possible. But the news-reel has found an excellent substitute for them—the "zoom" shot. On the film camera this is done by a special variable-focus lens, the Taylor-Hobson "Varo"; on the television camera it can be done by purely electrical means; I am informed that some months ago it actually appeared in several programmes, although I have not myself seen it. I would urge that it be increasingly employed wherever there seems scope for it. This technique could be advantageously employed to pick up an object at a considerable distance, with magnification, and gradually alter the focus as it approaches the camera.

Studio lighting tends to be at times very amateurish. I saw some time ago a bald-headed comedian, the top of whose cranium, instead of shining as it should have done, was in deep shadow, showing an absence of top lighting. I suppose, however, that one must make some allowance for the fact, several times pointed out to me, that, whereas the film studio produces two or three minutes of screen time per working day, the television studio has to produce two or three hours.

I may fitly conclude this article by quoting some further observations made to me by Mr. Brebner. I mentioned to him my view that films will be increasingly necessary as programme time increases, if only for reasons of cost; what would happen if the film industry were to withhold supplies?

Without making a direct reply, he suggested that one might envisage a time in the not too distant future when television and sound broadcasting will be linked together. There will be little or no duplication of programmes, and the money now spent on the normal radio programmes will be diverted to television.

I quote this remark, not in any immediate expectation of seeing it fulfilled, but as indicating that, with all the faults of the present system, we in this country have not acted too unwisely in placing these matters in the hands of a Government department, whose efforts have at any rate kept us for some years the only country in the world with a regular television programme.

Nine or ten years ago, there was an enormous outcry when one film firm decided not to make any more silent films. I'm looking forward to the day when the B.C.C. says, "No more blind programmes."

Book Review

A Simple Guide to Television, by Sydney A. Mosley and H. J. Barton-Chapple. The purpose of this handbook is to explain in a non-technical manner just what television is and how it functions.

Television development has been of so diverse a nature and the field covered by the practical results now being obtained is so wide that the task of the authors of setting out a simple explanation within the limitations of this book has not been easy. They have, however, succeeded and this handbook of forty odd pages is a clear exposition of the subject which will be understandable by anyone.

Although the major portion of the book deals with development, principles and equipment, other possibilities which at present are the subject of research are reviewed and the reader is thus able to obtain an outline knowledge of the entire subject. The price of the handbook is 1s. and it is published by Sir Isaac Pitman & Sons, Ltd.

Convertors for Television

We have received from the Electro Dynamic Construction Co., Ltd., St. Mary Cray, Kent, a catalogue of convertors for radio and television. A very wide range of apparatus of this kind is listed and of particular interest are those specially designed for operation with television receivers. These models range from 180 watts to 600 watts and are contained in sound-proof cabinets complete with filter. Copies of this list may be had on application and mention of this Journal.

HOW TO USE THE SUPERSONIC LIGHT VALVE

By M. J. Goddard, A.R.C.S., M.Sc., D.I.C.

THE SECOND OF TWO ARTICLES EXPLAINING THE CONSTRUCTION AND USE OF THE SUPERSONIC LIGHT RELAY

If the supersonic cell is adjusted to give complete black or complete white on the screen for the axial rays, it will not be properly so adjusted for the marginal rays, unless the condition in question is that corresponding to absence of supersonic waves in the cell. For a given angular subtense ϕ of the source at the cell, the deviation from true black or true white for the marginal rays increases as the width of the crystal parallel to the path of the light is increased. The crystal width is thus limited by the deviation from black or white which can be tolerated, and this is a matter of experience. Increase in the angle ϕ, which occurs when the frequency of the disturbances applied to the crystal is increased, has the same effect as increasing the width of the crystal.

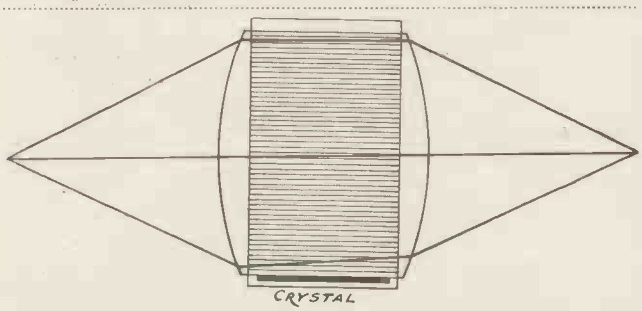


Fig. 5. Method of compensating for wave amplitude.

Furthermore, if the operating frequency is increased, the waves in the cell (i.e., the grating spaces) become smaller, which also has the same effect as increasing the crystal width. Consequently the crystal width must be inversely proportional to the square of the frequency of the electric forces applied to the crystal. The effect of the supersonic waves on the light beam is proportional to the crystal width so that the voltage necessary on the crystal is inversely proportional to the crystal width, other things being equal.

Apart from this, it may be shown that the necessary voltage is inversely proportional to the operating frequency, so that taking into account the necessary width of the crystal, the voltage necessary is directly proportional to the operating frequency.

Problems of Use

The effect of attenuation in the cell is in some ways similar to the problem just considered. The amplitude of the supersonic waves decreases as they travel across the cell, and consequently, if the cell is producing full black or full white at the end nearest the crystal, it is not doing so at the opposite end. The width of cell permissible therefore depends on the deviation from full black or full white which can be tolerated.

A partial compensation for this error can be effected by using slightly non-parallel light in the cell, and arranging that the rays of light are parallel to the supersonic wave-fronts at the end of the cell remote from the crystal (Fig. 5). Then the effect of the grating on the rays nearest the crystal is reduced, thereby making the effects more uniform all across the cell at the expense of a slightly higher voltage required to operate the part nearest to the crystal.

At this stage it will be of interest to compare the relative advantages of blocking out the central beam or the diffraction bands at the selection device. If the first method is adopted, then the screen is black when there are no disturbances in the cell, and gradually becomes white as the amplitude of the supersonic waves increases.

If the second method is adopted, then the screen is white when there are no disturbances in the cell, and gradually becomes black as the amplitude of the supersonic waves increases. There is comparatively little difficulty in ensuring that the system operates effectively when there are no disturbances in the cell, but, owing to the attenuation, the reduction of the effect on marginal rays, and other imperfections, it is more difficult to obtain efficient operation when the supersonic waves are operative; it is in fact almost impossible to diffract *all* the light from the central beam into the diffraction bands. Consequently, in the first case the blacks in the picture will be good, but the whites will be imperfect—which means, in effect, that the picture will not be quite as bright as it might be.

In the second case the whites will be good, but the blacks will be imperfect. The result of this is much more serious, since the presence of imperfect blacks gives the picture an objectionable semi-transparent appearance. In this way the method of blocking the central beam has definite advantages. Furthermore, if on account of the use of an unnecessarily large light-source, some of the light passes through the cell at a point outside the zone of the supersonic waves, then if the central beam is blocked this additional light is merely blocked out and has no effect on the picture, whereas if the diffraction bands are blocked it passes permanently into the picture, ruining the blacks.

Securing Efficiency

From the point of view of obtaining good blacks it is important that all the components of the cell should be clean. Traces of dust or grease on the cell or the lenses, or small particles in the liquid, cause scattering of the light which very much reduces the quality of the blacks; the quality of the whites is also reduced, but this is less noticeable.

In order to get the highest efficiency, the image at the selection device must be sharply defined; it is, therefore, important that spherical aberration should be small, and the lenses should be designed with this in view.

One important point has not yet been mentioned. It has been assumed that the supersonic waves travel endlessly in the direction away from the crystal across the cell. This assumption would be justified if the liquid were infinite in extent. In practice, however, this is not possible, and if the liquid terminates on the hard

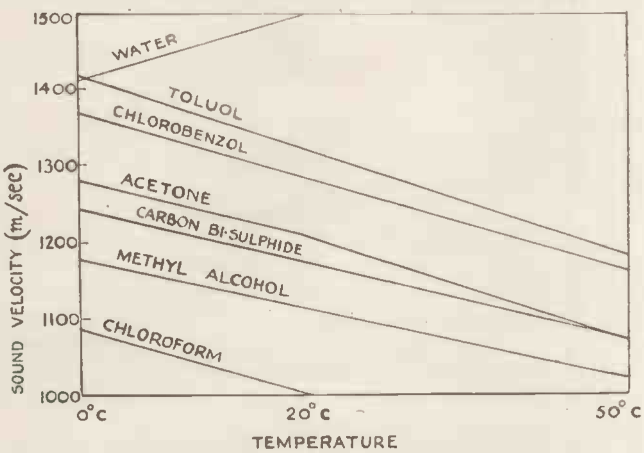


Fig. 6. Graph showing sound velocity in certain liquids as a function of temperature.

wall of the cell, the waves will be reflected, forming standing waves whose amplitude at any point will not be proportional to the intensity of any one single picture element. It is, therefore, necessary to prevent reflection of the waves from the wall of the cell. To accomplish this a " pillow " of soft material is placed at the end of the cell remote from the crystal to absorb the waves. It is important that the " pillow " should be made of a substance which will not give rise to tiny particles floating in suspension in the liquid.

One inconvenient factor in the supersonic wave cell is the change of sound velocity with temperature. In almost all liquids except water the velocity decreases with rise in temperature. The graph (Fig. 6) shows the behaviour of certain liquids in this respect.

The result is that if the image of the picture elements on the screen is brought to rest for a given temperature, it will not be brought completely to rest for other temperatures. If the motion is appreciable, blurring is produced in the picture. The blurring is proportional to the rise in temperature *and to the width W of the cell*; this restricts the maximum width of the cell which it is practicable to use even if it is not restricted by the attenuation of the supersonic waves.

It will be of interest to compare this form of supersonic light valve with the older Kerr cell. It is at once evident that there is a great improvement in the efficiency, both from the electrical and from the optical points of view. With the Kerr cell the necessary voltage was of the order of 1,000 to 2,000 volts, whereas with the supersonic wave cell, when the operating frequency is 20 megacycles, the necessary voltage of the carrier is of the order of 100 to 200 volts.

The optical efficiency, as we have seen, must be considered independently in the two planes, parallel and normal to the direction of propagation of the supersonic waves. In the latter plane the height of the image in the cell is limited only by the crystal height, which can easily be made at least 1 cm.

A similar condition holds for the Kerr cell in one plane.

In the other plane the light transmitted by the supersonic wave cell is limited by the width of the cell and the size of source which it is possible to use at a given distance from the cell. That transmitted by the Kerr cell is limited by the aperture between the plates which it is practicable to use—although with multiplate cells this is almost unlimited—and the angle of the cone which can be transmitted through the plates.

Thus, as far as light passing through the cell is concerned, the new cell seems to possess little advantage. However, it is very difficult to devise a scanner which will deal with all the light passing through the Kerr cell. After the cell the light diverges rapidly, and, unless the solid angle through the cell is quite small, a very large scanner is necessary. In the case of the supersonic cell, however, the light converges to a small compass at the selection device, and, if the scanner is placed near this, quite a small one can be employed. These considerations apply only to the plane of scanning.

The new cell has the further advantage that the fraction of the light absorbed in it is only about half that absorbed in the Kerr cell.

From these considerations it is plain that the supersonic wave cell has very considerable advantages from the optical point of view as well as from the electrical.

Special Note

The author of the above article and also that which appeared last month under the title of " The Supersonic Light Valve Simply Explained " wishes to make it clear that whilst it is common knowledge that Scophony, Ltd., employ a form of supersonic light valve on the lines which he has described, the articles are solely meant to describe the general application of supersonic light valves to television and are in no way intended to explain the particular way in which Scophony, Ltd., have developed the appartus.

Ilford and District Radio Society.—The call sign G3QU has now been allotted to this society, the honorary secretary of which is C. F. Largen, of 44 Trelawney Road, Barkingside, Ilford, Essex. At the last meeting held at the society's headquarters Mr. Lidbury described and demonstrated his three-valve short-wave receiver, while Mr. Stott, the chairman, gave a short *résumé* on and demonstrated his Fultograph receiver. In the Bulletin issued by this society is a description of an all electric output meter using a 6C5 described by A. Banthorpe. Full information on this society can be obtained from the honorary secretary.

Southend and District Radio and Scientific Society.—There are now well over 100 members of this society which ranks as one of the most active in the country. A large number of direction-finding contests are arranged each season with a complete syllabus of lectures and technical discussions. A large number of well-known amateurs are included amongst the members, while non-licensed amateurs can be trained by competent members up to the standard of efficiency which will enable them to obtain a Post Office transmitting licence. The secretary is J. M. S. Watson, G6CT, of 23 Eastwood Boulevard, Westcliff-on-Sea.

TELEVISION PICTURE FAULTS AND THEIR REMEDIES—II

By S. West

The second of a short series of articles dealing with faults in television receivers apparent in the pictures. Photographs have actually been taken of faulty reproduction and the causes and remedies are explained.

LAST month the requirements for linearity of scan in the time base were dealt with. It was shown that with adequate H.T. for the time base, it is a simple matter to adjust the negative bias for the discharge device to such a value that linearity is ensured and, at the same time, retaining adequate amplitude of the saw-tooth wave so that a full sweep across the screen is secured.

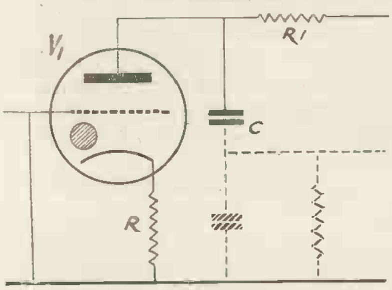


Fig. 1. Circuit of the conventional saw-toothed oscillator employing a gas relay.

It was also pointed out that, as the bias is reduced to a value where linearity is achieved, the frequency of the oscillation is correspondingly increased and it is necessary to restore to the correct frequency by increasing in value the charge resistance. It was assumed that the charge condenser has a value conforming to convention for the frequency of oscillation desired. This requirement usually is satisfied in an original design but, to ensure sufficient knowledge is imparted herein to permit a change in the value of this constant, should such prove necessary, the circuit diagram Fig. 1 is given.

In this diagram, V is a gas relay, R1 and C the charge resistance and charge condenser respectively. C usually is comprised of two condensers but for simplicity is depicted as a single condenser.

First, let us assume that by reducing the value for R (reducing the −ve bias) to a value where linearity is achieved, we have increased the frequency of oscillation considerably and let it be further assumed that it proves impossible to restore to the correct frequency by increasing the value of R1. Then the value for C must be increased. Similarly, if to increase the amplitude of sweep, we have increased R and thereby reduced the operating frequency, we may find it impossible to restore to correctness by reducing R1. Then the value for C must be reduced.

It is emphasised that if a design has been followed, it is unlikely that such changes in the constants will be required and such alterations should only be undertaken where exhaustive tests reveal the impossibility of securing good performances with normal manipulative changes to the variable constants included in the design.

Also the importance of C being comprised of two condensers must not be overlooked, for a haphazard change in value to only one of these can affect both the linearity and amplitude of sweep as is apparent when the combined capacities are regarded as a form of capacity potential divider.

Time Base Troubles

Now whilst on the subject of incorrect time base operating frequencies let us consider some of the more usual troubles experienced in this direction.

Fig. 2 depicts the effect obtained when the line (horizontal scan) time base is operating at too low a frequency, actually when the frequency of the line base is half the correct one. The remedy has already been outlined, namely, to reduce the value of the charge resistance (R1), or, to cause the discharge valve to operate earlier in the cycle with a reduction of bias (reduce R).

Fig. 3 again depicts a fault in the line base, in this case, however, the operating frequency is too high, actually twice the correct one. Readjustment of the same controls will effect a cure; e.g., increase the value

Fig. 2. Effect due to line time base operating at one-half frequency current.

of the charge resistance (R1) or, increase the value of −ve bias for the discharge valve by increasing in value the cathode resistance R.

It is possible readily to differentiate between the two effects. It will be seen that with the time base operating at a too low frequency, two or more entirely separate images are produced (integral sub-multiples of the correct frequency will produce a corresponding number of complete images horizontally displaced), whereas, when the frequency is higher than is correct two or more images result, but each will overlap and characteristic bright vertical bands will appear.

TIME BASE FAULTS

Fig. 4 shows the effect with the frame base (vertical scan) operating at one-half the correct frequency; that is the frequency is too low, whereas in Fig. 5 the frame base frequency is too high. These two faults are corrected in an identical manner to that described for the line time base, the procedure outlined being now applied to the discharge valve of the vertical scan generator. Again note that the characteristic appearance of these faulty images enables the fault to be correctly diagnosed, though a more readily apparent effect, not revealed in the photograph, renders the diagnosing of the fault of Fig. 4 (frame base operating at half correct frequency) very simple. Due to the low picture repetition frequency, 25 per second, a pronounced flicker is a characteristic of the fault.

Fig. 3. Effect due to line time base operating at twice correct frequency.

Finally, in this collection of multiple images attributable to incorrect scan frequencies, we have the generous phenomenon of four pictures instead of one (Fig. 6). This effect is obtained when both the line and frame bases are operating at one-half the correct frequencies. To remedy, the procedure already outlined is applied to both time bases.

Fig. 4. Frame time base operating at one-half the correct frequency.

The foregoing completes the description of faults directly attributable to the saw-tooth generators but, before leaving the time base as a whole, it is necessary to consider the sections concerned with amplifying these saw-tooth oscillations.

Fig. 5. Frame time base operating at twice correct frequency causing the picture to overlap.

Sweep Voltage

A quite high amplitude of sweep voltage is required if the deflection of the light spot is to provide the maximum size of picture accommodable by an average C.R. tube (7 in. to 12 in.) and it is necessary to amplify the saw-tooth wave provided by the discharge valve. Furthermore, in the case of electrostatic tubes it is very desirable to provide a balanced amplifying system to feed the deflector plates. The need for this is apparent, upon consideration, for otherwise the final anode, to which the deflecting plates must be tied, will have a varying potential and this will manifest itself in two ways. It should be mentioned that the above is not, truly speaking, an accurate description of what happens but it is simpler to understand in this manner.

(1) The deflection sensitivity of the tube, which bears a definite relationship to the final anode potential, will vary in sympathy with an unbalanced scan voltage. This is responsible for the effect known as "trapezium" distortion. See Figs. 7 and 8.

(2) The light spot focus which is a function of the ratio in potential between the second and final anode will vary, resulting in loss of focus and thus definition for some part of the picture. A balanced output system largely combats these defects and for this reason such a system is generally employed. Fig. 9 gives the circuit arrangement usually adopted. For simplicity, it is depicted shorn of non-essentials, for we are here concerned only with ensuring that a balanced output is secured.

It will be apparent from a study of this diagram that

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TRAPEZIUM DISTORTION

the output of V2 is of opposite sign to that of V1, for a reversal in phase of the signal is effected by V2. We have thus only to ensure that the output from this valve is substantially equal to that of V1 and a balanced deflection is obtained.

In the following, it is assumed the values assigned

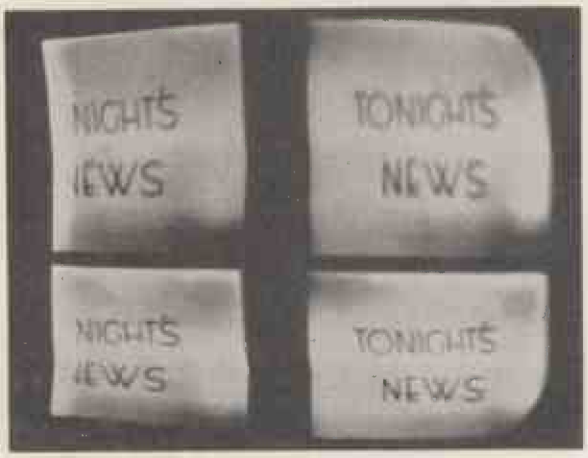


Fig. 6. Here both line frame time bases are operating at one-half the correct frequency.

the coupling condenser C and grid leak R3 permit the effect of these components to be ignored and, to ensure balance, we have only to assign values to R and R1 such that the ratio of $R/R + R1 = 1/M$ or more simply $1 + R1/R = M$ where M is the amplification provided by V2 and $R2 = R + R1$. For example, assume V2 provides a gain of some 10 times with R2 100,000 ohms, then R1 + R2 is also 100,000 ohms and R = 10,000 ohms with R1 90,000 ohms.

Checking Balance

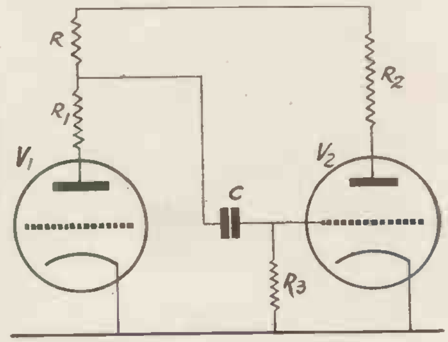
A simple manner in which to determine when the balance is correct is to remove the valve V2, when the picture should be substantially one-half the width or

Figs. 7 and 8. Showing the effect of trapezium distortion caused by unbalanced sweep potentials. The line formation is exaggerated.

height previously obtaining. Some care should be exercised if this latter scheme is adopted in order to ensure that it actually is the valve V2 that is removed. Obviously if V1 is removed the scan will collapse and there is a strong possibility of a line being burned on the screen. Of course, the circuit shown by Fig. 7 is only one form of balanced output. For some arrangements the scan will not collapse upon removal of either valve. However, as the circuit depicts the arrangement generally encountered it is well to bear in mind this point.

There remains only one form of raster distortion likely to occur. It is proposed to deal with this now

Fig. 9. Circuit of a conventional balanced output amplifier. A portion of the output of V.1. is fed to V.2.



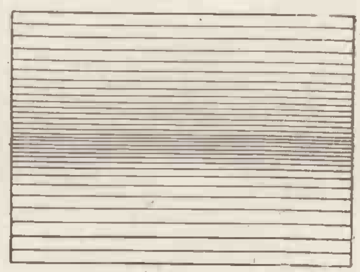
so that we may concern ourselves in the next article with actual vision receiver faults. This distortion, which, unfortunately, frequently occurs, is due to the presence of A.C. ripple (hum) in the time base H.T. supply.

The remedy, of course, is to increase the measure of smoothing provided. Where the time base H.T. is

Fig. 10. A.C. ripple in horizontal (line) time base.

adequate it often is convenient to effect this end by including a fixed resistance and condenser in the smoothing arrangements. Failing this, it will be necessary to include an additional choke and condenser. Either of these arrangements is satisfactory and which-

Fig. 11. A.C. ripple in vertical (frame) time base resulting in uneven line spacing.



ever is adopted will depend upon the adequacy or otherwise of the H.T. voltage.

A.C. Ripple

The effect of A.C. ripple in the time bases is readily apparent. It is illustrated by Figs. 10 and 11. It is seen that these faults, as were those for trapezium dis-

BAIRD RECEIVERS SET A PERFORMANCE STANDARD BY WHICH OTHERS ARE JUDGED

Model T.18 is a complete Television Receiver combined with a very selective and high quality All-wave Radio, yet the compact cabinet housing the complete equipment is little larger than the usual Table Radio. The most recent developments in Television design are included, yet the price is below that of many modern Radio-gramophones. The set is easy to operate—and without any technical knowledge you can be confident of good results.

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DEMONSTRATIONS ARRANGED

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CONTROLS : The T.20 has two main controls on the front of the cabinet. Picture Contrast and Sound Volume.

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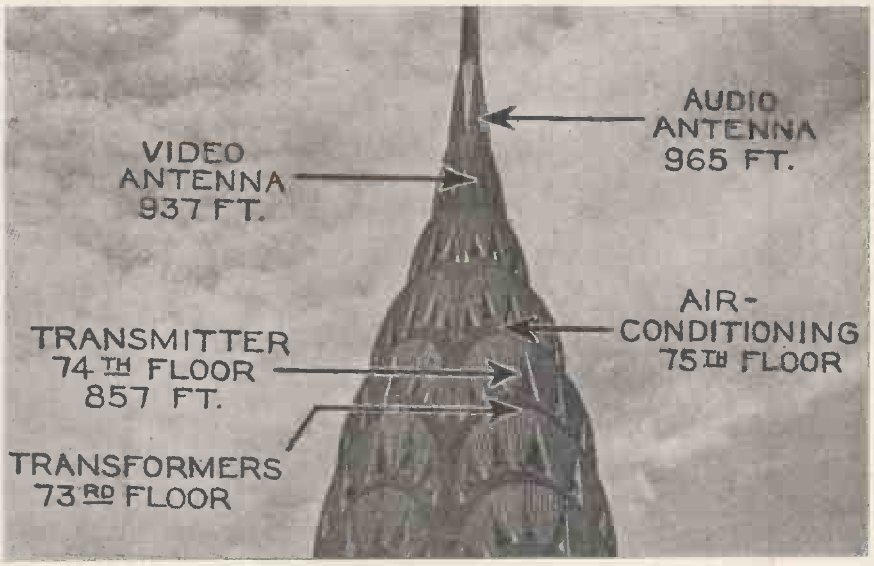
THE TELEVISION TRANSMITTER OF THE COLUMBIA BROADCASTING SYSTEM



The Chrysler Tower which houses the transmitter.

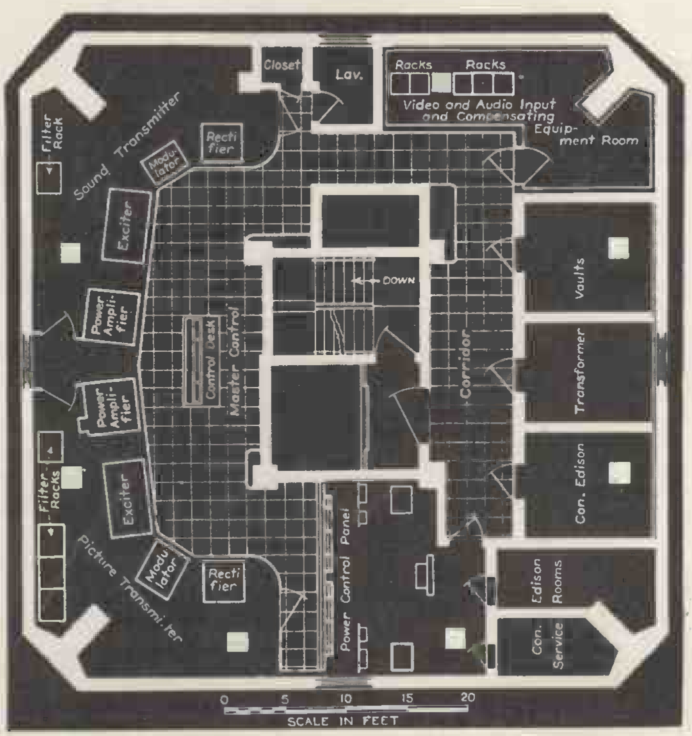
AFTER prolonged search and exhaustive study the top floors of the Chrysler Building in Lexington Avenue, and 42nd Street, New York City, were chosen for the site of the television transmitter of the Columbia Broadcasting System, as has been stated in an earlier issue of this journal.

In order to obtain reliable coverage within a radius of about 40 miles the aerial had to be located not less than, roughly, 1,000 feet above ground, according to the formula $h=d^2/1.5$ where "h" is the height of the antenna location in feet and "d" the distance from the antenna to the horizon in miles. Of course, receiving aerials beyond the horizon located above ground would still be in the path of direct waves, depending on their elevation.

> This article is by Dr. Peter C. Goldmark, Television Engineer of the Columbia Broadcasting System, and we acknowledge our indebtedness for the abstract to Communications. (New York.)

Another requirement was sufficient space at that height to house the entire transmitter equipment, weighing more than 100,000 lbs. Each unit of the transmitter and its associated equipment must, of course, be replaceable within the shortest period of time.

Power supply was an important consideration and though the total power input for both video and audio transmitters and the auxiliary equipment amounts roughly to 250 kW, sufficient tolerance had to be allowed for future expansion, as well as to ensure a minimum of voltage variation. The installation now under way will provide three transformer banks each of which consists of three transformers connected on the primary side to a 60-cycle, 13,000-volt feeder. The three high-voltage feeders will permit uninterrupted transmitter operations even when two feeders are out of service. The secondaries of all nine transformers are connected in parallel and yield a total power of 1,500 kW distributed over three 208-volt phases.



Plan of 74th floor housing the transmitter.

The next problem was to design an aerial system which could be mounted around the highest portion of the Chrysler Tower and have at the same time the desired electrical characteristics. Consequently the manufacturer of the transmitter was authorised to build a full-scale model of that portion of the Chrysler Tower around which the aerial would be located. This model was constructed of wood and covered with wire mesh, except where windows are located in the actual tower.

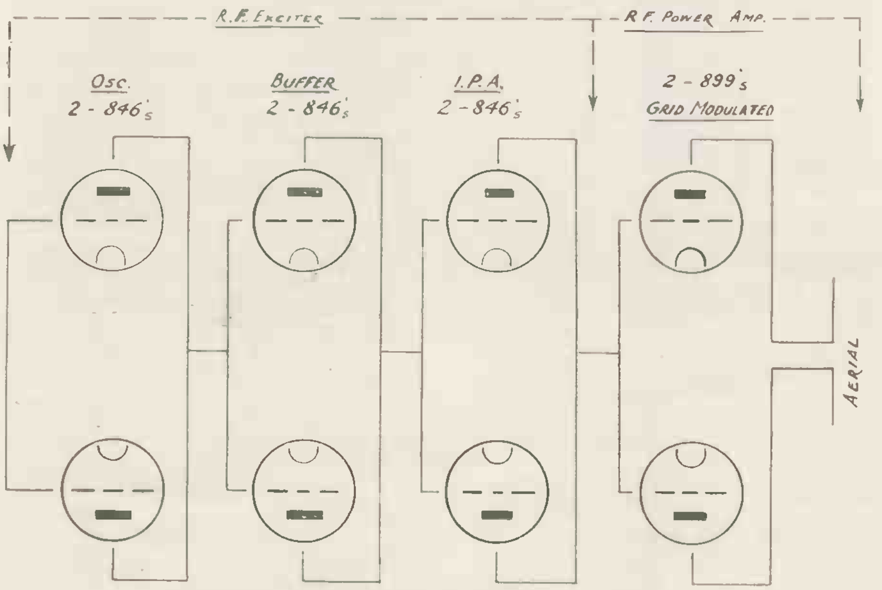
On this electrical model, which was

erected in the middle of a large field, many types of aerial were tested. The impedance and phase characteristics as well as field-strength diagrams of the various combination were determined. Eventually an aerial system was arrived at which showed a substantially flat impedance between 50-56 metres, and had a peak power gain of about 4:1 over crossed dipoles without the field-strength pattern deviating appreciably from a circle in the horizontal plane.

