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Special Features

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IMPORTANT

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COMMENT OF THE MONTH

Television Demonstrations

WE have long held the opinion that most of the demonstrations of television that have been given have done more harm than good. At the best it can only be said that they have served to show the technical possibilities. They have, however, furnished no idea of the entertainment that television is able to provide and the reason is simply that little or no attempt has been made to stage these shows under home conditions. Large proportions of the audiences have of necessity been too far away from the receivers and they have not been able to view the programmes in comfort, with the natural consequence that at the best television has appeared merely a novelty.

As many demonstrations are now being given on dealers' premises it would be as well if those responsible were to realise that if a sale is to be effected, conditions as near to those obtaining in the home should be aimed at. The audience should be small and its comfort should be the first consideration. Any attempt to emulate cinema methods either as regards accommodation or presentation is to be deprecated, and above all crowding should be absolutely taboo.

The original idea of letting as large a number of the public as possible witness demonstrations has proved a fallacy from the point of view of encouraging sales, for it has simply meant that viewing conditions were totally unsuitable for the class of entertainment provided and the result has been disappointment.

It is gratifying to note that the large-scale demonstrations at the coming radio show are to be on different lines to former exhibitions. The proposed plans appear to be the only way of giving adequate publicity to television where large numbers of people are concerned.

Mechanical-optical Television

IN this issue we present the first of a series of articles on mechanical-optical methods for the experimenter. The apparatus described has been designed by Mr. J. H. Jeffree, a well-known authority on mechanical systems. New and ingenious ideas are incorporated which on account of their simplicity should be of considerable interest to that large body of experimenters who hitherto have been prevented from doing any serious work in this branch of television. The apparatus to be described is purely experimental, and in its present form will not compare with the modern cathode-ray receiver, but it is our hope that it will indicate a line of engrossing experiment for the amateur.

BAIRD STILL-PICTURE TRANSMITTER

In our April issue we gave a description of the DuMont Phasmajector and it was stated that this class of still-picture projector was the first of its kind. We learn, however, that as far back as August, 1936, the Baird Laboratories produced equipment that was essentially similar in character and of which the following is a description.

THE Baird still-picture apparatus was designed primarily for the production of television signals for testing both cathode-ray tubes and television receiver performance without in any way being dependent on an outside transmitter for the signals. To carry this into effect, the vision signal itself is produced through the medium of a special type of tube which to all intents and purposes is a modified form of cathode-ray tube as illustrated in one of the accompanying photographs.

The tube is of the hard type but in place of the usual screen of fluorescent powder at the end of the belled out tube section, there is mounted a nickel plate 3½ in. diameter on which is "printed" a picture 2½ in. by 2 in. so as to give the standard B.B.C. picture ratio of 5:4. The picture is a positive one, being made from a half tone block so that *both* half tones as well as black and white effects can be included in the picture. As will be seen from the photograph, the picture itself comprises the head and shoulders of a woman with a check blouse on, together with lettering and special test signals for checking the linearity of scan in a receiver.

Photograph of Baird tube employed for producing still-picture signals.

This particular tube is 24 in. long with a 4 in. diameter bulb and functions on the principle of varying secondary emission. That is to say, when the cathode-ray beam produced by the normal electrode assembly common to all Baird "Cathovisor" tubes is made to scan the picture on the plate, varying numbers of secondary electrons are released according to whether the beam is traversing the metallic portion of the plate or the special composition which fills the interstices of the metal.

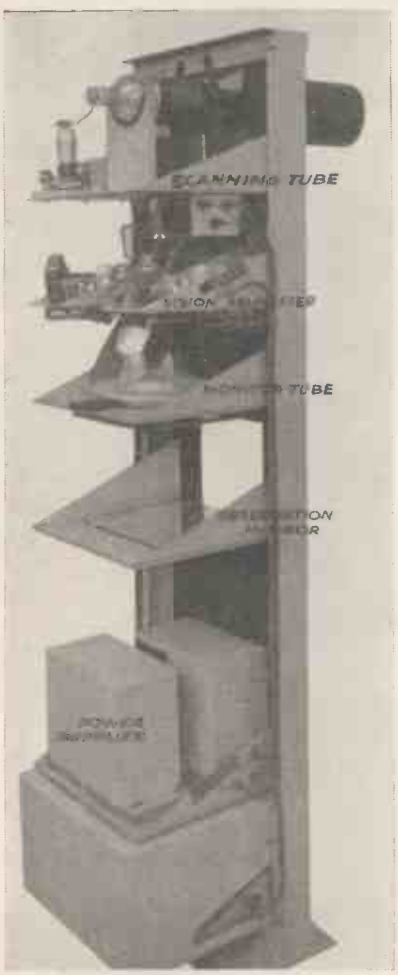
More electrons are released by the metallic portions than by the composition, and this varying secondary electron emission constitutes the picture signal, being picked up by a collector anode formed by metallising the inside wall of the tube.

A potential difference of 100 volts applied between the collector anode and the plate itself is found sufficient for this purpose, and the accompanying diagram gives in simple schematic form the main connections of the transmitter itself. The whole equipment is housed in two racks, one of which is shown in the accompanying illustration.

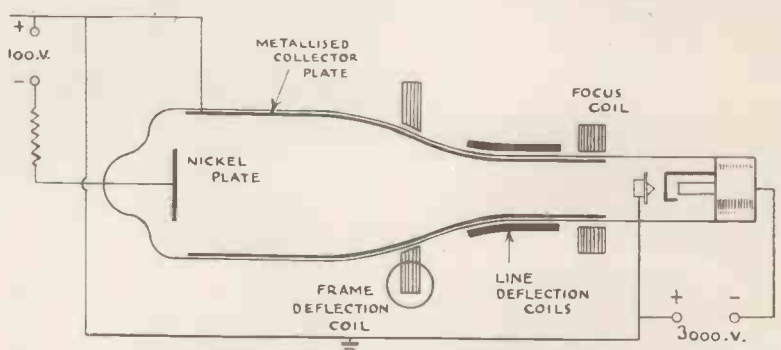
The tube complete with the standard form of Baird magnetic focusing is mounted in the top section of the rack together with a two-stage vision amplifier, the output from which constitutes the vision signal proper. Below this is accommodated a standard 12 in. Baird "Cathovisor" cathode-ray tube together with its associated time base generator, etc. This acts as a monitor tube, and, being mounted vertically, the picture built up on the screen of the tube can be viewed in a mirror mounted horizontally approximately 1 ft. from the tube face. With an arrangement of this character it is an extremely easy matter to watch the monitor picture while making any adjustments on the rack controls.

The necessary power supplies for this equipment are seen at the base of the rack and are quite standard.

(*Continued at foot of page* 341)



The Baird still-picture transmitter.



Schematic diagram of the Baird still-picture transmitting tube.

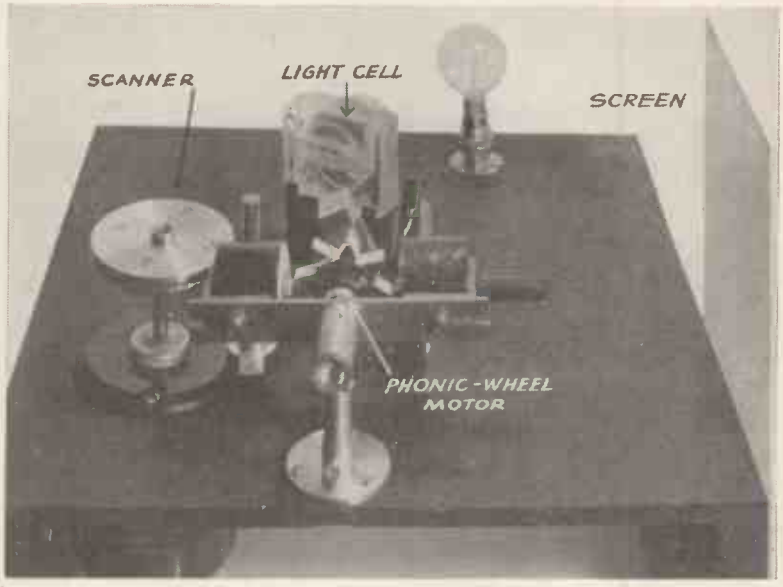
MECHANICAL-OPTICAL TELEVISION FOR THE EXPERIMENTER

By J. H. Jeffree.

In this series of articles it is proposed to show that, contrary to general opinion, there are distinct possibilities for the experimenter in mechanical-optical television. A complete receiver will be described and though it must be clearly understood that this is of an experimental type, it is hoped that it will prove the starting point for the development of mechanical-optical receivers which are within the ability of the amateur to construct.

WHEN the 405-line interlaced picture standard was introduced, many people thought that it would be impossible with optical-mechanical scanning methods. So far as the big companies are concerned, this has not proved to be the case. As far as amateur construction goes, however, it must be admitted that it does seem difficult now to do much with mechanical methods on the present transmissions. This is unfortunate, because there is probably still plenty of scope for development along these lines, and there is no reason why the keen experimenter should be content with building C.R. tube receivers only.

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



On the right is a photograph of a simple mechanical-optical receiver employing a new scanning device of very simple construction. Owing to its simplicity it will not give full definition, but it will be possible to use it on the present transmissions.

The difficulty is partly due to the average experimenter's lack of tools and research facilities; this will certainly prevent him from competing with the best professional developments. Moreover, since the commercial development of mechanical receivers is lagging a year or so behind the C.R. tube types, it is certainly unlikely that the amateur can at once build a mechanical receiver to equal a C.R. tube. On the other hand, a good many of the difficulties may be got round by "low cunning" if one knows what to aim at, and what to avoid, in planning one's experiments.

The writer believes that results of a sort should be obtainable fairly simply and cheaply by mechanical methods with the present transmissions, and proposes, in these articles to suggest a few ways of getting them. At the same time, he will try to explain in the simplest possible way the essential "theory" underlying the design of mechanical receiving arrangements, without which the chances of designing a successful receiver are very little more than nil. This theoretical basis is, of course, available to specialists already, in books, articles, patent specifications, etc., but is often expressed in forms far removed from the practical man's needs (whether specialist or amateur). However, the most essential parts of the laws governing light, synchronisation and so on can often be expressed in quite simple terms and applied in practice by use of the simplest arithmetic.

Present Problems

The main problems peculiar to mechanical methods are (1) light quantity, (2) driving and synchronisation, (3) necessary accuracy of construction. The present standards make all three quite difficult to solve!

To get the interlaced scan itself is not difficult, and there are various ways of doing it. To get enough (modulated) light needs attention to optical laws, and almost inevitably the use of principles such as "follow-up" (projection of a string of picture elements at once) which are only realisable, as yet, by patented methods. The *bona-fide* experimenter is not, however, prevented from trying out such methods for private work. As for synchronisation and accuracy of construction we must inevitably trust to cunning to get over the snags, at least till some enterprising manufacturer puts on the market a few accurately made mass-produced parts for amateur constructors.

Light

Since light is the most "theoretical" of our problems we will polish it off at once. Light on the screen is a matter of so many *lumens* per square metre, square

MAKING THE MOST OF AVAILABLE LIGHT

foot or the like: in practice one lumen per square metre gives, on ground glass, a useful picture, but more, up to, say, five lumens per square metre, is distinctly an improvement. That is a practical result of tests, and there is really no need for the amateur to work out calculations about screens. Their general behaviour is a commonsense matter of how far one can afford to spread out the limited quantity of light provided by the scanner. We will just touch on the essentials.

Screens

When the light beam is scanned over a screen, such as ground glass, the effect is to shatter it (the beam) into a myriad of independent rays, from the pits, threads, etc., of the screen. The more diffusing the latter, the bigger the angle over which these spread out, and the more people can comfortably view the picture at once, but also the less light each one of them gets. By reducing the diffusion (finer ground glass, oiling the screen, etc.) we get a brighter picture, viewed from the direct front, but fainter when viewed from the side; also there is a tendency to a " hot spot " in the direct line from the scanner to the viewer's eye, because most of the light is not diffused enough. In practice the diffusion of ground glass (or sandblasted, which is a trifle more satisfactory) is about as small as is desirable, and the picture, therefore, about as bright as can be got without special stunts; so that the minimum figure of one lumen per square metre is a fair minimum for any ordinary screen. The " thinnest " fabric screens are somewhat similar to ground glass in this respect.

There is no magic even in " stunt " screens. One can, for instance, reduce the diffusion vertically, so that an audience grouped horizontally all on one level gets more light each; one *can* also arrange to get a " hot spot " effect all over, from some particular viewing position (the beaded screen for front projection does this in a not-too-extreme way), but then people outside this position will see little.

For the tiny screens of experimental home receivers, such restricted angle effects would mean fixing one's head almost in a special viewing position) so the writer proposes to assume a diffusion angle at least equal to ground glass. That means that 1/100 lumen in the scanning beam will just about provide a 4-in. picture (if we can get so much).

Now for these "' lumens " ! The way to calculate them, for those who want to, is shown as simply as possible in the following paragraphs.

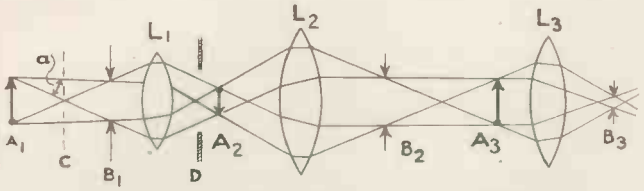


Fig. 1. The effect of lenses on a beam of light.

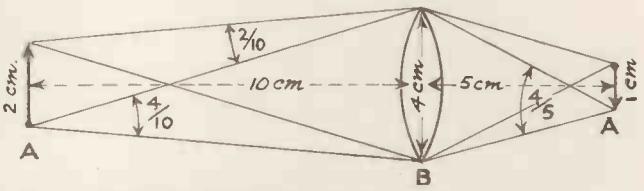
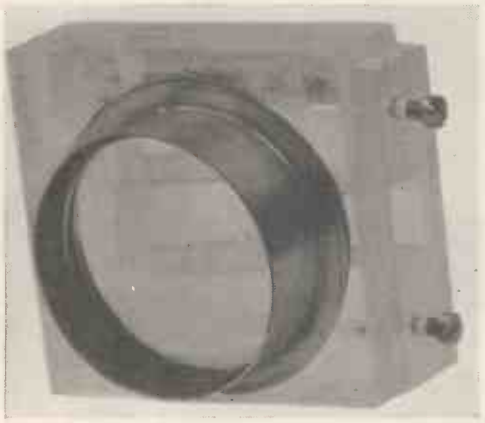


Fig. 2. Diagram explaining the selection of line systems.



A super-sonic cell is used and this also is of very simple construction. 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.

Light Quantity

Look at the " beam " of light shown passing through an imaginary optical system, in Fig. 1; it is an illustration of how beams in general pass through optical systems. A1 can be the " object " from which it starts, and A2, A3 are various images of this object; the B's are " pupils "; that is, one of them is an aperture or stop, and the rest are images of it: it does not matter which is the real one. The L's are lenses, but could be concave mirrors equally well, only that would make the drawing more complicated.

Now to get at light quantity, *always* start from one of the A's or B's; an object, stop, or one of their images. Suppose we start from A, and imagine it is the glowing surface of a light source. Obviously, the amount of light the beam gets from it depends upon its *size*: and also on the *brilliance* with which it glows —that is, its intrinsic brightness. Those are two factors which have to be multiplied together: is there yet a third? Yes, obviously ! The bigger the *angle, a,* of the light proceeding from *each point* of the source, the greater the light quantity.

This shows the importance of selecting an " A " or "B" (in our diagram) to start with. We could, theoretically, compute the light at the point C; but while the width is definite, the angle through each point of the width varies from a big cone in the middle to a single grazing " ray " at the edge, and would have to be carefully averaged. Always select an object, stop, image or pupil.

It does not matter which, so long as it really defines the beam and is not, like D in the figure (1) a mere mechanical extra. (That is a point to beware of, however !) By optical laws, if one genuine "A" or "B" point in a continuous beam is bigger than another, the angle of the light cones through it will be proportionately smaller, so that the product of width × angle

LOSSES IN LENSES

remains constant. Therefore, choose the most convenient.

Fig. 2 is a simple illustration of this point; the width × angle is 0.8 at both A's and at B. (Because the second A, being half as far from the lens as the first, is half as big: and the rest is simple geometry). Note that the angles are measured in radians; 2 cm. spread in 10 cm. distance is 2/10 radians, and so on (near enough!). Similarly, "F/3" means a cone of 1/3 radians.

Now take the other dimension: if Fig. 1 is a plan view, let Fig. 3 be the elevation. In practical television it is likely to be quite different: for instance, the lenses

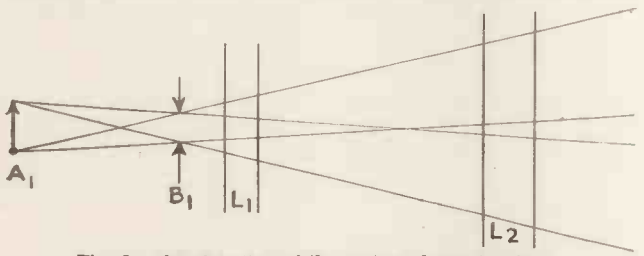


Fig. 3. An elevation of the system shown in Fig. 1.

may be all cylindricals (as shown) and have no effect in the vertical direction, and the sizes (and even positions) of the A's and B's may be quite different. Never mind: take them as they are in this dimension, forgetting all about the other for the time: for instance, take width (centimetres) × angle (radians) at B_1.

Now the Light Quantity is width × angle (horizontal), *times* width × angle (vertical), *times* intrinsic brightness of the source (in this case A_1). *Widths* in centimetres; *angles* in radians; intrinsic brightness in *candle power per square cm.* Result: quantity of light in *lumens*.

That is the foundation of practical light calculations in scanning beams. If we had to deal with large angles, approaching a hemisphere, it would not be strictly correct; (then trigonometrical expressions must be used and it is no longer simple) but that is not necessary for our purpose. There now remain only two commonsense corrections to make, when necessary, to the result.

We have tacitly assumed that the beams are rectangular in shape. If the object or stop is round (circular or elliptical) its area is $\frac{11}{14}$ times that of the rectangle, so multiply the light by $\frac{11}{14}$ (0.79). If *both* are round, multiply by $\left(\frac{11}{14}\right)^2$ (=0.62). That is the first correction.

Transmission Losses

Every lens or mirror loses light, lenses mainly by reflecting a little back, mirrors by absorption. Ten per cent. loss (90 per cent. transmission) per simple lens, or silver, rhodium or aluminium surfaced mirror, is an approximate figure, allowing a trifle for dirt, imperfect transparency, etc..

Back-silvered mirrors are about equal to two lenses, and steel (chromium, etc.) mirrors roughly to four or five. Count up, therefore, the number of simple lenses the whole system is equivalent to, on this basis; take 90 per cent. to this power, or look it up below, and that is the approximate transmission through the system. Multiply the light quantity by this, and that is all!

1 "lens"	90% transmission	11 "lenses"	32%
2	81%	12	28%
3	73%	13	26%
4	66%	14	23%
5	59%	15	21%
6	53%	16	19%
7	48%	17	17%
8	43%	18	15%
9	39%	19	14%
10	35%	20	12%

Now two mistakes are common enough to deserve mention. One is, to take the angles and widths of an immense beam of light issuing from a light source, in blissful disregard of the fact that 99 per cent. of it will be stopped by some part of the optical system further on: e.g., by the scanner. People imagine, "I can concentrate it down with a lens, to make the scanner accept it all." Yes, but then the angle is proportionately increased, and, as we shall see in dealing with scanners, there are limits to the angles they will accept for a given definition standard. The scanner and the light modulation usually set the limit to beam size: whichever limit is the smaller (width × angle) in either direction, has to be taken for that determines the maximum continuous beam through the system.

The other is to take a light source with gaps: e.g., a W shape filament, and not allow for the gaps, which make the *average* intrinsic brightness lower than that

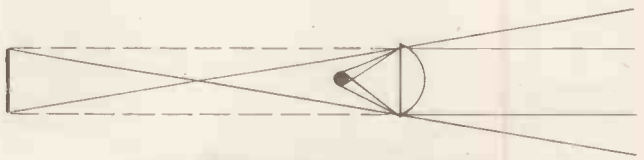


Fig. 4. A point light source is desirable.

of the filament itself. In television practice start from a source as continuous as possible, e.g., a close coiled filament (exciter lamp: motor head light, etc.) and, if a bigger beam is wanted than can be taken from it directly, start it small, with a big angle, and bring it to the desired shape with a lens: for example, as in Fig. 4. In the small beams usually needed in simple television receivers, this gives more light than starting directly from a large group of bunched filaments with gaps between them.

Much the same applies to high pressure mercury arcs, where high *intrinsic* brightness is got by keeping the size of the discharge down, in proportion to power. That, in fact, is the essence of what is desirable in television light sources:—The highest possible *intrinsic* brightness, quite apart from total "candlepower."

In next month's issue practical apparatus shown by the photographs will be described.

THE SPIRIT OF TELEVISION IS INFECTIOUS—

SAYS POUISHNOFF

IN AN INTERVIEW WITH WILSON G. LYLE

IT was on account of the artistic possibilities of television from a musician's point of view that I was interested in Leff Pouishnoff's performance of the Liszt Concerto in E flat, from Alexandra Palace. This fine pianist's identification with it indicates that the medium of television is fast outgrowing its speculative stage. When I raised the subject with Pouishnoff recently, it seemed inevitable that he should mention broadcasting conditions of fifteen years ago in relation to those of television to-day because then, as now, he was an explorer of the new method in the cause of his Art. The "step-child" of the B.B.C. (as Pouishnoff aptly described television) had not until recently resources other than the allowance granted from the none too indulgent parent.

A seasoned artist to broadcasting and recording, Pouishnoff confessed that the engagement gave him more than usual thought between its acceptance and performance. It was something new, offering vast and relatively unopened vistas, and altogether a solemn occasion. He arrived feeling very apprehensive, yet thrilled with the expectancy of a new experience.. That expectancy materialised when he entered the studio, a vast room, its size dwarfed by the presence of much apparatus and many cables.

Frantic Activity

That was not all. The atmosphere was charged with frantic activity—scene-shifters clearing away after the previous item, operators, and others engaged with infectious industry. His bewildement abated somewhat when the studio was set for his performance, but not his nervousness. At last he was seated at the piano which, although not of his favourite make, was used because it is tuned permanently with the microphone and is, moreover, painted specially to be suitable for vision transmission.

"The producer had previously marked certain points of interest in the score," Pouishnoff said, "so that the cameramen could take close-ups of, say, a particular group of instruments at a particular passage. There were two cameras, one semi-rigid for taking views of the soloist from all angles by swivelling, and one mounted on a pneumatic-tyred trolley that could be moved up and down the studio at will, to take in the orchestra, conductor, and even soloist, all in one if necessary.

Sound Rehearsal

"The first rehearsal—for sound—lasted three-quarters of an hour, during which time the producer noted opportunities for detail views of the soloist; for instance, my hands doing some particular passage work or octaves; or perhaps the feeling of the music by facial expression. You will understand the work and strain of the camera rehearsal which followed after a short break and lasted for a similar period. For me it was strenuous.

"Then the actual performance. I am familiar with the demands for aural perfection in recording and broadcasting, but on top of the exhausting rehearsals I was now facing something more complicated. My audience would not only expect to hear every note, but they would see me, watch my hands, my expression —everything would be open to study. I found it quite a feat to bear this in mind, and at the same time give the music the interpretation it requires."

A New Technique

Watching, I had a vivid impression of the great pianist undertaking a severe task in three distinct sections (and I know that it was severe from his ever scrupulous attention to detail), in a studio teeming with bewildering activity, and in an atmosphere where details are so important and of such involved nature. That great support was given to him by the staff is shown in his remark that he had "great admiration for the people who worked there, for their enthusiasm."

There is no question but that this item of television was successful, and from a musician's view an artistic achievement which should not be an isolated instance but the forerunner of other like attempts.

All cathode-ray tubes are tested to withstand a pressure greatly in excess of the atmospheric pressure under which they normally are used. This picture shows a tube about to undergo a pressure test at the Philips' works at Eindhoven.

THE LONDON TELEVISION SERVICE

SOME LITTLE KNOWN FACTS REVEALED IN A PAPER READ BEFORE THE INSTITUTION OF ELECTRICAL ENGINEERS

By T. C. Macnamara and D. C. Birkinshaw, M.A.

This is an abstract from the second of two important papers read before the Institution of Electrical Engineers on April 21st. The first, on the Marconi-E.M.I. Television System, was published in last month's issue. We acknowledge the kind permission of the Institution to publish these abstracts.

This paper is divided into six parts, as follows:—

PART 1. Early Television and the 30-line Experimental Service.
  (a) Brief historical survey of early television activities.

PART 2. Events leading to the establishment of the Alexandra Palace Station.

PART 3. General Design of the Station.

PART 4. Description of Equipment.

PART 5. Outside Broadcasts.

PART 6. Performance of the Station.

THE paper gives a general description of the London Television Station and touches upon past experience with experimental 30-line transmissions. It discusses the circumstances influencing the Television Advisory Committee's recommendations regarding the establishment of a high-definition service, and the subsequent factors of definition, and the Alexandra Palace site. The following is an abstract of the salient points in a very exhaustive review of the London television service.

Choice of Wavelengths

The choice of a working wavelength for the vision transmitter was largely dictated by the very wide band of frequencies to be transmitted, as it would clearly be impossible to modulate any but an ultra-short wavelength with such a band of frequencies.

In general it is not practical to operate a radio transmitter if the ratio of carrier-wave fundamental frequency to the modulating frequency is much less than 20/1, otherwise the problem of ensuring adequate response at the side-band frequencies becomes too complicated.

This being so, a carrier wave frequency of 40 to 50 mc./sec. is required for high-definition television, as it is called upon to accommodate modulation frequencies having an upper limit of about 2 mc./sec.

The Post Office allocated the band between 40.5 and 52.5 mc./sec. for the purposes of television, and the Television Advisory Committee decided that the London station should radiate vision on a frequency of 45 mc./sec.

Electrical Supply

The electricity supply for the Alexandra Palace Installation is taken from the North Metropolitan Electric Supply Co.'s system. A ring main in the form of two feeders exists between the Alexandra Palace local substation and the Wood Green traction substation via the supply company's substation at Ringslade Road. The Wood Green substation in turn is fed by alternative routes from the supply company's power station at Brimsdown, and thus continuity of supply is amply assured. Supply is at 11 kV, 3-phase, 50 cycles per sec., and distribution is at 415 volts, 3-phase, 4-wire, with earthed neutral.

Acoustic Treatment of Studios

The two main studios are 70 ft. long, 30 ft. wide, and 27 ft. high, and their acoustic treatment has called for careful consideration.

It was considered that the acoustic properties desirable in a studio intended for television should differ from those sought after in a studio exclusively used for sound broadcasting.

In the latter case, the ear is the only criterion of the reproduced performance, and the effect produced can be materially enhanced by the artistic introduction of a certain degree of reverberation or echo. Such effects, however, require careful arrangement of the performers before the microphone so that a pleasing balance of sound is obtained. Moreover, the degree of reverberation which is acceptable varies widely with the type of performance—thus a studio suitable for a variety performance would not be suitable for a symphony orchestra, and, in general, different studios are used for different types of programmes. Above all, the placing of the performers from an appearance point of view is a matter of complete indifference in sound broadcasting, so long as a correct sound balance is maintained.

In the case of television, however, it is an entirely different matter, as the proper location of performers from the point of view of appearance is of paramount importance in the interests of artistic production, so that sound requirements must, of necessity, be subservient to this consideration. Added to this, it is not at present economically possible to provide a series of studios of divergent acoustic properties, each fully equipped with the manifold requirements of television.

Consequently, studios designed for general purposes were required, adapted for a wide range of scenic presentations varying from an intimate *tête-à-tête* to an elaborate and extensive production. In order that the

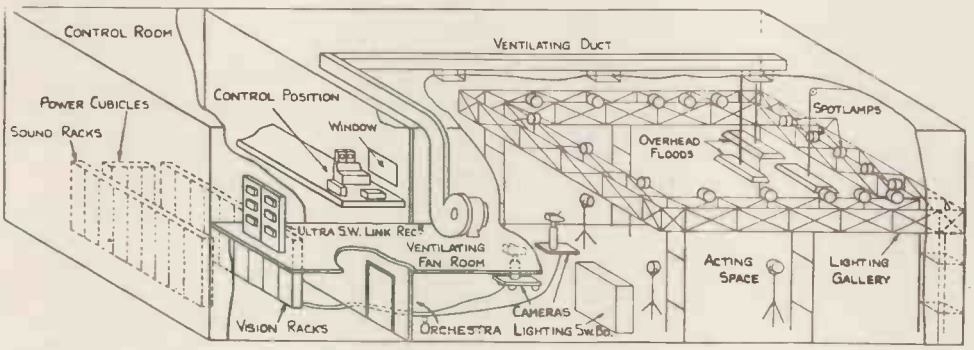
LIGHTING THE STUDIOS

sound accompanying scenes of such widely divergent character should be of uniformly good quality, and in the absence of much experience in television technique, it was thought desirable to design the acoustics of these studios on the basis of film-studio technique, that is to say, to make them as little reverberant as possible, and to allow the temporary sets built up as scenery to provide local reverberation for each particular scene. Film-studio practice is to cover as much as possible of the walls and ceiling with a highly absorbent material such as mineral wool. A convenient and less expensive alternative was found in the form of 2 ft. square slabs of asbestos felt about 1 in. thick. The original specification, therefore, was to cover the whole of the wall and ceiling surfaces with this material, stuck in contact with the plaster work. A form of sound-proof shutter was specified for the windows, consisting of a wooden framing, boarded on both sides, pugged with sawdust, and covered on both sides with canvas covered acoustic quilt. The floor was to be untreated acoustically.

satisfactory for television, and lens and mirror spotlamps in powers of 500, 1,000, 2,000 and 5,000 watts, together with multiple lampfloods of from 3,000 to 15,000 watts, have all found their place in the television studio.

It has been necessary to modify to some extent the arrangements for ventilation in some types of lamps, as previously remarked, in order to cater for the longer periods of operation involved in television as against the use for which they were originally designed, viz., the film studio.

Arc-lamp illuminators have not been used to any great extent up to the present, chiefly on account of their tendency to give sudden fluctuations in the total amount of light falling on the scene, a feature which is very objectionable from the television point of view. In addition, the fumes from arcs are inconvenient if they have to be operated for lengthy periods in any but a very large studio, and also they require frequent attention during production.



Diagrammatic layout of studio and control room, showing arrangement of production lighting.

Production Lighting

The lighting of studio scenes for television presentation appears to demand the development of a technique which, while akin to both theatrical and film-production lighting technique and embodying something of both, nevertheless is not exactly similar to either in its entirety.

The reason for this lies in the fact that a television programme is in effect produced before an audience, just as is a stage production, and, consequently, equal continuity of action is necessary. The condition is therefore imposed that the production lighting must, in the main, be on continuously from start to finsh, as in a stage presentation; and not intermittently as in usually the case in film studios, where isolated scenes are recorded and afterwards edited and knit together into a continuous whole.

This fact brings several difficulties in its train. First, all production lighting supply equipment must be rated to operate over comparatively long periods; secondly, the projectors and floodlights must themselves be capable of dealing with the continuous dissipation of power involved in high-intensity lighting.

In general, the types of incandescent studio illuminator used for film-studio work have proved equally

The supply to all incandescent lamps has been standardised at 110 volts, being the voltage used by almost all film studios, and hence bulbs are readily obtainable in all wattages at this voltage.

The advantages which, in general, have led to the use of 110 volts instead of a higher voltage, are manifold. Amongst other things the use of low-voltage high-current lamps has resulted in a smaller filament structure which is more rigid and hence less fragile, and also approximates more closely to a point source.

In order to reduce ventilating problems and give more comfortable working conditions for the artists, attention has been turned to lamps of the water-cooled gaseous-discharge type. Experiments will be carried out to determine the suitability of this type of illumination. The actual arrangement of lighting units for any given scene in the studio approximates very closely to that adopted for a similar scene in a film studio.

A certain general level of lighting is attained by the use of floodlamps, after which the artists and scene to be televised are lit in detail by means of spotlamps, the exact arrangement and direction of lighting depending a good deal on the nature of the scene. High-angle lighting from the top, back, and sides, is used to give depth to the scene, and modelling achieved by the use of further spotlamps judiciously placed at floor level. Delicate shading on the features of artists in close-up

OUTSIDE BROADCAST GEAR

is achieved in general by the use of low-intensity diffused frontal lighting.

Lighting for television has something in common with lighting for the production of film by some colour processes, in that a fair amount of attention has to be paid to uniformity of illumination. This implies that a good deal of care has to be taken to avoid excessive overlapping of the illumination areas of several spot-lamps.

Studio Ventilation

The ventilation of a television studio is a matter which requires some consideration and, in general, involves problems which are not met with in the broadcasting studio and probably only to a lesser degree in the film studio.

In order to ensure adequate ventilation it is necessary to change the air in the studio with sufficient rapidity to carry away the heat due to production lighting without the introduction of noise from the ventilating machinery, which would be picked up by the studio microphones.

Balanced television cable route in the West End.

Ideally, of course, the studio should be provided with conditioning and refrigerating machinery in addition to the mechanism for changing the air, so that when the outside temperature is high in summer, the incoming air may be quite clean and cool before its introduction into the studio. In the case of the Alexandra Palace installation no refrigerating machinery is provided, as it was felt that it was justifiable to dispense with it on economic grounds.

Each studio is provided with a separate ventilating system, the two equipments being similar in construction and disposition. Ventilation is effected by extracting the heated air from the upper part of the studio through three square grilled openings situated on the centre line of the ceiling and equally disposed along the length of the studio.

These outlets are connected by sheet metal trunking, lined with acoustic board to minimise the transmission of noise, to a centrifugal fan capable of a maximum continuous duty of 10,000 cu. ft. of air per minute, giving approximately 12 changes of air per hour.

The exact manner in which the studios would be arranged from the point of view of the television apparatus calls for very careful consideration, and it is essential that each should form part of a cognate scheme of working, which, although it might not be possible on economic grounds to complete at one time, could be gradually built up as time goes on.

Such a scheme has therefore been drawn up. It provides that each studio should be a complete unit with full production and rehearsal facilities, provision of film-scanning apparatus and everything necessary for the production and monitoring of a televised performance or rehearsal, with accompanying sound.

The outputs from all studio units would then be brought into a central control room where facilities for pre-viewing the picture and pre-hearing the sound from each studio would be available, and a master-control position would be established. The master-control position would be provided with means for fading from one studio to another, both vision and sound as required or making such superimpositions or dissolves as necessitated by the nature of the programme.

A further function of the proposed central control room would be to carry out introduction into the radiated programme, at appropriate times of television, outside broadcasts coming from points remote from Alexandra Palace.

In addition to the central control room, it is considered desirable that a centralised synchronising signal-generating equipment should be provided, so that all sources of vision signal local to Alexandra Palace would be supplied with synchronising impulses from a common source and superimposition of one upon the other could be carried out without difficulty.

Outside Broadcasts

The televising of national ceremonies and open-air events of sporting and topical interest is perhaps one of the most useful functions which a television service can fulfil. Such events can be divided into two general classes:—

(a) Events which can be brought within close proximity to the television station proper but not actually into the studio itself.

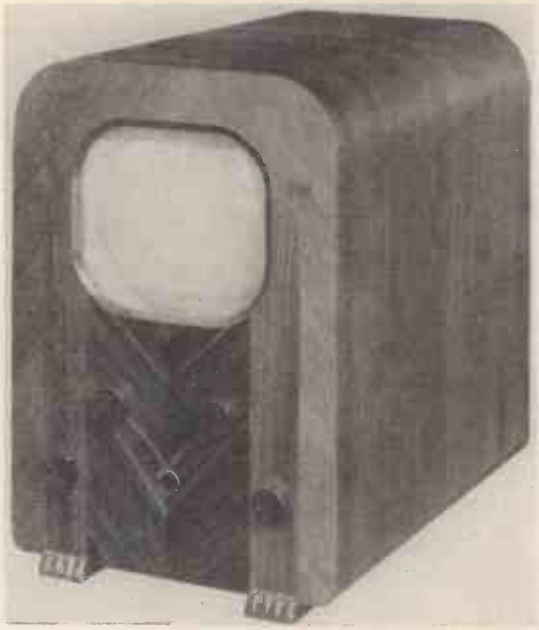
(b) Events which by their very nature occur at some point remote from the transmitter.

The events classed under (a) are such things as demonstrations of horsemanship or golf, and displays of physical culture. These obviously cannot be done in the confines of a studio, but it can be arranged that they take place within a selected area close to the actual television site. Such events are classed as local outside broadcasts, and their televising can be accomplished by an extension of the internal studio facilities. In general it may be said that the maximum allowable length of camera cable which can be used without running into serious technical difficulties is approximately 1,000 ft.

(To be concluded next month)

ADDING VISION TO YOUR RADIO SET

Here are details of the G.E.C. vision unit which is designed for use in conjunction with the ordinary broadcast receiver for the provision of the sound portion of the television programmes. The unit provides a very inexpensive method of receiving the television programmes.



The G.E.C. vision unit. Model BT 8090.

THE problem of reducing the cost of the television receiver has been given a great deal of attention of late for it is realised that price is bound to have a great influence on sales. It has become increasingly clear that economy in production cost is only possible in certain directions—one is reduction in the size of the picture and the other is by effecting certain economies in design. Unfortunately an idea prevails with the public that prices will be automatically reduced as the demand increases and people are apt to draw a comparison with the early days of broadcasting. It should be remembered, however, that the modern television receiver largely employs the standard type of components and valves used in ordinary broadcast receivers. Production of these has been developed to such an extent that any material saving in this respect is out of the question.

There seems very little doubt, therefore, that price reduction is only possible on the lines suggested above, a view which the G.E.C. have taken in producing a receiver in which economies are effected by employing a smaller screen and a design which provides for the use of the receiver in conjunction with an ordinary broadcast set to supply the sound side of the television programmes. The advantage from the price point of view is obvious, for the ordinary television sound receiver is eliminated and in its place is used a simple arrangement included in the vision receiver cabinet for provision of the sound in conjunction with an ordinary receiving set.

No alteration whatever to any existing broadcast set is necessary. A single wire connects it to the G.E.C. vision unit, and while the television pictures can be seen on its "screen," the accompanying sound is simultaneously reproduced by the loudspeaker of the broadcast receiver.

Excellent Pictures

Brilliantly clear black-and-white pictures are produced on a "screen" measuring $7\frac{1}{4} \times 5\frac{3}{4}$ in.—large enough for all the family to watch—with a degree of definition and brightness that shows up every detail.

There has been a considerable amount of adverse criticism regarding television picture size generally. Undoubtedly this has been partly due to the many public demonstrations that have been given where the programmes, of necessity, are viewed by a fairly large audience under conditions that do not obtain in the home, where in all probability the maximum number looking-in at any one time will be half-a-dozen. With a small screen receiver the definition is generally better than is the case with very large screens and in any case it provides a comfortable viewing distance of about 6 ft. It would be idle to pretend than a small-screen receiver is *better* than a large one, any more than a baby car is better than a full size model; but a small screen receiver provides adequate entertainment for home use and, as stated above, provides the real solution to the problem of low first costs and economical maintenance and running. It is calculated that the G.E.C. vision unit can be operated for a period of five or six hours with a single unit of electricity.

Circuit Arrangements

The vision receiver comprises a 15-valve unit incorporating a 9 in. cathode-ray tube and reproducing a picture $7\frac{1}{4}$ in. $\times$ $5\frac{3}{4}$ in. As mentioned it is intended to be used in conjunction with any standard radio receiver, the sound associated with the vision being reproduced by the receiver.

Connection is made to the radio receiver from a tuned circuit in the anode circuit of the frequency changer, the first valve in the vision unit. This circuit is tuned to such a frequency that the sound carrier beating with the local oscillator causes a signal having a wavelength of 550 metres approximately, to be injected into the input of the radio receiver, which is tuned to the upper limit of the medium waveband.

The vision signal is developed across the primary winding of an I.F. transformer which has a mid-band frequency of 3.5 mc. and a bandwidth of 3 mc. Four stages of I.F. amplification are employed. Demodulation is performed by a balanced detector circuit employing two diode valves. The signal is then fed to the control electrode of the cathode-ray tube having first been subjected to a further stage of amplification.

The time base circuit embodies two gas-filled relays and two low frequency amplifiers for amplification of the synchronising impulses. Electrostatic scanning is employed and the high and low frequency impulses are applied to the "X" and "Y" plates of the cathode-ray tube respectively.

Focusing of the beam is also electrostatic.

The power pack includes two rectifiers, one for the H.T. for the re-

(*Continued at foot of next page*)

TELEVISION SOUND PROGRAMMES

VERY few of the programmes transmitted from Alexandra Palace are heard by listeners on the medium and long wavelengths. So far only two of the television programmes have been relayed to Regional or National listeners so that listeners cannot form much idea of the rapid strides that are being made in programme composition at Alexandra Palace.

During the past few weeks a number of programmes have been transmitted which have been considerably better than anything heard from the National or Regional stations. To quote as an example, the stage shows put on by Jack Hylton, Ambrose, and Jack Jackson were extremely fine and would have been quite suitable for listeners without the additional aid of vision.

These stage shows were almost identical with the performances seen by theatre goers and were a vast improvement over the normal transmission of dance music on medium waves.

Exceptional Quality

A very large percentage of the television programmes are suitable for ordinary listeners while music lovers would very much appreciate the remarkable transmissions of the London Music Festival with the B.B.C. Symphony Orchestra conducted by Toscanni. These programmes have been transmitted on the Alexandra Palace sound channel. This is the first time the B.B.C. have transmitted special high fidelity programmes, and the reproduction is very striking and realistic. Owing to the wide band width available with this sound transmitter, all musical frequencies are radiated with very little distortion or attenuation.