Both the video and audio transmitters as well as the power supply transformers, the shielded room for the input equipment, the power distribution panels, control desk, etc., had all to be placed on the 74th floor which is only 50 ft. square, and the centre of which is occupied by the fire-tower and stairway. Additional equipment consisting of transformers, pumps, motor generators, etc., had to be placed on the floor below which already appeared to be completely filled with existing building facilities, such as water tanks, ducts, pumps, elevator machinery.

A great number of problems arose which could not be solved by experience because there were no precedents. They had to be tackled one by one, and took more than six months of continuous study.

The video and audio transmitters now being installed will operate in the band between 50-56 mc. The carrier of the audio transmitter will be 55.75 mc. and when unmodulated will have a power of 7.5 kW. The video transmitter will be modulated between 50 and approximately 55.5 mc. with a peak power of approximately 15 kW. Of course, at these two limits either the modulated input or the R.F. carrier must be attenuated to an adequately high degree in order to prevent interference.



Valve line-up of vision transmitter.

For double-sideband transmission the carrier would be located at 52.5 mc. and for single-sideband transmission, in the neighbourhood of 51 mc. In the latter case the lower sideband will be attenuated by suitable electrical filter networks following the R.F. power-amplifier output circuits.

Vision Transmitter

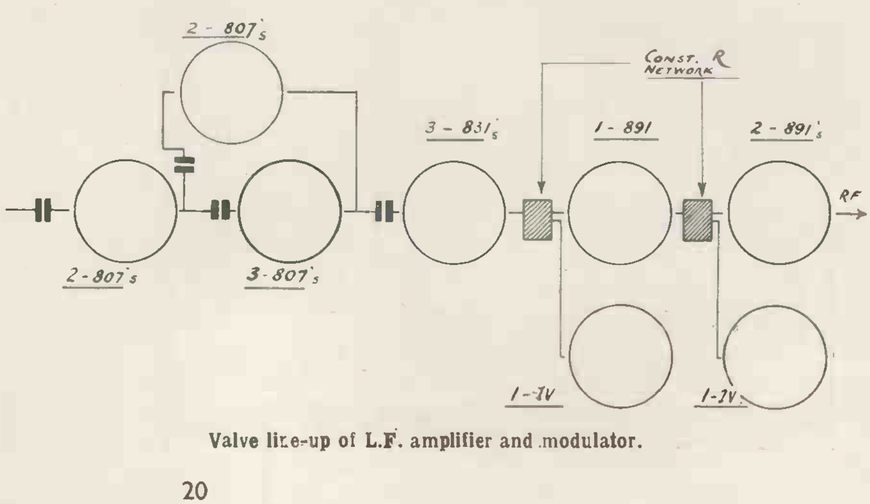
A schematic diagram of the video transmitter is shown by Fig. 1. A master oscillator with a temperature-compensated grid line with two 846's producing the carrier frequency and keeping the frequency constant within ± .02 per cent. of its value, is followed by a pair of 846's acting as buffer stage. Another pair of 846's acts as intermediate R.F. power amplifier and is followed by the grid-modulated R.F. power amplifier using two 899 type valves. These 899's operate with a plate voltage of approximately 9,000 and a plate current of 3 amps. per valve.

The plate power supply operates on 3-phase, full-wave, using hot-cathode mercury-vapour rectifiers. The grid bias to the power amplifier is supplied from a regulated voltage supply, floating above ground.

The first stage of the video modulator consists of two 807's in parallel, driving five 807 valves, the plates of which are all in parallel. The next stage consists of three 831's in parallel. Up to this point these three stages are resistance capacity coupled. However, the output of the 831's and the input of the next stage, consisting of one 891 valve which is water-cooled, are coupled by a special constant-resistance network which offers a constant impedance to all frequencies transmitted within the video band. The diode 1-V is connected between the grid and the cathode of the 891 valve and provides for the reinsertion of the picture D.C. component.

The D.C. reinsertion diode can be connected to the grid of the 891 valve either with its cathode or anode, depending on whether positive or negative type transmission is desired. Correspondingly, the bias to the 891 must be readjusted for which purpose a switch is provided.

Since the next stage, using two 891's in parallel, is in effect A.C.



Valve line-up of L.F. amplifier and modulator.

coupled, though through another constant-impedance network, the D.C. component has to be reinserted again using the same diode arrangement as before.

From here on the picture background value is maintained through a combination of a constant-resistance network and direct coupling to the grids of the R.F. power amplifiers. For this reason the bias supply of the 899 valves had to be kept above ground potential.

The R.F. portion of the audio transmitter is very similar to that of the video section, except, of course, that the master oscillator produces a 55·75 mc. carrier and the power amplifiers have a grounded bias supply. The 899's are class B operated while high-level modulation is employed.

Feeder Arrangements

The output of the video transmitter will be fed into a balanced transmission line, approximately 75 ft. long, leading to the video aerial system. The output of the audio transmitter will be fed through a single coaxial transmission line to the audio aerial located above the video radiators. All three transmission lines will have an impedance of 70 ohms. The video aerial as well as the audio aerial will consist of two rows of horizontal dipoles on all four sides of the building, separated in vertical direction by half a wavelength (about 9½ ft.). The audio and video aerial arrays are separated by approximately 28 ft. Thus on each side of the building there will be two video and two audio aerials placed above each other. Fig. 2 shows a plan of the aerial arrangement. The aerial on opposite sides

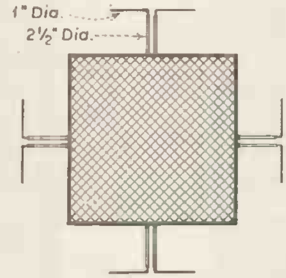


Fig. 2. Plan showing disposition of aerials.

of the building are fed out of phase with respect to each other.

Quarter-wave matching sections distributing the R.F. current derived from the 70-ohm transmission lines to the eight dipoles through correcting sections will be placed inside the tower at a close level to the aerials. The sixteen independent dipole aerials protruding beyond the tower will be heated from inside and thermostatically controlled so that no ice can accumulate on them. This is necessary to prevent detuning and danger to pedestrians from falling icicles.

The 73rd floor, that is, the one immediately below the two transmitters proper, will house the valve water-cooling equipment which is a closed system with a total water flow for both transmitters of approximately 180 gallons per minute.

Motor Generators

In another section of this floor there will be six motor generators supplying various filament and bias voltages for both transmitters.

On the 75th floor air-conditioning equipment will be installed to supply the transmitter on the floor below with fresh air and exhaust the heat generated by the various units behind the transmitter panel.

On the 74th floor a double-shielded room will contain the video and audio input equipment (see Fig. 3, page 19). The coaxial cable, coming from the studio, will be terminated in this shielded room and the signal, after being suitably amplified, will drive a picture monitor as well as the video modulator of the transmitter. The audio input equipment is standard.

Diode detectors coupled to the video aerial will supply rectified R.F. to a monitor in the shielded room permitting a constant check on the radiated signal.

"Television Picture Faults and Their Remedies"

(*Continued from page* 16)

tortion, are depicted by drawings. This is more satisfactory in these cases for the effects can be exaggerated and thus rendered plainer. Considering first Fig. 10. This fault is caused by the presence of A.C. ripple in the line (horizontal) deflecting circuit. It is seen that the effect is to displace the edges of the picture giving them a wavy appearance. This distortion is not restricted to the edges only and will result also in an actual corollary displacement of the reproduced image.

In Fig. 11 the result of A.C. ripple in the frame (vertical) deflecting circuit is depicted. In this case it is seen that there is apparent an uneven spacing of the line formation. It is fortunate that the picture repetition frequency adopted for the present transmission standards is an integral multiple of the frequency of the mains supply, for otherwise this uneven line formation would pass vertically across the picture giving rise to very distressing effects. As it is, with the time base locked by the transmitted sync. pulses, this uneven line spacing is rendered stationary and close examination permits its presence to be readily determined.

The remedy in both cases has been indicated. It is to increase the measure of smoothing provided for the H.T. supply to either one or to both the time bases.

One point in connection with Figs. 10 and 11 is worthy of mention. The figures depict the presence of a 50-cycle ripple. In some cases this ripple will have a frequency of 100 cycles, depending upon the arrangements adopted in the H.T. supply unit. In this case the effect is substantially the same but will be duplicated in the picture. Identical procedure is adopted in order to remove the fault.

In the next article, faults attributable to incorrect design or manipulation of the vision unit will be dealt with.

It is regretted a small error occurred in the December article. On p. 717, diagram Fig. 2, sections (a) and (b) should be transposed.

(*To be continued*)

TELEVISION RELAYING

Prospects of an extension of the television service were brightened very considerably when Mr. S. G. Ogilvie, Director-General of the B.B.C., stated that television programmes have passed from the experimental stage to the level of proved entertainment. The next problem is how to provide television programmes for the remainder of the country. The E.M.I. Company have put forward two possible methods of developing a country-wide service, one by means of special cables, and the other by radio link on very high frequencies. These schemes have been submitted to the Television Advisory Committee and have, it is believed, been passed as satisfactory.

Scannings and Reflections

AN EXTENSION TO TELEVISION

ACCORDING to the Television Advisory Committee there is nothing from a technical point of view to prevent television programmes being relayed from London to Birmingham or even Manchester. This information has been passed on to the Postmaster-General, who in turn is making a request to the Treasury for further grants to finance this proposed television expansion. Though no immediate decision is likely it is gratifying to know that it is possible for television to expand in this way directly the money is available. Apparently, the tests with micro-waves made by the Post Office have proved successful for it is understood that the programmes will be relayed from point-to-point by radio rather than via the expensive cable.

MORE POWER FROM ALEXANDRA PALACE

In order to increase the signal level on the fringe of the service area, it is suggested that the power of 17 kilowatts used at Alexandra Palace be increased to 25 kilowatts. This may also tend to increase the range although experiments on ultra-short waves have shown that the power does not always help in this way. It will undoubtedly provide a greater signal level for those who are in excess of 30 miles from Alexandra Palace.

NEW BERLIN TELEVISION TRANSMITTER STUDIOS

The new studio designed to replace the one already in operation at Witzleben is now in regular service. This studio is equipped with two Iconoscope cameras suitable also for open air operation and fitted with a type Iko-Mechau film analyser. The television and synchronising signals are conveyed through a cable to the transmitter which has a maximum peak power of 9 kilowatts for the carrier frequency of 47.8 megacycles/sec. (6.28 metres). The aerial is designed for convenient radiation of a waveband of ± 2.5 megacycles/sec.

The sound studio is equipped with two channels for two contemporary transmissions which are controlled in a special cabin by the sound operator. The artistic supervisor of programmes at his end controls both sound and vision channels in order to obtain the most suitable artistic effects from the transmission.

MOBILE TELEVISION DEMONSTRATION

The first of a fleet of television vans has been put into service by E. K. Cole. These vans are for service work and television installation, but they can also be used as mobile demonstration units. Apart from dipole aerials, etc. Ekco television receivers, spare kits of valves, drums of co-axial cable and all kinds of test gear are carried.

THE ENGINEERS' GERMAN CIRCLE

On December 19, the head of the Research Department of the German Post Office spoke on current problems in television technique, at a meeting held at the Institution of Electrical Engineers. This is the first of a series of similar highly specialised discussions of this Institution. Further details can be obtained from the secretary, Mr. E. L. Dimond, the I.M.E., Storey's Gate, West Kensington, S.W.1.

NEW YORK WORLD'S FAIR

Every endeavour is being made to make American listeners television-minded at the huge fair which is being staged at New York in April. The General Electric Company's studios will be fitted with a number of television cameras and receivers of the latest design. Visitors will be able to see modern high-definition television, while they will also be televised by means of a roving camera. Although television is going ahead technically in America they are still a long way from obtaining permanent service owing to the fact that programmes have to be paid for by advertisers. Until there are sufficient viewers it is hardly likely that commercial firms will sponsor these programmes.

TELEVISION PUBLICITY

A co-operative television campaign to provide adequate publicity is being sponsored by the Radio Manufacturers' Association. A television sub-committee is proceeding with the details and interested manufacturers are subscribing towards the cost. Apparently in addition to newspaper advertising a certain amount of money will be devoted to printed matter for distribution amongst dealers.

NEW TELEVISION STUDIOS

It is anticipated that when Broadcasting House is completely finished in 1940 some of the new studios will be available for television. These new studios will be as low as 54 ft. below ground level and it is hoped that there will be sufficient space to allocate at least one studio for television so as to overcome the necessity of all artists having to go to Alexandra Palace.

INTERNATIONAL TELEVISION

At a recent convention of Post Office engineers from European countries it was decided that the technical difficulties preventing the interchange of television programmes are not too great to completely remove the possibility of these relays becoming general. It was agreed that some internationally agreed standard would have to be decided upon. A good inter-change of ideas resulted at this convention.

THE CIRCUS AT OLYMPIA

Television pays a return visit to Bertram Mills' Circus at Olympia in January, and the transmissions, made at varying times, will cover the entire show with the exception of certain acrobatic acts which, for technical reasons, cannot be adequately shown.

In this, the nineteenth season of

MORE SCANNINGS . . . .

the circus, Charlie Rivels, the "Charlie Chaplin of the Trapeze," returns after an absence of eight years. Fast camera work will be needed to show the Cristians, an Italian family of bare-back riders, who come from America. John Roland and his troupe of sea lions, Little Fred's Footballing Dogs, Hagenbeck's Polar Bears on their first London visit, Mroczkowski's new Liberty Horses and Gena Lipkowska's Arabs will also be seen, and the company of acrobats, tumblers, jugglers and trapezists should make an exciting spectacle on the television screen.

Last year only one television camera was available for shots in the ring; this year there are three to give long shots, mid-shots and close-ups.

The television transmissions will be in the evening on January 5, 6 and 7, with an additional afternoon session on January 7.

SNOW AND ICE

"Snow and Ice," on the afternoon of January 1 will be something new in television programmes—a Winter holiday in half-an-hour. This feature programme introduces a party of girls, all more or less affected by that post-Christmas feeling of anti-climax which is rapidly dispelled by Peter Boumphrey, the ski-ing champion, who takes up the theme of Winter sports. Boumphrey, whom viewers saw ski-jumping at Earl's Court recently, was a member of the 1938 British Olympic team and winner of the Gold Badge of the White Riband of St. Moritz.

The script is being written by Bettie Cameron Smail who has proved an expert television commentator in recent Fashion Parades. She will also take part in the programme with Peter Boumphrey, as they tell the party where to go, what to do, and what to wear. Viewers will accompany the party on visits to shops and travel agencies, and afterwards on an imaginary journey, made realistic by the aid of vision, to the Winter sports ground to watch ski-ing, skating and bob-sleighing.

FORTHCOMING PLAYS

An Irish, and American and two Scottish plays are to be televised.

For the first time, a playwright will produce his own play for television display during the evening of January 3, when Denis Johnston, the television producer, will present "The Moon in the Yellow River," his comedy of modern Ireland. This was produced at the Haymarket Theatre, London, in 1934, and has since been broadcast. The cast includes Harry Hutchinson, Tony Quinn, Una O'Connor, Eileen Ashe, James Hayter and others.

Margaret Vines, Dame May Whitty and Esmond Knight play leading rôles in a television version of "Mary Rose," the mystic play by the late Sir James Barrie, which George More O'Ferrall will produce for television on January 1. The play will occupy the whole of the evening programme. The distinguished cast includes Winifred Oughton, J. H. Roberts, Frank Cellier and John Laurie.

"Campbell of Kilmhor," a one-act play which has been regarded as a classic of its kind, will be televised in the afternoon programme on January 2. This tale of the Scottish rebellion of 1745 concerns a fugitive hunted by the formidable Edinburgh lawyer, Campbell of Kilmhor, and the Governmental soldiery. The whole of the action takes place in a Highland cottage. The play will be produced by Moultrie Kelsall, and will be repeated in the evening programme on January 11.

"Once in a Lifetime," the riotiously funny Hollywood skit by George Kaufman and Moss Hart, will have another television performance on Boxing Day. It tells the story of three unsuccessful music-hall artists who arrive in Hollywood just in time to "cash in" on the arrival of talking pictures. Joan Miller, the television "Picture Page" girl, will again take the part of May, and Charles Farrell will again play the slow-witted George who, in spite of himself, becomes a genius among film directors. Fred Conygham will be seen as Jerry, the third member of the trio.

Eric Crozier will be the producer, and the play will be repeated in the evening programme on January 4.

NEW YEAR'S EVE

Television will see the New Year in at the Grosvenor House ballroom on December 31, and viewers will be invited to join the festivities on this first visit to a West End hotel.

It is expected that at least 1,500 dancers will come into the pictures provided by two mobile television cameras. Leslie Mitchell will give a special television commentary.

Sydney Lipton's band provides the music.

AMATEUR TELEVISION

Some American amateurs have recently installed a fairly high definition television transmitter which they are operating on a frequency of 57 megacycles. Members of their society have built their own receivers with miniature tubes, and considering the difficulties results, it is stated, are quite satisfactory. British amateurs are limited as to the amount of work they can undertake, for television licences are difficult to obtain with transmissions restricted to a frequency of approximately 29 megacycles, while only one picture per day can be transmitted.

INTERFERENCE TO TELEVISION

It would be rather interesting to discover the reason for television manufacturers omitting to include noise silencing circuits in the sound section of a television receiver. A very large number of viewers at the present time experience severe interference from motor car ignition systems, and while it is not possible completely to eliminate this interference as far as the picture is concerned, it can be reduced to a negligible quantity on the sound side. Most of the modern amateur receivers used for general short-wave communication are fitted with effective noise silencing systems which completely remove all traces of this trouble on frequencies above 28 megacycles. It would be a great help if similar noise silencers were made part of the average television receiver. Several manufacturers have included a phase-reversal valve which reduces, or appears to reduce, the interference to the picture, but country viewers, in particular, still have to tolerate intereference to the sound programmes.

PICTURE PAGE

The popular television item Picture Page reached its 200th edition on December 15, and on that evening was staged a very special programme in which a huge birthday cake was given great prominence. Altogether, during the 200 shows, there have

. . . . AND MORE REFLECTIONS

been 1,450 items in which have taken part over 1,500 men, 660 women, and a large number of animals of all kinds, including goats, snakes, lions and mice.

SUNDAY PROGRAMMES

Television programmes on Sunday afternoon, in addition to the Sunday evening relays, commenced on Christmas day. It is expected that the Sunday afternoon period will be a very popular one, and it is hoped that at first the programmes will consist of outside broadcasts from London's parks and rivers with possible excursions to some of the high spots, such as the East End Sunday markets, which are noted for their humour.

BRITISH TELEVISION AND THE NEW YORK FAIR

It seems rather a pity that in view of the immense strides made in television in this country that we should not be represented at the New York Fair. There is to be a large British Section, but there will not be any television exhibits. The B.B.C. were invited to stage a television show, but declined on the ground that the expenditure would not be justified. Whether this decision was a good one is being questioned in many quarters.

FRENCH PRAISE FOR B.B.C. TELEVISION

M. Jules Julien, the French Minister of P.T.T., states that "there is nothing comparable in either America or Germany to what is being done by the B.B.C. in England." This probably accounts for E.M.I. putting in equipment at the Eiffel Tower. Experiments are being continued in France with the intention of creating a chain of stations to cover the entire country. The next two stations to be completed will be at Lyons and Lille. Both of which will be identical with the Eiffel Tower station.

RECEPTION ON ULTRA-SHORT WAVES

To counteract the poor results that amateurs are experiencing on ultra-short waves, between 22 and 14 megacycles, amateurs are finding it very easy to maintain world-wide communication on the 28 megacycle band between the hours of 2 p.m. and 7 p.m. Short-wave listeners are also reporting that American commercial stations on 9 and 11 metres are being received in this country at a strength never before considered possible. At this rate of progress it is quite likely that communications on frequencies above 40 megacycles may soon become possible. In Australia tests have indicated that long distances can be covered on frequencies as high as 60 megacycles. The improvement in conditions on the very high frequencies is not altogether a natural one for new receivers, and components, plus highly directional beam aerials, are all playing their part.

U.S.A. TELEVISION INVENTION

The American inventor, K. Valdimar, Zworywkin, claims a new process for transmitting ultra-high frequency waves over a distance considerably in excess of line of sight. This new process uses two receiving aerials connected to a single receiving station combined with an automatic device to match the wavelength with atmospheric conditions. Just how this new system operates is not fully disclosed, but it is stated that unbroken ultra-high frequency communication between the transmitter and a receiving station beyond the horizon can be relied upon.

TELEVISION IN GUERNSEY

Another viewer is claiming reception of television at a distance of approximately 200 miles. It will be remembered that in the middle of last year television was received near Middlesbrough, also 200 miles from the transmitter. Mr. Bennett, who has installed a receiver in Guernsey, now claims a new record inasmuch as the pictures were received in a location where wide stretches of water had to be spanned.

TELEVISION IN ITALY

A regular service of television is promised early in 1939 from Rome and Milan. It will later be extended to other Italian cities. The ultra-short wave station on Monte Mario, the hill to the north-west of Rome, was built to transmit television as well as telephony. Manufacturers of radio apparatus are engaged in experimenting with a moderate-priced set for television and sound broadcasts, which, it is hoped to put on the market for about £22.

Television Society Meeting

At the December meeting of the Television Society held at University College, Dr. R. L. Smith-Ross, of the Radio Section of the National Physical Laboratory, delivered a lecture on "Some Aspects on the Propagation of Ultra-short Waves."

The lecturer dealt first of all with the properties of soil in relation to high-frequency wave propagation and absorption, and described the apparatus used for determining the behaviour of short waves when transmitted over short and long distances.

In relation to the propagation of short waves over the horizon distance, it was shown that there was no abrupt diminution in signal strength such as would be caused if the waves were propagated in a strictly linear manner.

During the discussion Mr. E. L. Gardiner referred to the work of the Radio Society of Great Britain in observing short-wave phenomena, and several other speakers described peculiarities with television reception which they had experienced.

The Ilford & District Radio Society

In our December issue we stated that this society had been granted a full radiating transmitting licence with the call sign G3QR; this should have been G3QU, for the owner of G3QR is Ernest A. Royes, of 76 Locks Road, Ham, Richmond, Surrey.

Book Review

The Radio and Telecommunications Engineers Design Manual. R. E. Blakey, D.Sc. (Pitman 15s.), 142 pp., 84 figs. in text.

In his preface the author states that this book is written to supply a demand for basic design principles of radio components and radio test gear. Actually he has covered more than this field as several complete circuits of useful test equipment are fully described in its pages. The chapters deal with the following components: Volume Controls, Inductances, Condensers and Transformers. Then follow sections on A.F.. oscillators, R.F. oscillators and valve voltmeters.

This is a most useful book which should be worthy of a place—not in the bookshelves, but on the desk of every radio design engineer.

THE ELECTRON BEAM AS A LIGHT RELAY

An article reviewing the possibilities of a new system of reception.

IT has occurred to many people that if the electron beam could be made to actuate some sort of light valve, it would make possible a receiving system which would be almost ideal. Such a system would have the advantage that although no moving parts would be required, the amount of modulated light available would be adequate to project a picture to cover any reasonably sized screen.

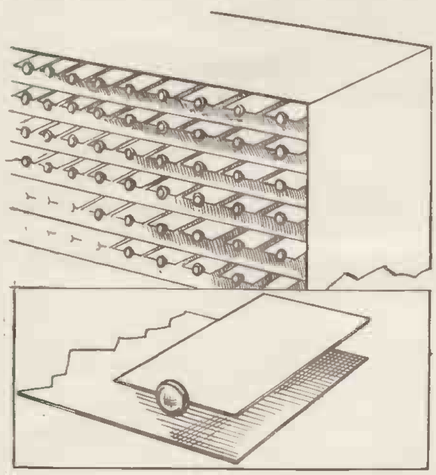


Fig. 1.—Mozaic for insertion in cathode-ray tube.

Very many suggestions for such a scheme have been made and several patents granted, but up to the present, so far as can be ascertained, no system has been devised which will give practical results. Although success has not yet been attained it by no means follows that the whole idea is impracticable and it will be of interest, therefore, briefly to review some of the suggestions that have been made for solving the problem.

Early in 1935 the Baird Company formulated a system using a mozaic of light cells of the Kerr type to rotate the plane of polarisation of a plane polarised light beam, the cells being actuated by the impingement of an electron beam upon the electrode of each cell, while the other electrode remains at a constant potential; the charge acquired by the bombarded electrode would, of course, vary to an extent sufficient to stress an intervening di-electric and produce the well-known Kerr effect. The suggestion was to make up a number of small electro-optical cells of this type into a matrix, or honey comb, one electrode of each cell being connected to a common conductor and earthed. Upon bombarding the other electrodes in sequence with an electron beam and placing the matrix between crossed Nicols, the cells would be optically "opened" in sequence to produce a scanning effect with a beam of light passing through. If the beam of electrons were modulated in intensity, the amount of light passing through the cells would vary accordingly and be projected upon a screen.

The suggested scheme is shown by Figs. 1 and 2. The electro-optical matrix, shown by Fig. 1, consists in a number of parallel strips *a* of an optical medium which would become birefrigent under the influence of electric stress (*e.g.*, glass, Rochelle salt or the like) arranged in the form of a rectangular plate, in alternate interstices of which are inserted thin strips (*b*) of metal foil so as to form an edge-on grille. In the other interstices are arranged small electrodes (*c*) in the form of flat extrusions located in rows. Each of the elemental electrodes (*b*) has a minute button (*d*) lying flush with the surface of the mozaic.

The mozaic is mounted within an evacuated bulb provided with an electron gun and deflector plates by means of which the buttons (*d*) on the mozaic can be scanned in the usual way by the electron beam. A beam of light from the light source is passed by way of a lens and a polarising prism P through the strips of the optical medium in the mozaic and then through a second polarising prism P2, which is crossed with respect to the first. The issuing beam is focused by means of a further lens to form an image upon a viewing screen.

When the electron beam, modulated in intensity, is caused to traverse the matrix, every time it falls upon a button, it changes the electrical potential with respect to the strips on either side of it, so stressing the optical medium between and permitting light passing through that element of the matrix to emerge from the second polarising prism and to fall upon the viewing screen.

Several alternative suggestions on similar lines were proposed, but they do not appear to have answered in practice.

Another idea was suggested later on in 1935 by Marconi's Wireless Telegraph Co., Ltd., and L. M. Myers, which is illustrated in Fig. 3. This scheme provided for a very large number of minute asymmetrical

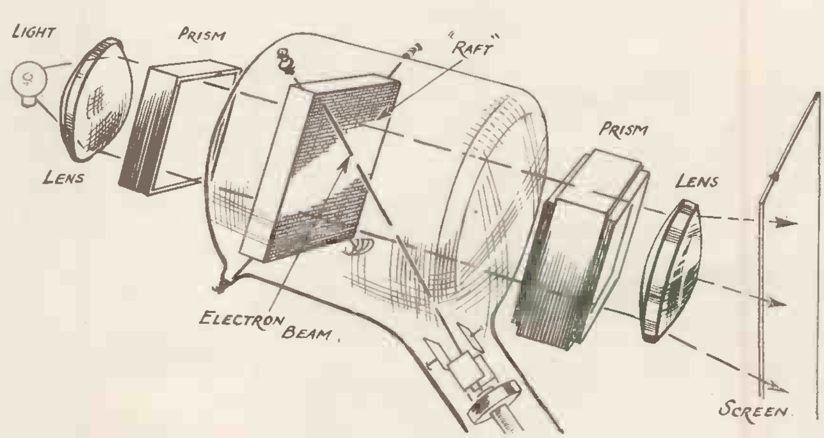


Fig. 2.—A Baird scheme using a mozaic of light cells in a cathode-ray tube.

ELECTROSTATIC SYSTEMS

crystals in association with an optical surface, and the idea was to electrostatically orient the crystals by means of the scanning beam.

Light from a suitable source is projected into, and collimated by, a lens, behind which is a silvered or similar mirror surface which reflects the light back through the lens to another point. The mirror surface is spaced a short distance from the back planar face of the lens, which is remote from the light source. If now, a layer of asymmetrical crystals, such as mica, be placed upon the polished planar back face of the lens, the light will be dispersed before reaching the mirror surface, and accordingly will not be reflected to, and collected at, the second point. If, however, the crystals at any elemental area on the back of the lens are suitably oriented by means of an electrostatic field, the light will not be dispersed at that elemental area but will be reflected to a second point.

As, apparently, there has been sufficient time to develop this scheme and nothing more has been heard of it, it is to be assumed that there are practical difficulties in the way of its operation that have not been overcome.

In another suggestion on these lines a cathode-ray tube is provided with an end wall which is optically polished and to which is attached the totally reflecting face of a totally reflecting prism. Light from a suitable source is projected as a beam through the prism to the end wall and from there it is re-directed to a screen. On the inside of the flat end plate of the tube are distributed extremely fine carbon particles. From the carbon particles, that is, on the side of the screen towards the electron gun of the tube, is a sheet of mica which is provided with a layer of electrically conductive particles, that is, with individual metal particles which are insulated from one another. The carbon layer on the surface of the end wall of the tube is positively charged so that by induction the surface of the conducting layer on the mica sheet will present a positive potential to the oncoming electron beam. The electron beam is modulated in the usual way and is caused to scan the picture area at the end of the tube. The beam tends to pull the carbon particles away from the end wall of the tube by electro-static forces which will depend upon the density of the charges. It is stated that a beam current of 100 microamperes, acting for one half of a micro-second, will provide a charge of roughly 1/10th of an electrostatic unit, and this charge will exert a force of about 30-40 dynes on the carbon particles per $\frac{1}{4}$ mm.^{2} of surface, such a force being sufficient to neutralise the adhesion force between a carbon particle and the glass end plate of the tube.

Another proposal by the Baird

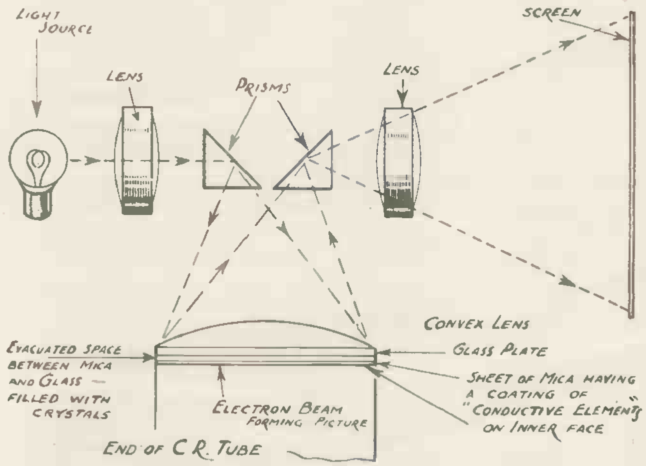


Fig. 3.—A light relay of crystals oriented by the cathode beam.

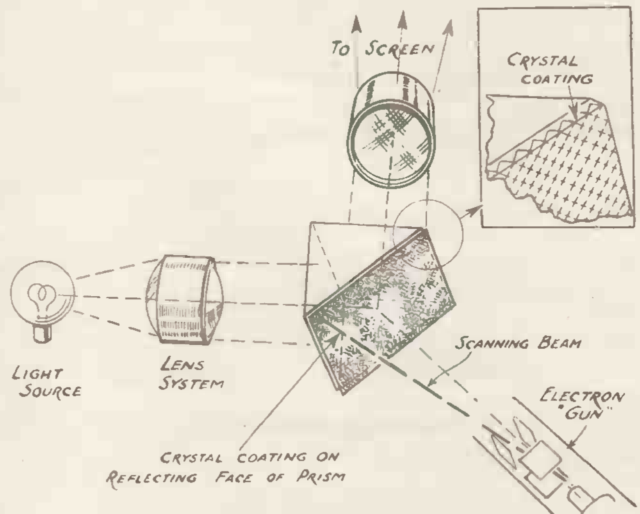


Fig. 4.—A modification of the scheme shown by Fig. 3.

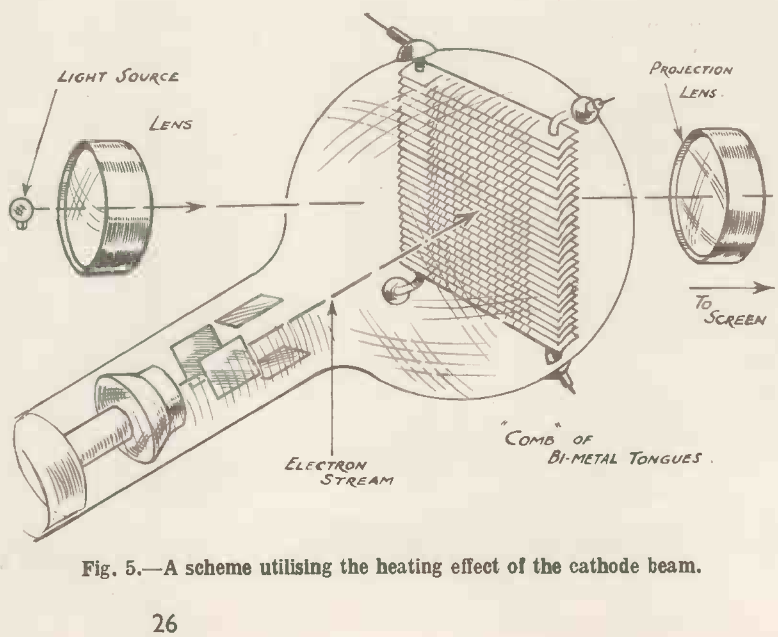


Fig. 5.—A scheme utilising the heating effect of the cathode beam.

A THERMO SYSTEM

Company was to vary the translucency to polarised light of a screen by means of the impact of an electron beam. Various colloids are known, which, when subjected to electrostatic stress, polarise the light which passes through them.

A pair of parallel electrodes between which is a colloidal suspension of dichroic crystals, such as sulphate of iodoquinine, was proposed and it was stated that the colloidal suspension used is such that normally, owing to Brownian movement, the crystals are oriented chaotically, but when the electric field is applied the crystals tend to orient themselves along the lines of force so that the medium becomes effectively dichroic.

Utilising the Heating Effect

There have been several proposals to use a very thin metal screen in place of the usual fluorescent type and cause individual areas of this to become white hot by electron bombardment by the scanning beam. Such a system, however, does not constitute a light relay, but merely has for its object the production of an intensely bright picture which will allow of projection.

It has, however, been proposed to utilise the heating effect of the beam in another way. The screen in this case consists of a large number of metal tongues which will vary in shape under the heating action of the electron beam and thereby effect variable local screening of a light falling on the screen. Light penetrating the screen may, of course, be received on a viewing screen. A material particularly suitable for the production of the tongues is the so-called bimetal which consists of two metal strips of different thermal coefficients of expansion, welded or brazed to one another. With a tongue 5 mm. long and 5/100 mm. thick heating of the tongues even by 100° Centigrade is sufficient to produce noticeable curvature of the metal tongues.

The proposed construction is as follows: The strips of which the screen is composed are divided like combs into a large number of tongues which are curved towards the next strip, as shown in Figs. 5 and 6. A nearly parallel beam of light is thrown on to the screen by a light source through an optical system, and the light passing through the screen is then thrown by another optical system on to a viewing screen. The lattice constituted by the strips is connected electrically to the anode and is at positive potential with respect to the anode. The tongues are so curved that at zero ray intensity no light passes through the screen. Under the action of the electron

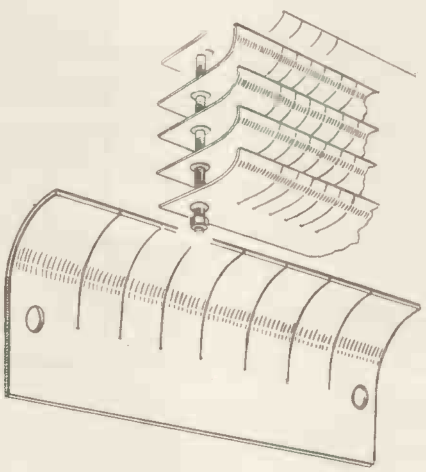


Fig. 6.—Detail of bimetal light valve.

beam, which impinges on the lattice, the curvature of the tongues is varied to an extent corresponding to the individual picture points, and thus, according to the modulation of the electron beam, varying light permeability of the screen results.

The time during which the shape of the tongues remains changed is determined by the heat conductance of the tongues, and this time may be reduced by connecting suitable heat conducting materials to the metal tongues or by increasing the heat conductance to the desired degree by other measure, such as water. The time required for recovery of the change in shape is preferably arranged so that the tongues return to their normal shape in the time of one picture change.

It is not definitely known whether any success has been obtained with this method, which is of German origin—presumably not—but if it could be made to work it would appear ideal, for there would be no limit to the amount of light that could be transmitted through the screen and this light would continue during the whole time taken for one picture scan if the metal tongues could be made to return to their normal positions practically instantaneously. This, however, seems impossible and it is evident that a comparatively slow return would have the effect of varying the tone values of the picture throughout the whole period of time taken for the tongues to cool and resume their normal shape.

The utilisation of the electron beam to operate a light relay would undoubtedly revolutionise receiver design—smaller tubes could be used and economies effected throughout the entire receiver; and there would be practically no limit to size and brightness of the picture. It is a field of research well worth attention.

The Director-General on Television.

Speaking at the twelfth annual banquet of the Radio Manufacturers' Association on Monday, December 6, at Grosvenor House Hotel, Mr. F. W. Ogilvie, Director-General of the B.B.C., said:

"Among the most pressing of our mutual problems is television. Here is a gift of science which is a challenge both for the B.B.C. and for your industry. In a remarkably short space of time programmes have passed from the level of experiment to the level of proved entertainment and value, and the march of your industry has not lagged behind the march of Alexandra Palace. As a regular viewer in my own home and having also seen at Radiolympia something of the achievements of your industry, I should like to take this chance of congratulating you warmly upon the improvement in the quality of television sets and in the reduction of their prices. Television, at roughly the price of a radio-gramophone, is now available to an area consisting of well over ten million people, that is, more than a fifth of the population of the country. And, of course, you and we regard this as only a very early stage. We at the B.B.C. are very glad to be working so closely with you in this matter of mutual interest."

AMERICAN TELEVISION STANDARDS

HOW THE U.S.A. SYSTEM COMPARES WITH THE BRITISH

In view of the interest taken in the British system of television by American engineers it is interesting to compare the proposed American standards with those adopted in this country. The first public television programmes in America are timed to begin with the opening of the World's Fair.

FOR some years the engineers of the principal broadcasting companies and radio manufacturers in America have been developing television systems for high-definition broadcasting. These systems have not necessarily been the same—in fact a certain degree of competition is possible owing to the special conditions which exist in the American broadcasting networks.

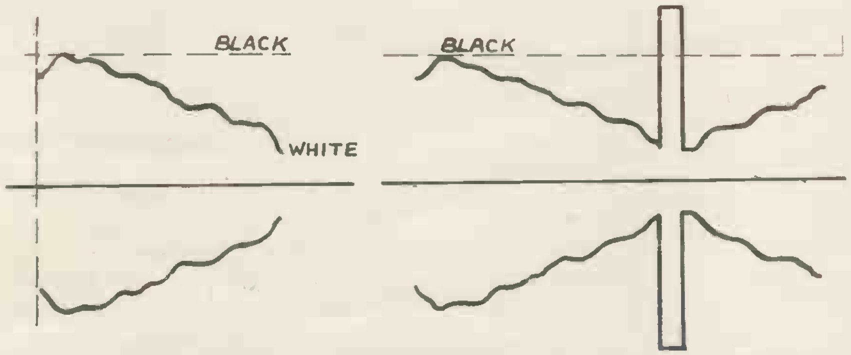


Fig. 1a. Illustrating "negative" transmission in which the carrier is fully modulated on white impulses.
b. The sync. pulse is in the black direction and is higher than black modulation level.

The position was made regular by the official recommendations of the American R.M.A. Television Committee which were published in 1936. These laid down, in a similar manner to the recommendation of our own Advisory Committee, the principles of satisfactory television systems and their recommendations have been adopted in the majority of cases.

The importance of having a single set of television standards for the whole of the continent was emphasised at the outset and to cover the possibility of the establishment of several stations broadcasting different programmes a wide band of frequencies was recommended to be set aside for their use. These covered from 42 mc. to 90 mc. or more and it was hoped that one receiver could tune several stations on its dial. The total band width allocated to an individual transmission was approximately 6 mc.

So far the recommendations were in close agreement with those put forward by the British Advisory Committee, but the nature of the transmission adopted was fundamentally different from that used in this country, and it is this which provides the most interesting points in a discussion of the two systems.

In transmitting picture intelligence it is basically possible to use the carrier wave in two ways—the bright parts of the picture corresponding to maximum current in the photo-sensitive device may either modulate the carrier to a maximum degree, or may cause the carrier to rise to a maximum degree.

The first method is that which corresponds to sound broadcasting, and was, in fact, used in the Baird 30-line system. It is usually known as "negative transmission" or negative modulation, and is illustrated in Fig. 1a.

Fig. 2. In the absence of D.C. level the mean potential of the signal alters with the picture content.

In this system, the transmitter is to all intents similar to an ordinary sound transmitter, except that the range of frequencies covered by the modulation is much wider. In consequence the design of a receiver for television reproduction is on the same lines as that of a standard short-wave receiver, due care being given to avoid phase distortion and loss of the upper frequencies.

It is, for example, possible to use A.V.C. on both the sound and vision receivers—an important point if the utmost range is required without fading.

From the point of view of the transmitter, the negative method of transmission is very efficient. The total energy contained in a modulated wave is the sum of the modulation frequencies and the carrier frequency, and if we assume that the carrier is modulated 100 per cent., the total energy radiated is 50 per cent. greater than that of the unmodulated carrier. It is, of course, not always possible to modulate the carrier 100 per cent., but although the available energy is reduced, with reduced depth of modulation, the power available is still considerable compared with the second modulation method mentioned.

At the end of each line of picture intelligence it is necessary to provide the synchronising signal. Theoreticarry this may be provided by altering the depth of modulation in such a way that it can easily be distinguished from the modulation produced by the picture intelligence. For example, the picture modulation may be limited to 90 per cent. modulation depth and the synchronising signal may increase the depth to 100 per cent. momentarily. With the negative system shown in Fig. 1a this is obviously impracticable, as the signal would produce an effect on the screen whiter than the white tones of the picture, and the return trace of the beam in the cathode-ray tube would be emphasised instead of blotted out.

The sync. signal must obviously

BRITISH v. AMERICAN SYSTEMS

act in such a direction that the beam is suppressed during its return, and for this reason can only be in the direction of black. The modulation of the carrier is therefore limited during the transmission of the line signal, and allowed to rise at the end of the line to give a characteristic sync.

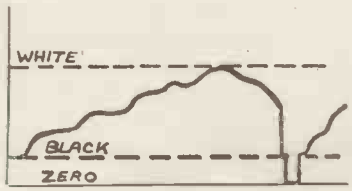


Fig. 3. In "positive" transmission the carrier level is proportional to the absolute value of picture brightness at any instant.

pulse. The complete line signal will then be as in Fig. 1b.

The negative transmission system described above produces in the receiver a rectified A.C. signal corresponding to the picture brightness throughout the line. This A.C. signal will vary about a mean datum line, the level of the peaks being determined by the average height of the wave during the transmission of the line.

In Fig. 2 two waves are shown for two successive lines, the first having a single black mark in the middle of the line, and the second a long black band. It will be seen that the height of the black level is different in each case, since the wave swings about a mean level in such a way that the area on each side of the centre line is the same. Unless the sync. signal is very much greater in amplitude than the black level there is a possibility of confusion in the re-

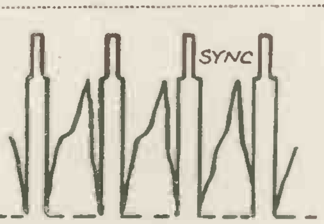


Fig. 4. Wave form of American transmitter showing the sync. impulses at the end of each line.

ceiver between the sync. pulse and the black level and the picture may get out of step.

In the negative transmission system this is taken care of by providing extra amplification for the sync. pulse in addition to careful separation by amplitude filters.

Another point which arises from the same wandering in level makes the transmitter liable to inefficient operation. If the ratio of black to white amplitude in the carrier is fixed an alteration in black level will produce a corresponding alteration in the white level and the whole signal may take up a range of values in the carrier which is greater than that actually required for the transmission of the picture intelligence.

Finally, it is important to consider the effect of external interference on a signal produced by negative transmission. If a strong external impulse occurs when the modulation is near its peak it will tend to increase it. This corresponds to a momentary increase in black signal, i.e., imitates a sync. pulse. As a result the line may be momentarily put out of synchronism, although the interfering pulse will not appear on the screen.

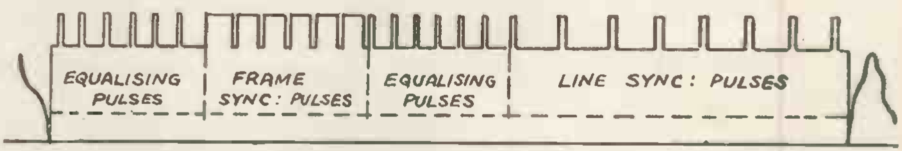


Fig. 5. Sync. impulses at the end of each frame in American system, showing the "equalising" pulses.

British System

The E.M.I. system which was adopted by the B.B.C. differs fundamentally from the American system in that the method of modulating the carrier is the exact reverse of the one described above. Instead of allowing the vision signal to modulate the carrier in a simliar manner to sound modulation a fixed carrier level is chosen to represent black. The lighter tones from black to full white are then rendered by a definite height of carrier which is fixed for the transmission.

In distinction from the negative system this is known as "positive transmission" and is characterised by the association of a definite carrier value with a definite tone value. Fig. 3 shows a typical line signal based on this system, and it will be seen that the carrier amplitude could be scaled in tone values ranging from black (min.) to white (max.).

In fitting in the synchronising signal the same considerations apply as in the previous case. The signal cannot act in the sense of "white" or it will appear as a bright streak on the screen of the tube. Accordingly the black level is limited to a value of carrier 30 per cent. of the maximum and the sync. pulses are supplied by allowing the carrier to drop below this level.

The important feature of the system lies in maintaining the black at a fixed level. If the black level is allowed to wander, the sync. pulse is liable to confusion with the picture intelligence as in the case illustrated in Fig. 2 and the advantage of the system is nullified.

To ensure a constant level of black it is theoretically necessary to design the amplifiers to pass D.C., but as is well known, this can be avoided in practice by "D.C. restoration."

Other advantages which are claimed for this method of transmission are in the utilisation of the carrier to the best efficiency. The synchronising pulses occupy the lower part of the modulation characteristic of the transmitter and whereas this might normally produce distortion in the vision signals, it does not affect the sync. pulses.

So far as interference is concerned, an external pulse will tend to appear as a white flash in the picture, owing to the momentary increase in carrier amplitude, but as these pulses act in the opposite direction to that of the sync. pulse they are less liable to upset synchronisation.

With this brief summary of the principal differences between the two systems and the advantages claimed for each, we can now examine one or two features peculiar to the R.C.A. system.

The waveform of one line is shown in Fig. 4 and it will be seen that the picture signal falls to a low level corresponding to full white. At the end

(*Continued on page* 34)

Telegossip

A Causerie of Fact, Comment and Criticism

By L. Marsland Gander

FOR obscure reasons the Marconi-E.M.I. Company is most secretive about the details of the scheme mentioned by Mr. Alfred Clark at the firm's general meeting. He alluded to it as an economical way of developing television on a national scale, and said that the plan was being considered sympathetically by the Post Office and the Television Advisory Committee.

Surprise was then caused by an official statement in the House of Commons to the effect that there was to be no immediate extension of television to the provinces. But I have since learnt on the best authority that this does not mean a rejection of the Marconi-E.M.I. scheme.

I am able to reveal that the scheme relates to a system of ultra-short wave relay points using wavelengths below five metres and probably in the neighbourhood of two metres. These would make it possible to relay the London programmes to Birmingham in three or four hops.

But before any final decision can be taken it will be necessary for the Post Office to carry out a series of practical tests. These will be done with one or two of these relay stations, perhaps of a small mobile type.

Owing to the mystery surrounding this new development it is difficult to sift fact from fiction, but it is clear that these experiments, even if carried out early in the New Year, will take some months, and the date for the opening of the first provincial station must, therefore, be deferred. I have also heard the very reasonable suggestion that any scheme for national distribution of television will combine radio and cable links, the cable to bridge awkward stretches of hilly country and the radio to cross the flat stretches.

Programme Times

One thing seems moderately certain, that there will be only one common programme, from London, and any provincial station or stations will simply relay the Alexandra Palace transmissions. I met Mr. Gerald Cock at Alexandra Palace the other day and he told me, uncompromisingly, that he did not intend to sacrifice quality for quantity. This means no substantial increase in programme hours for a long time to come.

Though I hope I am an outspoken critic I take the view that he is right, and that the radio precedent of prodigal outpouring all day long is too wasteful for television. I am satisfied with an hour and a half of evening entertainment. Be it noted, however, that we are to have regular Sunday afternoon programmes in the New Year so that the total hours of transmission is creeping up. But to my mind the most necessary change is to start the evening programme earlier.

Production and Demand

On all sides I hear stories of the manufacturers' production difficulties. The main trouble seems to be the making of satisfactory, cheap, cathode-ray tubes. At the time of writing there is an acute shortage of certain models and the demand exceeds the supply in a way likely to cause delay and exasperation to potential customers.

My disclosure in last month's TELEVISION AND SHORT-WAVE WORLD regarding set sales seems to have fluttered the dovecotes considerably, and there has been talk of "leakage." Personally, I cannot conceive any legitimate reason for this secrecy about a piece of good news we have all waited for so long. November figures, I gather, were below the October mark chiefly because of this difficulty of supply.

Picture Page

I had the doubtful privilege the other night of having my face distorted for the edification of about thirty foreign television and telephone experts. The occasion was the 200th edition of "Picture Page," to which I made a modest contribution, and on the same evening members of the international telephone committee which has been meeting in London were being shown the works.

Mr. Shoenberg, the reticent genius of Hayes, was present, and there was also a whole crowd of "big shots" from the B.B.C. Engineering Division. My arrival on the screen coincided with a demonstration of face twisting; but I must explain that this was for control-room entertainment only, and my image was faithfully transmitted to the submissive public. I had no idea at the time that Russians, French, Germans, Americans, and Italians were watching this programme and that my remark about the "Old Country" leading the rest by two years was heard by such an international company.

Believe it or not, these "Picture Page" programmes have little or no rehearsal. For instance, Viscount Castlerosse arrived after the programme had started and was thrust straight in front of the camera. Cecilia Colledge actually did not arrive till half-way through the programme. Howard Marshall had had no time to polish up his sports interviews. Imagine the anxiety of editor Cecil Madden when producing a programme under these circumstances!

I have already offered Mr. Madden my sincere congratulations on his efforts; I think few outside realise the constant strain and the interminable hours spent in preparation. I do not suggest that the programmes are beyond improvement, indeed I should like to see certain modifications, but I do think that "Picture Page" is made from the right recipe for television purposes—it has topicality, variety and makes plentiful use of the essential close-up. But personally I should like to see a little more speed and a more ruthless cutting down of the length of interviews.

As an interviewer Leslie Mitchell is a past-master and it matters little to him whether there has been a rehearsal or not. He bears a rare burden of responsibility for success or failure and is never at a loss for the appropriate phrase to keep the conversation running naturally in the right channels.

By the way, the original E.M.I. studio has been considerably enlarged by taking in part of the outside balcony for half its length. This alteration has the effect of increasing the width of the "stage end" by eight or nine feet. Actors may now make more graceful exits without weaving and bobbing and tripping over cables. An in the meantime there is still nothing done in the theatre conversion scheme.

SECONDARY-EMISSION VALVES IN VISION RECEIVERS

By Paul D. Tyers

DURING the past year the secondary-emission valve made its appearance in the form of ordinary standard valves which are now generally available. The properties of these valves, which are found in the Mullard range, are such that they are particularly suitable for television work. Many engineers have been working on their application and the valves are already to be found in a number of commercial vision receivers.

The manner in which the secondary-emission valve functions has been described several times, but it is advisable to consider very briefly exactly what is involved. The great advantage of the valves lies in the high gain which it is possible to obtain at vision frequencies and this is due to the fact that the mutual conductance is very high.

In these valves, which are the Mullard TSE4 and EE50, the single multiplying action is employed. If a primary electron stream impinges on a suitable surface it will dislodge a number of secondary electrons and the number dislodged is greater than the number striking the surface. The efficiency of the valve is therefore dependent on the ratio between the primary and secondary electrons.

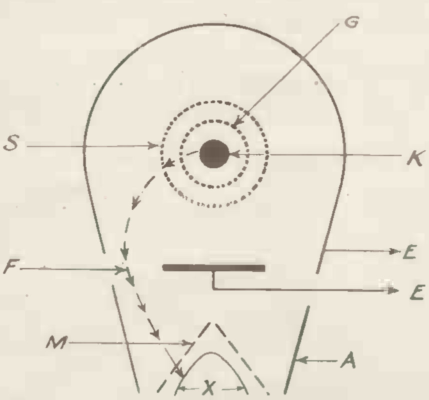


Fig. 1. Schematic diagram of secondary emission valve.

In an ordinary valve the electron stream is directed towards an anode through an accelerating grid and screening system and the primary source of electrons is modulated by a control grid. The change in anode current is proportional to the grid voltage. The greater the change the greater is the gain of the valve. In the secondary-emission valve the modulated stream of electrons impinges on the auxiliary cathode and accordingly as there is a multiplication ratio between the primary electrons and the ejected secondary electrons, it is obvious that the resultant anode current will be as many times as great as the multiplication factor. This briefly is the principle now employed.

The Mullard EE50 secondary emission valve.

Basic Principles

Very considerable development work has been done on the valves before they have taken their final form. Fig. 1 shows in very diagrammatic form the basic electrode system. This sketch bears a rough resemblance to the actual electrode assembly, from which it will be noticed that the main cathode and associated grid is actually off-set in the assembly, and accordingly it will be found not in the centre of the bulb but to one side. The cathode K is of normal construction and is rendered operative by the ordinary type of heater. Adjacent to the cathode is the normal control grid G and this is followed by the co-axial screen or accelerating grid S.

Up to this point the operation of the valve is perfectly normal. By suitable disposition of the anode A and the earthed screens E the field acting on the normal electrode assembly is such that the electron path is bent, the primary electrons following the line of flight F. These electrons pass through another grid M which is connected to the main anode. When the electrons strike the auxiliary cathode X they dislodge a greater number of secondary electrons which in turn are accelerated by the grid M and reach the main anode A.

It will be obvious that for a device of this type to function correctly the voltage limits on the various electrodes are likely to be more critical than in the case of an ordinary pentode, for example. This is found to be the case in practice, but at the same time it should not be imagined that the limits are in the least troublesome. Accordingly a potentiometer network is the most satisfactory method of maintaining correct voltages or ratio voltages on the various electrodes and a very satisfactory circuit is that shown in Fig. 2.

It is found that automatic bias by means of an ordinary cathode resistor is not satisfactory as the cathode current itself is quite small and is liable to vary between one valve and another. The operating voltage is therefore obtained by taking the grid return to a point on one of the potentiometer networks and the main cathode to a point on the other.

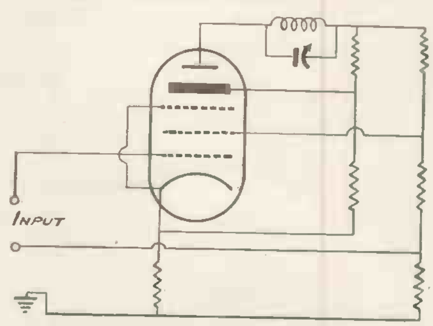


Fig. 2. Typical circuit arrangement for secondary emission valve.

The application of these valves presents no great difficulty, providing certain precautions are taken. In the first place it is advisable to use fairly

USING SECONDARY-EMISSION VALVES

close tolerances on the resistances as otherwise the voltages may not be too accurate and the writer has found that the gain and stability of the valve is definitely dependent upon maintaining the network quite accurately.

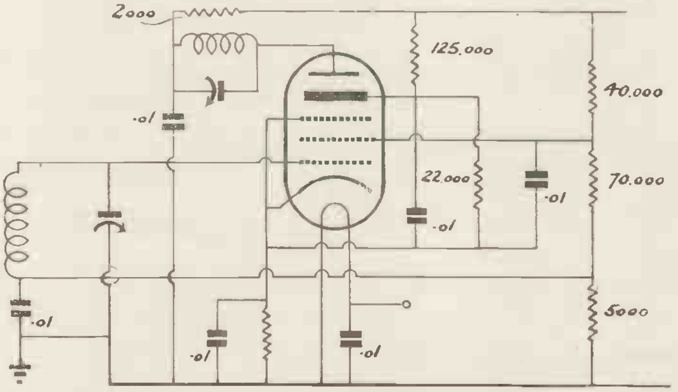


Fig. 3. Decoupling arrangements

The practical problem is that of associating six resistances and the necessary decoupling condensers fairly close to the valve base. Fig. 3 shows what appears to be a very satisfactory decoupling arrangement. It will be noticed that both the screen and the auxiliary cathode are decoupled to the primary cathode. As the currents are low, ½-watt resistors are quite suitable for the network, they take up little space and they can be arranged quite neatly round the base of the valve. The most important point in using these valves at high frequencies is to arrange decoupling condensers as close as possible to the valve pins. When using these valves at 45 megacycles it is essential, owing to the high gain, to use a very low resistance non-inductive decoupling condenser on the auxilary cathode, screen, main cathode and also the heater.

In an ordinary type of pentode the grid return circuit is generally taken direct to an earth line or a chassis. In this particular case the grid return has to go to the potentiometer network. This means that from a radio-frequency point of view the bottom of the circuit must be decoupled on to the chassis or earth line or cathode as the case may be by a non-inductive condenser using the shortest possible leads. One is only then left with the lead from the bottom of the decoupling condenser to the potentiometer network.

Theoretically, if the decoupling at the bottom of the tuned circuit is efficient it does not matter very much what happens to the lead from this point to the potentiometer network. On the other hand, however, it is very important that this lead should not couple with anything else and a number of such leads might possibly give rise to certain instability. It is, therefore, preferable to keep it as short as possible, particularly in view of the fact that the decoupling is never 100 per cent. perfect, and a large number of such return leads might easily give rise to trouble.

The final point to observe is the necessity of not exceeding the rated voltage. With an ordinary high-frequency pentode it is quite possible to exceed the rated voltage without going beyond the dissipation of the valve and at the same time maintain perfect stability. It does appear, however, that an appreciable increase above the rated voltage tends to give instability. It is important also to note that the gain is very dependent upon working at the correct rating.

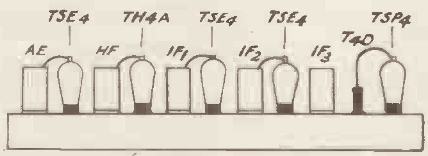


Fig. 4. A suitable combination of valves in a vision receiver.

Vision Receiver Line-up

A very successful combination of these valves for television purposes is shown diagrammatically in Fig. 4. The first valve operates at vision frequency and precedes an ordinary triode-hexode frequency changer. This is followed by two TSE4 valves as intermediate amplifiers. The diode and the video stage, if necessary, complete the receiver. The gain is such that with the usual acceptance band in the intermediate frequency, a receiver of this type will give a fully modulated picture under ordinary receiving conditions. The whole receiver chassis, apart, of course, from the power pack and the time base, need only be about 12 in. by 6 in. by 3 in. A great advantage lies in the fact that as the number of intermediate stages is reduced, so are the coupling transformers, which always add to the expense of the receiver and also the complication of alignment and general adjustment. It may be argued that an increased number of resistances and condensers are used, but, on the other hand, these must be offset against the saving in cost of the additional intermediate transformers, decoupling networks, valve holders, etc., which would be necessary. In the writer's opinion the TSE4 and EE50 are one of the most important contributions to practical television technique yet developed.