While many people are unable to afford a complete television receiver, and many are outside the service area as regards picture reception, it is a very good investment indeed to have some simple type of receiver merely to pick up the sound programmes.

This then lets the ordinary listener hear those television programmes, which can be appreciated without vision. We have in mind the orchestral relays, plays, and even outside commentaries such as the complete relay from Kennington Oval of the last Test Match.

While listeners on medium waves will be hearing short commentaries of the Test Match, viewers will be able to see and hear every ball bowled from the beginning to the end of the match.

Any listeners with a simple short-wave convertor, which can be added to almost any existing receiver, will be able to hear these programmes. As the cost of a convertor need not exceed 25s. for a mains operated type, the slight expense is more than warranted. A battery-operated convertor would be even cheaper and it must be remembered that the sound programmes can be picked up at distances in excess of 100 miles.

Suitable convertors have been described in this journal from time to time, but we shall be only too glad to advise readers of apparatus particularly suitable for their particular requirements and locations.

Readers who are situated at a long distance from the transmitter may, of course, require a more sensitive convertor, but in no circumstances, is it necessary to use more than two valves.

A TELEVISION RADIOLYMPIA

A CHANGE is to be made at Olympia this year. The familiar theatre where visitors were able to see their favourite radio stars in person is to give way to a gigantic television studio on the lines of the original Alexandra Palace studio.

Demonstrations of television receivers will be made all day, and not merely at infrequent intervals as was the case last year. The B.B.C. will be transmitting programmes actually from the studio at Olympia which viewers will be able to see from any point in the service area by the aid of a modern vision receiver.

At the same time most manufacturers will have receivers working so that visitors will be able to see the artists in the television studio and then to see them via radio on any of the vision receivers on the stands.

This is the first time that manufacturers will be able actually to demonstrate their products and visitors will be enabled to form some conclusion as to the merits of the various receivers and to see for themselves what strides have been made since the last show.

For many visitors this will be the first time that they will be able to look-in under normal conditions for only a very few were able to gain admittance to the demonstration booths last year.

The need for darkened rooms when demonstrating television receivers has passed for the new brilliant screens provide vivid pictures in almost normal lighting.

The ordinary radio receivers will also be demonstrated this year, for arrangements have been made for visitors to hear the receivers actually working on the stands. This radio show will in fact serve as a real guide to the new receivers instead of being just a cabinet show as in the past.

In order to include all phases of the entertainment and musical industry there is to be a piano and music section. Also included is a section devoted to test instruments which should please the service engineer and experimenter.

Altogether this 1938 Radio Show should be the best ever and will have something to offer to visitors which they have not previously been able to see elsewhere.

"ADDING VISION TO YOUR RADIO SET"

(*Continued from preceding page*).

ceiver and the other for the time base and cathode-ray tube.

Controls

There are four controls on the front of the set. These are (1) tuning control, employed for tuning-in the vision signal; (2) brightness control and mains switch for switching the unit on and controlling the average brilliance of the picture; (3) contrast control, for modifying the contrast between the light and dark portions of the picture, and (4) line-frequency control.

Mounted on the back of the unit are pre-set controls which only require adjustment when the unit is installed. It is quite unnecessary for them to be touched at all in the ordinary operation of the set. They are as follows:—L.F. amplitude control, H.F. amplitude control, synchronising amplitude control, focus control, L.F. centring control, H.F. centring control, sound receiver coupling trimmer, and frame frequency control.

The price of the G.E.C. vision unit is 30 guineas, and it may be had on exceptionally low deferred terms.

ADJUSTING AND OPERATING THE SIMPLEST HOME-BUILT TELEVISOR

Here are the instructions for the adjustment of the Simplest Home-built Televisor which employs a 4-inch tube. Full constructional details of this receiver which was designed by S. West, were given in the three preceding issues and it is guaranteed to provide a picture of wonderful clarity and definition.

WITH the constructional work of the televisor completed and the various units connected in the correct manner as has been indicated in the preceding articles of this series, the adjustment of the receiver may be made.

Firstly, the tuning of the vision unit is desirable.

Remove the fuse in the primary circuit of the Keston transformer T1 and connect headphones to the tube modulation terminal and to earth on the three-way terminal strip at the side of the vision unit. It is preferable to include a 0.1 mfd. condenser in series in order to isolate the phones from direct current and to avoid disturbing the value of the load resistance of the D.C. restoring diode. The two terminals above referred to are the outside pair. The power supply may now be switched on and after a short interval, when the various heaters have acquired operating temperature, the tuning of the vision unit may be commenced.

With an insulated trimming tool, which is conveniently fashioned from a thick knitting needle, the two trimmers are adjusted to give maximum signal from the vision carrier.

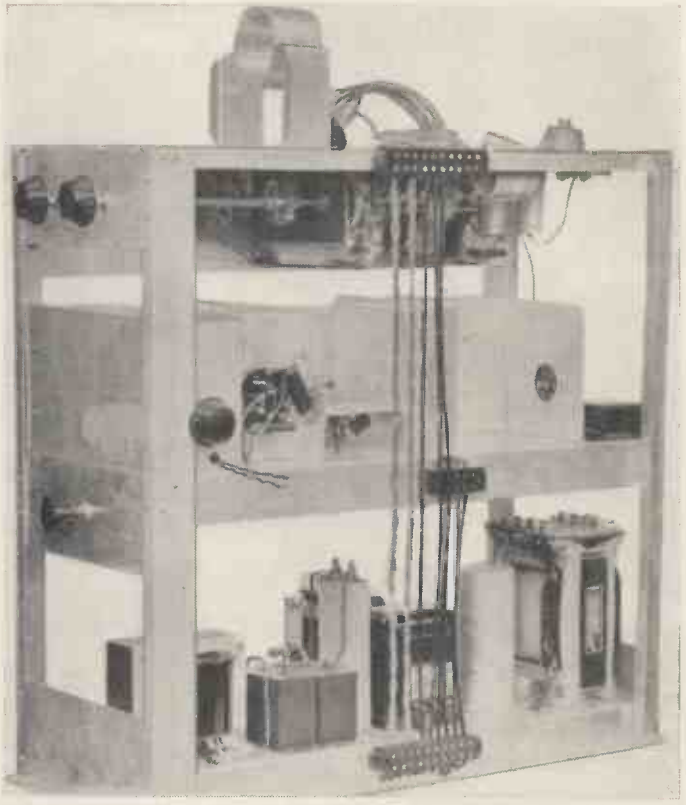
The adjustment will be found fairly critical and some care in arriving at the correct setting should be exercised. It is preferable to reduce the gain control to minimum during these adjustments as this will ensure greater accuracy. The aerial tuning condenser, which is in the first compartment, is adjusted concurrently with the trimmers.

With these adjustments completed, quite a large signal should be obtained. Operation of the gain control can be checked and this will complete the tuning adjustments for the vision unit.

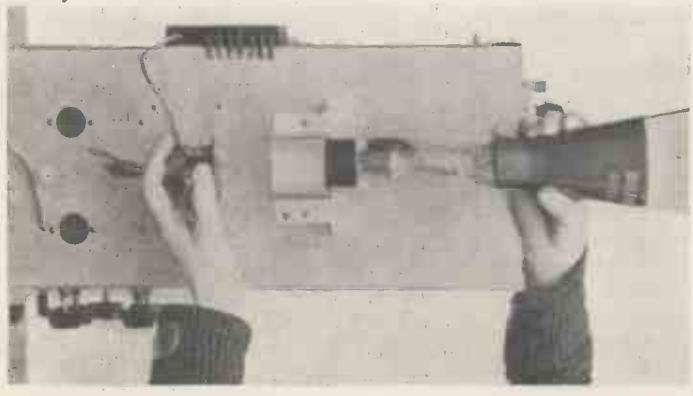
Synchronising

It is required now to adjust approximately the synchronising pulses filter valve. The control for this is the potentiometer R18, which is located near the three-way terminal strip at the side of the chassis. Turn this full anti-clockwise, i.e., so that the slider is at the earthy end. Now connect one lead of the headphones to the centre terminal of the three-way terminal board leaving the other phone lead connected to earth.

Slowly rotate R18 until a point is reached where the character of the signal commences to change. This change is indicated as an apparent difference in tone of the signal; the characteristic note will become heavier, with the rapid low pitched beat of the frame sync. pulses predominating.



This is a general view of the 4-inch tube receiver. Note that it is comprised of three simple sections, from top to bottom—time base, vision unit, power packs.



Fitting the Mullard tube into its holder.

The occurring change of pitch, due to variation of picture content, which was heard with the phones connected to the modulation terminal, no longer will be apparent when the correct adjustment for R18 is arrived at.

Some care is required to determine the correct setting, and to assist in getting this the following are briefly the effects obtained in the received picture when the adjustment is incorrect.

In cases where adjustment of the sync. pulses application potentiometers (Nos. 4 and 6 in Fig. 1), has very little apparent effect upon the stability of synchronism, it may be assumed, providing the synchronising connections are in order, that the sync. filter valve is biased incorrectly, rendering the sync. pulses weak.

POWER PACK ADJUSTMENT

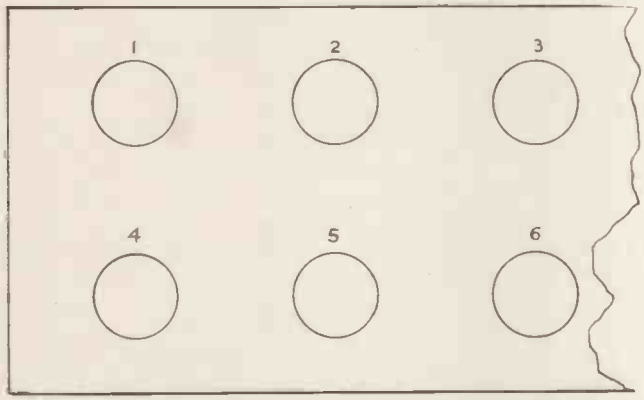
Slight re-adjustment of the control R18 is then called for.

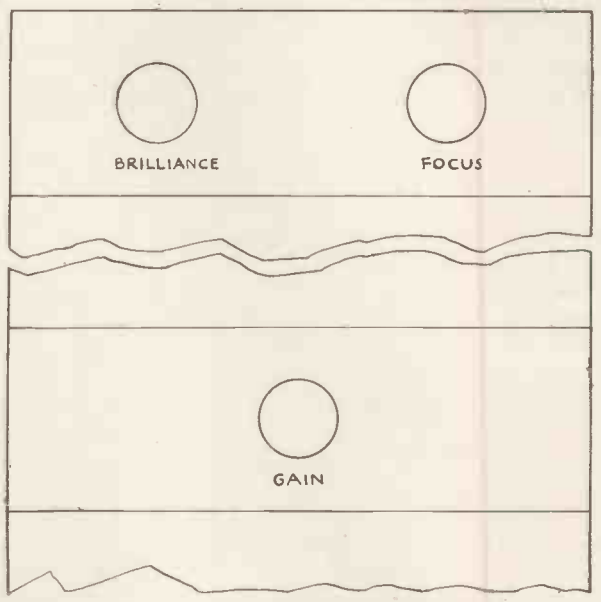
A fault which is likely to be more generally experienced is as follows: It will be possible to achieve synchronism of the picture, but, when subject movement takes place, there will be a tendency for the picture to distort. The effect will be an apparent displacement or tearing of one edge of the picture.

This effect is caused by the presence of picture modulation in the sync. valve output. The cure is again effected with slight readjustment of the control R18.

The Power Pack and Time Base

The adjustment of the time base may now be undertaken. Before commencing a description of the procedure involved for this, it will be advisable to give a few words of warning. A potential of approximately 1,200 volts exists at certain points in the time base unit. This potential can inflict a severe shock, accordingly, exercise all reasonable precaution. If any adjustment necessitating probing into the interior of the unit is called for *disconnect the mains supply.*





Figs. 1 & 2. The instructions given in the text can easily be followed by reference to these diagrams of the controls which are employed.

The time base unit can be given a preliminary test before applying picture modulation in the following manner.

Remove the fuse of the Sound Sales' transformer T2 and replace the fuse for the transformer T1.

Refer first to the diagram Fig. 1. This depicts the six controls for adjustment of the time base.

These controls are numbered, and initially they are set approximately as follows.

Control 1.—Turn fully anti-clockwise then turn for a third of the travel clockwise.

Control 2.—Turn fully clockwise then turn for a third of the travel anti-clockwise.

Control 3.—As for control 2.

Control 4.—Turn fully anti-clockwise.

Control 5.—As for control No. 1.

Control 6.—Turn fully anti-clockwise.

Now refer to Fig. 2. Set the brilliance control full anti-clockwise and the focus control half-way around its travel. Remove the D.L.S.1 vacuum delay switch and connect the mains supply. Having allowed a sufficient interval to elapse for the heaters to acquire sufficient temperature to become visible, ensure that these are all operating, including the C.R. tube and the MU2 rectifier heaters. Assuming this is found in order the power supply may be switched off and the D.L.S.1 valve re-inserted.

The power supply is now switched on once more and the D.L.S.1 valve should light. After an interval (between 1-2 mins.), the contacts of the D.L.S.1 valve will close whereupon the screen of the C.R. tube will momentarily be illuminated, at the same time a brief heavy discharge will be observed within the bulb of the M.U.2 rectifier which will die down and become a fainty observable haze for normal operation.

Now slowly rotate the brilliance control clockwise until the illumination of the C.R. tube screen is just visible. Carefully adjust the focus control so that the flyback lines become visible, and at the same time reduce the brilliance control if this proves necessary.

Actual adjustment of the time base unit may now be commenced. It is convenient to adjust the frame scan time base first. Ascertain from Fig. 1 which are the controls Nos. 3 and 5 and become familiar with the effects obtained when the settings for these are changed. Very slight changes of No. 3 will cause quite large changes of raster height. A similar effect is obtained with adjustment of No. 5 though in this case the change of height will be greatly reduced.

Re-set control 3 to its original adjustment and reduce the raster brilliance to the point where it becomes almost invisible. If the raster is now closely examined as control 5 is rotated, a setting will be found where a single horizontal black band will be observed, rolling vertically across the screen. If this is not the case, or if the raster height for this adjustment is found to be too great or the reverse, slightly re-adjust control 3 and repeat this procedure.

Having found this setting the mains supply may be disconnected and the vision power pack fuse replaced

and then re-connected. There is one important point to be observed in this connection. Ensure that the D.L.S.1 delay switch is afforded an opportunity to cool prior to switching on again, as otherwise the contacts of this are likely still to be closed and some damage may result through too early application of the full voltage.

Providing the adjustments so far have been correctly made, in accordance with the above recommendations, a very small adjustment to control 6 will lock the raster for the frame frequency. Whether this is so may be readily determined by increasing the raster brilliance when, the fact that the picture is no longer rolling across the screen is evidence.

Line Synchronising

It only remains to synchronise the line scan time base. Rotate control 4 until the effect of adjustment to it is observable at the left-hand picture edge. This edge will become somewhat ragged. Do not increase the control so that this raggedness is exaggerated or it will prove difficult to effect synchronism. Now very carefully rotate control 1 until a single picture is formed. Having found this setting re-adjust control 4 for an even picture edge, at the same time ensuring that the setting is such as to maintain stable synchronism.

To restore the correct picture dimensions, which are likely now to be upset, carefully adjust controls 1 and 2 concurrently to secure the correct picture width and controls 3 and 5 to secure the correct height.

It will prove advantageous to permit the raster corners to roll over the tube screen's periphery, as this will naturally permit a larger picture and improve definition.

If with the above adjustments correctly made the picture definition is still not sufficiently good, slight alterations to the vision unit trimming condensers can be made. There is also the possibility that the sound programme may get through to the picture and this will be revealed by the presence of variable dark horizontal areas. In this event proceed as above commencing with the aerial trimming condenser, the capacity of which should be reduced.

MIHALY-TRAUB TELEVISION

THE SYSTEM PERFECTED

FROM time to time we have recorded the progress of development of the Mihaly-Traub system of mechanical-optical television and on each occasion have been able to indicate that the solution of problems which appeared nearly insoluble were being overcome.

This system, as most of our readers will be aware, employs an ingenious scanning system which permits of a reasonably low motor speed when used for high definition. The original design, it will be remembered, consisted of a ring of mirrors with a polygon mirror revolving in the centre of the ring. Although the same principle has been retained, the present scanner bears little resemblance to the original, the size having been reduced to a fraction of the former and only a segment of a circle being used in place of the complete ring of mirrors.

The result of these modifications is a complete scanner of quite small dimensions with a very small and light revolving part which for 405-line television need only revolve at 13,000 revolutions per minute. The entire gear has now been made so compact that it can easily be accommodated in a cabinet of somewhat smaller proportions than are required for the average cathode-ray tube receiver.

One of the greatest problems that designers of mechanical-optical systems had to face was that of synchronism and many people had the idea that it was of such magnitude that it would be impossible to surmount the difficulties. Even after the scanning system of the Mihaly-Traub receiver had been perfected this problem still remained and the early experimental models relied on the mains for synchronism. This, however, was only until such time as the optical system had been perfected, when the problem of synchronising was tackled in earnest. All synchronising difficulties have now been overcome and the picture remains absolutely steady. Also, by virtue of the fixed relation of the mechanical moving parts perfect interlacing is secured.

A Demonstration

Recently we witnessed a demonstration of this receiver. It is not yet in its commercial form but any modifications that are to be made are only of a detail nature which will permit of a still more compact layout.

Excellent Pictures

The picture size of the model demonstrated was 12 in. by 15 in., but this will be increased in the commercial models. The picture is formed on a ground glass screen and is, of course, perfectly flat. The colour of the picture is sepia and this is the only criticism that we have to make. The use of a mercury-vapour lamp in the commercial models will, however, make a difference in this respect and provide greater contrast.

In operation the receiver was almost silent, despite the fact that the cabinet was partly open; in the finished models steps are to be taken to soundproof the apparatus entirely. Vibration is negligible and only by placing the hand on the cabinet was it possible to detect that there were any moving parts inside.

Operation is remarkably easy and apart from the on-off switch only two controls need be operated—one for framing the picture at the commencement and the other for contrast.

It is not as yet possible to give any indication of the price at which it will be possible to market this type of receiver; the construction, however, is remarkably simple and the units employed are not of a costly type so it should be possible to produce the complete receiver at a reasonable figure which will appeal to the public.

The staff of The International Television Corporation are to be congratulated on the highly satisfactory culmination of their efforts in the face of very great difficulties.

A CROWD ALWAYS ASSEMBLES TO WITNESS DEMONSTRATIONS ON BAIRD RECEIVERS.

WHY?

BECAUSE EACH MODEL IN THE RANGE REPRESENTS THE HIGH WATER-MARK OF ACHIEVEMENT.

Among the factors contributing to the first-class performance of all Baird Television receivers are brilliant pictures, freedom from distortion, excellent detail, wide angle of vision, extremely simple operation, high fidelity sound and all-wave radio. Each television receiver incorporates a Baird "Cathovisor" Cathode Ray Tube which has the outstanding advantage of being completely electro-magnetic in operation. These tubes can be supplied separately with the necessary scanning equipment where desired. Apart from manufacturing processes, stringent tests are made for electrical emission, tube characteristics, filament rating, and screen quality, and following normal picture reconstitution under service conditions, every Baird Cathode Ray Tube, on completion, is subjected to a very high external pressure test. Baird "Cathovisor" Cathode Ray Tubes are the ideal solution for high quality television pictures. Write for details.

★ ★ ★

A small section of the daily crowd which assembled at a recent exhibition to see demonstrations on Baird receivers.

★ ★ ★

WELCOME NEWS. Model T11 Television Receiver complete with All-Wave Radio has been reduced to 55 guineas. Send for full details at once, post free on request. Price includes aerial, installation of receiver and one year's free service.

★ ★ ★ SEE THE DERBY ON A BAIRD SET ★ ★ ★

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Osram valves

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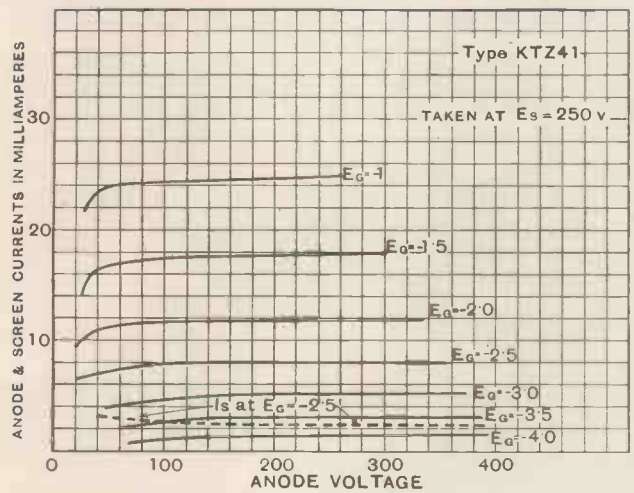


The new OSRAM KTZ41 is a Kinkless Tetrode with Indirectly heated Cathode intended for high stage gain—particularly in Television and broad band amplifiers.