Exeter and District Wireless Society

One of the most active societies in the west country, members meet each Monday at 8 p.m. at 3 Dix's Field, Exeter. Amongst recent lectures were the following: a talk by G5 2A on ultra-high frequencies and amateur radio work in general, which included a display of official films loaned by the R.S.G.B. Mr. L. Cornish described the electrical power station at Exeter while Mr. F. Thorn described and demonstrated a number of the latest radio receivers. Mr. C. Searl, M.S.C., of the Physics Department of the University College, Exeter, also spoke on "Pioneers of Radio." He mentioned Maxwell, Professor Pearson, Hertz and Sir Oliver Lodge in addition to such well known pioneers as Marconi and Sir Ambrose Fleming. At the next meeting there will be a demonstration of the Wireless World Straight 6, using 4-watt and 12-watt push-pull amplifiers. These have been constructed and will be demonstrated by F. W. Saunders, G3MU. Full information regarding this society can be obtained from the honorary secretary, W. J. Ching, 9 Civil Place, Heavitree, Exeter.

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

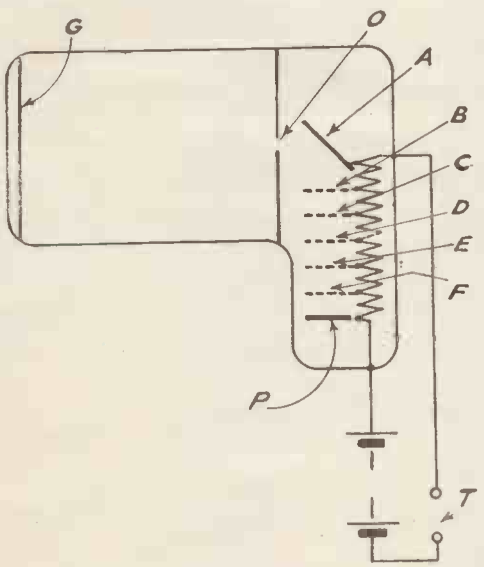
Specially Compiled for this Journal

Patentees: Baird Television Ltd. :: Marconi's Wireless Telegraph Co. Ltd. :: Kolster-Brandes Ltd., and C. N. Smyth :: Baird Television Ltd., and V. A. Jones :: Fernseh Akt.

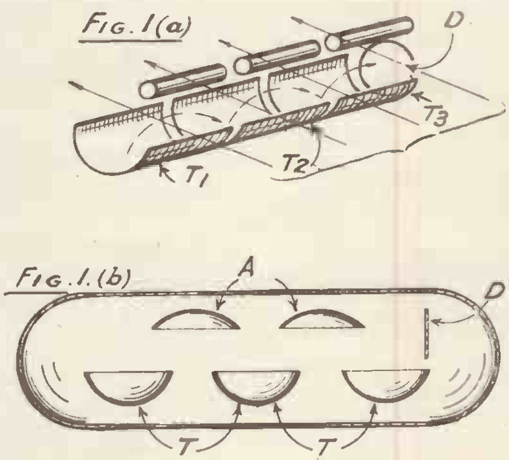
Secondary-emission Amplifiers

(Patent No. 490,230.)

IN the ordinary form of electron multiplier, the electron stream is intended to pass in a zig-zag path between two series of plates which carry progressively-increasing voltages; secondary electrons are emitted by the impact against each electrode and so help to increase the final cur-



Left: Combined television camera and electron multiplier. Patent No. 492,662.



Above: Electron multiplier with limited dispersion. Patent No.493,714

rent. In practice, however, it is found that a certain proportion of the electrons drift into the centre of the tube, and so travel along straight to the output, without making impact with the proper number of plate electrodes. The total amplification obtained is therefore less than it should be.

To prevent this, according to the invention, auxiliary grids are arranged between each of the plate electrodes. The grids are of open mesh-work, so that the electrons can pass through them, and they carry voltages which compel the stream to travel straight from one plate or "target" to the next, so that the full number of secondary electrons are produced and supplied to the final output. The mesh-work grids may also act as emitters and so help to increase the overall amplification.—*Baird Television, Ltd.*

"Target" Electrodes

(Patent No. 491,287.)

In the ordinary type of "target" electrode, as used in an electron-multiplier tube, a high ratio of secondary emission is of the order of nine or ten secondary electrons liberated by each primary electron striking the target.

It has recently been found that this ratio can be increased to an enormous extent by using a target electrode made of a metal plate, coated with a very thin layer of insulating material, over which is deposited an even thinner coating of rubidium or caesium. If the target is first subjected to a preliminary bombardment of electrons, in order to "polarise" it, then in this polarised condition it is capable of liberating as many as 3,000 secondary electrons for each primary electron striking it. In other words it is possible to get as much magnification from one target as has heretofore been possible from a series of targets arranged in cascade. The invention is concerned with a target electrode of this kind in which a borate of one of the alkali earth metals is used to form the thin layer of insulating material.—*Marconi's Wireless Telegraph Co., Ltd.,*

Sound and Vision "Control"

(Patent No. 491,502.)

When televising, say, from a cinema film there are times when a large field of view is presented, and the actors appear on a small scale, whilst at other times a "close-up" is given showing the head and shoulders only of one of the principal characters. But the level of the sound remains practically constant throughout, and so, to some extent, the impression of reality is lost.

The object of the invention is to improve matters in this respect by applying automatic volume control to make the speech from a distant actor seem somewhat "thinner" than that heard during a close-up. The "control" is applied by using an auxiliary photo-electric cell to explore the brightness of a certain part of the scene—selected to be representative of the character of the picture as a whole. The resulting current is then used to regulate a tone control; or it may be added to the radiated signals and used to exercise a corresponding control at the receiving end.—*Kolster-Brandes, Ltd.*, and *C. N. Smyth.*

Television Cameras

(Patent No. 492,662.)

The drawing shows the outline of a television camera combined with an electron multipler. The picture to be televised is projected on to a photo-sensitive cathode C and the liberated electrons are first focused on to the plane of the anode A, and are then swept to and fro past the central aperture O by scanning voltages in the ordinary way.

The electrons representing each picture detail, as they pass through the aperture O, strike against the first of a series of target electrodes A . . . F forming an electron multiplier, the amplified signal current being collected by an output electrode P.

It is desirable to render the whole device inoperative during the so-called "flyback" stroke of the scanning operation, and for this purpose an intermittent negative impulse is applied to the target electrodes through the terminals T at that particular period. This serves to block the output current from the camera during the change-over from one picture-frame to the next.—*Baird Television, Ltd.*, and *V. A. Jones.*

Electron Multipliers

(Patent No. 493,714.)

The feeble electron stream liberated from a photo-sensitive cathode by the action of a ray of light can be amplified by causing the stream to strike against a series of " target " electrodes, which are usually made as plane surfaces. It is found, however, that these tend to cause the amplified beam to " spread " unduly, as it increases in bulk, so that effective control is lost towards the end stages of the tube.

It is accordingly proposed to make the target electrodes concave, cylindrical, spherical or otherwise curved, instead of plane, so as to form the stream into a definite beam, and thereby limit its dispersion.

For instance, as shown in Fig. 1a, the target electrodes T, T1, T2 are cylindrical, and the electrons are made to jump from one to the other under the combined influence of the high biasing-voltage on the accelerating electrodes A, A1, A2, and a transverse magnetic field (indicated by arrows) from an external coil. In Fig. 1B both the targets T and accelerators A are shaped as parts of a sphere. The amplified stream is collected in both cases by the output anode D.—*Fernseh Akt.*

Summary of Other Television Patents

(Patent No. 484,404.)

Superhet in which a single local oscillator is used to heterodyne both the sound and picture signals, these being subsequently separated and fed to different amplifiers.—*W. S. Percival.*

(Patent No. 485,119.)

Metal-coated electrode arranged around the margin of the mosaic screen in a cathode-ray television transmitter for the purpose of producing synchronising signals.—*Radio-Akt D. S. Loewe.*

(Patent No. 485,132.)

Generating the synchronising impulses in an Iconoscope transmitter by means of a biased diode coupled to the deflecting plates.—*Radio-Akt D. S. Loewe.*

(Patent No. 485,622.)

Rotating disc and mirror scanning system designed to give a degree of definition equal to that obtained from a cathode-ray tube.—*S. L. Clothier* and *H. C. Hogencamp.*

(Patent No. 485,959.)

Television transmitter in which modulation is effected through a quarter-wave transmission line acting as an impedance inverter.—*Philco Radio* and *Television Corp.*

(Patent No. 486,048.)

Using infra-red light as a means for viewing scenes or objects obscured by fog.—*Farnsworth Television Inc.*

(Patent No. 490,523.)

Television system in which a number of light-sensitive cells are connected through a commutator arrangement to a bank of neon tubes. —*Sir O. Stoll.*

(Patent No. 490,533.)

Construction of television tube containing a uni-dimensional or " line " electrode of photo-sensitive cells.—*Baird Television, Ltd.*, and *V. A. Jones.*

(*More Summaries on third page of cover*).

"AMERICAN TELEVISION STANDARDS"

(*Continued from page 29*)

of each line there is a pause at black level (termed the " pedestal " in America) before the upward swing of the synchronising pulse.

The sync. pulse is separated from the picture signal by a form of amplitude limiting circuit similar to that used in some British receivers. A pentode with low anode voltage is biased so that current only flows when the signal exceeds the black amplitude. In one design of American receiver the amplitude limiter is preceded by two stages of amplification which are separate from the video amplifier. The line and picture pulses are separated by a form of filter circuit in the anode of the amplitude limiter. The line pulses pass through a " high pass " simple filter, while the frame pulses are caused to act through an " integrating " circuit, although other alternatives are possible.

The arrangement of the sync. pulses at the end of one of the frames is shown in Fig. 5. They are divided into distinct groups as shown by the indications. The first equalising pulse interval follows immediately on the completion of the frame and only differs in the odd and even frames by half a line in timing. In both frames the equalising pulses cease at the same time, so that each frame pulse starts at the same time. The frame synchronising conditions are therefore identical for each frame. After the frame synchronising pulses a second series of equalising pulses is sent and at their termination the line pulses begin. These pulses are spaced by half a line in alternate frames to provide interlacing.

The essential differences between this system of synchronising and the British system is in the provision of separate frame pulses which are the same for each frame. The leading edge of each pulse corresponds to the edge of the normal line pulse and thus ensuures line synchronisation during the framing pulse. The total length of the frame pulses is, however, sufficient to allow them to be separated from the line pulses by the integration method referred to above. After a time, equivalent to three lines, the true line pulses begin.

It is claimed that this method of synchronisation is not so critical in adjustment of circuit for satisfactory interlacing.

TELEVISION TERMS AND DEFINITIONS

OFFICIAL RECOMMENDATIONS

The desirability of television equipment manufacturers and television engineers using a common form of nomenclature has recently been given consideration by the Technical Section of the R.M.A. Television Development Sub-Committee.

It has been decided to recommend that, with a view to securing uniformity of practice and general understa ding, manufacturers of television equipment should, as far as possible—

(*a*) Make use of the technical terms recommended in Sub-sections 108 and 109 of the B.S.I. "Glossary of Terms Used in Electrical Engineering" (No. 205—1936) in their literature and in any instruction classes which they may operate.

(*b*) Apply markings to the various controls on television receiving sets.

Below are the recommended terms for the marking of television receiver controls and also the standard television terms in the B.S.I. "Glossary of Terms Used in Electrical Engineering."

MARKING OF TELEVISION RECEIVER CONTROLS

1. *Contrast Control*:

The control which normally affects the sensitivity of the receiver, when it is a major control situated on the front should be marked "Contrast." When it is located in a position other than the front of the receiver it should be marked "Sensitivity."

2. *Brightness Control*:

The control which affects the general level of illumination of the observed picture should be marked "Brightness."

3. *Focus*:

The control which affects the sharpness of the observed picture should be marked "Focus."

Note.—It should be remembered that the words "focusing" and "focused" should properly be spelt with one "s."

4. *Tuning Control*:

The control which primarily affects the sound tuning is a minor control and should be marked "Tuning." When alternative television transmissions are available it is assumed the tuning would not be continuous throughout the range of the desired frequencies.

5. *Line-hold and Frame-hold*:

The controls which normally alter the line and frame generated frequencies until synchronism is obtained should be termed "Line-hold" and "Frame-hold."

6. *Picture Height*:

The control which normally adjusts the height of the picture to fill the mask depth should be marked "Picture Height."

7. *Picture Width*:

The control which normally adjusts the width of the picture to fill the mask breadth should be marked "Picture Width."

8. *Inverter*:

The control which up to the present has been more generally known as "black spotter" and is for the purpose of reducing interference of the ignition type, should be marked "Inverter."

9. *Line Shift*:

The control which normally positions the picture so that it is centred within the vertical edges of the mask should be marked "Line Shift."

10. *Frame Shift*:

The control which normally positions the picture so that it is centred within the horizontal edges of the mask should be marked "Frame Shift."

11. *Line Linearity*:

The control which corrects the output wave form to bring about uniform velocity of scan in the horizontal direction should be marked "Line Linearity."

12. *Frame Linearity*:

The control which corrects the output wave form to bring about uniform velocity of scan in the vertical direction should be marked "Frame Linearity."

13. *Synchronising Separator*:

The control which sets the synchronising separator network to its optimum working condition should be marked "Synchronising Separator," and prefixed, when required, as "Line and/or Frame."

14. *Astigmatism*:

The control which adjusts the electron optical system to the condition in which the minimum aberration due to astigmatism is produced, should be marked "Astigmatism."

STANDARD TELEVISION TERMS

Extract from B.S.I. 205-1936 : Sub-Sections 108 and 109.

Term.	Definition.
Television.	The art of instantaneously producing at a distance a visible image of an actual or recorded scene by means of an electrical system of communication.
High-definition Television.	A system of television in which the number of scanning lines into which the complete picture is divided is 100 or more.
Low-definition Television.	A system of television in which the number of scanning lines into which the complete picture is divided is less than 100.
Scanning (Exploring).	(a) In a transmitter. The process of analysing the scene or object into picture-elements or elemental areas. (b) In a receiver. The process of building up the image from picture-elements or elemental areas.
Progressive Scanning.	A system of exploration of the scene or image in which contiguous strips of the

scanning-field are traversed in order.

Interlaced Scanning. A system of exploration of the scene or image in which complete scanning is accomplished in two or more operations, the strips of scanning-field successively traversed in the course of one operation not being contiguous. During subsequent operations the lines previously omitted are scanned according to some set rule or order.

Picture-element (Elemental Area). That portion of the scene which determines or is determined by the instantaneous value of the signal current.

Scanning-line (Picture-strip). A sequence of picture-elements extending throughout one dimension of the picture and represented by successive signal values.

Line-frequency (Strip-frequency, deprecated). The number of scanning-lines traversed per second.

Picture-frequency. The number of complete images transmitted per second.

Frame-frequency. The number of scannings of the frame by the scanning-beam per second. In interlaced scanning the frame-frequency is an integral multiple of the picture-frequency.

Synchronism. The operating-condition which obtains when all the elements of the image are reproduced in the same special relationship as the elements in the scene.

Phasing. That process by which the forming of the image is brought point for point into the same space-time relationship as the exploring of the object.

Framing. The process by which that portion of the exploring device upon which the phased image is formed is brought into an allocated relationship with a fixed screen.

Isochronism. The operating-condition which obtains when the reconstruction of the image and the scanning of the object occur at the same rate.

Scanning-field. The area explored by the scanning-apparatus at the sending or receiving ends.

Blocking-oscillator. A type of oscillator in which oscillations are generated by the charging of a capacitor through an impedance followed by the discharging of the capacitor through another impedance, and used in conjunction with an electronic device to produce a scanning-field.

Phase-distortion. That type of distortion produced by inequality of transmission-velocities of the individual frequency-constituents of the electrical output from a vision-frequency generator.

Vision-frequency. The frequency of any single frequency-component of the electric wave produced by a scanning-device.

Vision-frequency Generator. The apparatus at the output of which appear electric currents corresponding to successive scene-elements.

Photo-electric Cell. Ab'n. Photo-cell. A device in which electron-emission is produced by the incidence of light on an electrode, and containing one or more electrodes for the utilisation of these electrons.

Dot-frequency. Half the number of elements transmitted per second.

Aperture. That part of the vision-frequency generator which determines the ratio of the area of an element to that of the scene.

Time-base. Time-scale. The trace of the spot of light on the screen of a cathode-ray tube, which spot of light moves with a predetermined velocity for the purpose of imparting a time-scale.

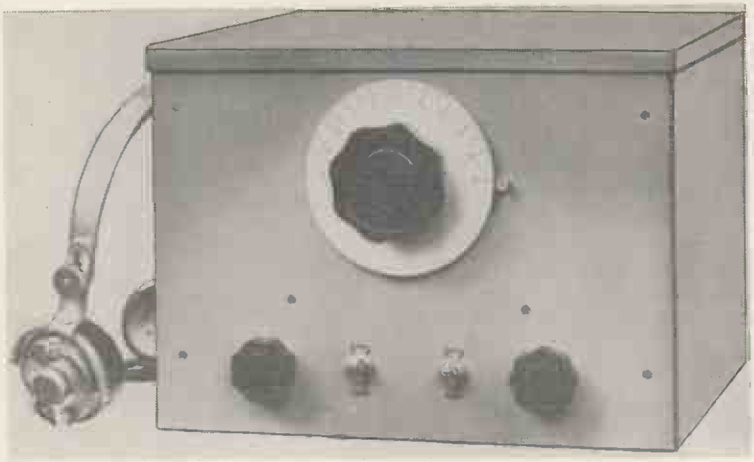
Kerr-cell. A device wherein the optical properties of a medium are modified by an electric field in such a way that when a beam of polarised light is passed through the cell, after optical resolution, the intensity of the emergent light can be controlled by the field.

Faraday-cell. A device wherein a magnetic field causes a rotation of the plane of polarisation of a beam of plane-polarised light.

Electron-lens. A system of electric or magnetic fields having an action upon a beam of electrons analogous to that of an optical lens upon a beam of light.

Time-base Generator.	A device for producing a potential varying in a definite and periodic manner and used to impress on the beam of a cathode-ray tube a time-scale deflection (usually linear with respect to time).
Cathode-ray Tube.	A vessel containing an electrode system arranged to emit electrons and to project them in the form of a well-defined and controllable beam. In general, the beam is incident upon a luminescent screen.
Cathode.	The primary source from which the electrons constituting the beam are emitted.
Directly-heated Cathode.	A cathode heated by a current which passes through the whole or part of it. This type of cathode is commonly known as a filament.
Indirectly-heated Cathode.	A cathode heated by an electrically separate element known as the heater.
Anode. Accelerator.	An electrode normally positive with respect to the cathode whose primary function is the acceleration of the electrons forming the beam.
Grid.	An electrode which does not primarily serve for the acceleration of the beam, but is for the purpose of otherwise controlling the flow of electrons.
Modulator.	A grid or other device to which a varying potential is applied in order to produce a modulating action on the intensity of the beam.
Focusing.	The concentration of the electron beam in order to produce a sharply defined small luminous spot on the screen. Methods of focusing are classified as follows:— (a) Gas Focusing, in which the beam is constricted by its ionising action on traces of gas present in the tube. (b) Magnetic Focusing, in which the electron beam is constricted by means of a magnetic field parallel to the axis of the tube. (c) Electrostatic Focusing, in which the beam is caused to converge by the action of electrostatic fields between two or more electrodes through which it passes.
Focusing Electrodes.	Anodes or accelerators or other electrodes to which a potential is applied in order to produce the focusing action on the beam.
Deflector Plates.	Those electrodes the primary function of which is to change the position of incidence of the beam on the screen. The deflector plates are distinguished by the letters X_1 and X_2, Y_1 and Y_2.
Screen. Fluorescent Screen, deprecated.	A specially prepared surface which becomes luminescent under the stimulus of the electron beam at the point of impact.
Afterglow. Persistence, deprecated.	The persistence of screen luminosity after the stimulus has been reduced or removed.
Colour.	The predominating colour of the luminous radiation from the screen under the electron impact.
Screen Luminous-Efficiency.	A measure of the ability of the screen to convert the beam energy into luminous radiation.
Screen Characteristics.	The relation between the brightness of the screen, beam current, and beam velocity expressed in volts at the final anode or accelerator.
Beam Current.	The electron current of the beam arriving at the screen.
Beam Current Characteristics.	The relation between the beam current and the potentials applied to the electrodes.
Brightness Characteristics.	The relation between the brightness of the screen and the potentials applied to the electrodes.
Sensitivity (Electric).	The displacement of the spot on the screen produced by the application of unit potential difference between the deflector plates. The electric sensitivity is usually expressed in terms of millimetres (on the screen) per volt (between plates).
Sensitivity (Magnetic).	The displacement of the spot on the screen produced by the application of unit magnetic field, perpendicular to the axis of the beam, and acting on unit length of the beam. The magnetic sensitivity is usually expressed in terms of millimetres (on the screen) per ampere (through the deflecting coil).

We take great pleasure in describing a simple ultra-high frequency receiver using acorn valves which should be of particular interest to those engaged in long distance 5-metre reception but are not prepared to construct a multi-valve superheterodyne. The main feature of this receiver is the extremely simple quench circuit employed and the ease in which the circuit quenches.



A 4-valve A.C. Operated U.H.F. Receiver

IT is possible to cover amazingly long distances with a supergenerative type of receiver provided some of the little troubles associated with this type of set are ironed out.

The supergenerative receiver is still without question the most popular 5 metre receiver, for very few amateurs are prepared or can afford to go to the expense of a multi-valve superhet. A supergenerative receiver even when fitted with acorn valves is not an expensive as a superhet if American type acorns are employed.

I have been experimenting with a three valve supergenerative receiver for quite a time and have found that it will give a very good account of itself provided the quench noise is of a low order that will vanish with a weak signal input and an R.F. stage is used that does give some indication of gain.

The Circuit

The circuit of the receiver in its final form is shown on this page and so far it has proved to be extremely satisfactory. Far more so than was at first thought possible.

On test without any aerial connected to the receiver, a simple transceiver using approximately 2 watts at a distance of three miles completely kills every vestige of quench noise, while signals at a distance of 35 miles have been put on the loudspeaker at good volume. There is also quite a good stage gain without the R.F. amplifier, but it is noticed that when a signal is struggling hard to beat the quench noise, the introduction of the R.F. stage generally kills the noise altogether.

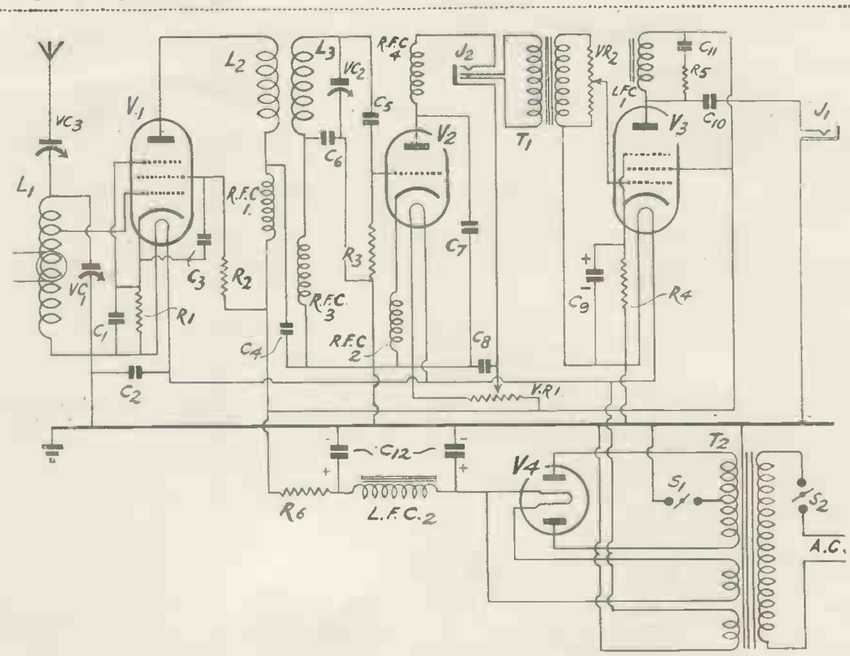
The receiver as it is now in use, is entirely hum free, has a gain control generally in use, and is fitted with a regeneration control which is extremely docile to handle. The two circuits, L3 and L1, can be ganged quite easily and remain ganged over the limits of VC1 and VC2. The high pitched whistle usually noticeable with this type of receiver is completely absent, while the circuit arrangement is simplicity itself and should not cause any trouble to constructors. It is infinitely superior to the ordinary quench circuit and under actual measurement has proved to quench with a much lower input than with the normal set having a separate quench valve.

Tuned Transformer

Consider the circuit of the receiver. V1 is one of the 954 type acorn pentodes operating in a tuned transformer circuit. The control grid is also tapped down the coil approximately 1½ turns and this provides quite a high degree of selectivity without radically reducing stage gain.

In order to obtain maximum amplification, a slight bias is essential and this is obtained automatically by means of R1 which has a value of 1,500 ohms.

Anode voltage is not critical and is taken directly from the main H.T. sup-



The receiver as can be seen from this circuit is complete, including power-unit and embodies a stand-by switch.

2.5 to 8 Metres

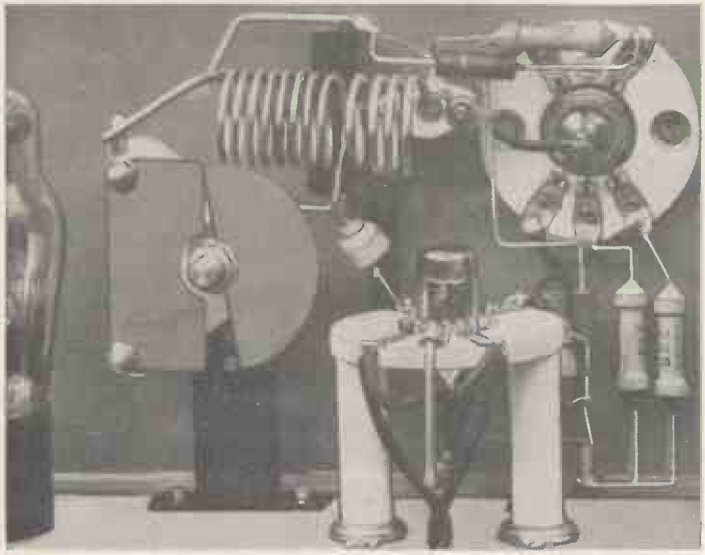
ply source via R6, a resistance of 3,000 ohms. There is also no need for a screen potential divider provided R2 has a value of 100,000 ohms.

The R.F. stage will be completely unstable unless adequate by-passing is included. Condensers, C3 is most important should have a value of .0002 mfd. and be taken to cathode and not to chassis. Across R1 is the normal cathode shunt condenser having a value of .0002, while the heater is shunted also with a .0002 mfd. condenser.

Next comes the R.F. transformer. Several circuits were tried, but none compared with the tuned transformer arrangement which gave a very much higher stage gain. Coil L3 is rather critical as regards inductance, but L2 was surprisingly docile and great difficulty was experienced in determining the best value for this coil.

The Detector Circuit

Next comes the self-quenching detector, which is probably the simplest type of circuit imaginable. It consists of a straightforward grid coil, but has an R.F. choke in series with the cathode. There is also an R.F. choke in series with the grid coil and a third choke in the anode circuit. Condenser C7 is very important and if this is any value other than .001 mfd. results cannot be guaranteed. The choke, RFC3, is not important and on strong signals can be omitted altogether, but it was found on several occasions that the receiver was quieter on very weak signals with this choke included.



When building, take particular notice of how the components are wired and make quite sure that the construction is duplicated.

The remainder of the circuit is quite straightforward. Anode voltage for the detector is obtained by means of the potentiometer VR1 which has a value of 100,000 ohms. It is, however, essential that this potentiometer be of the wire-wound type. A jack has been included in the anode circuit of T1 in order that a pair of headphones can be included immediately after the detector. For local working, there is ample signal strength at this point.

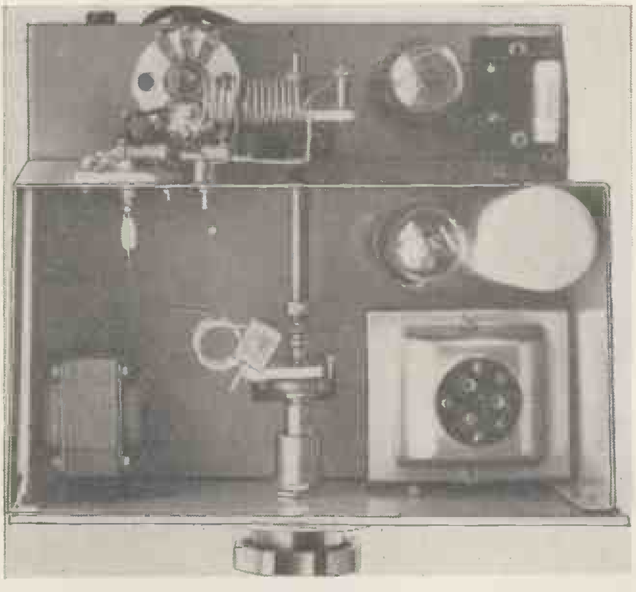
Transformer coupling is used between V2 and V3 and a volume control to limit the audio gain is very necessary on most signals. The output valve is the very popular 6F6 pentode, and it is no exaggeration to say that signals, admittedly good ones, will provide an output of over 1 watt at 25 miles, but this must not be taken too literally for so much depends on the transmitter and location at both ends.