Owing to the inherent difficulty of obtaining high coupling impedance at very high frequencies, it is characteristic of such amplifiers that a high mutual conductance is required in the associated valve, and further, a low cathode current is desirable.

The OSRAM KTZ41 is outstanding for the following reasons :

(1) *It has an exceedingly high mutual conductance at the working point, thus enabling high stage gain to be obtained, even with a low anode loading.*

(2) *It has a high ratio of mutual conductance to total cathode current—a feature of importance resulting in low noise-to-signal ratio in operation.*

(3) *It has a remarkably flat top characteristic over a wide range of anode voltages (see curve), and a sharp, well defined knee to the curve resulting in increased output.*

(4) *Although not designed as an H.F. amplifier for broadcast wavelengths, the low anode-grid capacity coupled with high conductance makes the valve suitable as a sensitive detector.*

The type is suitable for the first stage of an audio amplifier, except where followed by "high gain."

The OSRAM KTZ41 is fitted with a standard 7-pin base, grid to top cap.

CHARACTERISTICS

Heater Voltage	4.0 volts.
Heater Current	1.5 amp.
Anode Voltage	250 max.
Screen Voltage	250 max.
Grid Voltage	—2.5 approx.
Anode Current average	8 mA.
Screen Current average	2.25 mA.
Bias Resistance	244 ohms.
Impedance	1 megohm.
Mutual Conductance.	7.5 mA/volt (measured at Ea=250, Es=250, Eg=—2.5)
Grid to Anode Interelectrode Capacity	0.008 micro-mfd. Approx.

PRICE EACH 15/-

Scannings and Reflections

A TELEVISION TRIUMPH

THE Cup Final broadcast has generally been acclaimed a great triumph for television, in fact, it has ranked second with the Coronation. Reports from many districts, some of them well outside the normal range, have proved that the game could be followed on the television screen almost as well as if seen direct. Excellent use was made of the facilities provided by the telephoto lens and the camera work was most praiseworthy. The only criticism is in regard to the commentary, which appeared to be lagging somewhat behind the actual events. The delay which was only very short was somewhat disconcerting, but perhaps inevitable in such a fast moving game.

THE EIFFEL TOWER RECEIVED ON THE SOUTH COAST

Some considerable time ago we forecast that in all probability the Eiffel Tower television transmissions would be receivable in the southern counties when this station got going on its full power. It is gratifying to learn, therefore, that even on the present power, which is considerably less than what will ultimately be used, pictures have been received in Brighton. Faint pictures have been received by Mr. W. R. Westhead, of Brighton, on a receiver situated about 330 ft. above sea level. The distance from Brighton to Paris is a little under two hundred miles.

BROADCASTING ON TELEVISION SOUND WAVELENGTHS

Special and exceptional arrangements were made to enable all those who possessed receivers capable of tuning in to the television sound wavelength to hear the London Musical Festival. This, of course, included all those who own television receivers. A decision was made to relay certain items from the series by the B.B.C. Symphony Orchestra, conducted by Toscanini, in order that advantage could be taken of the fine quality of sound which is only possible by the use of high frequencies. It was arranged to give five of these relays and two now remain—on June 3 and June 10. The transmissions begin at 8.15 and are preceded by a tuning note. The transmissions are, of course, in addition to the ordinary television programmes. The items which remain to be given are:—Friday, June 3, 8.18-8.48—Symphony No. 41 in C (Jupiter), K.551 (Mozart); Friday, June 10, 8.18—God Save the King; 8.19-8.25, Overture, La Scala di Seta (Rossini); 8.27-9.7, Symphony No. 2 in D (Sibelius).

In regard to the above it is interesting to note that all Cossor console television receivers are provided with an extra position on the waveband switch permitting television sound to be received (without re-tuning) while the entire vision deck, including, of course, the cathode-ray tube, is switched off.

It is probable that the B.B.C. will further utilise the 41.5-megacycle frequency channel.

EASTERN CABARET

"Eastern Cabaret" to be televised in the evening programme on June 4 will be a development of the "Cabaret Cruises," which have already scored a big success, but this time Harry Pringle, the producer, will have landed his "passengers," and viewers will see them making their way through an oriental town somewhere East of Suez en route for the European hotel. The atmosphere of the East will be built up in the Alexandra Palace studios and a number of coloured artists will take part. An oriental bazaar, rickshaws, snake charmers and dancing girls will add to the realism. Surya Sena, the well-known Indian singer and dancer, will act as compère.

TELEVISION IN BOMBAY

We are informed by an Indian correspondent that the private experimental television service which was to have commenced in Bombay at the end of April, with the object of arousing the interest of Indians in the new science, has been delayed by the illness of Mr. N. A. Printer, President of the Bombay Technical Institute, who was to have been responsible for the inauguration of the service.

DON LEE TELEVISION POWER INCREASE

The Federal Communications Commission (U.S.A.) has granted a licence to W6XAO, the television station of the Don Lee Broadcasting System, Los Angeles, permitting an increase of power of the vision transmitter to one kilowatt. Previously with a power of only 150 watts pictures were received at a distance of twenty miles and with the larger power it is expected that a range of forty miles will be possible. At one receiving location, where the broadcasts are checked daily, a fourfold (400 per cent.) increase in the strength of the received signal was recorded.

TELEVISING NORTHOLT DERBY

Elaborate plans have been made for relaying the scene at Northolt Park on "Derby Day," June 13 Three cameras will be in operation, and the broadcast, which covers two races, will last an hour.

At 3.30 p.m., a camera situated on top of the members' stand will pan in on a race in progress, and a microphone will pick up the details of running from Northolt's own commentator. Following the preliminary race, Miss Jasmine Bligh will interview celebrities in the parade ring where a camera mounted on a "dolly" is to be installed. From this central position—in full view of all enclosures—the parade ring camera will record crowd scenes, and the jockeys mounting for the big event. A B.B.C. commentator will describe the "Derby Day" atmosphere.

The third camera will be situated close to the saddling and unsaddling paddocks, so that every detail of the

MORE SCANNINGS . . . . . .

Pony Turf Club's premier classic will be adequately covered.

The running of the Northolt Derby will be televised from start to finish and described by Mr. Leonard Jayne, Northolt's own commentator, while Miss Jasmine Bligh and a B.B.C. official will comment on the incidental scenes.

THE BALLETS JOOS

The famous Ballets Joos Company, now touring England, will pay its second visit to the Alexandra Palace on Sunday evening, June 5, with a performance of "The Big City." The Ballets Joos' technique is especially suitable to television as its aim is to produce true pictures of life with mimicry based on nature rather than symbolism.

THE POLO TRANSMISSION

A misunderstanding arose during the transmission of the Whitney Cup Final as a result of some of the B.B.C. engineers, who were viewing the event in their own homes, telephoning to say that the quality was poor. The transmission was therefore stopped, much to the surprise of many viewers who were getting excellent reception, and a Mickey Mouse film was substituted. Actually, reception in most districts had been very good, and within a few minutes of the announcement that the broadcast was to be stopped, several viewers telephoned to express their surprise.

"THE CONSTANT NYMPH"

Victoria Hopper will be seen as Teresa in a special television production of "The Constant Nymph," which George More O'Ferrall will present for the second time in the evening programme of June 4. This famous play by Margaret Kennedy and Basil Dean, first produced at the New Theatre in September, 1926, with Noel Coward and Edna Best in the leading parts, is based on Margaret Kennedy's novel.

"DERBY DAY"

An operetta, "Derby Day," is to be televised in the evening on June 1 with Tessa Deane in the part of Rose. This operetta by A. P. Herbert, with music by Alfred Reynolds, was first produced at the Lyric Theatre in 1932 and was an instant success.

The story revolves around the beautiful barmaid, Rose, whose hand is sought by both Bones the tipster, and Eddy Waters, the jaunty son of Sir Horace Waters, J.P., owner of the Derby favourite. Lady Waters, severe, but likeable and full of vigour, keeps everyone on tip toe and causes a tremendous scene in the last act when John Bitter, landlord of the "Old Black Horse" is threatened with the loss of his licence.

Esther Coleman will be seen as Lady Waters, Frederick Ranalow as Sir Horace Waters, George Baker as Mr. Bitter, Muriel George as Mrs. Bones, Bert's mother, Esmond Knight, as Bert Bones, and Gordon Macdonald as Eddy Waters.

A COMPLETE TEST MATCH RELAY

There should be considerable interest in television during the period of August 20 and for the five days following when the B.B.C. are to televise the whole of the final Test Match between England and Australia from Kennington Oval. This will be the first time that such an event has been relayed in full, for at the most, the commentators on sound wavelengths are on the air for an hour.

This relay is an addition to the relay of the Test Match from Lords on June 21, when some of the more exciting periods will be seen by viewers.

AMATEUR 5-METRE BAND

In America at the present time the amateurs on 5 metres are sandwiched in between two commercial television bands so that control of transmissions on this wavelength is very strict. It practically means the universal application of crystal control transmitters and this fact has done very much to improve the technical efficiency of the ultra-high frequency apparatus used by American amateurs.

At the recent Cairo conference it was decided that in future television stations could be erected for use on frequencies up to 58.5 Mc. This means that half of the amateur 5-metre bands will be used by television stations at the same time as the amateurs.

This will be an advantage rather than a disadvantage for in the future British amateurs must surely use crystal control rather than self-excited oscillators.

The British amateurs will not be quite so sandwiched as the American, but it is hoped that they will take the same step as the Americans to ensure frequency stability and efficient transmitters.

THE WORLD'S SWIMMING CHAMPIONSHIPS

A rather unusual television relay will be the world swimming championships from Wembley Pool on August 6. This programme should be rather interesting to technical viewers for it is not at all certain just how this type of programme will come over in view of the rather poor background.

This lack of contrast may affect the picture, until the time comes when we have colour television. This point was amply demonstrated at the recent televising of the Chelsea Flower Show, for although viewers were able to gain a very good idea of the layout of the Exhibition, the beauty of the individual flowers could not be appreciated.

MORE SPACE AT ALEXANDRA PALACE

For the next few weeks, producers at Alexandra Palace will have to be content with one studio until the second studio has been re-wired and re-equipped. This studio will be a duplicate of the present Studio A and will be equipped with four of the latest type Emitron cameras, which it has been found give much sharper and clearer definition and a better picture.

Two months should be sufficient time for these alterations to be made after which viewers can look forward to even greater variety of programme and greater scope of action.

BRITISH VALVE DESIGNS

Although the British valve makers are endeavouring to capture the amateur market as regards transmitting valves, amateurs so far have not really appreciated that British valves are available which are the exact counterparts of the more popular American valves at competitive prices.

The general attitude appears to be that the American valves have been available for so long and are comparatively fool-proof that there is not sufficient inducement for the amateur to change over to the English valves

. . . . AND MORE REFLECTIONS

even if they are of similar efficiency and price.

COMMUNICATION RECEIVERS

Several multi-valve communication receivers of British design are in the offing and it is expected that the next Radio Show will bring to light a wide range of apparatus, specifically designed for amateurs.

Many of our leading set makers have found that communication receivers of American design were being bought by British services, including the Post Office. They have, for the past few years, been developing competitive receivers in their usual thorough manner, and we have now conclusive proof that there are receivers in this country which are better in performance than even such sets as the HRO. This may sound rather a tall order in view of the popularity and efficiency of this well-known receiver, but this claim has been substantiated and is one of the reasons why we are looking forward to the 1938 Radio Show.

THE UNIVERSAL LANGUAGE

From time to time one hears of the claims for a universal language of some sort or the other. This idea seems slowly but surely to be losing its value for English is rapidly becoming used all over the world. It is well appreciated by the average amateur who finds little difficulty in talking to brother amateurs even in the most obscure foreign countries.

It is also interesting to notice that foreign countries more often than not use English when making contact. For example, we have heard an Albanian amateur talking to a Portuguese both in fluent English.

This is even more noticeable in countries where the language is a difficult one, and for this reason, it is usual to hear Russian, Chinese and Japanese amateurs making complete use of English.

THE PARIS EXHIBITION

Television appears to be hanging fire in France despite the fact that programmes are now available in experimental form from the Eiffel Tower Station.

At the Paris Exhibition not one television receiver was on show, most makers devoting their space to radio receivers of advanced design. The cabinet work in most instances was of the ultra-modern type while all-wave units were a general rule.

Press-button tuning has also made its bow, while one or two receivers have clock-face tuning of the type first used in this country some years ago.

Combination sets including lamp standards, gramophone and all-wave receivers of the armchair type are also very popular.

TELEVISION IN AUSTRALIA

At the World Radio Convention organised by the Institution of Radio Engineers of Australia several excellent papers were read by well-known engineers.

John L. Baird gave a general survey of television in England and dealt with some of his early low-definition experiments and also the latest colour television.

Another good paper was by J. D. McGee, M.Sc., of E.M.I., who gave a very complete story of high-definition television as it is in this country. This was followed by a paper from the head of the R.C.A., Major-General James G. Harbordon.

The series was wound up by a paper from the well-known Director of Research of the Telefunken Co., Dr. F. Schroter, who spoke about television problems and their solution.

Book Review

La Television, by Prof. Marc Chauvierre (Dunod, Paris).

The sub-title of this book is "Theoretical and Practical Problems in Television and Their Solution," and the author has covered the ground in a clear and thorough manner. Commencing with the general theory of the subject, the mechanical systems of television are reviewed, and—an important feature—are not allowed to monopolise the greater part of the book. Cathode-ray tubes are described together with their circuits, and a complete description is given of scanning circuits and synchronising.

The theory of video amplifiers is followed by a most lucid chapter on the modern systems, in which the E.M.., R.C.A. and Barthelemy systems are compared. The only criticism of the book from the point of view of English readers is the crudity of the diagrams, in which the bare outline of the connections is frequently given. Is there no international agreement on the drawing of circuit diagrams? English circuits have, as we know, the H.T. line at the top; American circuits have the H.T. at the bottom together with the L.T., but circuits in which the H.T. appears at the side are difficult to follow!

This is an excellent book on the subject and it is to be hoped that an English translation will be available in the future.

"THE BAIRD STILL-PICTURE TRANSMITTER"

(*Continued from page* 324)

The second rack is built to house the frame and line synchronising pulse generators, these pulses being fed to the time base generators of the picture tube, and the cathode-ray tube monitor.

In the Baird factory the signal is made to modulate a transmitter fed with 405-line interlaced synchronising pulses and in this way make up a convenient and most efficient test signal for judging receiver performance.

Apart from a normal picture signal, the apparatus will also provide the usual type of black cross and, when desired for lecture purposes, the principles of television can quite easily be demonstrated.

It should be emphasised that this apparatus has now been in constant use for a period of nearly two years and has given no trouble and, bearing in mind the priority of date when compared with the DuMont equipment, it was felt that readers would be interested in this brief description, together with the accompayning illustrations.

An Insulated Octal Valve Cap Connector.

Constructors who have had difficulty in buying a top-cap connector for octal valves should remember that the British Mechanical Productions Co., Ltd., who market Clix components, have now produced such a connector.

It is insulated with a black end piece and is fitted with a split ring to allow for variation in valve cap size. The insulated piece unscrews to allow for connection to be made. This useful component is priced at 1½d.

TELEVISION AND SHORT-WAVE WORLD

JUNE, 1938

THE RECEIVING AERIAL AND RECEPTION FIDELITY

This article is an abstract from a paper by Stuart W. Seeley of the License Laboratory of the Radio Corporation of America It deals with the effects of interference between direct and reflected signals and the production of double images on the screen. Means for minimising such interferences are explained.

IN broadcast-receiver practice a simple wire of from a few feet to one hundred or more in length will suffice as a receiving aerial and its operation is completely satisfactory if the received signal is sufficiently above the local and extraneous noise level. A television receiving aerial will have to be erected with much more care. This is because of the introduction of an additional factor in visual reception not present in sound broadcasting. This factor is the necessity for preventing reflected waves, which have travelled a few hundred feet or more further than the direct wave, from entering the receiver. Fortunately this can be done in all cases, and quite easily in most cases. It is the object of this paper to point out that the problem exists in visual reception, and to describe certain methods of meeting it which have been found effective.

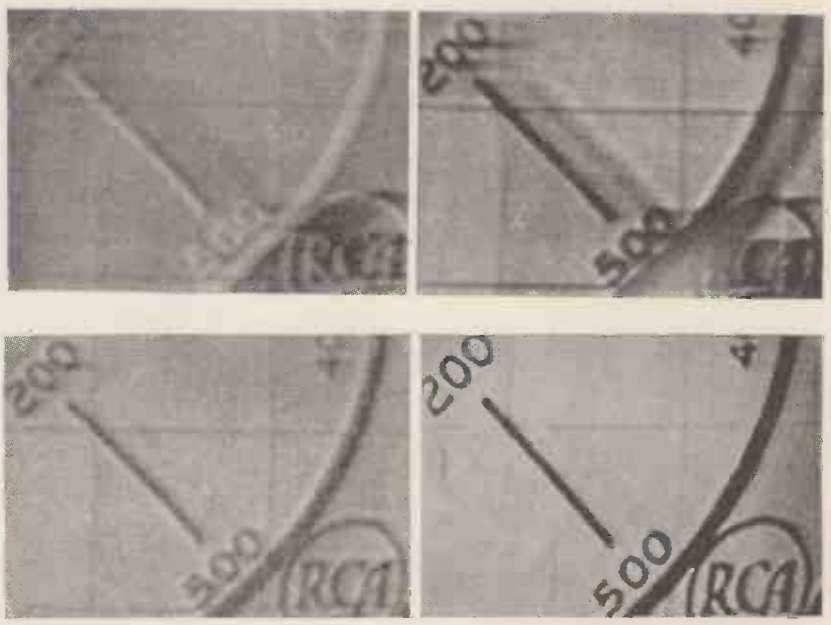
Space Wave Reflections

When reproducing a 441-line, 30-frame per second picture, the cathode-ray spot travels across the screen of a 12 in. cathode-ray tube at a speed of about 2½ miles per second. This is 1/75,000 times the speed of light or radio waves in free space. In other words the spot will move about 0.060 in. while a radio wave is travelling 400 ft. Therefore, if both a direct and a reflected wave arrive with comparable magnitude at the input terminals of a television receiver, and one has travelled 400 ft. further than the other, a double image will result. The displacement of the two images in such event will be about one-sixteenth of an inch and will cause blurring of all vertical lines in the picture. Actually such a condition results in even more complication than is immediately apparent from the above example. The reflected wave may have any phase with respect to the direct wave. Furthermore, each has its own side components, and those of the direct and reflected wave may be entirely different. This interference in the form of cancellation or reinforcement frequently causes a black line to be repeated as a white line or vice-versa. If the reflected wave travels 1,000 ft. or more further than the direct wave a distinct double image will result.

Thus it is readily apparent that the aerial must supply a television receiver with one signal only from a desired transmission. In metropolitan areas, reflections from large buildings may give rise to several images and the problem of proper construction, location and orientation of the receiving aerial becomes extremely important. However, at *any* location an improperly constructed aerial or aerial network and feed system may produce multiple signals of sufficient intensity and time-phase displacement to be objectionable.

Transmission Line Reflections

Under ordinary conditions, at most installations, it is necessary to use transmission lines between the aerial proper and the receiver in order to control properly the point of signal pick-up. If the maximum dimension of the aerial system (transmission line plus aerial) is of the order of 100 ft. or more, and the line is not properly balanced and terminated at the receiver, reflection in the aerial network may cause a loss of detail in the reproduced picture.



Figs. 1, 2, and 3 show a small section of the cathode-ray tube screen to illustrate the effect of various receiving aerials on reproduction. The receiver was operated with reduced contrast for best photographic results. Fig. 4 is the same as Fig. 3, except that the receiver was operated with normal contrast.

Thus the problem of preventing blurring or double images caused by multiple-signal reception may be divided into two parts. First, the aerial must be made non-susceptible to strong secondary waves from external reflecting media, and second, the aerial and its transmission line

EFFECT OF REFLECTIONS

must be so constructed and terminated that reflections from the receiver end of the system cannot bound back to the outer end of the aerial and be reflected there to re-enter the receiver as a delayed signal.

It is difficult to describe in words the appearance of images produced by multiple-signal reception, and difficult to show it clearly by illustrations produced by the photographic and printing processes necessarily involved. Figures 1 and 4 are illustrations showing a small section of a tube screen reproducing a transmitted pattern, under different conditions of multiple-signal reception. The illustrations are, of course, not clear or representative of the general appearance of the screen when viewed by the eye, and are intended merely to show the relative effects of aerial changes. The pictures were taken on the same receiver with different aerials, but without any changes in receiver tuning. A detailed description of the aerials and the effect of each on the received image will be given later.

Source of Space Wave Reflections

It is to be understood that the reflecting medium need not be a metallic object. The specific inductive capacities of building stone, brick paving material, and ordinary soil, are sufficiently greater than that of air to have high coefficients of reflection for television frequencies at some angle of incidence. Therefore almost any surface can act as a reflector, if its dimensions are comparable to, or greater than, one-half wavelength.