Construction

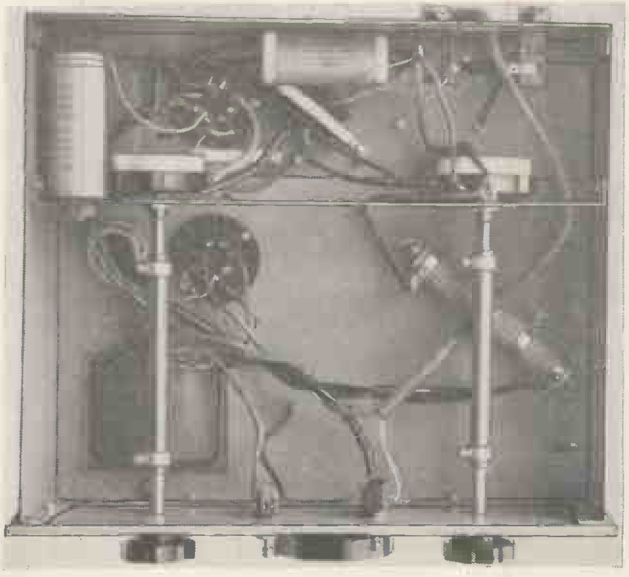
Far more attention should be paid to the construction of this receiver than to the technical details and, if it is built strictly to specification, the receiver will be as docile to handle as the average amateur band set.

First of all the cabinet is of steel, with a special panel of aluminium, ⅛ in. thick. The panel is anchored to the chassis by means of the screen and side supports, so that it is absolutely impossible for any movement to take place. The screen is also anchored on five sides for it must be realised that the acorn F.R. valve is actually mounted on the screen and any movement would be disastrous.

The tuning condenser has to be very



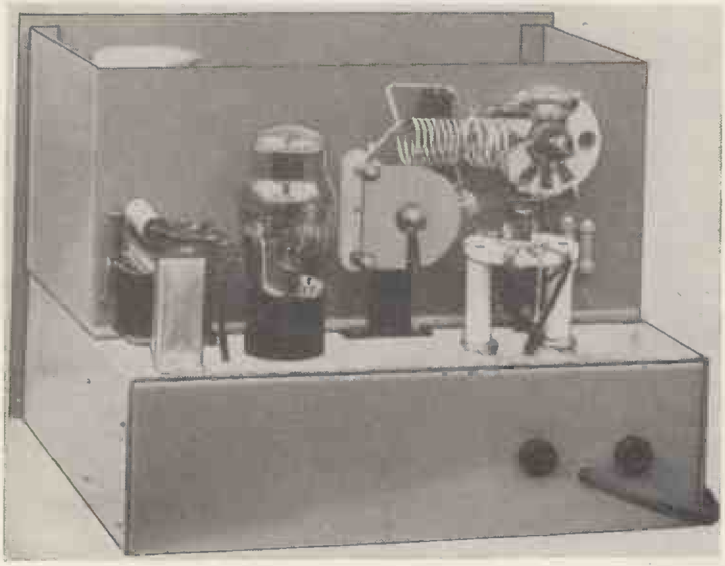
This plan view shows the power-unit and the layout of the H.F. and detector stages.



Most of the audio components are in the separate compartment at the rear of the chassis.

Coil Construction

carefully mounted and lined up for if it is slightly out of true, will cause a very slight movement of the screen despite the fact that this is so well anchored.



This illustration shows the detector and audio section and the two jacks, one for loudspeaker and one for headphones.

Power Unit

The aerial coil, L_1, is actually mounted on to the tuning condenser VC_1, with the series aerial condenser VC_3 tapped directly on to one end. This can clearly be seen from the illustration. While on the R.F. amplifier, it will be noticed that the entire power unit is mounted in this section. In this way, there is practically no hum pick-up which would hardly be possible if the power unit were in the audio side. From the plan view, the mains transformer can be seen in the right-hand corner, the smoothing choke in the left-hand corner, with the valve and two-section smoothing condenser behind the mains transformer.

The balance of the R.F. circuit and the whole of the detector circuit should next be considered. A close up view of this has been taken so that constructors will not have any difficulty in following very closely the original layout.

The R.F. valve is mounted in its ceramic holder on the screen so that the grid protrudes into the R.F. section and is connected by means of a thin flexible wire to a tapping point on the coil, L_1. The detector valve which, of course, is a triode, having its five connections brought out to individual pins, is mounted in a holder on two stand-off insulators. The grid coil has one side directly to VC_2, with the other side to a small fixed condenser which is, in turn, connected to VC_2. It will be noticed that the grid tuning condenser is not earthed and is mounted on its own insulated adjustable holder. The anode coil, is supported on a miniature stand-off insulator mounted the wrong way round so that what should normally be the fixing holes are fitted with two small 6 BA bolts on to which are soldered L_2. In this way, the coil is absolutely rigid.

All earth returns are made to a common point as can clearly be seen from the close up view. Unfortunately, the cathode choke does not show very well in the photograph, but the section of 14-gauge wire from the cathode to the end of the choke, is clearly shown. Actually, the cathode choke is parallel with the baseboard underneath the valve holder.

The various resistors and condensers in the R.F. stage all come from contacts on the acorn valve holder as can be seen. The condenser C_2 which is connected across the heater winding is also rather difficult to see, but in the plan view it can be noticed between the grid coil and the screen. It is, however, connected from the heater terminal on V_1 to chassis.

In the close up view stands out very clearly C_5, which is a miniature ceramic condenser having a capacity of 100 mfd. All these connections in this circuit must be very rigid and where conveniently possible wired with heavy gauge wire.

Unfortunately, the anode lead cannot be made rigid owing to the fact that the anode connection is extremely fragile and if any pressure is put on this connection, there is every possibility of it cracking. However, the anode lead should be made as short as possible.

While ultra-high frequency con-

(*Continued on page* 60).

Components for A 4-VALVE A.C. OPERATED U.H.F. RECEIVER.

CABINET.
1 Special steel finished grey 11 × 9¼ × 8 ins. (Peto-Scott).

CHASSIS AND PANEL.
1 Chassis 10 × 9 × 3 ins. finished grey (Peto-Scott).
1 Screen 9¾ × 5½ × 4¾ ins. finished grey (Peto-Scott).
1 Screen 9⅝ × 2½ × ½ ins. finished grey (Peto-Scott).

COILS.
1 set to specification home-built.

CONDENSERS, FIXED.
1—.0002-mfd. type CTS 620 10% tolerance (C1) (Dubilier).
1—.0002-mfd. type CTS 620 10% tolerance (C2) (Dubilier).
1—.0002-mfd. type CTS 620 10% tolerance (C3) (Dubilier).
1—.006-mfd. type 691W (C4) (Dubilier).
1—.0001-mfd. type CCS 10% tolerance (C5) (Dubilier).
1—.0002-mfd. type CTS 620 10% tolerance (C6) (Dubilier).
1—.001-mfd. type 4601/S (C7) (Dubilier).
1—.5-mfd. type 4608/S (C8) (Dubilier).
1—8-mfd. type 402 150 v. (C9) (Dubilier).
1—1-mfd. type 460/S (C10) (Dubilier).
1—.01-mfd. type 4700 (C11) (Dubilier).
1—8-mfd. type 32840 (C12) (Dubilier).

CONDENSERS, VARIABLE.
1—15-mmfd. type VC15X (VC1) (Raymart).
1—15-mmfd. type VC15X (VC2) (Raymart).
1—5/20-mmfd. type 340120 (VC3) (Dubilier).

CHOKES, LOW FREQUENCY.
1jType LF14S (LFC1) (Bulgin).
1 Type LF14S (LFC2) (Bulgin).

CHOKES, HIGH FREQUENCY.
1 Type 1011 (RFC1) (Eddystone).
1 Home-built to specification (RFC2).
1 Type 1011 (RFC3) (Eddystone).
1 Type 1011 (RFC4) (Eddystone).

DIAL.
1 Type 1085 (Eddystone).

HOLDERS, VALVE.
2 Ceramic acorn American fitting (Clix).
2 Chassis type octal 8-pin fitting (Clix).

JACKS.
2 Closed circuit insulated jacks (Premier Supply Stores).

KNOBS.
2 Type 1089 (Eddystone).

PLUGS.
2 Plugs type P15 (Bulgin).

RESISTANCES, FIXED.
1—1,500 ohm ½ watt (R1) (Erie).
1—100,000 ohm 1 watt (R2) (Erie).
1—1 megohm type ½ watt (R3) (Erie).
1—400 ohm type 1 watt (R4) (Erie).
1—20,000 ohm type 1 watt (R5) (Erie).
1—3,000 ohm type PR8 (R6) (Bulgin).

RESISTANCES, VARIABLE.
1—100,000 ohm type potentiometer (VR1) (Reliance).
1—500,000 ohm type potentiometer (VR2) (Reliance).

SUNDRIES.
¼ lb. 16 gauge tinned copper wire (Peto-Scott).
2—Adjustable type 1007 (Eddystone).
3—Extension control outfits type 1008 (Eddystone)
1—Stand-off insulator type 1019 (Eddystone).
2—Insulating pillars type 1029 (Eddystone).
1—Plug adaptor type 29 (Clix).

SWITCHES.
2—Toggle type S80T (Bulgin).

TRANSFORMER, INTER-VALVE.
1—Inter-valve type LF37 (Bulgin).

TRANSFORMER, MAINS.
1—Type, octal (T2), giving: 320-0-320 volts 80 m/A., 6.3 volts 1 amp., 5 volts 3 amp. (Peto-Scott).

VALVES.
1—Type 954 acorn (V1) (Webbs Radio).
1—Type 955 acorn (V2) (Webbs Radio).
1—Type 6F6G (V3) (Premier Supply Stores).
1—Type U50 (V4) (Osram).

Microphones and Pick-ups for Sound

This data is of value to sound engineers and those interested in sound reproduction in all its phases. We are indebted to Robert S. Nash, of the Nash Co., St. Louis, and "Radio Retailing" for the information.

EQUALLY keeping pace with sound advances have been the microphone and pick-up innovations—an extensive variety of microphones and record reproducers offered to-day to adequately handle any conceivable pick-up requirement. High fidelity, heretofore available only at a prohibitive price, is within the reach of the smallest and limited sound equipment budget as to microphone and pick-up accessories.

The complexity of selecting the proper microphone for each installation has been the main difficulty of every sound engineer at one time or another. Two identical installations of equal physical dimensions will require different microphone characteristics due to inherent acoustical conditions.

As the average public address engineer does not possess expensive measuring devices to determine the exact placement in public address installations, the sound engineer to a certain extent must depend upon the trial and error method of selecting microphone equipment.

Whether in a church, or a school, the microphone equipment is usually suited only for the purpose for which it is to be utilised. In a church pulpit, for example, it is presumed that little besides straight talking will be done, whereas in a school, singing is combined with announcement work, as well as dramatic acting which will make necessary a microphone type different and probably not suited at all for the church installation.

Types of Microphones

Present-day microphones are divided into the following basic types:

(1) *Velocity or Ribbon Type.*—These are well suited for pick-up purposes from a distance three or four feet or more away from the microphone. For musical reproduction and singing, especially by artists in stage plays and vocalists with an orchestra, the velocity microphone is excellent.

(2) *Crystal* (Sound cell and diaphragm types).—Because of the high output, compactness and ruggedness of construction, these microphones are popular with P.A. engineers and sound equipment manufacturers alike. Due to the high impedance output, line transformers are not required over long distances, eliminating possible pick-up of hum through the transformer into the first stages of the amplifier.

A response from 60 to 7,500 cycles, as far as music and voice are concerned is more than adequate for average P.A. Lower frequencies are not necessary when voice is used exclusively and when eliminated by the use of a crystal microphone, reduce the boominess of the installation.

The crystal diaphragm type is most commonly used because of its high output, compared to output of the sound cell type.

(3) *Dynamic Type.*—Used extensively in broadcasting, especially remote work, since 1931. This type is one of the best all-round types available for pick-up work. Many models do not show any appreciable signs of being affected by temperature, wind or atmospheric conditions. Close talking, necessary in the majority of cases, does not cause boominess.

The three types mentioned have the different models such as lapel semi-directional models, spherical and other different mechanical forms, all using the basic idea mentioned.

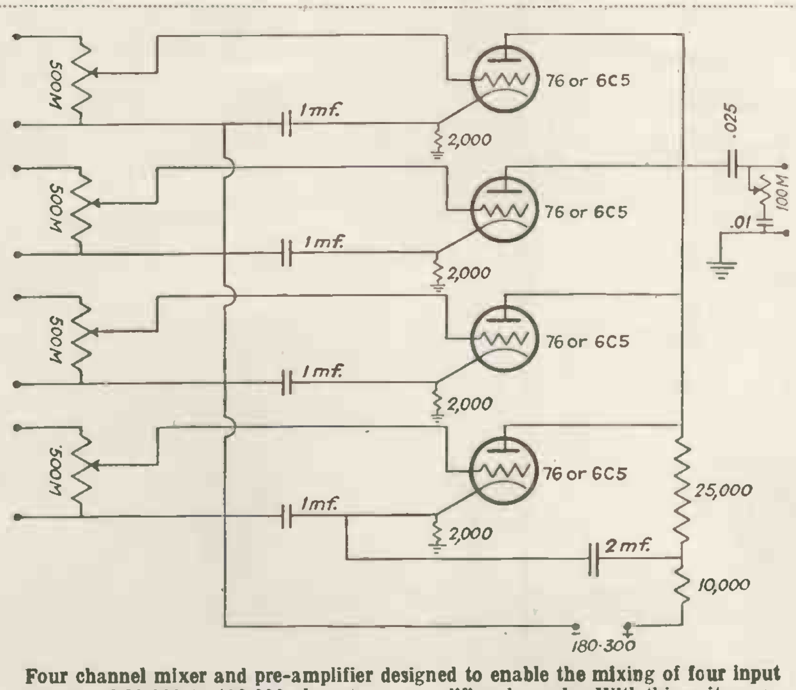
The condenser microphone, with its necessary associated pre-amplifier, and carbon-button microphones with its power supply have been generally supplanted. The latter type, however, useful where a relatively low-gain amplifier must be used, has recently been appreciably improved.

Lapel microphones are not generally used in outdoor public address or in large halls when more than one person uses the same mike, due to the possibility of breakage of the wires by the speaker's feet. Two mikes offer a good solution to this problem, placed on either side of the speaker on the stand, one picking up his utterances on either side and also acting as an emergency precaution in the event of one mike going dead in the midst of the proceedings.

Microphones for general announcement work may well include a crystal mike for rental use and, where possible, in a permanent installation, a ribbon velocity microphone. For music and singing a ribbon microphone would be desirable. A dynamic microphone is suitable in any case. Carbon microphones are suitable for aircraft.

More and more amateur type microphones are being used by sound engineers because of their excellent characteristics for voice transmission. However, their use for music, especially orchestra pieces, is questionable due to their sharp cut-off characteristics.

A 100,000-ohm input in the amplifier for microphones will capably handle any microphone requirement even if the microphone output is only 75,000



Four channel mixer and pre-amplifier designed to enable the mixing of four input sources of 80,000 to 100,000 ohms to one amplifier channel. With this unit, combinations of four microphones may be added to each microphone input channel.

An Effective Scratch Filter

ohms. The use of a high-impedance input eliminates the cost and inconvenience of matching transformers which are necessary for a 200- or 500-ohm microphone.

Feedback must be overcome solely by the placement of speakers, as the microphone must in any case be put in a certain position, and the speakers installed where feedback is least obvious. Heavy drapes or celotex in the back of the microphone will reduce feedback.

Recording and Pick-ups

Reproduction of records is to-day becoming a big rental industry. As one person or organisation can hardly keep all the new song hits in current favour, due to the high cost, sound engineers can furnish this service even if the client has a permanent installation. The rapidity with which recordings have been made successfully to recreate the original sound is giving "canned music" universal acceptance. One large factor leading to its acceptance by the public has been the avalanche of automatic gramophones of the coin-operated variety in restaurants, etc.

As the sound engineer with recordings available to-day can place at the disposal of the rental installation the leading orchestras at a mere fraction of what a mediocre orchestra would cost, the rental possibilities are great.

Before purchasing any pick-up the following essentials should carefully be noted:

Needle pressure of three ounces maximum is suggested.

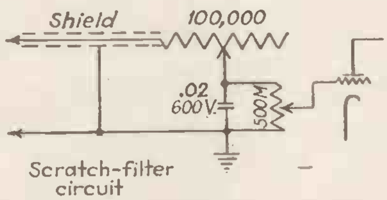
Arm design free to travel with ease and not binding in any position. The arm should also be free from vibration.

Two distinct types of pick-ups, crystal and magnetic, are available for reproducing work; both of which have their adherents. Crystal pick-ups to-day are enjoying a large acceptance by the sound industry because of their remarkable high fidelity reproduction and high output. One manufacturer is about to release a pick-up employing both principles.

The magnetic pick, first electric pick invented, is still apparently preferred in the broadcasting industry and also by numerous sound engineers. The selection in any case may be a personal preference because both type pick-ups have their advantages and disadvantages.

Some of the new pick-up models offer a tangent or offset head which eliminates record wear to a certain extent by virtue of the fact that the tangency of the pick-up to the record is more equal to that in recording than possible with the straight arm pick-up. To accomplish this in a straight arm pick-up would render necessary an infinite arm. These new improvements give better reproduction and lower surface noise.

Selection of needles as recommended by the manufacturers include half-tone steel needles with the preference on shadowgraphed needles. The shadowgraphed needle is scientifically tested and individually inspected by placing in front of a lens and the light from behind reproducing the needle point magnified several hundred times. The purpose of this test by the manufacturer is to assure a perfectly round point as illustrated. Cheap needles do not seat in the record groove perfectly but scrape on the groove as shown. It is good practice to change most needles after each record even with the added inconvenience, assuring perfect reproduction of each record.



Scratch filter. A novel circuit offering advantages over the conventional design. By use of this filter circuit record scratch is attenuated without any modification on the part of the amplifier.

Circuit Accessories

The installation of the scratch filter shown in the illustration will materially remove much of the scratch from recordings without cutting down the high fidelity response of the system.

The decibel (db.) table of sound loss and gain is the standard unit of measurement. Zero level in a system is referred to as .006 watt. By the use of this table, knowing the gain of the amplifier as stated by the manufacture, it is a simple matter to determine just which microphone or phonograph pick-up will render full excitation and output from the amplifier.

For example:

Overall gain, 130 db.

Power output, 60 watts, or 40 db.

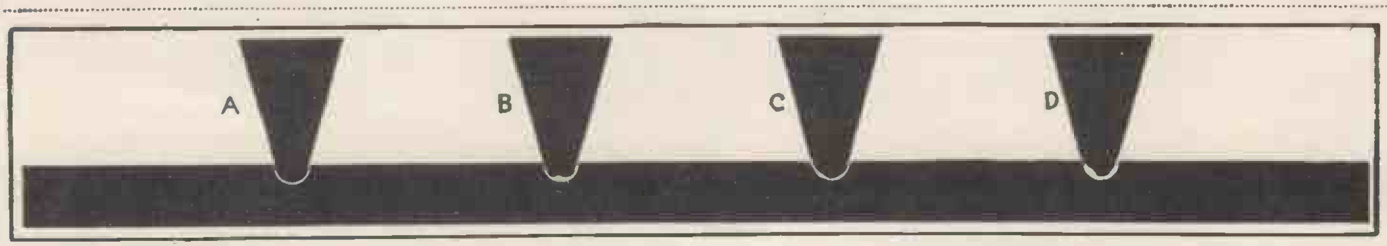
Full output will be made with a microphone of 90 db.

(Subtraction of power output from gain to give needed decibel ratio of microphone or gramophone).

As the majority of microphones range from −65 db. to −42 db., they are well suited for this purpose.

Decibels—Watts Conversion Chart.

DB.	Watts	DB.	Watts
—20	0.00006	13	0.1187
—19	0.00007	14	0.1518
—18	0.00009	15	0.1898
—17	0.00011	16	0.2372
—16	0.00015	17	0.3037
—14	0.00023	18	0.3795
—13	0.00030	19	0.4744
—12	0.00039	20	0.600
—11	0.00047	21	0.759
—10	0.0006	22	0.948
— 9	0.00076	23	1.185
— 8	0.00095	24	1.518
— 7	0.00119	26	2.371
— 6	0.00152	27	3.036
— 5	0.00190	28	3.795
— 4	0.00237	29	4.743
— 3	0.00303	30	6.000
— 2	0.00397	31	7.590
— 1	0.00474	32	9.487
0	0.006	33	11.859
1	0.0076	34	15.180
2	0.0095	35	18.975
3	0.0119	36	23.718
4	0.0153	37	30.360
6	0.0237	38	37.950
7	0.305	39	47.43
8	0.0380	40	60.00
9	0.0474	41	75.90
10	0.060	42	94.87
11	0.0759	43	118.59
12	0.0948	44	151.8



PERFECT AND FAULTY NEEDLES—(A) shows a perfect shadowgraphed needle, while (B, C and D) show imperfect needles and their effect on record grooves (microscopic line drawing).

With the Amateurs

It appears that long distance transmissions can be consistently carried out with low power on 10 metres, and results on these lines are given in this article.

A FEW British amateurs have discovered that the 10 metre band, at the present time, is capable of providing a large number of unusual DX contracts if suitable equipment, particularly with regard to the aerial, is used.

Low-power Tests

Power is not of primary importance as has been proved by G8MX, who never uses more than 25 watts, and telephony at that. Just recently G8MX has made a large number of contacts on 10 metres and with such ease that he has been experimenting with an extremely low power.

His first QSO with reduced input was made on November 28, 1938, when the American station W8ETJ was raised on phone with an input of just under 2 watts. The whole QSO was carried out at this extremely low input and a report obtained of QSA5 and R8. On November 24, 1938, a report was obtained from W8DST with even lower power. He was first contacted with a normal input of just under 25 watts, and as conditions were particularly favourable power was rapidly reduced and some tests carried out.

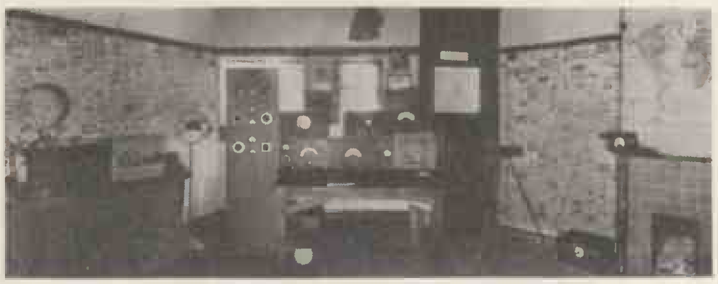
As inputs of 1-2 watts provided a signal that could easily be read in America, the final H.T was reduced to 12 volts with an anode current of 4 mA. The input to the final was then approximately 1/20th of a watt! A transmission was made giving these details of input to W8DST who came back and repeated practically all the conversation and gave a report of QSA4 at R4.

The method of reducing input it as follows. The anode voltage is obtained from a 12 volt H.T. battery. The fixed grid bias on the primary stage is removed and grid leak bias used. Grid drive is reduced to about 1 mA., the modulator gain control practically reduced to zero, after which it is necessary to speak very quietly in order to maintain a very steady P.A. anode current.

Meter Reading

In case it is thought that over modulation may account for the exceptionally fine results, it should be appreciated that the R4 report is obtained by a meter reading, and if anything the modulation with low power is lower in percentage than normally obtained probably owing to mis-match as the modulation transformer should work into a 10,000 ohm load.

G8MX is using an extended Zepp aerial with a closed space reflector, with certain modifications, and arrangements have been made for details of the aerial to be published in the next issue.



This is the new station of G5ZJ, which has been completely rebuilt during the last six months.

G's Heard in W

While on the subject of 10 metres, the following list of stations has been received from W8BST, via G8MX. The star British station heard in America on 10 metres is GM6RG, but in addition there are several others who put an extremely strong and consistent signal at least into W8. Some of the stations which are particularly outstanding in this are:

G8DM
G5KJ
G6BW
G5BM
EI9J
G8MX

There are also quite a considerable number of other British amateurs well heard by W8BST and amongst these are: G8TD, G6WT, G6WY, G2IS, G8SA, G2VG, G5OL, G5PP, G6DH, G8IA, G6LK, and GM8RJ.

Reports Please

On December 3 last, G8MX reports that there was a complete absence of 10 metre signals at his QRA and it would be appreciated if any other amateurs could confirm this report.

At the present time, 10 metres are consistently being received from 12.30 G.M.T. to 19.00 G.M.T. but consist mainly of W and VE stations.

G5ZJ

My own station has been out of action since last May owing to a complete rebuild of transmitters and receivers. The new equipment is now completed and first tests will be made in a few days time on 10, 20 and 160 metres. The equipment can be seen in the illustration on this page, which from left to right is oscillscope, speech equipment, 10 and 20-metre transmitter, 5 and 10-metre receiver, normal amateur band receiver, R. meter, local working 5-metre transceiver and the exciter.

The oscilloscope uses a 10-in. tube and is used for modulation percentage and quality checks, while the transmitter has in the final stage a pair of Eimac 100TH's. These are driven by a T40 which can be used on 40 metres as a power amplifier.

The 160-metre transmitter is made up of a 6L6 and an 801 while the 5-metre transmitter is crystal controlled having 35T in the final stage. One of the amateur model Tobe tuners is the main part of the receiver, covering amateurs' bands from 20 to 160 metres, but the first detector is preceded by three R.F. stages, one of which is regenerative.

A special ultra-short wave receiver using 9 valves covers 20 to 70 megacycles while there is also a convertor with one R.F. stage covering 27 to 75 megacycles which can be used with the ordinary short-wave receiver if required. In addition, a super-regenerative acorn valve receiver is available for reception of non-crystal controlled

F8VC has now worked 28 zones and 61 countries on telephony, with an RK20 in the final stage.

A 2-stage 25-watt Transmitter

This simple transmitter for the amateur was designed by the Standard Transformer Corporation of America who have made arrangements for the necessary transformers to be obtained in this country.

A TRANSMITTER sui able for the amateur licensed for 10 or 25 watts input can be constructed simply with modern valves and need not consist of more than two stages.

The immediate choice for the crystal oscillator is the very popular 6L6 tetrode which when operated under optimum conditions will provide 10 to 15 watts R.F. output on its own. This is more than sufficient R.F. to drive any of the popular low-power triodes such as the 10, 801 or T20. The transmitter to be described uses such a 6L6 while any of the three output valves mentioned are suitable and almost inter-changeable.

This transmitter has been designed for the beginner who needs an efficient rig on the 160, 80 or 40 metre amateur bands. It will operate quite effectively down to 10 watts while there is no trace of overload at 25 watts input.

The C.O.

First of all the crystal oscillator which is straightforward except that the anode circuit is the parallel feed arrangement so that the tuning condenser has one side at earth potential. With this arrangement it is most important that the choke in the anode circuit be a good one, for on this choke largely depends the efficiency of the C.O. stage.

In order to obtain maximum R.F. output from the 6L6 the anode and screen voltages must have definite values. With the power supply recommended and the appropriate resistance network these voltages are accurately taken care of so it is essential not to make any variation in resistance values. These remarks also apply to grid resistor R5, although for a different reason. This grid resistor supplies a certain amount of bias to the 6L6, and the value chosen 50,000 ohms, enables the valve to oscillate very freely and to start up quickly if the C.O. stage is keyed.

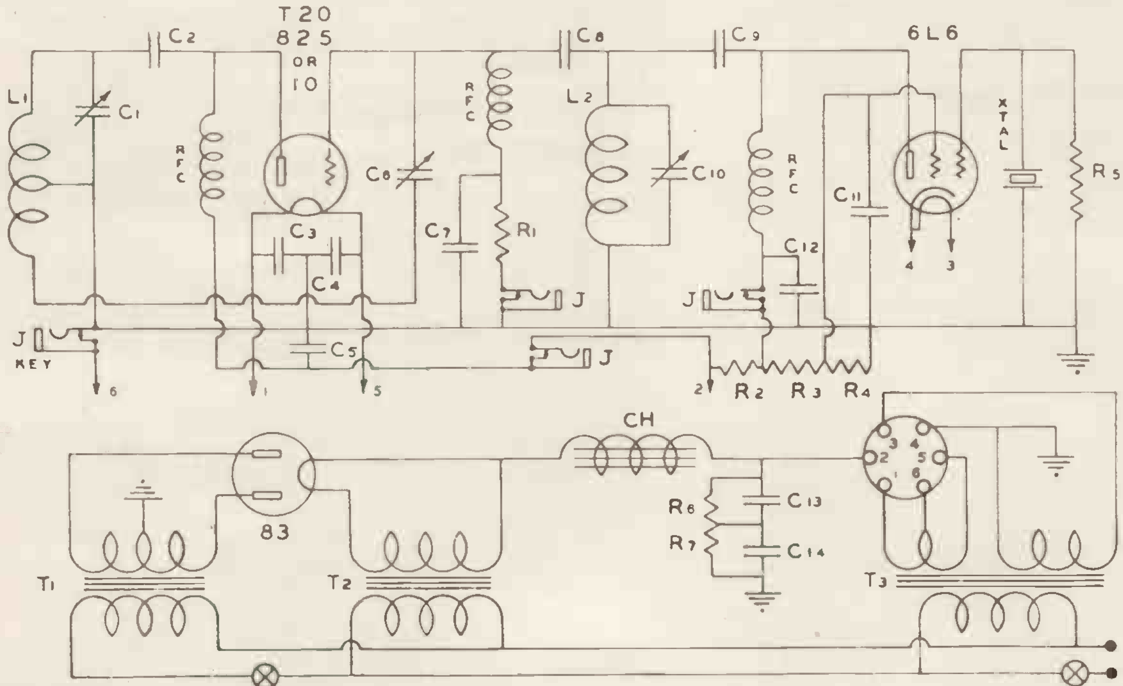
Also notice that there are more than the usual number of fixed condensers in the C.O. stage. There is, for example, C12 which by-passes the anode choke and C9, the .0005 blocking condenser.

Anode coil L2, is wound on a standard 4-pin plug-in former, as can be seen from the illustration. Provided C8 has a capacity of 50 mmfd. the 6L6 is virtualy isolated from the final stage and it will be noticed that when the final is correctly neutralised there is complete absence of pull between stages.

Before describing the P.A. stage, there is still one more point regarding the oscillator. The resistance network made up of R2, R3, and R4, can either be three separate resistors as specified, or one tapped potentiometer having a resistance equal to the total of the three resistors.

This potential divider slightly reduces the main H.T. voltage to the anode of the 6L6 and also provides the optimum screen voltage. Each resistor has a rating of 8 watts.

Next comes the power amplifier. The only differences between the types 10, 801 and T20 is inter-electrode capacity and anode connection. The T20 has a very low capacity with the anode to the top cap. The 801 is similar to the 10 except that it has a top cap connection and a slightly lower capacity than the 10. For 10 watts input it is recommended that amateurs use the type 10, and for higher inputs the 801 or the



This is the complete circuit of the transmitter and its power-unit. The two units are inter-connected by means of a 6-way plug and cable.