If the transmitting aerial is within line of sight of the receiving aerial, and a plane surface parallel to the ground is located between the two and within sight of both, the strength and delay factor of the reflected energy will depend upon all of the dimensions of the geometrical orientation of the three objects. However, it can be shown by simple calculations that only within a radius, from the transmitter, of about six times the combined transmitting and receiving aerial heights (above such a surface) can reflections of this nature be sufficiently delayed to cause a loss of detail in the reproduced image. This, of course, is based on our present standard of 441-line, 30-frame per second transmission. Therefore, at most receiving locations, more than a mile or two from the transmitter, where reflections are troublesome, the reflecting area must lie in some plane other than that parallel to the ground.

Large buildings surrounding a receiving location offer ample opportunity for multiple-path reception even when the transmitting and receiving aerials are within line of sight. If the two are hidden from each other by tall buildings or by hills, the direct signal may be so greatly attenuated that the reflected energy exceeds that which travels the direct path. One example of this was noticed recently at a receiving location which was hidden from line-of-sight of the transmitting aerial by a nearby building. In this case, the single strong reflected wave produced an image misplaced by an amount which indicated it had travelled about nine hundred feet further than the direct wave. The receiving doublet was rotated to a position which eliminated the direct signal (which was much the weaker of the two) and good reproduction was obtained.

Detecting Reflected Waves

The most satisfactory indicator for determining the presence of undesired reflected waves and for aiding in the determination of their source, is a television receiver equipped with a portable doublet on the end of a long pole. It is necessary, of course, that the transmitter be in operation at the time of test, and that the transmitted image be stationary and of such a nature that either blurring of horizontal detail (at the edges of vertical lines) or the presence of a secondary image, is readily apparent. A single black vertical line in the middle of a white background would suffice.

The effect of orientation and rotation of the portable doublet on the relative strength of the direct and reflected signals, as reproduced by the receiver, together with a calculation of the difference in path lengths by a measurement of the displacement of the two images on the screen, will usually indicate the probable source of the reflection quite accurately. However, in many cases such information may turn out to be of only academic interest, since it will often be found that the correct answer to the problem of proper location and construction of the fixed receiving aerial can be determined only by empirical investigation.

Minimising Secondary Signals

Probably the most generally useful type of television-receiving aerial will be a simple doublet, or double doublet, connected to the receiver by means of a low-impedance, twisted-pair transmission line. At the majority of receiving locations this will undoubtedly give completely satisfactory reception if normal care and thought are used in its installation. Even at many places where multiple-path reception is encountered, the same type of aerial may be made to serve satisfactorily by orientation to minimise the reflected signal, or by shielding it from the reflecting source. This might be done by placing it in proper relation to existing conductors such as metal flashings, copings, eave troughs, etc. Usually such location can be found only by trying different positions and noting the effect on the received image. Another method of shielding a receiving doublet from reflected waves is to place a second, unloaded, dipole near it and in proper position to minimise the reflection image. Here again the cut-and-dry method will probably yield the best results.

If several strong reflected signals are present at the receiving location, more drastic action will probably be necessary. This was the case at the R.C.A. License Laboratory, which is located about 6,000 ft. north of the transmitter on the Empire State Building. Fig. 1 was taken to illustrate the maximum number and relative strength of reflected signals which could be picked up at this location. The aerial was a half-wave doublet at the end of a 60-ft. twisted pair which, however, was connected with the two wires in parallel to act as a "T" aerial against ground. In this case the first reflection arrived with proper phase and intensity to invert a large amount of the direct-signal detail into negative values of light intensity. This was followed by five more reflected signals varying in time of arrival and amplitude. The last of these is displaced by an amount which indicated that it had travelled 3.8 microseconds longer, and thus about 3,700 ft. further, than the direct wave.

(To be concluded next month)

ADJUSTING A VISION RECEIVER —WITH PARTICULAR REFERENCE TO THE "LOW-COST TELEVISOR"

By S. West

CONDENSED instructions for adjusting the time base of the "Low-cost Televisor" were given in the February issue. These instructions included a diagram with the controls numbered clearly and referring directly to the actual assembled unit. It was thus possible to adjust the unit simply by following these short instructions in conjunction with the simple diagram.

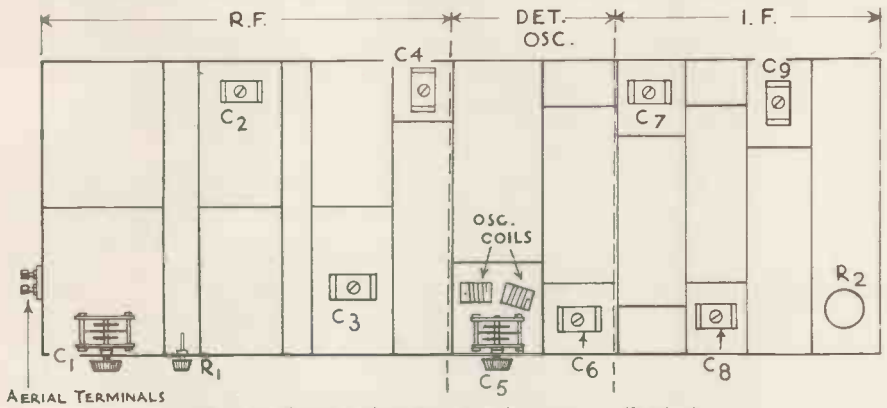


Diagram showing the controls referred to in the text.

A number of constructors have expressed a wish for similar concise instructions dealing with the vision unit and accordingly these are given here.

The diagram shows the various controls, including the trimmers. These are consecutively numbered and the following instructions refer to these numbers and not to those given in the original theoretical circuit.

Adjustment of the vision unit will be found very simple if the following procedure is observed.

It is assumed that a rough preliminary check has revealed the various circuits to be in order, i.e., the voltages have been measured in accordance with the directions given in the preceding articles, and found to be substantially the same as in the original model.

Having ensured this is the case tuning adjustments can be commenced. Headphones are connected with a 0.1 mfd. or similar capacity condenser to the "M" terminal and to earth.

The I.F. Amplifier

It is convenient approximately to adjust the I.F. amplifier first.

Disconnect the aerial feeders from their terminals and attach the feeder (one side of this will suffice) through a small fixed condenser. to the grid of the first I.F. valve. A number of stations will be heard and by adjusting for maximum sensitivity an adjustment quite close to the correct one will be arrived at.

The condensers to adjust are C6, C7, C8 and C9. Note that tuning will be found uncritical for these circuits due to the heavy circuit damping which is necessitated by the requirements for a broad frequency characteristic.

With these adjustments made, attention may be turned to the mixer stage. Here we are chiefly concerned with ensuring that the triode section of the valve is oscillating. Coupling for the two oscillator coils initially should be made as tight as possible. The optimum coupling can later be found.

If C5 is now slowly rotated, two positions (because the condenser rotates through 360 degrees) will be found where there is a considerable increase in the noise pickup. The aerial can be connected to the anode of the third R.F. valve, retaining the small fixed condenser in series when, ignition noise, due to passing cars, should be heard.

The intensity of this ignition noise will be affected with rotation of C5 and if this proves to be the case it can be assumed that in all probability, the mixer stage is functioning correctly.

To complete the preliminary trimming adjust C1, C2, C3 and C4.

Testing on Signals

It is a little difficult to give any definite instructions for the correct way in which to proceed for adjustment of these controls; the following information, however, will be of assistance.

Choose a time when the transmitter is radiating, preferably before the actual programme is scheduled to commence. The transmitter usually comes on for about half an hour prior to the commencement of the programme proper.

Set C1, C2, C3 and C4 for about half their maximum capacity and slowly rotate C5. At a certain setting the carrier of the vision transmitter will be heard.

As a rough guide, in the original model, this setting occurred when the moving vanes of C4 were half enmeshed.

It will be found simple to recognise the vision carrier. It has quite a characteristic noise consisting of a rapid, low-pitched beat, superimposed upon which is a high-pitched whistle.

If it is not found possible to tune in the vision carrier, reset the four condensers already referred to and try once more.

Having tuned in the signal, the I.F. amplifier may be more accurately adjusted, the trimmers C6, C7, C8 and C9 being carefully adjusted for maximum signal. Should it prove that any trimmer has insufficient latitude to permit correct adjustment, adopt normal procedure for the oscillator condenser setting. Re-set this very slightly and re-adjust the I.F. amplifier to the new I.F. frequency.

Whilst on the subject of the I.F. amplifier it can be pointed out that, due to the comparatively large trim-

(*Continued on page 346*)

Telegossip

A Causerie of Fact, Comment and Criticism

By L. Marsland Gander

PROGRESS on all fronts to report this month! But not a clean break through into open country, and the prospect, I fear, of more long delays while the laborious work of further preparation behind the lines goes on.

The big news is that

(a) Conversion of Studio B, otherwise known as No. 2, begins on June 5.

(b) Radiolympia will, for the first time, be a real Television Exhibition.

The disappointments are

(a) Single studio working only for six or eight weeks while Studio B is being rewired and rearranged.

(b) No news yet of the conversion of the Alexandra Palace Theatre. Rumours that the work may not be started till the late autumn.

Studio B, like Studio A, will have four camera channels. The upper storey of the glass-walled dolls' house which was erected originally will be used as a producer's eyrie. Owing to the central position it is considered that the producer may have the advantage of his fellow in Studio A who looks down from a top corner.

Then the main control room—where the engineers operate and watch the perfect picture on monitors—is to be considerably enlarged to accommodate the four extra vision channels from Studio B. Above this control room is the gallery from which the producer and productions manager peer through a glass darkly into Studio A, twiddle umpteen knobs, and so run the show. I understand that this gallery is also to be extended though details of the plans are somewhat "hush-hush."

Double or Single Working?

An interesting controversy has meanwhile broken out among the producers. Should there be double or single studio working in any one production? Should a producer be able to switch at will from one studio to another, or should he confine himself to a number of different "sets" erected in one studio, and leave the other absolutely free for the next show?

I am afraid that the multi-studio boys are counting their studios before they are hatched, but I should say that one of these days multi-studio technique will become inevitable for the really big "all-star" show.

Continued postponement of the theatre conversion is a blow, and still I vainly seek a satisfactory explanation. The stage is being used for rehearsals but the main auditorium remains as before except that scenery and property is accumulating there in such formidable masses that one day its removal and storage will present a first-class problem when the B.B.C. really do set to work.

I met Mr. Gerald Cock at Alexandra Palace the other day. He was discreetly silent on the subject of the theatre, but did ask me to be merciful during the six or eight weeks that the B.B.C. is restricted to one studio only. He is relying on the mobile unit to supplement the studio programmes. During June, July and August till Radiolympia the "O.B." team will be worked to the limit.

He mentioned another matter which is making him ponder nowadays. Improved lighting and the new "long gun" cameras are giving greatly improved results, but they are exposing some of the deficiencies of the "sets" and the backgrounds. He and I have both felt when watching recent plays such as "Emperor Jones" and "So Much to Do," that the pictures lacked depth and spaciousness. And incidentally the B.B.C. intend to replace the "long guns" with the new type super-Emitrons as and when they become available. So we may look for a still more searching exposure of the imperfections of the B.B.C. backgrounds unless there is a big improvement.

Radiolympia

I welcome the Radiolympia news without reservations. The show virtually becomes a television exhibition. The old variety theatre is to be banished and a large glass-walled studio, a replica on a larger scale of Studio A at Alexandra Palace, is to be built in the National Hall.

According to present intentions the B.B.C. will relay three half-hour programmes daily from this temporary studio during the run of the exhibition. The public will be allowed to pass through practically continuously while shows or rehearsals are proceeding on a stage measuring 100 feet square. Some of these shows, arranged by the exhibition authorities, will be for local relay on the sets throughout Olympia. There is also an excellent proposal, which I hope will be adopted, of televising visitors, so that Mother, stationed at Stand 150, may see the adored countenance of Little Willie on an XYZ receiver.

The main idea behind the B.B.C. shows, I hear, will be the presentation of typical programmes which have stood the test of time and emerged the most popular with the viewing audience—such as "Picture Page," "Cabaret Cruise," and fashion parades.

Mr. Cecil Madden, producer of this B.B.C. magazine, tells me that Joan Miller will be back in her character of telephone girl, plugging into the various items. Mr. Madden was regretful when his chief persuaded him to drop the telephone girl idea. But I agree with Mr. Cock that we needed a change. The telephone girl was the first television character to make a hit but she could not go on for ever without the risk of deadly monotony.

Now, of course, Miss Miller faces the camera as herself, introducing the items and personalities, as any compère might do, in a straightforward manner. The snag is that as the stage hands must have time to clear away the last "set" she has to do a certain amount of gagging and sometimes it is a little obvious. Moreover the headphones which she wore at her switchboard served a really useful purpose. She was able to receive instructions from the control room and could thus meet any emergency. Now, if emergency arises (and it is bound to arise in a last minute programme such as "Picture Page"), there are often some awkward moments.

Mr. D. H. Munro, the energetic Productions Manager at A.P., has just left for America, but is cutting short his trip in order to be back for Radiolympia. He his taking "grace leave" which normally comes to all senior B.B.C. officials after ten years' service. In his case it is three years overdue as he postponed it to take over the television job.

Even now it will be a busman's holiday. Before sailing in the *Queen Mary* he said that his main purpose was to compare notes with the National Broadcasting Company and Columbia on television.

In particular he has dates with Mr. Gilbert Seldes, his opposite number in the Columbia network, and with Mr. John F. Royal, vice-president of the N.B.C., who recently completed a European tour. While he is away his work at A.P. will be done by Mr. Pat Hilliard.

The Present Craze

I am disappointed that the television staff should be so slavishly imitating the sound department in staging Spelling Bees. The Spelling Bee is pre-eminently a programme for a sightless audience and I should have thought that if the television producers could think of nothing better they should have left them severely alone.

Mary Adams is, however, doing her best with a poor idea by producing a " period " Bee in the costumes of 1870 on June 18. She was much exercised in mind when I saw her recently over the method of indicating by visual means when a mistake had been made. (Placing of a dunce's cap on the victim's head has been ruled out as un-B.B.C. like and offensive.) The most ingenious idea she had was switching over the picture to a negative, or making it go momentarily all " haywire." The danger with these little pranks is, however, that they might cause a breakdown of the transmitter.

When viewers were invited to apply to take part in the Artists v. Viewers contest about fifty wrote in.

I hear that about eighty M.P.'s accepted the invitation extended by the Postmaster-General to visit Alexandra Palace and see behind the scenes of television. At the time of writing about fifty had been, in parties of six to a dozen. Many of them are bringing wives, sons and daughters.

All excellent propaganda and, we hope, a guarantee that M.P.'s will be sympathetically disposed when next there is talk of more money needed for television. The visits are, at any rate, clearing away many misconceptions. For example, some M.P.'s have been under the impression that the pictures as received on the home screen are in natural colours.

How to Do It

Look to the television screen shortly for instruction in A.R.P., " How to put on your gas-mask, etc.," and also for practical hints on a very different topic, " How to play tennis." Both subjects are under consideration for future programmes.

As an example of the momentous things which happen behind the scenes of television I cite the following memorandum which passed between in the hectic rush of preparation for the Chelsea Flower Show between Mr. Alick Hayes and Mr. Peter Bax. " Required for o.b., the following props: one lettuce, one tortoise." History does not reveal the motive behind the request, nor whether it was ever fulfilled.

" Adjusting a Vision Receiver "
(*Continued from page* 344)

ming condensers included, it is possible to adjust the resonant response frequency of the I.F. amplifier over fairly wide limits. Care with the selection of the optimum frequency is well repaid with freedom from spurious screen patterns and enhanced picture quality.

Having ensured that the I.F. section is correctly tuned, attention may once more be directed to a more accurate adjustment of the R.F. section. No attempt to tune for maximum response should be attempted but, rather to increase the intensity of the signal whilst at the same time retaining the clear characteristic " ring " of the signal. In particular ensure that the high pitched whistle component is well maintained. Operation of the gain control R1 can be checked before leaving this section of the receiver.

Synchronising

It is required now to adjust the synchronising pulses filter. Remove the headphones lead from the "M" terminal and re-connect to the "S.F." terminal. Set R2 full anti-clockwise at which position, if everything is correct, no signal will be heard. Now slowly rotate R2. As the control is turned, first the frame pulses will be heard as a rapid heavy beat. Slight further adjustment will permit the shrill whistle of the line sync. pulses to be heard.

Still further rotation, and the picture content is enabled to pass. This is revealed as an apparent change in intensity of the signal, for each change of scene.

The correct adjustment for R2 is that just before the picture can be heard, i.e., when only the rapid beat of the frame sync. pulses and the shrill whistle of the line pulses can be heard. This will complete adjustment of the vision unit and the appropriate connections from it to the time base unit can be made.

If the adjustments have been correctly made as indicated above, a picture having quite good definition should be obtainable at once, providing the time base controls are set correctly.

Final accurate tuning to secure the very best picture quality may now be carried out, but very little further adjustment will be required and the effect of each small change to the trimmer settings should be observed at the C.R. tube screen. In general it is the R.F. trimmers which will require slight re-adjustment and only in rare cases will it be necessary to touch the I.F. trimmers.

BOOK REVIEW

Electron Optics in Television, by Maloff and Epstein (McGraw-Hill Co., 21s.). 292 pp. 162 diagrams and photographs.

This is the first book to appear on the science of electron optics and television. It will appeal to the television engineer as a concise source of information on the theory of the cathode-ray tube. The book is divided into two sections, the first dealing with the general theory of electron optics and focusing and the second with the tube applied to the reproduction of television images.

To make the subject complete a portion of the second part is devoted to the theory of oscillator scanning circuits, and much of this matter has not appeared before.

Messrs. Maloff and Epstein are well-known research engineers in the R.C.A. Manufacturing Co. of America, and their book can be considered as authoritative on American cathode-ray tube practice.

The McGraw-Hill Co. are to be congratulated on the production of such a useful treatise, which should find a ready sale.

The Phoenix Book Co. are also prepared to supply copies of the book on deferred terms, according to their usual practice.

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

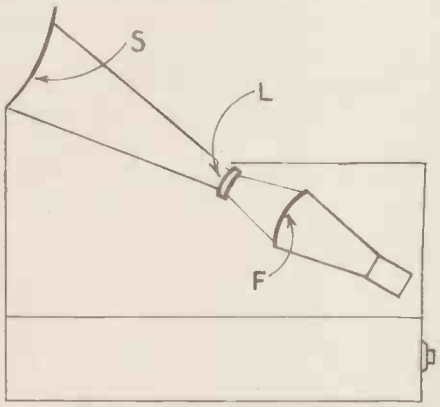
Specially Compiled for this Journal

Patentees: E. Michaelis :: V. Zeitline, A. Zeitline and V. Kliatchko :: Marconi's Wireless Telegraph Co., Ltd. :: Standard Telephones and Cables, Ltd. :: Baird Television, Ltd. and V. Jones :: Radio Akt. D. S. Loewe

Television Projection

(Patent No. 477,814.)

THE picture produced on the fluorescent screen F of a cathode-ray receiver is magnified by a lens L and projected on to a viewing screen S. The tube and lens are mounted in the cabinet below the level of the screen S, so that they are normally out of sight.



Method of Television projection. Patent No. 477,814.

Since the fluorescent material of the screen F is deposited on the glass surface of the C.R. tube, the effect of its curvature must be corrected. This is done, according to the invention, by giving the viewing screen S a "reverse" curvature, as shown in the figure. An ordinary magnifying lens L can then be used without causing distortion in the picture as seen by an observer.—*E. Michaelis.*

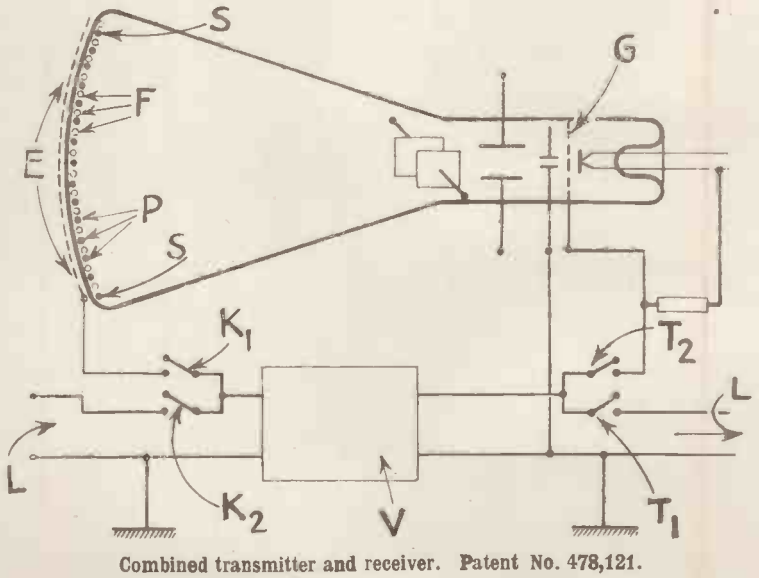
Combined Transmitter and Receiver

(Patent No. 478,121.)