Coil Winding Data

T20. British valves such as the Ediswan ESW20 can also be used without alteration, while the Mullard TZ08-20 can be embodied provided an English 4-pin base is included.

The grid circuit of the output stage is untuned and there is merely a choke and resistor in the grid circuit, the resistor being by-passed by C7.

As with the crystal oscillator the anode circuit is parallel fed, so that C1 has the moving plates at earth potential. This scheme is open to criticism as so much depends on the efficiency of the R.F. choke but as previously explained the transmitter is not designed for the higher-frequency bands, so that the problem of obtaining a good choke is not a difficult one. Constructors will find that the Eddystone chokes specified are excellent in this transmitter and enable a very high degree of efficiency to be obtained.

The neutralising condenser, C6, has a maximum capacity of approximately 8 mmfd. for the T20 or 801 type of valve, but for the type 10, it should have a capacity of up to 15 mmfd.

Both these stages are mounted on the top chassis, while the complete power pack is on the second chassis. While at this point it should be noticed that mA. meter has been specified, this is rather a matter of personal taste. Closed circuit jacks have been included in grid and anode circuits so that one meter can be plugged in to read the various currents. If a spare meter is available then it can be mounted on the top panel with a flexible lead terminated in a plug, otherwise, any external meter can be used.

As regards the power unit, this is made up of three transformers of which T3 has a double secondary. T1 provides high tension voltage for the entire transmitter and should provide at least 500-0-500 volts at 120 mA. or 750-0-750 volts at 150 mA. for maximum input.

This illustration shows the construction of the completed transmitter, with the power-unit on the bottom deck.

T2 is a filament transformer for the 83 rectifier and has a secondary providing 5 volts at 3 amperes. The third transformer provides filament voltage to the 6L6 and filament voltage for the final valve. As the transformers are separately switched, primary keying can be used if required, otherwise, any of the meter jacks can be used.

The voltage regulation is excellent for there is choke input with a choke having an extremely low resistance. In order to reduce cost the condensers C13 and C14 are of the electrolytic type suitable for 500 volt working. These have a capacity of 8 mfds. each so providing an effective capacity of 4 mfds. as they are wired in series. In this way, the working voltage is doubled. In order that the leakage current of the two condensers be equal they are shunted with fixed resistors having a value of 500,000 ohms each.

As with the crystal oscillator circuit, the tank coil in the final stage is of the plug type for only three contacts are necessary. The link winding to the aerial coil is actually wound around the outside of the coil and is made of a single turn of rubber covered wire.

Next comes coil construction, and the following data will be accurate provided condensers C1 and C10 are of the specified value. The difference in valve capacity in the final stage is not sufficient for it not to be taken up by the tuning condensers.

First of all the 160-metre band. This needs 78 turns of 24-enamelled covered wire close wound. If it is possible to obtain a 2½-in. coil form then use 46 turns of 18-gauge enamelled covered wire again close wound. That is the crystal oscillator coil. The final tank coil must be wound on a 2½ diameter form and should consist of 48 turns of 16 gauge enamelled covered wire and is centre tapped. While on the topic of 16-metre operation, we have found

(*Continued on page 47*)

Components for
A 2-STAGE 25-WATT TX.

CHASSIS.
1—two-tier rack with panels and chassis (Premier).

CONDENSERS.
1—.0001 mfd. type TRO100 (C1) (Premier).
1—.002 mfd. type 1000 v. tubular (C2) (Dubilier).
1—.002 mfd. type 500 v. tubular (C3) (Dujbilier)
1—.002 mfd. type 500 v. tubular (C4) (Dubilier).
1—.002 mfd. type 1000 v. tubular (C5) (Dubilier).
1—Type 1088 neutralising (C6) (Eddystone).
1—.002 mfd. type 500 v. tubular (C7) (Dubilier).
1—.00005 mfd. type 500 v. tubular (C8) (Dubilier).
1.—.0005 mfd. type 500 v. tubular (C9) (Dubilier).
1—.00016 mfd. type TRO160T (C10) (Premier).
1—.01 mfd. type 691W (C11) (Dubilier).
1—.002 mfd. type 500 v. tubular (C12) (Dubilier).
1—8 mfd. type 0281 500 v. (13) (Dubilier).
1—8. mfd type 0281 500 v. (C14) (Dubilier).

CHOKE, LOW FREQUENCY.
1—Type C-1803 (CH) (Stancor—Webbs Radio).

CHOKES, HIGH FREQUENCY.
3—Type 1010 (Eddystone).

CRYSTAL.
1—1.7 3.5 or 7 Mc. with enclosed holder (Q.C.C.).

DIALS.
2—Type 1097 (Eddystone).

HOLDERS, VALVE.
1—4 pin ceramic (Webbs Radio).
1—8-pin octal ceramic type (Clix).
1—4-pin type American chassis less terminals (Clix).
1—5-pin type American ceramic (Webbs Radio).
1—5-pin type American chassis less terminals (Clix).

JACKS.
4—Insulated closed circuit (Premier).

RESISTANCES, FIXED.
1—10,000 ohm 8 watt (R1) (Premier).
1—20,000-ohm 8 watt (R2) (Premier).
1—10,000-ohm 8 watt (R3) (Premier).
1—10,000-ohm 8 watt (R4) (Premier).
1—50,000 ohm 1 watt (R5) (Erie).
1—500,000 ohm ½ watt (R6) (Erie).
1—500,000 ohm ½ watt (R7) (Erie).

SWITCHES.
2—Toggle type S80T (Bulgin).

SUNDRIES.
6—Insulating pillars type 1029 (Eddystone)

TRANSFORMERS, MAINS.
1—Typ3 P-3699 (T1) (Stancor—Webbs Radio)
1—Type P-4088 (T2) (Stancor—Webbs Radio).
1—Type P.4090 (T3) (Stancor—Webbs Radio).

VALVES.
1—T20 (Webbs Radio).
1—6L6G (Webbs Radio).
1—83 (Webbs Radio).
All the equipment needed for this transmitter can be obtained in kit form from:
Webbs Radio Limited.
Premier Supply Stores.
Peto-Scott Limited.

The Short-wave Radio World

A Review of the Most Important Features of the World's Short-wave Developments

SPEECH-OPERATED BREAK-IN

A MOST interesting short article in the December issue of the American publication *Radio* and written by W2BFG, describes a speech-operated break-in system. The circuit of this is shown in Fig. 1 and the method of operation as described by the author is as follows:—

Directly the microphone is spoken

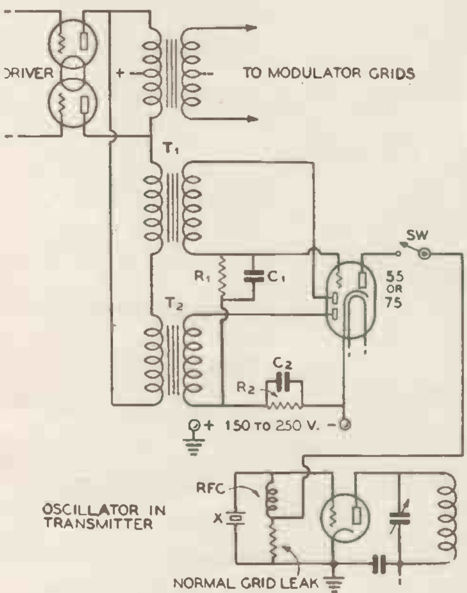


Fig. 1.—This is the simple circuit for voice-operated break-in.

into, a small portion of the amplified audio frequency is diverted from the output of the speech amplifier or driver into the primaries of transformers T1 and T2. The secondaries of these transformers are reconnected to the diode anodes of the type 55 control valve. These diodes rectify audio frequencies and the resultant direct current creates a drop across resistors R1 and R2 which are in series with each other.

These resistors are connected between the cathode and control grid of the triode half of the 55 valve. The D.C. potentials appearing across them cause the triode anode current to decrease to cut-off. The resistor through which the anode current is drawn is the normal oscillator grid leak in the transmitter. In the no-bias condition the 55 anode current should cause sufficient drop to this resistor completely to block the oscillator. When the microphone is spoken into the rectified current causes the triode anode current to drop to zero and the oscillator starts up. This action is so rapid that reports received tend to indicate that the carrier invariably comes on without losing a noticeable fraction of the first word.

The purpose of condensers C1 and C2 is to introduce a lag approximately one-half second after the voice has ceased before the carrier is turned off. This prevents the transmitter from going on and off with each syllable and holds on until the moduation ceases.

Condensers C2 can be made larger than 1 mfd. for the more leisurely speaker, while 2 mfds. will delay cut-off for about three seconds. The maximum value for C1 is 0.1 mfd. The anode supply to the 55 valve has its positive terminal earthed with the cathode maintained at a potential of between 150 and 250 volts negative in respect to earth.

A circuit for blocking the receiver is shown in Fig. 2 and the complete description can be found in the September, 1935 issue of the same publication.

A PORTABLE TRANSMITTER FOR EMERGENCY WORK

Amateurs in Europe are devoting considerably more time to portable equipment than they have done in the past. For this reason, the simple transmitter designed by W1JPE and published in the December number of *QST* should be of particular interest.

The full technical and constructional details are given very concisely in this

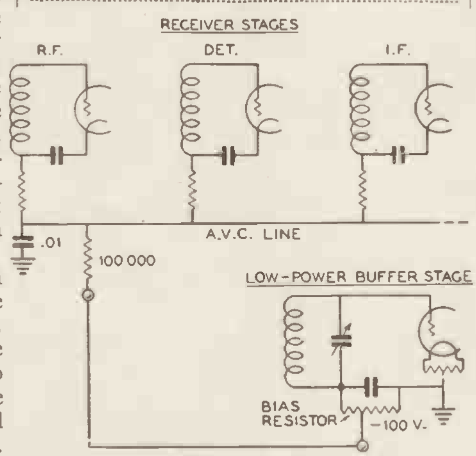


Fig. 2.—With break-in the receiver must also be silenced in this way.

publication which we advise readers to obtain, but here are some notes on the equipment.

The power supply is a small Genemotor or Mallory vibrator, either of which can be run from a 6-volt accumulator and provides 300 volts D.C. The designer states that the same R.F. output could be obtained from a single valve, but he strongly recommends the use of two valves so that the percentage of modulation can be increased.

Also it will be noticed from Fig. 3 that even though two stages are employed there is still only one tuning control which is ideal for rough and ready portable use.

The circuit of the transmitter is a 6C5G crystal oscillator with the crystal connected between grid and anode. Using a 2.5 mh. R.F. choke in the anode circuit this oscillator works very

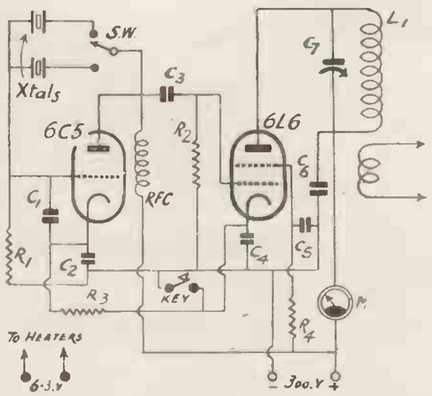


Fig. 3.—This two-stage transmitter only has one tuning control.

well with 1.7, 3.5 and 7 Mc crystals. It has the big advantage that it does not require tuning.

The oscillator is capacity-coupled in the normal way to the 6L6G which obtains bias automatically by means of R2. The receiver is keyed by opening both cathode circuits which it is claimed gives clean and complete keying for break-in.

In this circuit the output valve does not require neutralising on any of the three frequencies recommended. The component values are fairly elastic, but should be approximately as follows:—

C1, 50 mmfd.
C2, 200 mmfd.
C3, 250 mmfd.
C4 and C6, 500 mmfd.
C5, .01 mfd.
C7, 140 mmfd.
R1, 25,000 ohms.
R2, 100,000 ohms.
R3, 1,000 ohms.
R4, 10,000 ohms.

Coil data is as follows: On 1.7 Mc, 46 turns number 24 D.S.C. close wound with a coupling coil of 11 turns; for 3.5 Mc. 25 turns number 18 gauge enamelled wound to a length of $1\frac{1}{2}$ in. and a coupling coil of 7 turns; for the highest frequency band, that is 7 Mc. 13 turns

A U.H.F. Receiver

number 18 gauge enamelled, wound to a length of $1\frac{3}{4}$ in. with a coupling coil of 4 turns. This coupling coil is in each case wound with push-back wire over the lower end of L1 and a standard plug-in former is used throughout.

A U.H.F. RECEIVER

Don B. Knock, the Australian radio amateur who has just recently been breaking so many records on 5 metres, has produced a three-valve tuned R.F. receiver specially for use on the ultra-high frequencies.

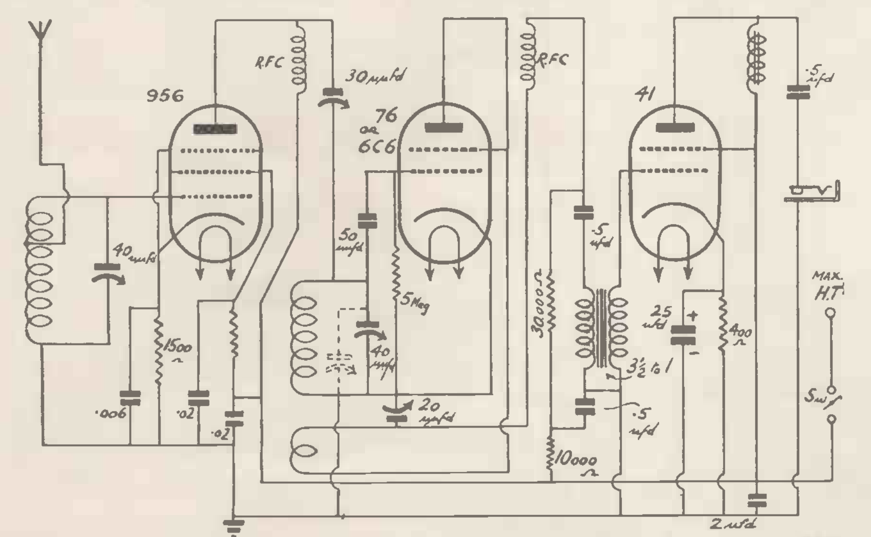


Fig. 4.—VK2NO uses this straight ultra-high frequency receiver. The important part is the reaction control.

It is described in full in the October 10 issue of *Australasian Radio World*. A circuit of the receiver is shown in Fig. 4, from which it can be seen that it consists of a 956 acorn pentode followed by a 6C6 or 76 triode detector and a 41 output pentode.

The detector includes the familiar "throttle" reaction circuit which has been found to be quite sensitive and very smooth even at the highest frequencies. The detector circuit is transformer coupled with a conventional pentode, while arrangements have been made for a loudspeaker or headphone output.

The receiver as it stands covers from 4 to 12 metres with only two sets of coils, so that it is excellent for amateur use on 5- and 10-metre bands. VK2NO stresses the fact that the success of the receiver depends on the oscillation control and if this is not positive and perfectly smooth, results will not be satisfactory.

Oscillation is controlled by a small variable condenser from the H.T. side of the reaction coil to earth. It is a most reliable method and always works provided the coil arrangements are suitable and the components have been properly laid-out.

It is also mentioned that conventional plug-in coils are of little use so readers are recommended to purchase some of the new low-loss coils made by Denco, of Clacton, which are mounted on Trolitule insulating material.

Coil data is as follows: First of all from 4 to 8 metres. The R.F. coil is made up of 6 turns of 14 gauge enamelled covered wire with a diameter of $\frac{5}{8}$-in. The detector coil is approximately the same except that the diameter is $\frac{1}{2}$ in., while the reaction winding is 4 turns of 30 gauge B.S.C. To cover from 7 to 12 metres, use 7 turns of 14 gauge enamelled wire with a diameter of $\frac{3}{4}$ in. for the R.F. coil. The detector coil requires nine turns of 12 gauge enamelled wire with a diameter of $\frac{5}{8}$-in. and the reaction winding 6 turns of 30 gauge D.S.C. wire.

PHOTO-CELL RELAYS

A sensitive light relay is shown in Fig. 5. This simple hook-up is described in the December issue of the American publication *Radio and Television*, and it does have many uses. Although designed for 110 volts A.C. mains it can very simply be adapted for normal British supplies.

The cell can be almost any photo emissive type, but a most sensitive one can be obtained from Tungsram. The relay should be capable of operating on a variation of 1 milliamp. Pure D.C. is not necessary so an 8 mfd. condenser is sufficient for a filter system. The 20 megohm resistor is most important and any lower value will result in a decrease in sensitivity.

It is also suggested that the 360-ohm resistor be fitted in the line cord. This resistor will, of course, have to be increased in value for 250 volt mains.

In operation, the potentiometer is adjusted so that with the light source focussed on the cell, the relay is just barely closed. Immediately the beam is interrupted the relay will open. Distances of up to 150 ft. have been covered with this relay, but for invisible beams a piece of red cellophane can be placed

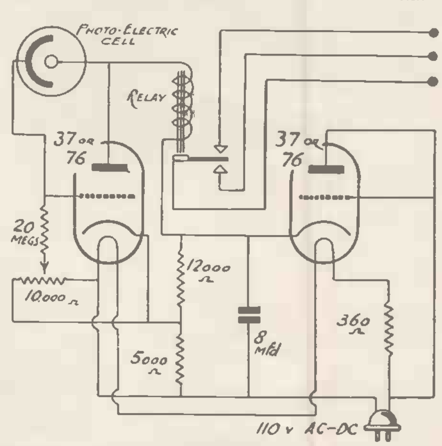


Fig. 5.—This type of relay can be used to open and shut doors by means of interrupting a light source.

over the light source. This reduces the maximum distance of operation to about 10 ft. The author recommends a 6-volt motor-car headlight bulb complete with a small transformer and a 1 in. lens. The relay can be used for a large number of purposes such as automatically opening garage doors and we feel that constructors will find this interesting equipment of value.

"A 2-stage 25-watt Transmitter"

(*Continued from page 45*)

that the 6L6 is excellent as a fundamental crystal-oscillator without there being too high a crystal current. If, however, constructors should have any trouble about this, it should be remembered that a 6F6 can be used in this circuit without alteration.

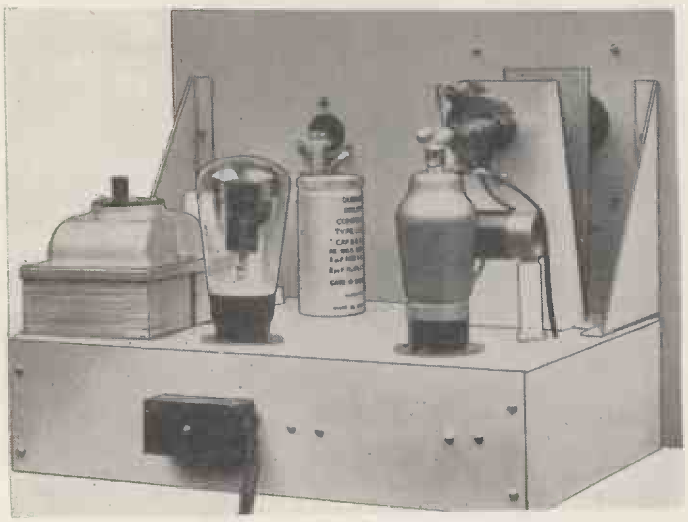
On 80 metres the oscillator coil is made up of 35 turns of number 22 gauge enamelled covered wire, close wound with a final tank coil of 25 turns of 16 gauge enamelled wire spaced one in. diameter on a $2\frac{1}{2}$ in. form. The 40 meter coil in the oscillator circuit is made up of 20 turns of 16 gauge enamelled wire spaced one in. diameter with the tank coil 16 turns of 14 gauge enamelled covered wire spaced one inch diameter. Wherever possible, wind the tank coil on a $2\frac{1}{2}$ in. diameter form, and the oscillator coil on a $1\frac{1}{2}$ in. diameter form.

This dial can be read to one degree in 800.

An A.C. Operated Amateur-bands Frequency Meter

This frequency meter covers all amateur bands from 5 to 160 metres with an accuracy of better than 1 per cent. Arrangements have been made for the completed unit to be accurately calibrated.

It is extremely difficult for the amateur without expensive measuring equipment to be able accurately to give frequency checks, particularly at short notice. Those amateurs who have a hundred kilocycle bar are able to tell fairly closely the frequency of amateur stations, but this type of meter is not particularly popular.



It is essential that components be rigidly mounted. Also notice the ceramic grid condenser. The valve does not have the metalising earthed.

There are quite a number of different ways in which frequencies can be measured, but when one starts operating with an accuracy of better than one per cent. the biggest difficulty is the accuracy of the original calibration.

Before this meter was even considered in an experimental form, we had to make up our minds just how it could be calibrated with a high degree of accuracy. We came to the conclusion that the usual method of checking against known stations or by using calibrated crystals was quite out of the question.

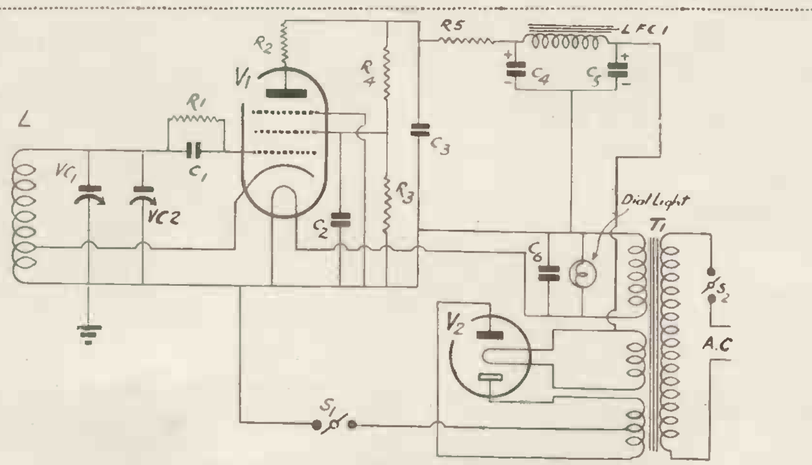
Messrs. Peto-Scott, Ltd., came to our assistance and offered to calibrate this frequency meter made by amateurs against their standard generator. In this way, they could guarantee an accuracy of better than one per cent. which is sufficient for general amateur use.

This accuracy is dependent on the stability of the meter, while a pointer must also be available so that the meter could be re-checked by the user should the original calibration be upset in transport.

It was decided to calibrate the meter on the 1.7 Mc. amateur band. Actually, this covered 1,700 to 2,000 Kc. As most receivers will pick up the second harmonic of one of the B.B.C. medium wave transmitters, which are very stable as regards frequency, it is obvious that these harmonics make a reliable pointer. Just how the calibration is maintained will be explained later in this description.

The circuit of the meter is shown on this page. It consists of an electron-coupled oscillator which, by virtue of component values and a steady voltage source, is reasonably constant in operation. A built-in power unit is included and the voltage stabilised by means of a low value resistance network made up of R3 and R4. This network also provides a stable screen voltage which is essential.

In order to obtain wide band spreading, the inductance of the coil and the capacity of the condensers across it have to be carefully worked out and for this reason it is essential that these components be strictly to specification.



This is the complete circuit diagram. Resistance R5 is merely to reduce the total H.T. voltage while the network R3 and R4 is purposely made of a low value in order to stabilise voltage.

Construction

The rotary switch on the right-hand side is in the mains lead, while the toggle switch is for stand-by operation. The small condenser underneath the mains condenser is for band setting.

Constructors will, of course, be able to tune the 160-metre band with almost any value of parallel capacity, but they will find that unless considerable care is taken they will only be able to spread the band with a fairly high-capacity condenser. This is of little importance on 160 metres, but as the meter makes use of harmonics generated, the amount of coverage decreases as the frequency increases.

With the values recommended, a bandspread of no less than 500 degrees has been obtained which is sufficient to allow of an exceptionally good coverage on the 5-metre band. The second point in the design of this meter was the choice of a dial. For several months this meter has been in the course of preparation, but has been held up owing to the fact that so few dials were available that would give a wide coverage at a reasonable price.

The new Peto-Scott dial is ideal for use with frequency measuring apparatus of this kind for it is comparatively easy to read one part in 800. This dial has two pointers; one covering a scale calibrated in hundreds and the other, on the outer edge, covering a scale calibrated in tens.

Next comes the mechanical aspect of such a meter. The slight trace of movement will completely destroy complete accuracy, so for this reason a chassis and panel have been built complete with two very strong brackets and an additional bracket for the trimmer condenser. Then by keeping the leads short in the actual oscillator section there is no trace of frequency shift if the panel is deliberately mishandled.

How this chassis and panel is constructed can quite clearly be seen from the illustration, while the layout of the components is also quite clear.

Construction is of particular importance and every care should be taken to build the meter exactly to specification, to make quite sure that there is no possibility of movement in any of the components and that the wiring, particularly in the tuning circuit, is rigid.

The chassis and panel are supplied with the mounting bracket for the band-spread condenser VC2, and this is fitted as shown. Immediately under this condenser is the tapped coil which is mounted on a pair of Eddystone insulating pillars. In this way, the grid and earth leads come directly under VC2, and only need connecting wires having a total length of about one inch. As the grid connection is taken to the fixed plate it should be arranged so that one fixed plate terminal is at the bottom and one at the top. It will then be found that the top connection is on a level with the grid contact of the valve.

The grid condenser and leak which are in parallel should then go directly between the top of the valve and top of the condenser without any additional wiring. It will also be noticed that this grid condenser is of the ceramic type.

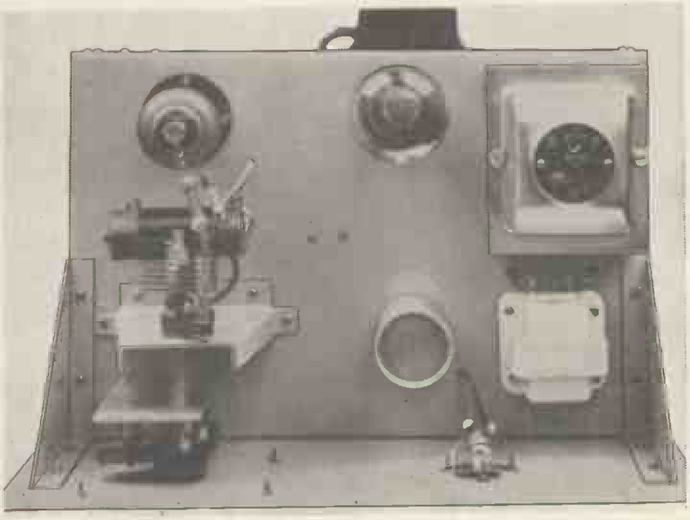
Underneath the main tuning drive is the band setting condenser VC2 which has a capacity of 50 mfd. It is connected in parallel with VC1 and the leads should be made very tight and be well insulated from the metal chassis through which the connections pass. Throughout this meter no earth connections are made automatically to the chassis; it will be noticed that they are taken to a common earthed point.

The longest lead is from the cathode of the valve to the tap on the coil, and it should be arranged so that the connection drops down through a hole underneath the coil to the cathode pin which should be as close to this hole as possible.

In the anode circuit of the pentode valve is the resistance R2 which has a value of 100,000 ohms. This value is unimportant, but should not be lower than 60,000 ohms. As previously explained across the entire power unit are resistors R3 and R4, having a value of 25,000 ohms and 5,000 ohms respectively. The mid points of these two resistors are taken to the screen of the valve.

As the power unit provides over 300 volts and only 250 volts are required, the bulk of this excess voltage is knocked down by means of resistance R5, which has a value of 7,500 ohms with a rating of 8 watts.

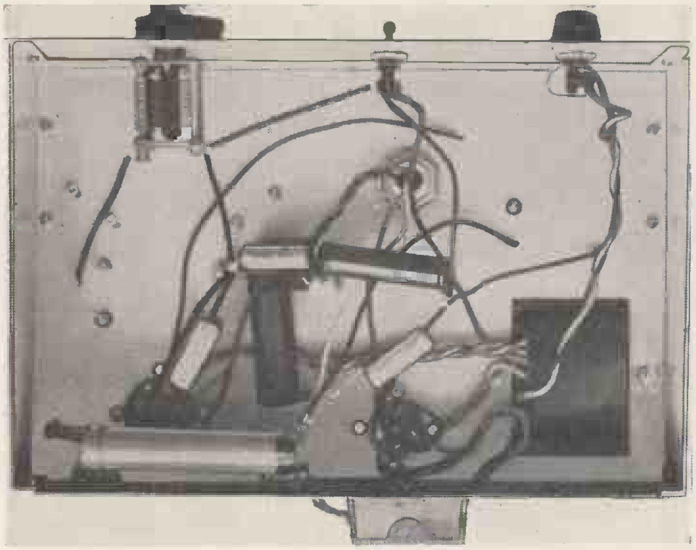
Several by-pass condensers are included, such as C2 by-passing the screen of the valve, having a capacity of .01 mfd. and C3 having a value of .01 mfd. A most important condenser is C6 which is across the filament supply. Condenser C6 again having a value of .01 mfd. effectively prevents a type of modulation hum which is very noticeable should it be omitted.



This plan view shows the layout of the components. Notice particularly the special bracket for tuning condenser.

Calibrating

Next consider the power unit which is made up of a standard British type Peto-Scott transformer, a smoothing choke capable of passing 25 mA. and a two-section dry electrolytic condenser, each section having a capacity of 8 mfd.



There are very few components under the base plate, the three most important being the resistors. Notice that C4 and C5 are in one container.

In series with the primary of the mains transformer is a rotary make-and-break switch, while a toggle switch is connected in series with the centre tap of the high-voltage winding for stand-by operation. It is recommended that the frequency meter be left switched on so that the valve heaters are thoroughly warm and the meter only put into active use when required.

Dial lights are generally used for effect and are not very often of importance, but we have found that users are inclined to leave a frequency meter permanently switched on unless some indication is available. For this reason, a red dial light has been included and connected across the heater supply. As one side of the heater is connected directly to earth, there is no need to make use of an insulated dial light.