It is sometimes necessary to have a television receiver and a television transmitter located at the same spot, and in such cases it is usual to employ two separate outfits. In order to avoid this duplication, a single cathode-ray tube is so designed and arranged that it can be used for reception or transmission at will.

As shown in the figure, the screen S is made up of fluorescent particles F interspersed with photo-sensitive particles P. When used as a transmitter, the image of the picture to be televised is focused upon the screen S, so as to excite the photo-sensitive particles P. The latter, scanned by the electron stream from the cathode of the tube, set up voltage variations on an external electrode E. These are transferred through a switch K1 to an amplifier V, and from there through a switch T1 to the transmitting aerial.

Where the cathode-ray tube is to be used as a receiver, the incoming signals from the line L are passed through a switch K2 to the amplifier V, which transfers them through a switch T2 to the control grid G of the cathode-ray tube. The received picture is then reproduced by the action of the electron stream on the fluorescent particles F of the screen S.—*V. Zeitline, A. Zeitline* and *V. Kliatchko.*



Combined transmitter and receiver. Patent No. 478,121.

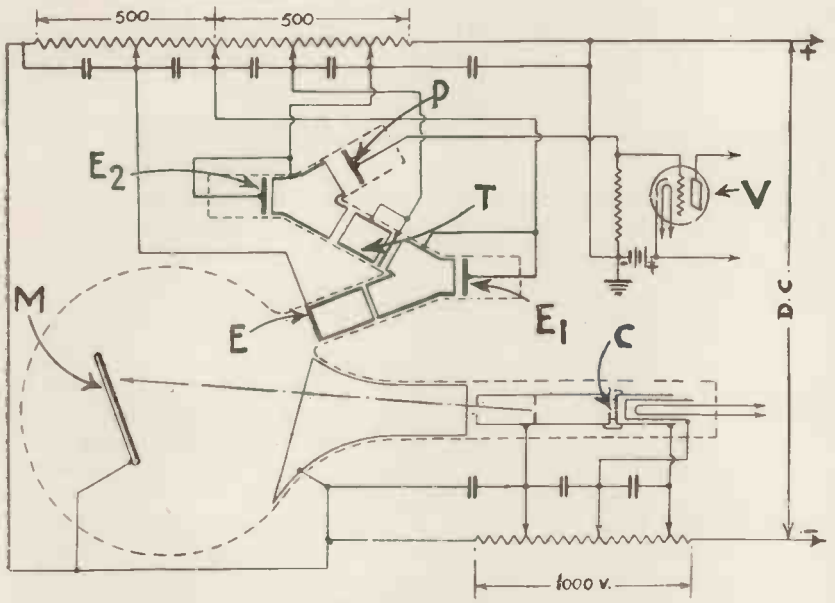
Intensifying the Signals

(Patent No. 478,967.)

In an Iconoscope transmitter, the picture is first projected optically on to a mosaic-cell screen M, which is scanned by an electron stream from the cathode C of the cathode-ray tube. The action of the scanning stream releases the charges built up by the cells, and the resulting pulses of current can then be drawn off from the backing-plate of the screen and amplified up to form the outgoing signals.

At the same time, it is known that secondary electrons are emitted from each of the mosaic cells as they are acted on by the scanning stream, and it is the object of the invention to make use of these as a source of signalling current. For this purpose a separate electron-multiplier tube T is combined with the main C.R. tube, as shown. The secondary electrons are drawn into tube T by the high voltage on an electrode E. Once inside, the electrons are accelerated and strike against a plate electrode E1, where they set free more secondary electrons. These, in turn, are projected against another plate electrode E2, where the stream is again reinforced by secondary electrons, so

that a greatly strengthened signal current is drawn off from the output electrode P and fed to the amplifier



Intensifying the signals. Patent No. 478,967.

V.—*Marconi's Wireless Telegraph Co., Ltd.*

Studio Lighting

(Patent No. 480,483.)

If lamps fed from A.C. mains are used for flood-lighting a television studio, a fluctuating light will be superposed on the ordinary signalling currents, and will produce undesirable bands or flashes of light on the picture as seen in the receiver.

In order to prevent this effect, a second photo-electric cell P1 is arranged to be energised directly from the flood-light lamp L, whilst the main photo-electric cell P is fed with reflected light through the scanning device D in the ordinary way. The output from both cells is separately amplified at V and V1.

The output from V1 is fed to a telephone receiver T, which is coupled to a microphone M in the circuit of the amplifier V. The result is that the undesirable current fluctuations in V1 are fed back in phase-opposition so as to neutralise the same components in the amplifier V. The pure signal currents alone are finally passed on to be transmitted.—*Standard Telephones and Cables, Ltd.*

Transmitting the D.C. Components

(Patent No. 480,646.)

It is difficult when televising a picture to include, in addition to the ordinary signal currents, the low-frequency component (sometimes called the D.C. component) which represents gradual changes in the average lighting of the picture as a whole.

The reason is said to be due to the gradual building-up of a charge on each photo-electric cell of the mosaic screen as light first falls upon it, and before it is discharged by the scanning stream. This relatively-slow process gives rise to corresponding low-frequency variations in the output resistance of the cathode-ray tube.

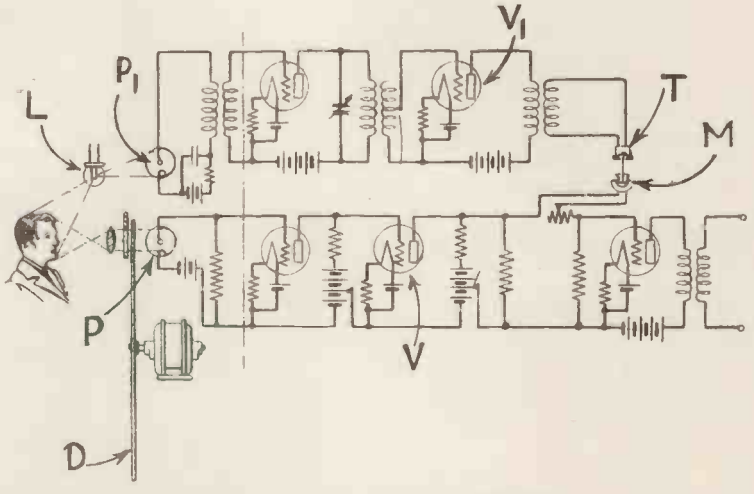
The discharging action of the scanning stream, which is rapid by contrast, produces clear-cut signal currents across the load resistance, though any D..C. component forming part of the signals is masked by the low-frequency charging current previously mentioned.

To overcome the difficulty, a second photo-electric cell is connected in opposition so as to produce charging currents which are equal and opposite to those coming from the mosaic screen. This leaves the output resistance free to respond both to the ordinary signal currents and to the slow variations due to changes in background illumination.—*Standard Telephones and Cables, Ltd.*

Secondary-emission Tubes

(Patent No. 480,691.)

The modulated stream in a cathode-ray tube is made to strike first upon a grid where it liberates secondary electrons, which are in turn forced through other secondary emission grids. The greatly amplified stream is then focused by external coils on to a fluorescent screen of relatively small size. Although small, the image so produced is sufficiently brilliant to stand up to considerable magnification by a lens before it is projected on to the final viewing screen.—*Baird Television, Ltd.*, and *V. Jones.*



Studio Lighting. Patent No. 480,483.

Summary of Other Television Patents

(Patent No. 481,430.)

Multiple-lens system for focusing the electron-stream in a cathode-ray tube.—*Radio-Akt D. S. Loewe.*

(Patent No. 481,516.)

Preventing stream curvature when using magnetic deflecting coils for a cathode-ray tube.—*Baird Television, Ltd.*, and *A. H. Gilbert.*

TELEVISION IN EASY STAGES

IV.—GETTING A PICTURE

This article, which is the fourth in a short series of simple explanations of television, describes how the cathode beam is focused and modulated by the incoming television signal

IN last month's article in this series it was explained how the beam was caused to scan the screen of the cathode-ray tube and produce the " raster " or series of lines which form the basis of the picture. As has been explained earlier the picture is produced by varying the light intensity of these lines from instant to instant. Before considering how this is done, however, it will be interesting to review some of the physical properties of the cathode-ray tube which make this possible.

Focusing

In the first place there is the necessity of focusing the beam so that the spot of light on the screen, or line as it appears when moving quickly, is of quite small dimensions. Obviously, it must be of such a size that the full number of 405 lines can be accommodated in the space available and in addition, of course, upon the spot size depends the degree of definition.

It has been found possible to make the beam in many respects have the same characteristics as a beam of light—that is, it can be refracted, but instead of employing glass lenses for this purpose electro-static or electro-magnetic fields are used, the principles involved coming under the title of electron-optics.

The subject of electron-optics is too advanced to be discussed in this article and it will suffice to say that, by suitably shaping the electrodes in the case of electrostatic focusing, it is possible to produce an electrostatic field of symmetrical shape so that electrons diverging from a given point are brought to a focus at some other point. In magnetic focusing, the focal length and ultimate spot size are governed by the relative positions of the electrodes and the strength of the focusing field.

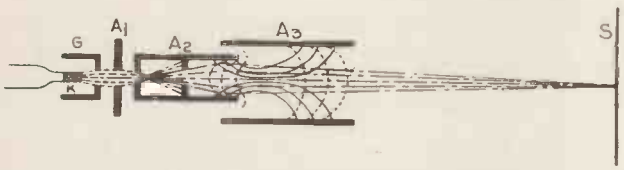
Fig. 1 shows the beam outline for a three-anode tube when adjusted for correct focus and from this it will be clear what actually takes place.

Initially the beam is convergent at the second anode, which means, in effect, that the electron lens has something approximating to a point source of electrons upon which to operate. At the second anode the beam diverges again, but under the action of the electrostatic field between the second and third anodes it again becomes convergent, being finally brought to a focus at the screen.

The cathode, which approximates to a point source, provides the electron stream; surrounding it concentrically, and designed to produce a powerful controlling effect is the grid which introduces the necessary modulation of the beam current for varying the beam intensity. Immediately in front of the grid is the first anode which provides the initial accelerating impetus and also acts in a similar way to the screening grid of a radio valve in that it ensures that the electrostatic field of the electron optical system remains constant.

The focusing anode has a diaphragm, the purpose of which is to intercept electrons too widely divergent to be brought to a good focus, and this has the effect of minimising the " spherical aberration " effect.

As stated, the main electron lens effect takes place between the second and third anodes, and the focal length can be adjusted through a wide range by varying the ratio between the voltages applied to these two electrodes. The optimum focal length is, however, fixed by the position of the fluorescent screen, and therefore, the ratio of the second and third anode voltages is also fixed, and is virtually independent of the magnitude of the applied voltages within the working range.



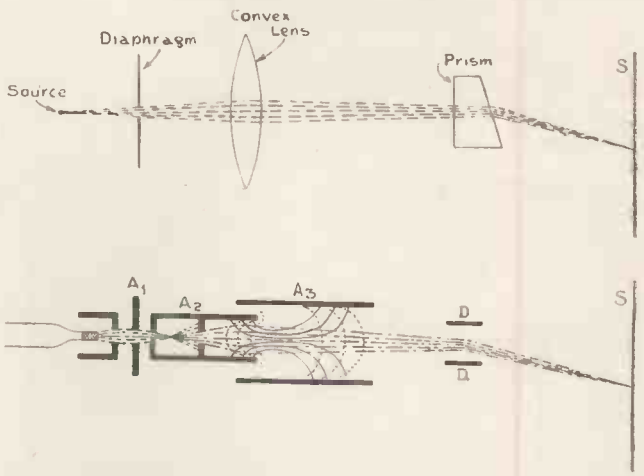


Fig. 1. (left) **The electrode arrangement of a 3-anode tube showing their effect on the electron beam.**
Fig. 2. (right) **Diagrams showing the comparison between optical and electronic focusing.**

A Light Analogy

The analogy between the optical and electron lens effects can be seen by a study of Fig. 2. Commencing with a constant third anode voltage and a second anode voltage which is several hundred volts too high for correct focus, the beam will be found to be divergent. If the second anode voltage is now gradually reduced, the beam will become less and less divergent, finally becoming first a parallel beam, and then more and more convergent until, at the correct value of second anode voltage, it is brought to a focus at the screen.

CATHODE-RAY TUBE CONNECTIONS

If the second anode voltage is further reduced, that is, the focusing field is made too strong, the focal point will recede from the screen toward the third anode, and at the same time the diameter of the beam at the new focal point will be decreased.

It is, of course, desirable to obtain the smallest possible spot size at the screen, and it may be thought that the distance between the final anode and the screen should be reduced and a higher value of electrostatic field be used for focusing. If this were done, however, the deflection sensitivity of the tube would be very greatly reduced because the deflection sensitivity is largely dependent upon the distance between the deflection plates and the screen. In this matter, therefore, as in many others, the tube manufacturer has to design the electrode system as the best possible compromise between the optimum requirements for the individual characteristics.

Magnetic Focusing

The basic principle employed in magnetic focusing is that the electron beam behaves as a conductor carrying current and will therefore be influenced by magnetic fields. If the tube is surrounded by a coil arranged with its axis co-incident with the path of the ray and a direct current is passed through the coil, the magnetic field acts upon all electrons which are not travelling exactly in the axial direction, compels them to follow curved paths. By correct location of the coil and correct adjustment of the magnetising current, these curved paths can be made such that electrons emitted from the cathode are brought to a focus at one particular point on the screen (Fig. 3).

The magnetising force required for a medium size tube is of the order of 250 ampere-turns. In practice the number of ampere-turns may be considerably decreased by concentrating the magnetic field by means of an iron yoke terminating in an annular gap concentric with the neck of the tube.

How the Tube is Connected

The cathode-ray tube is connected to the vision receiver like an output valve, the signal being applied to the equivalent of the grid. Instead of varying the anode current as in the case of the valve, the beam current is varied, and with it, the intensity of the spot on the end of the tube. So each time that the incoming television signals make the shield more negative the beam is cut off and a black patch appears on the screen (black by contrast with the lighter parts, of course).

Conversely, each time the shield potential is decreased, the beam current increases and the spot brightens up. So the incoming television signal is turned into light and dark variations on the screen, all ranges of tone being produced by varying the strength of signal.

Provided that these variations occur in the correct order and place on the screen, a television picture will be built up which will be a replica of the scene transmitted.

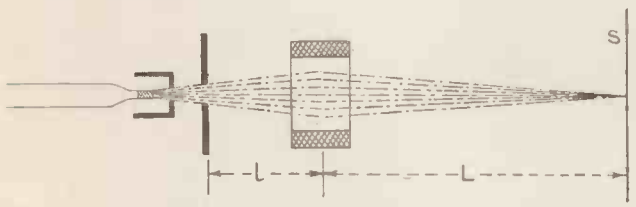


Fig. 3. Diagram explaining the principle of magnetic focusing.

The Cairo Conference and Television.

ONE of the most important conclusions arrived at by the delegates at the recent Cairo Conference was that television should be given official status. During the allocation of frequencies for broadcasting, commercial and amateur purposes, considerable attention was given to the ultra-high frequencies at present used only experimentally and by the amateurs.

Provision for 11 Stations

In future, provision has been made television stations of the high definition wide-band width type. All these stations will be accommodated on wavelengths of between 7.407 and 1.5 metres.

The first channel of 7.407 to 5.128 metres, equal to 40.5 to 58.5 Mc. will accommodate three stations. The second channel from 4.688 to 4.255 metres, approximately 64 to 70.5 Mc., will accommodate one station, while there will be room for two stations between 85 and 94 Mc., that is 3.529 to 3.191 metres.

The largest frequency band is from 170 to 200 Mc., being equal to 1.765 to 1.5 metres. This band will accommodate no less than five stations all of which would have a clear channel free from interference.

It appears from these allocations that future television may use an even lower wavelength than in use at present, for it is not at all certain that the 6.5-metre channel has such a limited range as was at first suggested. If television transmissions do cover wide areas, then this will be a disadvantage rather than an advantage, for it will mean that instead of being able to use one frequency for several widespread stations, each station would have to have a separate channel in order to be free of mutual interference.

The use of the very short wavelengths of under 2 metres would, of course, completely stop interference between stations separated by 120 miles or so and would give a very reliable short-distance service. This would also prevent local interference problems which are at present rather difficult at the edge of the service area, for such interference as motor car ignition completely disappears at about 2 metres.

There is also little possibility of reflected waves being obtained on this wavelength, so that freak long-distance reception would be completely stopped.

It is very important to those interested in television to know that television has a definite place in the frequency spectrum and that provision is being made for a large number of stations in this country.

As, however, these wavelengths are to be shared by all European countries it is very probable that the lower wavelengths will come into more general use when there are a number of television stations in each European country.

Our Readers' Views

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

Interference from Aircraft

SIR,

The aircraft interference reported by Mr. Davies in last month's issue is by no means an infrequent phenomenon on the ultra-high frequencies. The explanation appears to be as follows.

The plane being at a considerable height above the ground is in a relatively intense field and since at these frequencies, its size is comparable with the wavelength of the radiation, it will act as a reflector. A reflected ray will be picked up by the receiving antenna on the ground and will, in general, differ in phase from the ray picked up direct from the transmitter.

Now as the plane moves, the total path length from transmitter to plane and from plane to receiver will normally alter in magnitude and consequently the phase of the reflected ray received at the set will vary, the rate of variation being dependent on the speed of the plane and the direction in which it is travelling.

Thus the two rays at the receiver will alternately reinforce and oppose one another, giving a characteristic fluttering effect.

The phenomenon is often not observed in the normal way owing to the radiation received direct from the transmitter being many times greater than that received via the plane.

W. DOUGHARTY (Clapham, S.W.4).

SIR,

With regard to the letter under the above heading from D. S. G. Davies, of Hendon, I think he has misunderstood the original point mentioned in "Scannings and Reflections."

I find considerable interference from the ignition systems of low-flying aircraft which is quite distinct from the fading which aeroplanes sometimes cause.

The trouble is due to the fact that the electrical systems in the average aeroplane are only screened for use down to 10 metres. The spark from such ignition systems causes interference of long duration. There is generally a certain amount of fading but whether this is noticeable depends to a great extent on the local field strength.

The G.P.O. have also found that interference occurs on the ultra-short waves. They have made checks for a number of years between Dollis Hill and St. Albans where there is a considerable amount of low flying. Fading and interference generally coincides with the passage of an aeroplane.

It would be interesting to have the views of readers in the Croydon district.

A.C.W. (London, W.)

Aerial for Long-distance Television

SIR,

I note in the diagram for a television aerial which I described in last month's issue that the various elements appear all to commence at the same distance from the support.

Actually optimum results are secured from the arrangement when the centres of each element are horizontally in line.

To avoid any misunderstanding perhaps you will be good enough to draw attention to this by publication of this letter.

S. WEST (Beccles).

Television in Bognor

Abstract of letter sent to the Bognor Local Press.

SIR,

In view of the recent correspondence to your paper with regard to television reception in Bognor Regis, the following may be of interest to you.

Since the inauguration of the London television service I have always maintained that signal strength in this locality was adequate to allow of satisfactory pictures being received. Preliminary tests appeared to confirm this view and work was commenced of building a television receiver. A design taken from the periodical TELEVISION AND SHORT-WAVE WORLD, was decided upon and eventually constructed.

As manufacturers' reports of signal strength in this district were somewhat disappointing, another stage was built into this receiver to compensate for a weak signal. After a certain amount of experimenting, excellent pictures were obtained, and it was found that it was possible to remove the extra stage and still obtain excellent pictures with the receiver operated at only three-quarters of its full gain!

The pictures obtained are clear, bright, steady and of very good definition. Electrical interference is far from serious. I am personally delighted with the results and the few friends to whom I have so far shown it have all remarked upon the quality of the results.

In the event that it may be of interest to some, I give brief details of the apparatus used. A half-wave dipole aerial and reflector are mounted at a height of 55 feet. Receiver consists of three R.F. stages, triode-hex. F.C., three I.F. stages, diode detector and one V.F. stage. A diode synch. separator and pentode amplifier are included.

R. F. HANSFORD

22 Sudley Road, Bognor Regis.

Vertical or Horizontal Polarisation?

SIR,

Our interest has been aroused in the question of whether vertical or horizontal polarisation should be utilised for television transmission.

We have been utilising vertical polarisation for the past seven years, and we know that the broadcasts of the British Broadcasting Corporation in London are also with vertical polarisation.

We note in the current issue of the *R.C.A. Review*, Vol. 2, No. 4, April, 1938, page 433, an account of the use of horizontal polarisation; in the paper by Stuart Wm. Seeley on "Effect of the Receiving Antenna on Television Reception Fidelity."*

We have not experienced difficulties of this type and feel sure that if such did occur with vertical polarisation they must have come to notice in England by this time.

We would be pleased to have the experience of others who would be in a position to know as to whether or not bothersome reflections have been received in England.

We will be glad to furnish you with any information that we have in this regard, should you desire to investigate this matter further.