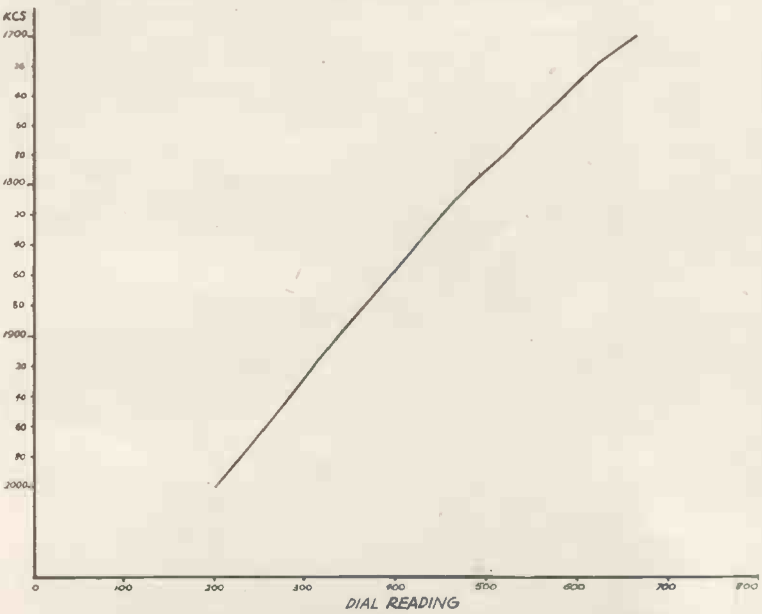
The coil can be purchased already wound from Messrs. Peto-Scott, but provided the constructor takes care to follow the instructions the coil can be home-built. It is wound on a 1 in. paxolin former having a total length of three inches and is made up of 76 turns of 30 gauge enamelled covered wire with a tapping point 23 turns up from the earthy end. This tap, of course, is taken directly to cathode.

The coil is wound without any gap between windings and if the meter is to be of any use at all, it must be extremely tight. Should different wire gauges be used, there is very possibility that the coverage of 500 degrees will not be obtained which will restrict the utility of the meter on the higher frequency band.

On a receiver such as the Hallicrafter without aerial and earth connections, harmonics can be received very strongly on 20, 40, 80 and, of course, the fundamental on 160 metres. With any sort of aerial harmonics are strongly picked up right down to the 5-metre band. Down to 10 metres the signal is so strong that there is little need to use a beat-frequency oscillator, although the B.S.O. does enable the operator to obtain a very accurate measurement.

If the meter is built to specification it can be sent to Messrs. Peto-Scott, who will calibrate it and supply a curve covering 1,700 Kc. to 2,000 Kc. for a fee of 10s. 6d. The accuracy will then be better than one per cent., while it would not matter if the band-setting condenser shifts in transit. The arrangement is this; after the meter has been calibrated, the dial should be set to the frequency of the second harmonic

(*Continued at foot of page 62*)



This is a very much reduced curve of the meter. Notice how the 3,000 kilocycles have been spread no less than 500 degrees.

Components for: AN A.C.-OPERATED AMATEUR BANDS METER

CHASSIS AND PANEL.
1 Aluminium with brackets and condenser mounts, finished grey (Peto-Scott).
COIL.
1—To specification, see text (Peto-Scott).
CONDENSERS, FIXED.
1—200-mmfd. type CTS620 10 per cent. tolerance (C1) (Dubilier).
1—.01-mfd. type 4601/S (C2) (Dubilier).
1—.01-mfd. type 4601/S (C3) (Dubilier).
1—8 plus 8-mfd. type 32851 (C4 and C5) (Dubilier).
1—.01-mfd. type 4601/S (C6) (Dubilier).
CONDENSERS, VARIABLE.
1—50-mfd. (VC1) (Peto-Scott).
1—40-mfd. type 1129 (VC2) (Eddystone).
CHOKE, LOW-FREQUENCY.
1—20 h. 25 m/A. (Premier Supply Stores).
DIAL.
1—Geared dial (Peto-Scott).
HOLDER, FUSE.
1—Type F14 (Bulgin).
HOLDERS, VALVE.
1—7-pin chassis type V2 less terminals (Clix).
1—4-pin type V1 less terminals (Clix).
PLUGS.
1—Type P41 (Bulgin).
RESISTANCES, FIXED.
1—75,000-ohm type ½ watt (R1) (Bulgin).
1—100,000-ohm type 1 watt (R2) (Bulgin).
1—25,000-ohm 8 watt (R3) (Premier Supply Stores).
1—5,000-ohm 8 watt (R4) (Premier Supply Stores).
1—7,500-ohm type 8 watt (R5) (Premier Supply Stores).
SWITCHES.
2—Type S80T (Bulgin).
SUNDRIES.
1—Type D7 dial light (Bulgin).
2—Type 1029 insulators (Eddystone).
3—Type 1019 insulators (Eddystone).
TRANSFORMER, MAINS.
1—Standard type British (Peto-Scott).
VALVES.
1—Type SP4B met. (V1) (Tungsram).
1—UU5 (V2) (Mazda).
A complete kit of components can be obtained from Messrs. Peto-Scott, Limited, who are also prepared to build and supply the receiver complete with calibration curve.

Low-cost Amplifiers For Amateurs

In this article are described two inexpensive amplifiers suitable for modulating either a 10 or 25-watt transmitter or public address gear.

AMATEURS when first licensed usually prefer a C.W. transmitter owing to the average speech amplifier and modulator being so expensive. A 10-watt transmitter for C.W. complete with all power unit and key,

The 14-watt amplifier is completely self-contained with double smoothing. Two triodes in push-pull provide excellent quality at maximum output. As there are two drive stages, quite a small input voltage is required to fully load the output triodes.

costs considerably less than the normal priced 5-watt audio amplifier with power pack and microphone which is required to modulate the C.W. transmitter.

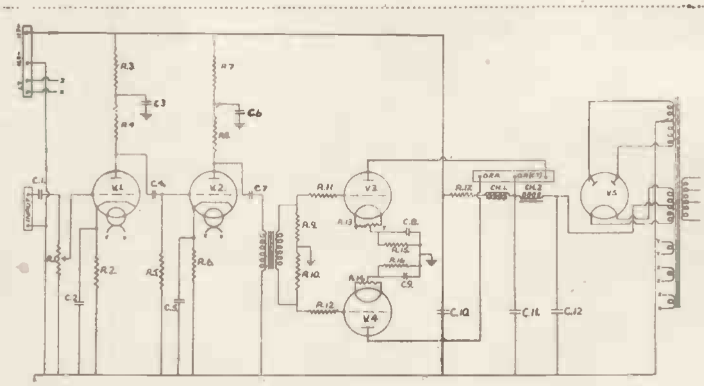
However, it is now possible to obtain high-gain amplifiers complete with microphone and input transformer which can be used for modulation purposes and if required, for public address work.

A 7-watt Amplifier

For modulating a 10-watt transmitter the new Peto-Scott amplifier type HC67 has much to recommend it. It provides an output of 7 watts and is priced complete with microphone and input transformer at £4 15s. To this must be added the cost of a special smoothing choke and a modulation transformer. If, however, the equipment is used for public address work then a special loudspeaker is available for 47s. 6d., the field of which is used for smoothing purposes. This loudspeaker also embodies its own matching transformer. The whole public address installation is then available for £7 2s. 6d.

In the circuit is shown the valve line up of the Peto-Scott 7 watt amplifier. It consists of a 6C5 high-gain triode which is used to drive a pair of 6F6 pentodes in push-pull. A parallel-feed transformer arrangement is used for coupling and in this way high gain and good quality are obtained. A special amplifying valve type 6Z4 provides ample H.T. voltage and current, while the smoothing circuit is arranged as previously explained by means of the field of the loudspeaker, with a 4 mfd. reservoir condenser and 8 mfd. filter condenser.

A valve holder socket is mounted on the chassis and a 4-pin plug provided with the amplifier and this is used for connecting up the energised loud speaker.



This is the circuit of the 14-watt amplifier which has two resistance - capacity coupled stages before the push-pull stage.

Valve Types

American type valves, manufactured by Tungsram, are used throughout and these are inter-changeable with valves of similar characteristics in the British International or American ranges. Full output is obtained with an input of 1 volt r.m.s. either from a pick up or microphone circuit. The microphone supplied is of the high output type and complete with transformer and energising battery in a separate box. This microphone is one that we have tried under actual working conditions in our own laboratory and which has proved to be highly satisfactory. So much so that it gives quality comparable with microphones costing many times as much.

The amplifier is designed for 200-250 volt A.C. mains only and cannot be used on D.C. mains unless a convertor is employed. The possibility of modulation hum has also been counteracted by use of a condenser from each anode to cathode of the rectifying valve, while sufficient top note attenuation is obtained by connecting a .002 mfd. condenser across the primary of the output transformer.

Providing that screened leads are used for microphone and pick-up hum level is negligible. Fuses are included, actually in the mains plug and they can be replaced by merely taking one screw out of the plug.

Modulating 25 Watts

For amateurs who have graduated to a 25-watt transmitter, a larger amplifier for modulation purposes is required. The minimum wattage needed is approximately 12.5, but it is always advisable to have a little spare in hand. For this service there is the Peto-Scott A.C. 14, a high quality amplifier which is a self-contained unit with very complete double smoothing.

Five valves are used in this circuit, two speech amplifiers and push-pull modulators with a full wave rectifying valve. The input circuit feeds into a

14 Watts of Audio

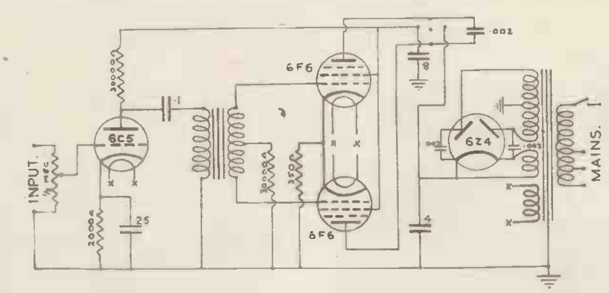
Tungsram HL4+ triode which is R.C. coupled to a new L.F. amplifying valve, a Tungsram LL4. A combination of resistance capacity and transformer coupling is employed between second and third stages so as to obtain

In the —7-watt amplifier a smoothing choke has been omitted for this is part of the loudspeaker. Actually, either a 1,250 ohm smoothing choke must be used, or for P.A. work a 1,250 ohm feed coil.

high primary inductance in the transformer used by not passing any D.C. current through the windings.

The push-pull modulators are Tungsram triodes type P27/500, which give a comfortable 14 watts in this amplifier. If the amplifier is used for modulation purposes, an output transformer which will match the optimum load of the push-pull stage to the R.F. load is essential. This transformer should be capable of carrying the full current of C3 and C4 in the primary and the full current of the R.F. amplifier in the secondary.

Complete with valves the amplifier is priced at £14, to which must be added the 25s. for the microphone, and very approximately a similar sum for a modulation transformer. When used as a public address amplifier, a loudspeaker capable of handling 14 watts is required and it can be of the permanent magnet or energised type. As smoothing is arranged internally, there is no need to consider the field coil as with the AC67 amplifier.



The circuit of the 7-watt amplifier is very simple as there are only two stages. Valves having American characteristics are used, but the valves supplied with the amplifier are manufactured by Tungsram in this country.

Using a Radio Unit

To make this amplifier suitable for all purposes, it is interesting to note that an additional 4 volt 8 amperes and 250 volts at 40 mA. are available in order that a radio unit can be used in conjunction with the amplifier. Five terminals are provided and in this way, a radio set can be built into a cabinet, power taken from the amplifier, while the amplifier is in addition used to boost signals from the radio set.

As the output transformer is a separate unit, it is a simple matter to use the amplifier for modulating a transmitter or for public address work as required.

Both those amplifiers have been soundly constructed, are conservatively rated and will give good service despite their very low price. Full information can be obtained from the manufacturers. The Peto Scott Co., Ltd., of Pilot House, Church Street, Stoke Newington, N.16, who have brochures describing these amplifiers, while they can also supply modulation transformers suitable for matching practically any R.F. load.

A New Radio Component Catalogue

In the latest edition of the radio catalogue issued by Raymart, Limited, of 44 Holloway Head, Birmingham, 1, are a large number of new lines, while a considerable number of the existing items have been reduced in price.

Of particular interest are the new racks, panels and screening boxes in a multiplicity of sizes, all of which can be supplied drilled or undrilled, as required. There is also the Bliley crystal unit which is now available with 40-metre type AT-cut crystals. This unit has a variation of 12 Kc. at fundamental frequency, 24 Kc. on 14 Mc. 48 Kc. on 28 Mc. and 96 Kc. on 56 Mc. It is priced at 45s., being the same as for the 80 metre unit.

Amongst other items of interest are 4-in. transmitter dials in solid nickel at 5s., a complete range of very low priced ceramic coil forms, aerial change over relays of the heavy duty type with low-loss insulation and also a new type of over-load relay.

Constructors interested in U.H.F. network will find the new Raymart mica fixed condensers of particular use. They have been tested at 1,000 volts and the 50, 100 and 150 mmfd. type are priced at 1s. A copy of this catalogue can be obtained from Messrs. Raymart at the above address, sending 1½d. to cover postage.

The 1939 A.R.R.L. Handbook

We have just received a copy of the *Radio Handbook*, published by the American Radio Relay League, which is available from F. L. Postlethwaite, G5KA, at 41 Kinfauns Road, Goodmayes, Ilford, Essex, for 5s. 6d. post free.

This is the 16th edition of the *American Radio Amateurs Handbook* and this year consists of over 560 pages and no less than 20 chapters. It is without question the most comprehensive amateur publication available and has only one small disadvantage in that it deals solely with American components and equipment.

However, it is of particular use to transmitting amateurs for it includes a large number of new designs and ideas, an extremely good ultra-high frequency section and no less than 20 pages dealing with valve characteristics and operating data.

We are pleased to see that in this issue they have devoted a considerable amount of space to low-power equipment suitable for British amateurs and also an interesting chapter on emergency and portable equipment.

All the chapters in the manual this year are greatly enlarged and deal with ultra modern practice. We feel that the chapter devoted to aerials will intrigue all amateurs interested in consistent long-distance communication.

PREMIER 1938/1939 RADIO

PREMIER 1938 HIGH FIDELITY AMPLIFIERS

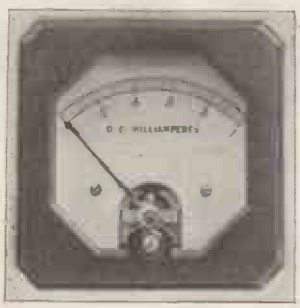
A NEW COMPLETE RANGE OF 7 HIGH FIDELITY PA AMPLIFIERS FOR A.C. or A.C./D.C MAINS OPERATION.

With the exception of the 3-watt models, all Premier Amplifiers incorporate the new Premier Matchmaker Output Transformer, enabling any single or combination of speakers to be used. 6, 8/10, and 15-watt systems are provided with two separate input channels which can be mixed to any level. The 30- and 60-watt systems have 3 input channels The built-in Pre-Amplifiers ensure that the gain is sufficient for any low level crystal or velocity microphone. The actual gain of the 6-, 15-, 30- and 60-watt amplifiers is over 100 decibels. Tone controls are also incorporated. Matchmaker Modulation Transformer can be substituted for Output Transformer at no extra cost.

	Kit of Parts with Valves.	Completely Wired & Tested.
3-watt A.C. Amplifier	£2 : 0 : 0	£2 : 15 : 0
3-watt A.C./D.C. Amplifier ...	£2 : 0 : 0	£2 : 15 : 0
6-watt A.C. Amplifier	£5 : 5 : 0	£6 : 0 : 0
8-10-watt A.C./D.C. Amplifier ...	£4 : 10 : 0	£5 : 5 : 0
15-watt A.C. Amplifier ...	£5 : 15 : 0	£7 : 0 : 0

Black Crackle Steel Cabinet 15/- extra.

30-60-watt A.C. Amplifiers or Modulators, completely wired and tested, in Black Crackle steel case. Power Pack in separate case to match. 30-watt £12 : 12 : 0 complete. 60-watt £15 : 15 : 0 complete.



PREMIER MOVING COIL METERS

Guaranteed Accuracy within ± 2 per cent.

Model No. 2 (as illustrated), Bakelite Case, 3 in. by 3 in. square, with Zero Adjuster.

0.500 Micro-amps.	31/-
0-1 m/A.	25/-
0-10 m/A.	22/6
0-50 m/A.	22/6
0-100 m/A.	22/6
0-250 m/A.	22/6
0-1 m/A. movements with calibrated scale volts-ohms-m/A.	27/6

MODEL No. 21. 3-in. square case.		MODEL No. 311. 3½-in. diameter round case.	
0-1 m/A. ...	18/6	0-1 m/A.	22/6
0-10 m/A.	17/6	0-10 m/A.	20/-
0-50 m/A.	17/6	0-50 m/A.	20/-
0-100 m/A.	17/6	0-100 m/A.	20/-
0-250 m/A.	17/6	0-250 m/A.	20/-

MODEL 311. 0-1 m/A. movement, with calibrated scale, volts-ohms-m/A., 25/-.

VOLTAGE MULTIPLIER RESISTANCES, guaranteed accuracy ± 2 per cent. All standard ranges, 1/3 each.

TAPPED SHUNT to provide readings of 5 m/A., 25 m/A., 250 m/A., and 1,000 m/A., 5/6.

Premier Short-Wave Kits

Are all sold complete to the last detail. All valves and coils are included as well as theoretical and wiring diagrams, and lucid instructions for building and working. Thousands are giving excellent results all over the world.
Each Kit uses plug-in Coils and the Coils supplied tune from 13 to 170 metres. All Kits are supplied with a steel chassis and Panel.

1 Valve Short-Wave Receiver or Adaptor Kit	17/6
1 Valve Short-Wave Superhet Converter Kit	20/-
1 Valve Short-Wave A.C. Superhet Converter Kit	22/6
2 Valve Short-Wave Receiver Kit	25/-
3 Valve Short-Wave Screen Grid and Pentode Kit	58/6

Premier Mains Transformers

Screened primaries 200-250 volts.
Fully Guaranteed. Wire end types.

S.P. 250, 250-250 v. 60 m/A. 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., 10/-.
S.P. 300. 300-300 v. 60 m/A. 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., 10/-.
S.P. 351. 350-350 v. 150 m/A., 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 4 a., all C.T., 13/-.
S.P. 352 350-350 v. 150 m/A. 5 v. 2 a., 6-3 v. 2 a., 6-3 v. 2 a., all C.T. 13/6.
The above can be supplied fitted with Panel and Terminals, at 1/6 extra.
S.P. 500. 500-500 v. 150 m/A., 15/-.
S.P. 501. 500-500 v. 150 m/A. 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-5 a., all C.T., 21/-.
S.P. 502. 500-500 v. 150 m/A. 5 v. 3 a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3.5 a., all C.T., 25/-.
S.P. 503. 500-500 v. 200 m/A. 5 a. 3 a., 6.3 v. 3 a., 7.5 v. 3 a., or 2.5 v. 5 a., all C.T., 25/-.
The above can be supplied fitted with Panels and Terminals, at 2/- extra. Details of complete range available.

Special Transformers wound to order.

PREMIER SMOOTHING CHOKES

60 m/A. 40 hy., 6/6. 150 m/A. 40 hy., 11/6.
80 m/A. 30 hy., 7/6. 250 m/A. 40 hy., 15/-.

PREMIER SWINGING CHOKES

150 m/A. 160 ohms, 3,000 v. insul., 10/6.
250 m/A. 80 ohms, 2,000 v. insul., 15/-
500 m/A. 100 ohms, 4,000 v. insul., 18/-

PREMIER MATCHMAKER UNIVERSAL MODULATION TRANSFORMERS

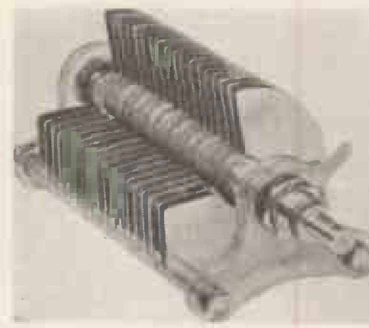
Will match any modulator to any R.F. Secondary Load. Triodes, Tetrodes, and Pentodes Class A. Single or Push-Pull Class "AB1" and "B" in Push-Pull or 500 ohms line input, can easily be matched to any of the following Radio Frequency final stages requiring modulation.

Triodes, Tetrodes or Pentodes operating under Class "A," "B" "BC" and "C" conditions either Single or Push-Pull.

Totally enclosed in cast cases with engraved Panel, and full instructions. Ratings are based on R.F. inputs.

50 Watt, 17/6. 150 Watt, 29/6.
300 Watt, 49/6.

A new range of "Matchmaker" Universal Output Transformers which are designed to match any output valves to any speaker impedance, are now ready.
11 ratios, from 13 : 1 to 80 : 1.
5-7 Watt, 13/6. 10-15 Watt, 17/6.
20-30 Watt, 29/6.



SHORT-WAVE CONDENSERS

Trolitul insulation. Certified superior to ceramic. All-brass construction. Easily ganged.

15 m.mfd. ...	1/6	100 m.mfd. ...	2/-
25 m.mfd. ...	1/9	160 m.mfd. ...	2/3
40 m.mfd. ...	1/9	250 m.mfd. ...	2/6

All-brass slow-motion Condensers, 150 m.mfd., Tuning, 4/3; Reaction, 3/9.

Double-Spaced Transmitting Types.

15 m.mfd., 2/9. 40 m.mfd., 3/6.
160 m.mfd. 4/6.

VALVES

American Valves.

We hold the largest stocks of U.S.A. tubes in this country and are sole British Distributors for TRIAD High-Grade American Valves. All types in stock. Standard types, 5/6 each. All the new Metal-Class Octal Base tubes at 6/6 each, 210 and 250, 8/6 each.

EUROPA MAINS VALVES, 4 v. A.C. Types, A.C./HL., A.C./L., A.C./S.G., A.C./V.M.S.G., A.C./H.P., A.C./V.H.P., A.C./P., and 1 watt D.H. Pentodes, all 4/6 each. A.C./Pens., I.H., 5/6; A.C./P.X.4, 6/6; Oct. Freq. changers, 8/6; Double Diode Triodes, 7/6; Triode H. ex. Freq. Ch., 8/6; Tri. Grid. Pen., 10/6; 3½ watt I.H. Triode, 7/6.

UNIVERSAL TYPES, 20 v. .18 amps. S.G., Var.-Mu., S.G., Power, H.F. Pen., Var.-Mu. H.F. Pen., 4/6 each.
13 v. .2 amps. gen. purpose Triodes, 5/6; H.F. Pens. and Var.-Mu. H.F. Pens., Double Diode Triodes, Oct. Freq. Changers, 7/6 each. Full-Wave and Half-Wave Rectifiers, 5/9 each.

New Taylor Tubes

T.40. TZ.40. NOW IN STOCK. Price, 24/- each. Prices now reduced on 866 Rectifier, now 10/-; 866 Junior, 7/6; T55, 45/-; 203Z, 52/6; 745, 65/-; T.20 and TZ.20, 17/6 each.

Have you had our 1938 Catalogue, Handbook and Valve Manual? 90 pages of Radio Bargains and interesting Data. Price 6d.

ALL POST ORDERS to:— Jubilee Works, 167, Lower Clapton Road, London, E.5. *Amherst* 4723.

PREMIER RADIO

CALLERS to:—Jubilee Works, or 165 Fleet St., E.C.4. *Central* **2833 or 50 High St., Clapham, S.W.4.** *Macaulay* 2381.

Improving *The* Tobe Communication Receiver

Readers who built the very popular communication receiver embodying the Tobe tuner which was described in December, 1936, will be interested in the modifications described in this brief article.

IN our issue dated December, 1936, was published the complete technica details of a communication receivei for home construction which embodied the amateur band Tobe tuner.

This receiver proved to be extremely popular amongst amateurs in this country and provided a perfoimance greatly in excess of that given by ready built receivers of a similar price. However, although the Tobe receivers in use are still giving satisfactory service, they must now be considered as being a little out of date.

A New Circuit

The designers of the tuner have now made quite a number of modifications so as to bring the receiver into line with current ideas. Readers who built the original receiver can include the majority of these improvements without making any radical changes in design. We realise that once the receiver has been correctly aligned with the aid of commercial apparatus, constructors will not wish to change the R.F. and I.F. sections. With this end in view the modifications are mainly confined to the second detector and audio stages. In fact, there is only one small change to be made in the R.F. stage and this is optional.

The new circuit is shown on this page from which it can be seen that a great increase in R.F. gain can be obtained by using one of the new high slope pentodes type 1851. This will mean using a new valve holder, but in the majority of cases the change-over is not a difficult one.

In the original receiver, the oscillator and mixer was a 6A7 pentigrid and it is now recommended that this be exchanged for one of a later pattern, type 6A8G. It is not recommended that an 1851 be used in the I.F. stage, otherwise there may be traces of instability. An excellent valve in this position is the 6K7G, which gives a high stage gain and with the circuit values recommended is quite stable.

The biggest change comes in the second detector circuit where instead of a double-diode triode is used a double diode detector, followed by a separate triode first stage ampifier. This amplifier is a 6F5G, valve having extremely high amplification and a top-cap grid connection. The two output valves are 6F6G's in push-pull, which, as they are resistance-coupled, need a phase invertor, type 6C5G.

A magic eye type 6G5 has been included, the connections being extremely simple, having the grid connected to one side of the one megohm resistor in the AVC line. Provision have also been made for including a gramophone pick-up and this is in the diode circuit, at the point marked with a cross. The phone jack is in the grid circuit of the phase invertor, also in the position marked with a cross.

The tuner has not been modified in any drastic manner so that there is no need to make any changes in this respect. The beat-frequency oscillator which was included in the original communication receiver is not shown in this circuit, but this again is optional and is only used when the set is in amateur hands.

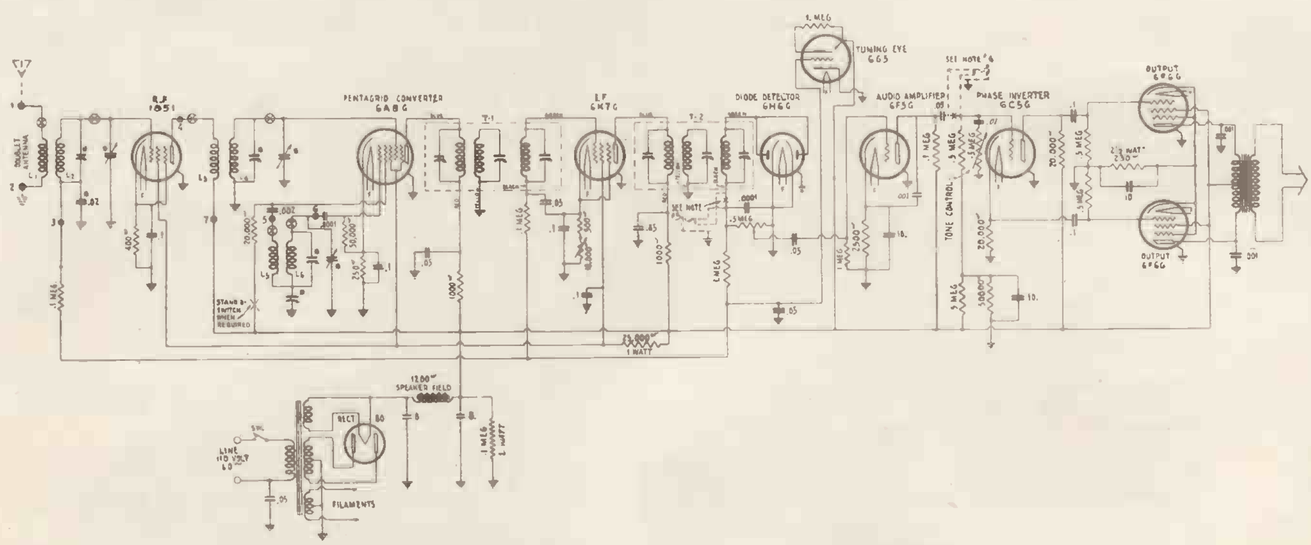
For those who wish still further to increase the R.F. gain a special switched coil unit is now available which is complete with bandspread condenser having a coverage equal to that in the Tobe tuner.

This bandspread unit covers amateur bands only and it is suggested that it be used in a R.F. circuit with regeneration by means of the conventional cathode tap to the grid coil. A suitable R.F. amplifier on these lines for use with the Tobe and other communication receivers will be published in an early issue.

Bulgin Television Aerial

Messrs. A. F. Bulgin and Co., Ltd., point out that in their advertisement which appeared in the December, 1938, issuue the television di-pole aerial was priced at 30s. instead of 35s. The special twin feeder for use with this aerial has now been priced at 5s. 6d. per 100 ft. and the type number is L-20.

Full details of Bulgin's television and radio components are contained in their catalogue, which is 3d. post free, from the Head Office at Abbey Road, Barking, Essex.



This is the final circuit of the latest communication receiver using the Tobe tuner.

Trade News of the Month

Many new components have been produced just recently specifically for amateurs, and some of these are discussed in this short review.

A THREE section aluminium valve shield is now available from Eddystone. This shield illustrated in Fig. 1, is intended for use with the American octal and British international type valves. The base, a separate part, is drilled so that the holes coincide with the fixing holes on the average 8-pin ceramic base. In this way, the shield can be quite easily fixed to the chassis so giving perfect screening. The type number is 1121, and the price complete, 1s. 3d. We have also used these screens with the Mullard type "E" series valves, and although the screen is a trifle on the large side, they are quite satisfactory and also match up with the Bulgin side contact valve holders.

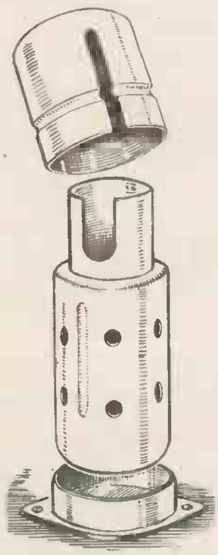


Fig. 1.—The special Eddystone valve shield designed to fit the new octal valve.