HARRY R. LUBCKE,

Director of Television,

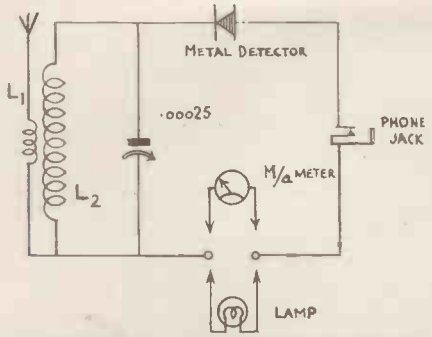
Don Lee Broadcasting System

(Los Angeles).

*An abstract from this paper is published in this issue.—ED.

Simple Two-channel Phone Monitors

These two simple monitors have been designed by G2HK in order to assist those amateurs who require some method of transmitter checking with the very minimum of expense.



The circuits for the two monitors are fundamentally similar with the exception of the method of indication.

EVERY amateur should have in use some simple type of monitor. Personally, I think it should be a regulation making it compulsory for all transmissions to be monitored, for this would prevent quite a big percentage of the accidental over-modulation one hears so frequently on the higher frequency bands. Monitors are very cheap to build in the normal way, but I have just recently been experimenting with some Westector monitors which give excellent results and are extremely cheap. They operate right down to 5 metres although it must be admitted that on the 5- and 10-metre bands they require a fairly longish aerial. The circuit of the two monitors that I use are shown on this page. It will be seen that fundamentally they are identical with the exception that one has a milliammeter and the other a fuse-bulb.

The Simple Type

For straightforward monitoring the one with the fuse-bulb is quite satisfactory, but should the amateur wish to make field-strength tests from a new aerial or to check radiation pattern, then the inclusion of an 0-1 mA. meter is absolutely essential.

It will be seen that both monitors consist of a primary and secondary coil parallel tuned by a 250-mmfd. condenser with a WX6 type Westinghouse rectifier, a phone jack and either meter or fuse-bulb. A short aerial of 6 to 8 ft. should be connected to the primary coil or on the other hand if the monitor is mounted close to the transmitter there will be sufficient pick up on the coil to enable the constructor to dispense with the aerial When, however, the monitor is being used for field strength purposes then it is advisable to connect a short rigid aerial permanently in circuit, otherwise readings will vary. I find that a length of copper rod works excellently and enables me to check quite accurately the radiation pattern of any aerial I may be using.

How the two monitors are constructed can be seen from this illustration. The smaller one on the left-hand side can be obtained completely wired and tested for 10s.

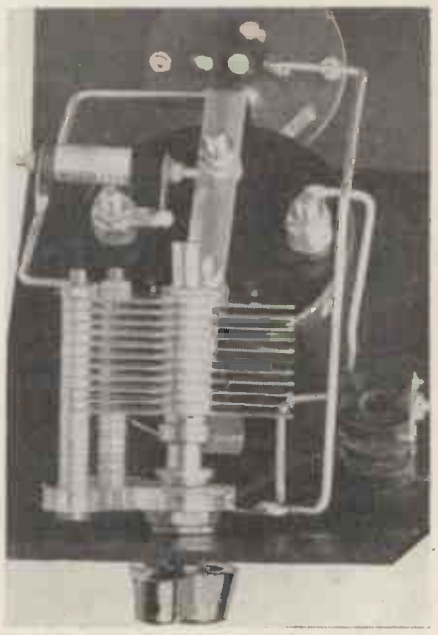
The coils L1 and L2 are of the standard plug-in type and as they are tuned by a comparatively high capacity condenser will cover two bands simultaneously. For example, the coil illustrated for 20 and 40 metres has nine turns on L2 and five turns on L1. For 80 and 160 metres, the number of turns should be 35 on L2 and 15 on L1, all close spaced. For 5 and 10 metres, five turns are required for L2 and three turns for L1.

It should be noticed that the phone jack is of the closed circuit type so that with the headphones removed, the meter or fuse-bulb still indicates the presence of R.F. and can be used as a guide to check transmissions.

I have purposely built two monitors, one being absolutely as cheap as possible and the other reasonably cheap in view of the fact that an 0-1 mA. meter is included. The cheap monitor is built up on a simple ebonite panel and chassis while the better one has a bent steel framework so arranged as to mount the condenser on the front, the coil on the top and the meter and jack at an easily readable angle.

The components required are three standard 4-pin plug-in coils, a .00025 mfd. Premier low-loss tuning condenser, either a baseboard mounting or a chassis mounting 4-pin valve holder, a closed circuit jack, a Westinghouse WX6 rectifier and one or two sundries which can be seen from the illustration. The 60 mA. fuse-bulb, or 0-1 mA. meter are quite optional.

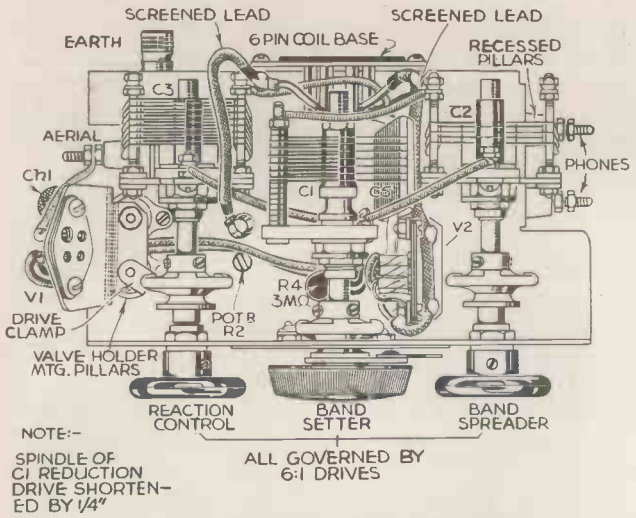
However, I have made arrangements with The Premier Supply Stores to construct these monitors at a very low figure. The monitor with the fuse-bulb can be supplied for 10s. completely wired and tested which is the bare cost of the material. The monitor with the milliammeter can be obtained for 30s.



This is the underside of the chassis showing the Westinghouse rectifier connected in circuit.

A Midget Amateur Band Two Valver

Constructors interested in efficient semi-portable equipment will appreciate this design of a two-valve receiver covering amateur bands down to 10 metres. A novel circuit is used and this is described by the designer, H. F. Measures.



This plan sketch shows the layout of the condensers and the method of mounting the first valve.

A CURSORY glance at the circuit diagram of this receiver may give the impression that very little departure has been made from the conventional methods, yet the preliminary experiments in various circuit arrangements proved of such interest as to prompt the writer to construct the model illustrated, having moulded his observations for the use of those readers possibly contemplating a project of this nature.

After making comparative tests with one or two simple tuned H.F., circuits with triode detection, the principle objection arose with regard to the influence of the different types of aerial to which the set was connected, dead spots proving almost impossible to eliminate, whilst instability and hand capacity left a great deal to be desired. The reaction control was anything but acceptable, although the usual adjustments to load and bias were made, thus it became necessary to resort to an untuned H.F.-det-circuit, since by so doing, the tuning could first of all be isolated from the aerial and detrimental effects referred to above, whilst more exacting considerations could be made to the operation of the detector and the effects of utilising this stage as the output stage.

An XSG was chosen for the H.F. stage with the grid being returned to earth through a choke of 2.5 mh. and tests proved that aerial resonance—which would cause "break through" of the normal broadcast transmissions, when the receiver was operated on a long aerial—was reduced to a satisfactory minimum.

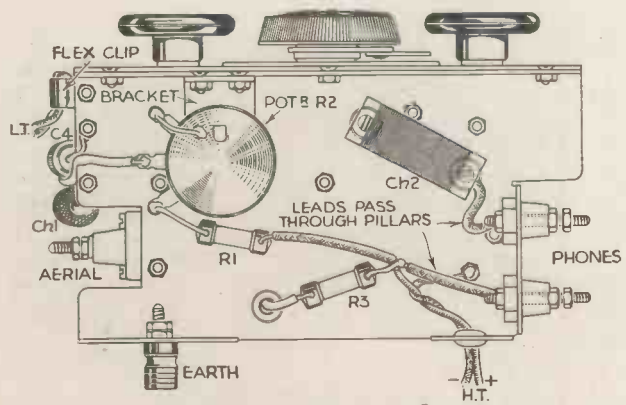
By incorporating a potentiometer in the screen grid circuit, a further advantage was obtained in that maximum sensitivity could be obtained with obvious improvements to the higher frequencies, it being only necessary to make one adjustment; thus the potentiometer was positioned under the chassis with the spindle (previously slotted) protruding for adjustment with a non-metallic trimmer adjuster.

So far as any possible deviation in the normal trend of detector circuit design was concerned, an output pentode valve—the XY—surpassed expectations, and whilst it would have been desirable for this valve to have had a ceramic base for experiments below 11 metres, the writer firmly believes that with such adjustments as the use of a 75 mmfd. condenser in the grid circuit, and a 5 megohm grid leak this receiver should respond to the reception of the higher frequencies, but space will not permit the modifications to be detailed here, however, suffice it to say that to the time of writing, the XY is supplied only with the ebonite base, but its performance is, to say the least, admirable.

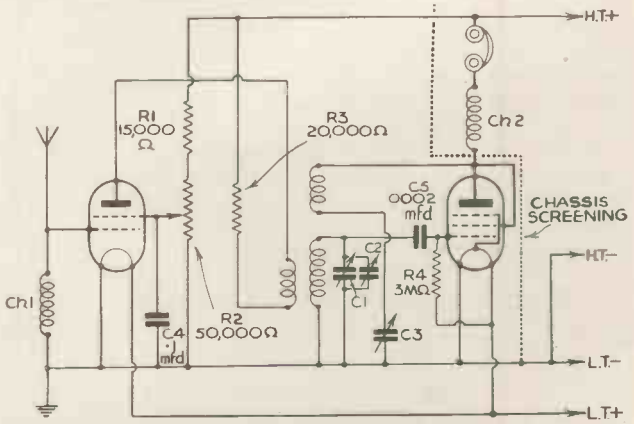
On referring to the theoretical diagram it will be seen that the screen grid of the pentode is commoned directly to the anode, and not, as is more usual, taken to the H.T. phone terminal. The reason will be apparent when it is seen that by the incorporation of the choke CH_2 filtering would tend to prevent self-oscillation, a state which in this particular instance is welcomed, and the reaction on the 11-metre coil would have been impossible to obtain at certain points in the tuning, even with a capacity (c3) of as much as 250 to 300 mmfds.

Whilst rigidity and smoothness in operation formed the basic requirements in the chassis design, the simplicity with which the assembly may be effected can clearly be seen on referring to the above and below chassis pictorial diagrams,

The careful consideration given to the question of drives resulted in the fitment of 6 : 1 ratio epicyclic reduction for each control, and the "slip-free" nature of these movements, together with their smooth easy control,



These are the components underneath the chassis; this diagram also indicates how this actual chassis is bent.



An untuned H.F. stage followed by a pentode detector is used in this two-valver and there is ample output for headphone use without any low frequency stage.

Points to Notice

and compact design, seemed to meet the very demands of the layout.

To obviate the influence of the chassis on the tuning which would have resulted in the coil being mounted in close proximity to the front panel and chassis, provision was made by allowing, in the size of the aluminium sheet used for the chassis, for the coil socket mount bent up vertically above the rear chassis runner, as illustrated, this also permitting short wiring and easy insertion and extraction of coils whether the receiver be incorporated in a cabinet or not.

Two 1½ in. insulated pillars were used to mount the XSG for easy access and in order to keep wiring short, whilst the screened anode lead would be kept clear of the coil wiring and any adjacent apparatus likely to be affected by H.F. leakage.

It will be noticed that the pentode grid condenser C_5 is connected directly to the valve holder socket and coil socket, whilst the grid leak B4 is connected across the grid and filament positive sockets, this is detailed here since the illustration view is such that it is rather awkward for these connections to be depicted clearly in true reproduction in this perspective.

Importance is attached to the extra earthing provided for the condensers C_1, 2 and 3, since should this be left out, noisy operation will result and this feature brings to one's attention the precautionary measures referred to in the use of stand-off insulators for phone terminals.

It is more or less generally understood that R.F. currents pass along the surface of a conductor, and it will be apparent therefore that in utilising the pentode as a combined detector and output valve, stray H.F. will tend to cause parasitic oscillation or instability, whilst resonance with the grid coil will certainly influence portions of the tuning range. The aerial terminal therefore was afforded this extra precaution, and whilst the size of the chassis restricted vertical mounting of the aerial and phone terminals, this proved a little difficult and accessibility was obtained by horizontally mounting these components on the brackets fashioned as illustrated.

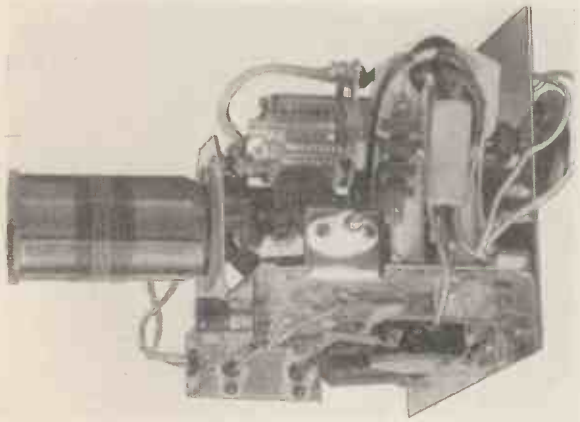
Although in the model being described, two only type EH9 Bulgin brackets were used, one for the condenser C_2 and the other for C_3, and as the drillings C, D and E were for home constructed brackets, EH9 brackets will, however, serve well for mounting C_1 and the potentiometer on the under chassis. The potentiometer bracket should be positioned and the drillings marked as in the case of the C_1 bracket, the surplus length should then be cut off.

There is a point to be watched in the assembly of the components and this is with regard to the relationship of the condenser C_1 to the XSG valve. It will be seen that this valve holder is mounted at a cant, since the valve would foul the ceramic of the condenser if mounted truly horizontal; this has been taken into consideration and it facilitates the removal of this valve, whilst the depth of the front panel is such that this valve will not foul the top of a cabinet when one is used.

The reduction drive of C_3 is clamped by bending over the lug and thus causing this to engage with a small piece of brass affixed to the mounting pillar screw nearest the front panel, the application of the soldering iron at this point completes the fixture. The reduction drive of C_2 is held in position by a small aluminium bracket secured to the chassis and to which is fixed the drive lug by means of a 6BA screw and nut.

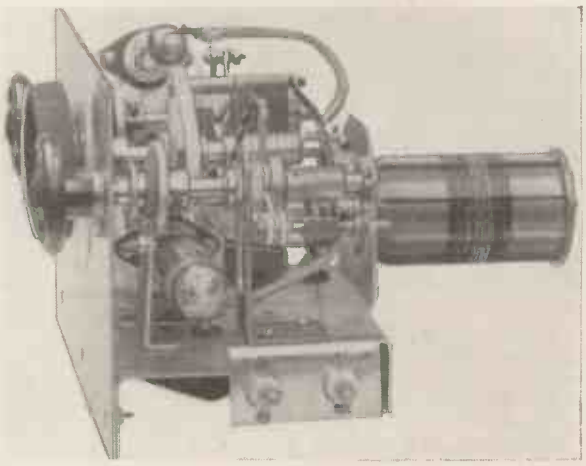
The drive for C_1 is mounted directly on to the front panel necessitated by the modifications to the dial assembly.

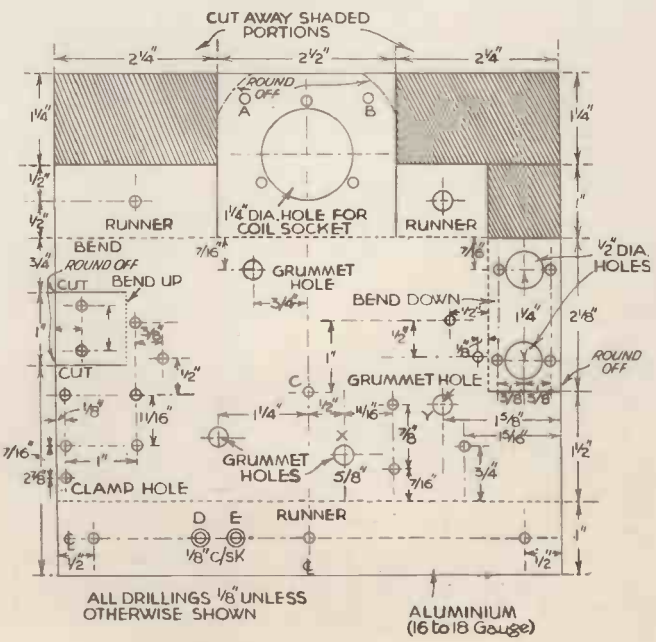
It will be seen that a $\frac{7}{8}$ in. hole on either side of which are two $\frac{1}{8}$ in. holes, constitute the only fixing holes for the



Left is a view of the underside of the receivershowing component layout.

Right is an end view of the receiver showing the coil mounting.





In order to obtain satisfactory results the components must be mounted in the manner suggested by the designer. This sketch shows the actual holes that have to be drilled.

Construction

band setting dial. The large hole permits the protrusion of the reduction drive cursor fixing disc, and with two 6BA c/sk. hd. screws, the drive is fixed by the aid of the lug and by soldering to the screws after centring.

Two ⅜ in. bushes filed down to about 5/16 in. (length) provide steady control of the bandspread and reaction condensers and a little oil or vaseline applied to the drive shafts when finally positioning will add to the smooth "lash-free" movements.

It will, no doubt, have been noticed that no L.T. filament switch has been included in the design, the designer contending that such a consideration is really not essential and only increases the cost and number of panel controls, if, however, one should be desired, there is ample room underneath the centre drive.

Another interesting feature in the design is the manner in which the anode choke Ch2 is mounted beneath the chassis, but owing to the compact nature of this fitment, it is not possible to clearly represent this. Naturally, with only one inch runners, it would be courting trouble to float the choke in the wiring, consequently, two rubber grummets were let into the chassis, as briefly referred to before, in the positions indicated by "X" and "Y" and the choke terminals proved sufficiently long to enable the terminal heads to be screwed on for about three or four turns; these were then soldered, the solder running into the cavity of the head. Only one of these terminal heads constitutes the connection above chassis, the other connection being from the phone terminal on the underside of the chassis.

The two screened flex connections were anchored by soldering the sleeving at suitable points, thus two nuts and bolts were let into the coil base mount and these are indicated by "A" and "B"; by so doing, not only was adequate earthing obtained, but rigidity and the obviation of possible fouling with other components.

A lead is taken directly from the aerial terminal to the grid socket of V1, this connection being clearly shown; also one end of the choke Ch1 is connected to the grid socket, the other end being earthed to one of the valve holder mounting pillar fixing screws. A lead should now be taken from the screen-grid socket—that socket next to the large one nearest the panel—via a small slot, made with a round file in the side of the chassis, to the wiper contact of the potentiometer. The next consideration is the screen-grid condenser C4, and one end of this should be connected to the same socket, the other end being earthed to a pillar fixing screw.

The grid leak R4 is directly connected across the grid and filament positive sockets of the V2 holder and the grid condenser C5, as mentioned previously, is taken directly from valve holder sockets to coil socket as illustrated.

It will be very noticeable that hand capacity effects usually prevalent through the use of an "output-detector" stage have been reduced to a minimum, whilst the silent (mechanically) operation will prove particularly pleasing.

Components for
A MIDGET AMATEUR-BAND TWO VALVER

ACCUMULATOR.
1—Type RDJ1 (Exide)
BATTERY, HIGH TENSION.
1—35-volt type X463 (Exide).
CHASSIS AND PANEL.
1—Aluminium to specification (Peto-Scott).
COILS.
1—Type CA6 11-25-metres (Raymart).
1—Type CB6 20-45-metres (Raymart).
1—Type CC6 44-100-metres (Raymart).
1—Type VH6S coil base (Raymart).
CONDENSERS, FIXED.
1—.0002-mfd. type 690W (Dubilier).
1—.1-mfd. type 4603/S (Dubilier).
CONDENSERS, VARIABLE
1—20-mmfd. type 1094 (Eddystone).
1—100-mmfd. type 900/100 (Eddystone).
1—160-mmfd. type VC160X (Raymart).
CHOKES, HIGH FREQUENCY.
1—Type CHP (Raymart).
1—Type CHN (Raymart).
DIALS AND KNOBS.
1—Type 1026 (Eddystone).
2—Black Wheel Knobs (Webb's Radio).
HEADPHONES.
1—Pair super-sensitive (Ericsson).
HOLDERS, VALVE.
1—Type V6 Midget 4-pin (Clix).
1—Type V6 Midget 5-pin (Clix).
INSULATORS, STAND-OFF.
2—Type 1019 (Eddystone).
2—Type 1029 (Eddystone).
RESISTANCES, FIXED.
1—15,000-ohm type F½ (Dubilier).
1—20,000-ohm type F½ (Dubilier).
1—3-megohms type F½ (Dubilier).
RESISTANCES, VARIABLE.
1—50,000-ohm type B less switch (Dubilier).
SUNDRIES.
4—Type EH9 brackets (Bulgin).
3—Type ERD reduction drives (Raymart).
2—Type 1048 panel bushes (Bulgin).
1—Coil screened flex type W32 (Bulgin).
1—4 oz. reel 16-gauge wire type 741 (Bulgin).
1—Terminal type 13 marked E, black (Clix).
2—Spade terminals type 14 (1 Red, 1 Black) (Clix).
2—Master plugs type 33 (Clix).
VALVES.
1—Type XSG Midget with ceramic bass (Hivac).
1—Type XY Midget (Hivac).