Incidentally, while on the topic of valve holders, constructors who are using the new "E" valves should make a special point of obtaining a good holder. When these valves were originally produced, difficulty was experienced in making good contacts. However, the New BULGIN type VH24 holder, which only costs a shilling, gives perfect contact and is not likely to lose its spring with rough usage.

Bulgin are also making a most interesting shielded plug and socket. These are intended for use in television receivers, but they have an alternative use for interconnecting a crystal microphone to an amplifier. The plug and socket in the three-way type, costs 6d., and the type numbers are P139 and P143 respectively. They are available in different types up to 6 contacts.

Many amateurs wish to use 4-volt valves in a receiver designed for 6-volt valves, and *visa versa.* SOUND SALES have just produced a transformer which when fed with 4 volts to the primary, provides 6.3 volts on the secondary. It can also be used in a reversed manner and with 6 volts on one winding provides 4 volts on the other. In this way, constructors can use some of the new octal valves in their British-built receivers, or use British valves in American receivers. This transformer is extremely small, so that it can be fitted to most commercial receivers. It is priced at 7s. 6d., and is shown in Fig. 2.

Nothing is more annoying than to have a crystal which does not oscillate too freely. A lot of this trouble is caused by a badly made or unsuitable crystal holder. We have just been testing one of the new Bud crystal holders, shown in Fig. 3, which has a ceramic body and very carefully ground plates. It is of the variable pressure type and WEBBS RADIO have fixed the price at 8s. 6d. net.

Fig. 2.—This transformer can be used to supply 4 volts on a 6-volt winding or 6 volts from a 4-volt winding and is made by Sound Sales.

There are very few ultra-short wave ganged condensers available, so the new Eddystone cradle should be of particular interest to constructors. This cradle, shown in Fig. 4, enables three standard short-wave condensers to be mounted in the form of a three-gang condenser unit. Insulated flexible couplers are used between the condensers, so that the ganged unit has both rotors and stators completely isolated. This type of cradle enables the constructor to build a ganged condenser suitable for band-pass input, having earthed rotors and an isolated oscillator condenser.

Fig. 3.—Bud crystal holders are very popular in America. Here is a new sample with a variable pressure control.

The cradle is made up of a brass base, plus three insulated brackets. Metal screens are also available when it is necessary to isolate one condenser from its neighbour. The cradle, type 1114, is priced at 3s. 6d., while the metal screens, type 1125, are 8d. per pair.

One of the most popular valves at the present time is the Taylor T40, with its carbon anode. It has proved to be thoroughly reliable and to have a long life. In view of the fact that this valve only costs 24s., it is a pity that so far mains transformers suitable for use with the T40 have been comparatively costly. Messrs. Premier Supply Stores have now introduced an H.T. transformer,

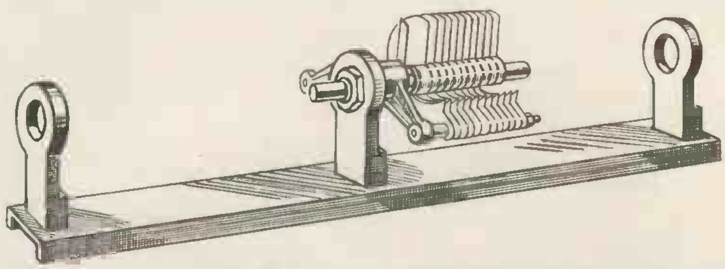
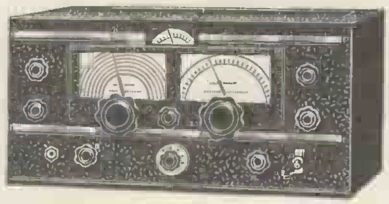


Fig. 4.—A three section condenser can be made by using one of these Eddystone cradles. Screens for fixing between the units are also available.

G5NI Communication — Receivers —

NATIONAL NC-44

This new NC-44 Communication Receiver combines capable performance with exceedingly low price. It employs seven tubes in a superheterodyne circuit with a 6K8 first detector and oscillator having exceptional stability and conversion gain, two 456 KC IF stages, diode second detector, AVC with ON-OFF switch, CW oscillator and 25L6G beam tube output (2 watts UPO). A coil switch with silver plated contacts selects the four ranges from 30 MC to 550 KC. A full vision dial is calibrated directly in frequency, and a separate electrical bandspread dial makes accurate tuning easy. There are separate controls for RF and Audio Gain. The self-contained power supply operates on 105-130 volts A.C. or D.C. **PRICE** *with tubes & speaker chassis* **£16**



RME 70

All the advantages of the 69 plus a Built-in Noise Silencer, Iron-cored IF's, Illuminated DB-R Meter, new type Crystal Filter with phasing and selectivity Controls, Relay and Break-in Control, new Cabinet with Chromium trim. Lower in **PRICE 35 GNS.**

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T7307—350/350 v. 80 m/A., 6.3VCT. 3A. 5V3A	7/6
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P.92

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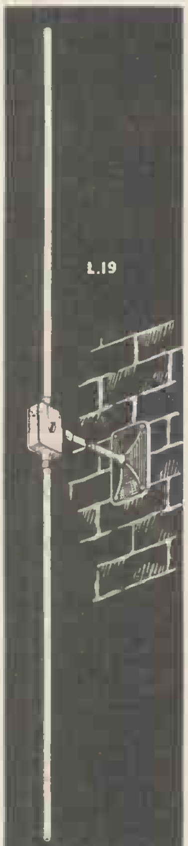

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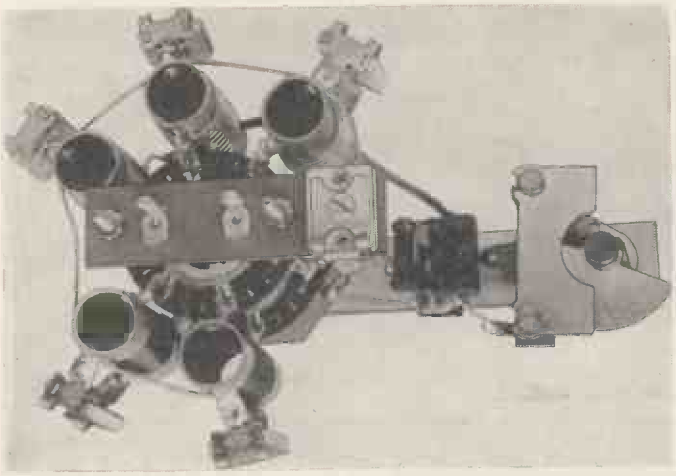
Foundation Units

type ST1000, which gives 1000-0-1000 at 2.50 m.A., and is priced at 21s. with wire end or 23s. with terminals. This transformer is very robust, weighs 10½ lb., and from personal experience can be relied upon to give consistently satisfactory service. The coils are wound on bakelite bodies and every transformer is tested at double the working voltage. The new Premier catalogue, price 6d., gives further information on this and other transformers.

One of the most interesting new components of the month which most amateurs will appreciate is a new foundation unit built by the Browning Laboratories, Incorporated, who are closely connected with the design of the Tobe amateur tuner. These foundation units have many uses, for example, the BL-5H which consists of five coils, five band-setting condensers, series aerial condenser main tuner and the grid-resistor condenser is arranged to cover 10, 20, 40, 80 and 160 metre bands. It can be used on an electron-coupled oscillator or regenerative pre-amplifier and is so arranged that the coverage is the same as the H type Tobe tuner.



This is one of the new foundation units suitable for use in a transmitter or a receiver. They should be very popular amongst constructors and full information including circuit data is obtainable from Webbs Radio.

Next in the series is the BL-5G, which can be used as an exciter, or in any low power transmitter, being suitable for harmonic operation on the 10 to 160 metre amateur bands. It is also suitable as a signal generator with fundamental operation on 20 to 160 metres, and harmonic operation on 5 and 10 metres.

The BL-5C is a complete oscillator-anode unit with a high L/C ratio. With this unit in circuit amateurs are sure of coils having the correct inductance and it enables even an amateur with a limited knowledge to build himself a switched coil transmitter or receiver. Supplies of these new coils are available from Webbs Radio.

An all-wave oscillator has been produced by the Automatic Coil Winder & Electrical Equipment Co., Ltd. It has a continuous coverage from 95 Kc. to 40 Mc. with fundamental operation throughout.

There is also a calibrated harmonic range from 30 Mc. to 80 Mc. This oscillator uses a turret selector which completely removes the coils not in use so minimising absorption and losses. The dial is directly calibrated and accurate to one per cent. It can be externally modulated, while internal modulation is 30 per cent. at 400 cycles. A calibrated double attenuator enables signals to be varied from a few microvolts to 50 millivolts with a fixed output of one volt. The battery model, complete, is 9 guineas, and an A.C. model 10 guineas.

There are a large number of new components available from Bulgin. These include midget volume controls, vibrator transformers, and a television aerial. The midget volume controls are only 11/16th of an in. in diameter with a depth of 2 in., and are made in ten different values from 1,000 ohms to 1 megohm, with a standard price of 2s. 3d. Amongst the vibrator transformers are the following: the MT10/4, MT10/6, MT10/12 and MT10/32, all priced at 17s. 6d. These transformers provide an output of 60 mA at 250-0-250 volts and are designed for use with 4, 6, 12 and 32 volt vibrators.

Those who use American type cathode ray tubing indicators will be glad to hear of a new American type octal holder with shrouded connections priced at 2s. We suggest that readers obtain a new catalogue from Messrs. A. F. Bulgin and Co., Ltd., Abbey Road, Barking, Essex, sending 3d. and postage.

A comprehensive power unit suitable for use with large amplifiers or transmitting equipment is being produced by Premier Supply Stores. The type number is AC7 and it provides 500 volts at 200 mA. This is in addition to the filament windings, which provide 6.3 volts at 3 amperes, or 2.5 volts at 5 amperes, or 7.5 volts at 3 amperes as required. The price of the wired unit is 65s.

Resistors of practically any value up to 50,000 ohms, suitable for use as grid resistors in transmitting circuits, are available from Premier in ratings of 4 watts up to 100 watts. The prices vary between 1s. for the 4 watt type up to 8s. 6d. for the 100 watt type. All these resistors are wire-wound, fitted with soldering lugs and with the exception of the 4 watt type are suitable for use with an additional tapping clip. The resistances are then suitable for use as fixed potentiometers in circuits where screen voltage, etc., has to remain constant.

A. R. Twiss, F.T.S., F.F.Sc., M.I.R.E., has just put into service this very modern mobile service van, with which he can test radio receivers of all kinds, make field-strength measurements, etc., actually under working conditions. Customers' receivers are tested and repaired at their front door. We shall be glad to advise readers on this service.

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"A 4-valve A.C. operated U.H.F. Receiver"

(*Continued from page 40*)

densers all are very similar in design, the Raymart condensers chosen should be used as they have an extremely low minimum capacity, making them excellent for use in this particular circuit.

Audio Layout

Most of the audio section is underneath the chassis, but before actually discussing the audio components, in detail, it will be noticed that the output transformer is mounted on top of the chassis next to the 6F6 output valve. This can be seen in the plan view, while across the choke is C11 with R5 mounted vertically. Next study the photograph of the underside of the baseboard. The inter-valve transformer is in the centre of the rear compartment. It is one of the little Bulgin units which, however, gives quite a high step up.

Almost on top of this transformer is the output condenser C10, while on the extreme left is the cathode condenser C9 mounted on the dividing screen. The variable potentiometer, on the left-hand side is VR2 controlling audio gain, while the potentiometer on the right-hand side is VR1, a regeneration control.

In the first compartment can be seen R6, the Bulgin power resistor which reduces the total H.T. voltage The reason for this is the transformer neutralised provides 320 volts, which is rather on the high side, so that the total voltage is reduced by means of this single resistor.

Stand-by Switch

On the front panel are two toggle switches, one being in series with the mains, the other acting as a standby switch and indicated as S1 in the theoretical circuit.

While the under circuit wiring would look a lot neater if done in square sections it is rather a waste of time for it would not have any bearing on the ultimate results obtained, so confine your activities in this respect to carefully wiring the R.F. and detector stages.

Coil Construction

Constructors will probably be interested in the number of turns used for 5-metre reception. Owing to the extremely low capacity of acorn valves, coils are a lot larger than would be expected. To quote an example, when the original model was being built in the laboratory, standard 5-metre coils were used for testing purposes and it was found that these coils were tuning to approximately 3 metres, so that the receiver will work quite well on 2½ metres. The grid coil L1, is made up of 10 turns of 16 gauge tinned copper wire wound to a distance of 1¼ in. The diameter is ⅜ in. and the tapping made experimentally about 1½ turns from the grid end. The second grid coil L3, is of the same gauge wire and winding length, but consists of 8½ turns, spaced 1½ in. The anode coil L2 can be any number of turns from 4 to 7, but as there is no difference in signal strength with 4 turns and there does appear to be a slight increase in selectivity, it is recommend that L2 be made up of 4 complete turns.

When a dipole or beam type of aerial is employed, it is essential that the coupling to L1 be made by means of a single turned link. Make this link out of 2 m/m rubber covered wire and push it in the centre of L1 and experiment with the amount of coupling to give maximum signal strength.

Lining up the two condensers is extremely simple; the extension rod is made quite loose at the VC1 end, and rotated by hand until a weak signal is heard in the detector stage. VC1 is then rotated from the front panel until it is absolutely in line with VC2, and then the extension spindle tightened up.

After doing this twice, it will be found that both condensers are accurately lined and apparently remain so at both minimum and maximum capacity.

The receiver has been tested on 2½ up to 8 metres, and has been found quite satisfactory throughout this wave range. At a distance of 35 miles, the sound section of the Alexandra Palace transmission was tuned in on the loud-speaker with only an Eddystone collapsible aerial in use.

At a distance of 2 miles, from a 5 watt 5-metre station, the acorn receiver provides a stronger signal without an aerial and the lid removed, than a commercial 5-metre receiver on a dipole aerial. However, no signals of any kind can be received unless the lid is removed so proving that the shielding is reasonably complete. It is recommended that 3 feed-through insulators be mounted on the panel to take either a di-pole or tapped on aerial.

Individual components can be obtained from Messrs. Webb's Radio, but we have made arrangements with Messrs. Peto-Scott to furnish a complete kit or ready-wired receiver as required.

A British Amateur Radio Handbook

The Radio Society of Great Britain are to be congratulated on producing the first comprehensive all-British manual for the short-wave transmitting and receiving amateur. This new manual entitled *The Amateur Radio Handbook* has just been released and is priced 2s. 6d. or 3s. post free, and 3s. 6d. abroad post free.

This manual of over 300 pages and 25 chapters covers all phases of amateur radio. It is of particular interest to British experimenters for it does cover equipment using British valves and components. In addition, however, a certain amount of American equipment is recommended so that this book combines the advantages of a British and American manual.

It has been compiled under the Editorship of G6CL and amongst the contributors are VP4TO, G6CJ, G6OT, G5CD, G6GR, G6WY, and others.

We feel that this first British handbook will become extremely popular amongst amateurs particularly those who are using only moderate power and who prefer if possible to use equipment and components of British manufacture. It is published by and can be obtained from the Incorporated Radio Society of Great Britain, 53 Victoria Street, London, S.W.1.

Long Skip

G5KA would like notes from amateurs who have worked any exceptional DX for inclusion in this feature.

BEING full of the spirit of the festive season, we open up this month with what, in our opinion, is a very funny story. It concerns a certain 3 letter call station in Leicester, who was heard "testing for local BCL trouble on an artificial aerial and who was pushing an R8 signal at least 100 miles out of his native city. We are mentioning no call-sign as we wish to avoid sending his tubes into a blush! If you can't work DX with your existing antenna fellows, we suggest you try your luck with a "dummy" one!

Before proceeding with the month's DX news, there are one or two points to be disposed of. Firstly, we have been receiving some nice lists of DX which we have been unable to make use of as certain details have been lacking. When submitting lists, please state clearly whether the station was on either phone or key, date, time and approximate frequency. This latter point is the most important of all. We do not expect you all to have frequency meters that will log stations to within 0.005 of a kilocycle, but it is a great help for us to know whether a station is in the American phone band or around the LF of HF ends of the band. We regret we cannot publish logs in full, as we already have to do a lot of pruning to get our matter to fit the allotted space!

Our remarks in last month's notes about the seven "countries" in the U.S.S.R. was apparently news to lots of people, so we are giving you the various districts herewith which comprise the 7 countries: Ul-3-4-7; U2; U5; U6; U8 (Usbek Soviet Socialist Republic); U8 (Turkoman Soviet Socialist Republic); U9-0.

(*Continued on page 62*)

This business-like rig is that of G3BS, Chelmsford, who has worked 73 countries in just over 12 months operating.

"Long Skip"

(*Continued from page* 61)

Conditions on the 14 and 28 mc. bands over the period of this month's survey (15th November-15th December) have been very erratic, with poor conditions predominating. The 7mc. band is getting very lively in the evenings with hosts of East Coast U.S.A., C.W. and West Indian and South American phone stations putting over strong signals. During these conditions on this band, it is comparatively easy to work DX on QRP GI3SP tells us that he has been receiving lots of R8 reports from Eastern U.S.A. on his 10 watt fone. We put forward the suggestion that if you work fone on this band during the DX hours, you call "Test DX 'phone or CW"—we understand a number of "W" C.W. stations have been calling our phone men without much success simply because the "G's" had no idea their signals were reaching the U.S.A. and were consequently not listening for C.W.

G6WU tells us that VP6MR (who you all know for his 14mc. phone signal) told him in a recent QSO that British phone signals simply swarm over to the West Indies from about 2230 GMT onwards and that he is now on 7 mc. most evenings looking out for "G" phones. We are not guaranteeing his frequency, but will be greatly surprised if it is not 7080 kcs. We have been hearing stories that FO8AA in Tahiti is active on this band between 0200 and 0300 G.M.T. If this tempts you to work overtime, you might also listen for K6DSF, Howland Island (7190 kcs.), K6NVJ (Jarvis Island) on 7187 kcs. and K6JEG (Baker Island) on 7015 kcs. (all CW)

G3BS was rather peeved to learn that his contact with OXVC cannot count as a new country. This is apparently an official A.R.R.L. ruling. Hector has now received his card for the QSO, on which the operator says that to avoid further disappointment his transmitter is now coming off the amateur bands. After his country list went down one point, Hector promptly got busy and has now raised his total to 75 countries worked. His latest is PK4KS in Sumatra. Apart from that, 3BS complains of bad conditions, his only other DX being ZS4AA, OQ5AS (14285 kcs. approx.) and a line of VK6's (all on the key). He has noticed Asiatic signals coming through around 0800 G.M.T. with the South Americans and lists most of the regular "J's" as being heard.

There is no need to tell you that PK4 (Sumatra) counts as a separate country as distinct from the other PK's. If you want this one, you should tune to 14100 kcs. Saturday afternoons from about 1330 onwards, when you will probably run across PK4DJ, who has a habit of getting over when the band seems comparatively dead.

G5ZG, like the rest, is complaining of poor hunting on both 28 and 14mc. His best on the latter band have been VU2FU, VK6ZO and HI3N. W. R. Jones, 2DGG, sends along a list simply teeming with DX, among which might be mentioned KA1ME (HF end of U.S. phone band), ZS4H (LF end), ZS3X (LF) and FB8AD (HF end) all on phone. 2DGG "blows off steam" in his letter about poor operating and we would like your views on the following "quote" from his letter: "Bad conditions are blamed, I am afraid, too often—the DX is there in my opinion, but "hams" are almost always after the loudest signal on the band. I heard Fi8AC calling "CQ British stations" the other evening until his throat was sore and not one station went back to him. They all seemed more interested in Europeans and other locals. I have noticed this hundreds of times, yet most "hams" in this country seem to possess super-super RX's."

Dennis Tyler, of Ilford, is still living up to his receiving reputation by logging VR2FF (Fiji) up the HF end, and ZP2AB (Paraguay) both on phone.

We had hoped to list the new Pacific Islands' prefixes this month, but space forbids, so they will appear next month. Happy 1939 to all, with lots of rare DX!

"An A.C. Frequency Meter"

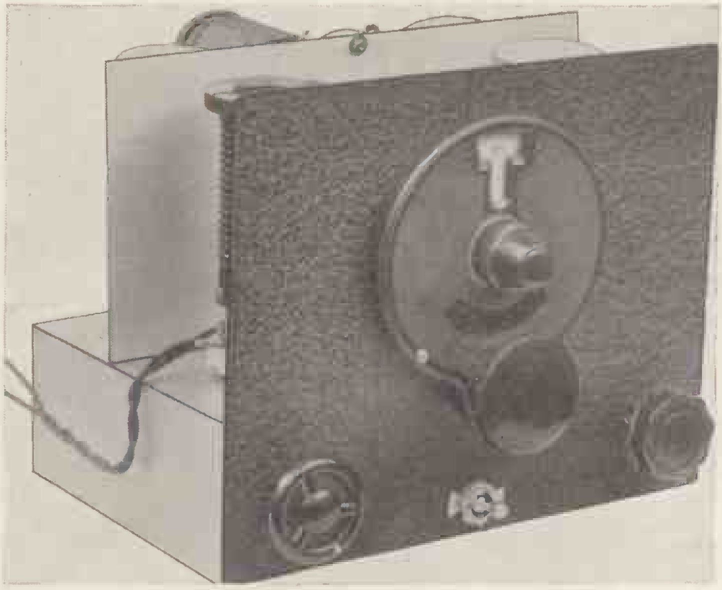
(*Continued from page* 50)

of any medium wave B.B.C. transmitter which can be received.

Those in the London area will probably use the London Regional transmitter, and this should be picked up by the main receiver. The frequency meter is set into operation and the trimmer condenser adjusted until the meter beats up the station picked up on the receiver. If this is carefully done, the meter will then be accurately calibrated according to the curve.

It is immaterial which station is used as a marker provided the second harmonic falls between the range of the meter. If a very accurate crystal is available, such as will be used in the transmitter, then this can take the place of the suggested marker station.

The complete cost of the meter, already wired and tested, is £7 10s. from Messrs. Peto-Scott, Ltd.



This is the new 3-valve receiver which uses the new E series valves.

A 3-valve Receiver for A.C. Mains

Coil data and the power unit are discussed in this concluding article, which first appeared in our December issue.

(*Continued on page* 64).

Components for A 3-VALVE RECEIVER FOR A.C. MAINS POWER UNIT SECTION.

CHASSIS.
1—Die-cast aluminium with terminal panels, type 1117 (Eddystone).

CONDENSERS, FIXED.
1—4-mfd. type 0283 (C1) (Dubilier).
1—8 plus 8-mfd. type 0289 (C2 and C3) (Dubilier).
1—.01-mfd. 4601/S (C4) (Dubilier).

CHOKE, SMOOTHING.
1—40/H (Sound Sales).

HOLDER, VALVE.
1—Side contact type VH24 (Bulgin).

TRANSFORMER, MAINS.
1—Giving 300-0-300 volts 60 mA.
3.15-0-3.15 volts 1.5 A.
2-0-2 volts. 2A. (Premier Supply Stores).

RESISTANCE, FIXED.
1—5,000 ohms type PR9 (Bulgin).

VALVE.
1—AZ3 (Mullard).

IN the December issue was published the constructional details of a 3-valve receiver covering all amateur bands plus the C.W.R. channel of approximately 116 metres. This receiver did not include the power unit which is built on an entirely separate chassis, but the same size as that of the receiver.

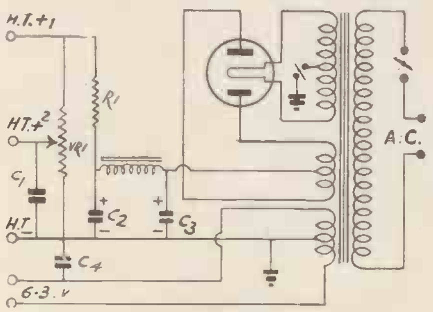
The second chassis is an aluminium die-casting and is quite large enough to take the few components needed for the power unit. The transformer recommended is a standard Premier unit providing 300 volts at 60 mA. and two filament windings. It will be noticed that there is only one smoothing choke which has an induction of 40 hys. at full load. This is shunted on either side by an 8 mfd. condenser shown as C2 and C3

"A 3-valve Receiver for A.C. Mains"

(*Continued from page 63*)

which are actually two condensers in one container.

The lower voltage tapping is obtained from a variable potentiometer, the slider of which is by-passed to earth. So as to keep in line with the E type valves used in the receiver, the rectifying valve with side contact base is used and this is a Mullard type AZ_3.



A power unit is required and here is the suggested circuit.

As there were slight traces of modulation hum, on strong signals, a condenser is shunted across the heater windings, and this completely removes the trouble.

The die-cast chassis is already drilled with suitable holes for the potentiometer, mains lead and voltage tappings, while terminal sockets for the voltage tappings are supplied with the chassis. The wiring is straightforward and can be seen from the circuit.

Coils should be home constructed and are approximately as follows:—For the first range covering 9 to 20 metres, primary two turns and the grid coil 2½ turns, aerial coil 2 turns; on the second range, covering 12 to 30 metres, primary 3 turns, grid 4 turns, aerial 4 turns; covering 20 to 47 metres, primary 4½ turns, grid 9 turns, earial 5 turns, with a tap at the 8th turn from the earthy end of the grid coil. To cover 45 to 100 metres, the primary 10 turns, grid 24 turns, aerial 10 turns with a tapping 1 turn from the earthy end of the grid coil. On the final band covering C.W.R. and the amateur top band, the primary coil 13 turns, grid coil 32 turns, aerial coil 15 turns and a tapping 1½ turns from the earthy end of the grid coil.

Components for A 3-VALVE RECEIVER FOR A.C. MAINS

CHASSIS.
1—Type aluminium No. 1117·8½ × 5¾ × 2⅜ (Eddystone).

CONDENSERS, FIXED.
1—.01 mfd. type tubular (C1) (Premier).
1—.01 mfd. type tubular (C2) (Premier).
1—.001 mfd. type tubular (C3) (Premier).
1—.0001 mfd. type mica (C4) (Premier).
1—.006 mfd. type tubular (C5) (Premier).
1—.006 mfd. type mica (C6) (Premier).
1—.005 mfd. type tubular (C7) (Premier).
1—25 mfd. 25 volt electrolytic (C8) (Premier).

CONDENSERS, VARIABLE
1—Type VC15X (VC1) (Raymart).
1—Type VC15X (VC2) (Raymart).

COIL FORMS.
1—CF6 (Raymart).
1—CF4 (Raymart).

DIAL.
1—Type Indigraph (Peto-Scott).

HOLDERS, VALVE
3—Type VH24 (Bulgin).

HOLDERS, COIL.
1—Type SW21 (Bulgin).
1—Type SW51 (Bulgin).

HEADPHONES.
1—Pair supersensitive (Ericsson).

PLUGS, SOCKETS, ETC.
2—Top cap anode connectors type T41 (Bulgin).
4—Parallel sockets (Clix).
4—Plugs, type 3 (Clix).

RESISTANCES, FIXED.
1—300 ohm type 1 wztt (R1) (Erie).
1—500 ohm type WE10 (R2) (Rrie).
1—500 ohm type WE10 (R2) (Bulgin).
1—250,000 ohm type HW 28 (C3) (Bulgin).
1—40 000 ohm type HW 22 (R4) (Bulgin).
1—100 000 ohm type HW 25 (R5) (Bulgin).
1—100,000 ohm type HW 25 (R6) (Bulgin).
1—150 ohm type 1 watt (R7) (Erie).
1—1 megohm type HW23 (R8) (Bulgin).

RESISTANCE, VARIABLE.
1—50,000 ohm potentiometer (VR1) (Reliance).

SWITCH.
1—Type S80T (Bulgin).

VALVES.
1—Type EF8 (V1) (Mullard).
1—Type EF6 (V2) (Mullard).
1—Type EL3 (V3) (Mullard).

A compiete kit of components can be obtained from Messrs. Peto-Scott, Limited, Webbs Rzdio, Limited, and Premier Supply Stores.

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The charge for miscellaneous advertisements on this page is 12 words or less 2/-, and 2d. for every additional word. Single-column inch rate displayed, 12/6. All advertisements must be accompanied by remittance. Cheques and Postal Orders should be made payable to Bernard Jones Publications Ltd., and crossed, and should reach this office not later than the 15th of the month previous to date of issue.

SUMMARY OF TELEVISION PATENTS

Continued from page 34.

(Patent No. 490,981.)

Method of producing light modulations by causing an electron beam to impinge on a number of bi-metal tongues which are deformable to extents depending upon temperature and which under the action of the scanning beam act as light valves. —*Zeiss Ikon Akt.*

(Patent No. 491,020.)

Cathode-ray tube incorporating a series of secondary-emission electrodes in addition to the usual scanning system.—*Fernseh Akt.*

(Patent No. 491,292.)

Method of preparing the sensitised mosaic-cell screens used in a cathode-ray television transmitter of the Iconoscope type.—*Marconi's Wireless Telegraph Co., Ltd.*

(Patent No. 491,389.)

Means for preventing "hum" in a multi-stage amplifier designed for handling the wide frequency bands used in television and driven from an A.C. source.—*Scophony, Ltd.*, and *J. H. Jeffree.*

(Patent No. 491,448.)

Cathode-ray tube with a sensitive mosaic screen to which positive impulses are periodically applied to restore the electrons lost by emission. —*Marconi's Wireless Telegraph Co., Ltd.*

(Patent No. 492,278.)

Saw-toothed oscillation-generator in which the discharge condenser consists of two pairs of electrodes enclosed inside a gas-filled tube.—*Marconi's Wireless Telegraph Co., Ltd.*, and *D. J. Fewings.*

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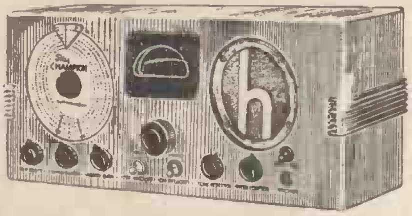

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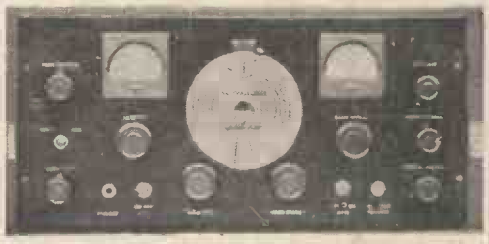

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