Southend and District Radio and Scientific Society.

The Southend and District Radio and Scientific Society opened their summer's programme on Sunday, May 15, with a field day. Fifty-four members and friends with 17 cars took part; this included 13 members of the Ilford and District Radio Society, and we were very pleased to have the opportunity of welcoming them..

The start was at Battlesbridge and transmissions were on 1.75 Mc. No difficulty was experienced in receiving transmissions and bearings were quickly taken. The transmitter was eventually located two miles south of Brentwood and eleven miles from the start. It was found hidden in an innocent looking hike tent up a little used lane.

Mr. G. T. Peck was the first to arrive, having taken 1 hour 40 minutes and covered about 20 miles. After a long interval Mr. Greenwood arrived to claim second place.

The next 1.75 Mc. field day is to be held on June 26, by which time it is hoped there will be several more receivers available, and it is hoped that the attendance will exceed the record number set up at this meeting.

Interest in the forthcoming 56 Mc. experiments is high, and many members are conducting minor field days on this band and so obtaining valuable experience for the first official meeting on July 3.

The first informal meeting for the younger members, covering some of the elementary principles of radio, was well supported, and it has been decided to continue these meetings fortnightly during the summer.

It will interest readers to know that this Society was founded in 1920, and it is believed that it is one of the oldest provincial radio societies. It has been found an excellent training ground for many who have entered commercial radio work.

The Hon. Secretary, J. M. S. Watson, G6CT, of 23 Eastwood Boulevard, Westcliff-on-Sea, will always be pleased to hear from any person who is interested in the Society's activities.

Metal Rectifiers.

The Westinghouse Brake and Signal Co., Ltd., have produced a complete range of metal rectifiers for use with d.c. meters. This type of rectifier enables experimenters to build multi-purpose meters suitable for measuring a.c. or d.c. One type of rectifier provides an output of either 10, 5 or 1 mA., according to design, and is priced at 25s. All these rectifiers are small in dimensions, so that they can be fitted directly to the terminal of the meter. Full information on these interesting rectifiers can be obtained from The Westinghouse Brake and Signal Co., Ltd., of York Way, Kings Cross, N.1.

With the Amateurs

By G5ZJ

Some interesting details regarding long distance communication on low power are given in this article while news of the Radio Societies has also been included.

AMATEURS who have wondered just how W1KKP can put over such a consistent signal into Europe when the 20-metre band is comparatively dead have not realised that he is using a rotatable beam aerial which is highly directional and does have an appreciable power gain in the right direction.

Owned and operated by C. Coakley, at Buzzards Bay, Cape Cod, Massachussets, W1KKP has on 20 metres an input of 700 watts. Both his station and the rotatable beam are illustrated on this page, and a very good idea of layout and location can be obtained.

This is the half-wave rotary aerial in use at W1KKP. Its effectiveness is proved by the fact that this station can often be heard when the 20-metre band is quite dead for long distance reception.

The Tx.

Starting at the base of the righthand rack the lower panels conceals the 5Z3 power supply for the exciter unit which is in the chassis above. The exciter includes two type 6A6 and one RK-39 valve, the latter always being used as a sub-amplifier.

In contrast to the average English station using one or perhaps at the most two crystals, W1KKP has a pair of variable frequency 80-metre crystals so as to obtain a wide frequency coverage. Incidentally, the buffer stage is capacity coupled to any desired 6A6 anode circuit according to the output frequency required.

The top panel contains the second buffer, a T-55, which is link coupled to the R-39. This second buffer delivers 65 watts output to the final stage which is also accommodated on the same chassis. The final valves are two RK-36's, in push pull operating at 350 mA. 2,000 volts D.C. input.

The lower panel of the left hand rack contains the power supply for the final stage and uses a pair of 866's half-wave rectifiers. Also included in this rack is the class-B modulator power unit which also includes a pair of 866's. This supply delivers 500 mA. at 1250 volts to the speech equipment which consists of two 6C6 valves in cascade driving a type 89 which in turn drives the two type 53's connected in push-pull parallel. This driver stage then connects through a 500 ohm line to the class-B modulator stage in which is used a pair of RCA type 805 zero bias triodes. A Varimatch transformer is used to modulate the push-pull anodes of the RK36's in the Class B final stage.

Coaxial Cable

Bassett concentric cable is used to couple the rotatable aerial which at the moment is a centre fed half-wave radiator with a parasitic reflector spaced one-quarter wave. The elements are aluminium tubes. The 40 feet lattice mast is hinged at its base which can be lowered quite easily for experimental work which is being carried out in conjunction with the well-known British amateur G6DT.

The super structure is rotated at one revolution per minute by means of a suitably geared fractional horse power motor situated near the top of the mast and controlled from the operating position.

In the illustration can be seen the receiving equipment consisting of a National HRO receiver and a three inch oscilloscope for modulation checking. The whole equipment is relay operated and arranged for instantaneous break-in.

The Q Aerial

After discussing aerials with 2CY and 6VA, I decided to try the suggestion regarding half-wave Johnson Q aerial and give it a really good test. As is usual, when one is making aerial experiments, an hour or so after the Johnson Q was erected, there was a complete black-out on short waves.

Stations on 20 metres consisted of a few North Africans, an odd French station now and then and very little else. However, the aerial was erected N.E./S.W. in free space and used for both transmitting and reception. During the following week or so, quite a number of stations were worked, some of which could not be even heard on other aerials having a different radiation pattern. Stations such as PK1ZZ and PK2WL gave a report of R9 on telephony using a Johnson Q aerial; R3-4 on a 132 which was also N.E.S.W. and no report at all on two half-waves in phase N.W.S.E.

It is hardly fair, of course, to compare these various aerials unless correctly directed on to the proper spot. But the fact remains that this little half-wave aerial is excellent providing it can be erected in the correct direction. It looks very unimposing as compared with two half-waves in phase and it takes quite a lot of good contacts to convince one that a little 33 ft. aerial can be a really good radiator. My log book, however, shows the Johnson Q properly used is as good as any half-wave of its type and vastly better than

(*Continued on page 380*)

W1KKP uses an HRO receiver in conjunction with a 700 watt transmitter. Notice the oscilloscope for checking modulation percentage.

A 40-metre Breadboard Transmitter

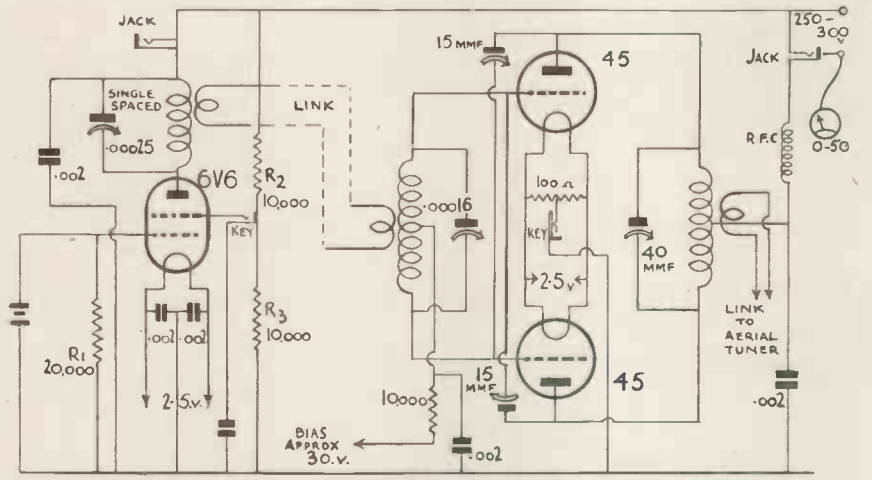
Cheap to Build Easy to Operate

In response to many requests, G2HK has built this very simple transmitter which is excellent in every respect for the beginner and uses the very minimum of components. It is intended for low voltage C.W. use but can, of course, be modulated if required.

A VERY large percentage of the British amateurs are now using rack and panel transmitters of the approved semi-commercial style. There are, however, quite a number who use wooden chassis and panels and an even greater number who have not been converted from the reliable breadboard transmitter.

The Circuit

The crystal is connected in the usual way between the control grid and earth, while shunted across it is a resistor of 20,000 ohms. This provides approximately the correct amount of automatic bias by virtue of the grid current flowing across it.



Only three valves are used in this simple transmitter, both being of the receiving type. Most of the components are of the ordinary kind used in broadcast receivers.

As the amount of interest in very simple transmitting equipment seems to be on the increase, probably due to the issuing of so many licences to new comers, I decided to build a transmitter suitable for two-band operation with the minimum number of components and the lowest possible cost. It is surprising just what can be done in the way of reliable communication work with the very simplest type of apparatus using ordinary receiving type valves, plug-in coils and a low-voltage type of power unit.

Two Stages Only

The transmitter is made up of two stages, both of which are entirely complete on one small wooden baseboard 15 in. by 10 in. It has a crystal oscillator using a 47 pentode, a valve designed for 250 volt operation. A straightforward circuit has been employed, but quite an appreciable output can be obtained on 20 metres from a 40 metre crystal. This enables the transmitter to be used on two bands by merely plugging-in the correct inductance coils.

It is rather important to obtain the correct value of screen voltage and to make sure that this remains constant. To this end I have used a fixed potentiometer made up of two 10,000 ohm resistors. This network across 200-300 volts provides a steady 125 to 150 volts for the screen which remains sensibly constant despite a reasonable fluctuation in total anode current.

C.W. Use

In series with the screen is a closed circuit jack into which the key is connected. I have not shown the necessary filter circuit across the key because this conforms to standard practice and is well-known to all CW operators.

The anode circuit of the oscillator is parallel tuned by a 250-mfd. condenser of the ordinary receiving type. There is absolutely no need to worry about double spacing in this circuit for even without load there is only the barest chance of R.F. flap-over.

It was noticed that an R.F. choke in series with the H.T. supply was quite unnecessary, but a .002-mfd. by-pass condenser had to be included to obtain satisfactory oscillation.

Coil Data

While dealing with this crysta oscillator, here are the full coil details for 40-metre and 20-metre operation. On 40 metres this coil will require approximately 13 turns of 18-gauge copper wire wound to occupy a space of 1 1/16 in. On 20 metres only 7 turns are required, and this can be accommodated in slightly under ¾ in. The coil is not tapped in any way while the windings are terminated in the conventional grid and anode pins of the coil. The link coupling coil consists of one complete turn on the H.T. end of the winding with a very small gap. This can be taken directly to the succeeding grid coil or it can be made an integral part of the oscillator coil and terminated at the two filament pins. I have found, however, that with an experimental rig, it is much better merely to wind a single turn of rubber covered wire around the coil and to adjust the coupling after the transmitter has been put into operation. This enables the correct load to be obtained to suit various valves.

In the anode circuit, or rather the H.T. supply, is a single closed circuit jack. This is mounted flush on to the baseboard and when the meter is plugged in will indicate the anode current flow. At this point it is well worth realising that only one meter is used to check the whole transmitter. It can be plugged into either anode circuit as required.

The P.A. Stage

Next comes the push-pull power amplifier. Considerable time was spent on testing various cheap receiving valves in order to obtain maximum efficiency without going to the expense of buying large valves of the T-20 type. It was found that one of the best valves for this purpose was the 45 type, a low impedance power triode.

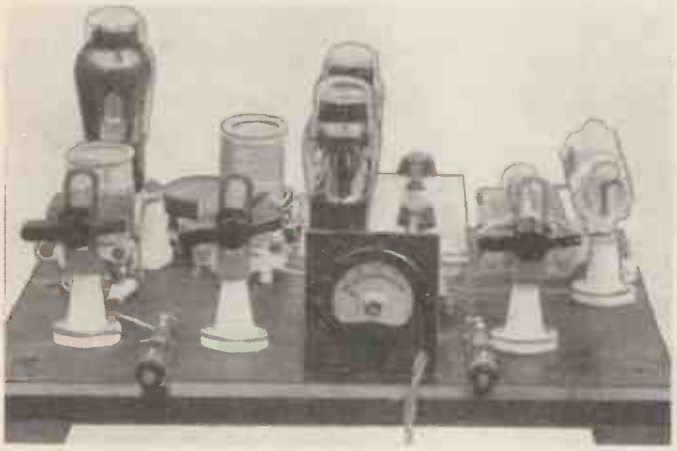
Two valves of this type operate very comfortably at 20 to 25 watts at about 350 volts H.T., but at the same time with a low voltage of between 200 and 250 the input can be varied quite nicely from 5 to 10 watts They are, therefore, ideal for the beginner, or in fact anyone limited to 10 watts or who does not wish to expend too much money on high-voltage power supplies.

250-volts H.T. :: Push-pull Final

Again a conventional circuit is used, being the neutralised push-pull arrangement with a tuned grid input. Across the grids of the 45's is connected a centre tapped coil. This is parellel tuned by a condenser having a capacity of 160-mmfd. It is again of the single spaced receiving type, for directly the anode circuit is tuned to resonance there is no sign of R.F. splash-over. The centre tap of this coil is taken to approximately 30 volts of negative bias via a 10,000-ohm 5-watt resistor. The junction of the centre tap and the resistor is by-passed to earth by means of a .002-mfd. condenser. This condenser, incidentally, need only be of the low voltage type. For 40 metres this coil consists of 22 turns of 18-gauge wire spaced to occupy a length of 1¾ in. In the centre of the coil, where the tap point is made, is a gap equal to the diameter of two turns.

The outers of this coil are connected to grid and anode on the coil base while the centre tap is taken to one of the filament pins. If the constructor should wish to embody the link coil, a 5-pin former and base will be required, but the same remarks apply to the link coil in this circuit as in the oscillator anode circuit.

On 20 metres the grid coil required 12 turns of the same guage wire and wound to occupy a space of 1 in.



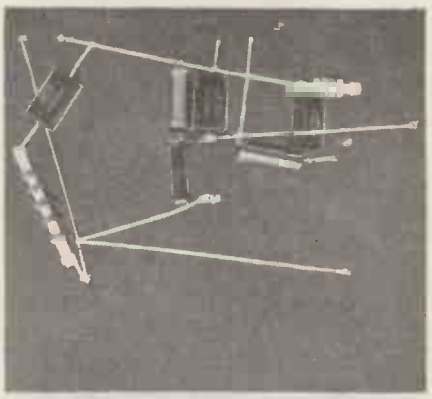
A single meter is mounted on the front of the baseboard and can be connected into either C.O. or P.A. anode circuits by means of a plug and jack.

Making the P.A.

In order to obtain the maximum efficiency in this T.A. stage the two valves and the two neutralising condensers are mounted directly onto a strip of Trolitul, which is in turn raised off the base board by means of two 1¾ in stand-off insulators. This makes quite a neat arrangement and dispenses with adjustable brackets and rather unnecessary stand-off insulators.

Also this arrangement enables the lead to the neutralising condenser to be kept quite short. It will be seen from the circuit that these condensers, which have a capacity of 15-mfd and are double spaced, are connected between the anode of one valve and the grid of the other, so that this portion of the circuit can be wired up before the Trolitul strip is fixed in position.

Across the heaters of the P.A. valves is connected a 100-ohm resistor which is centre tapped and connected to earth via another single closed circuit jack, so that keying can be carried out on either the final or the crystal oscillator stage as required.



These are the components mounted underneath the baseboard.

Tank Capacity

The tank condenser in the final stage should have a capacity of 40-mmfd. in order to obtain a reasonable degree of efficiency, but for multi-band operation it is possible to use a .00016-mfd. condenser so as to tune two bands with one coil. This is, however, a point of interest only for those who do not wish to change too many coils. With a 40-mmfd. condenser the tank coil consists of 20 turns of 16-gauge wire wound to cover 1½ in. It is, of course, centre tapped in the usual way and in series with this tap and R.F. choke and jack for the meter. The centre point is also by-passed to earth by another .002-mfd. condenser.

As can be seen from the illustrations there are three terminal saddles mounted on the back of the breadboard. The one near the crystal oscillator is for 2.5 volt heater supply. The one in the centre is for grid bias, while the one on the right-hand side carries H.T.

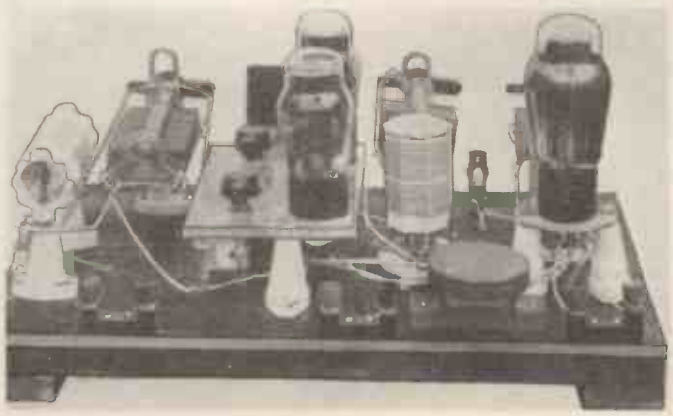
The crystal, with its enclosed holder, is mounted just behind the C.O. valve, while in front of this valve and next to the tuning condenser is the C.O. anode coil. Notice how the C.O. valve is mounted off the baseboard on tall stand-off insulators to make wiring simple.

The grid coil for the 45 valves comes next and is mounted directly on to the breadboard.

On the extreme right, next to the tank condenser, is the tank coil, a Raymart product, which is fitted with plugs so that it can be made interchangeable. Constructors will, therefore, appreciate that the three coils can be changed over in a matter of seconds in order to change from say 40 to 20 metre operation.

Only one meter is required, and this is mounted on a small metal panel of its own on the front of the chassis and with conventional plugs. It can then be switched into either anode circuit as required. This meter reads from 0 to 250 mA., which is more than sufficient

(*Continued on page* 384)



The three terminal saddles take the L.T., G.B. and H.T. supplies while the Q.C.C. crystal holder can be seen mounted behind type 47 valve.

The Short-wave Radio World

AN ULTRA HIGH-FREQUENCY RECEIVER

AN interesting two-valve receiver for the "ultra high's" is published in the American Handbook "Radio." It uses a triode acorn valve as a super-regen. detector followed by a low-voltage tetrode as an audio amplifier.

The circuit is shown by Fig. 1, and as it is arranged will tune down to 1 metre. All coils are self-supporting but are mounted on a strip of low-loss insulating material which is in turn mounted on the 15 mmfd. tuning condenser.

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

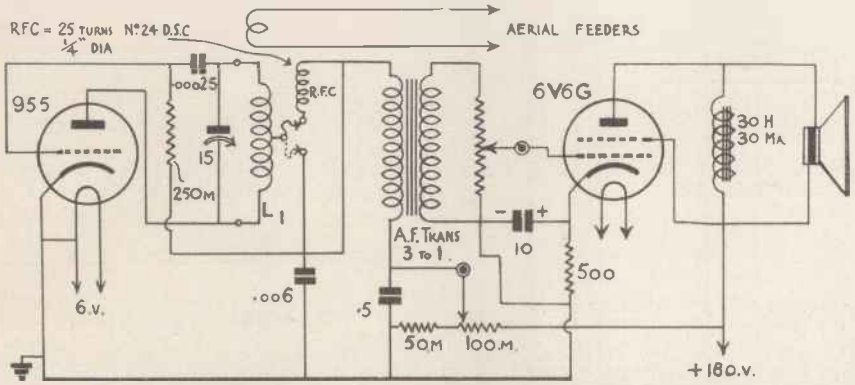


Fig. 1. The super regenerative detector valve is a triode acorn which is essential in ultra-high frequency circuits of this type.

As the coils are terminated in plugs with sockets on the base the receiver can be made to cover several ultra-short wavebands up to 10 metres.

The grid condenser is of the low-capacity ceramic type having a value of 250 mmfd. The tuning coil L1 is mounted close to the stator plates of the condenser and to the anode of the 955 valve. It is important that the coil lead to the stator plates be very short and the designers suggest a total length of ¼ in.

Coil L1 is centre tapped and at this point a home made high-frequency choke is connected. This choke is made up of 25-turns of 24 d.c.c. wire close wound and with a diameter of ¼ in.

In the audio stage the circuit is conventional and has a 6V6 tetrode operated from a power supply of 180 volts. A potentiometer regulates the audio gain while a second potentiometer varies the amount of super regeneration.

Coils can be made to cover all wavelengths from 1 to 11.8 metres with each coil overlapping its neighbour on both sides.

The first coil consists of slightly less than one full turn of 14-gauge wire measured from the tip of each socket. The wavelength covered is approximately 0.9 to 1.7 metres. A coverage of 1.6 to 2 metres is obtained with a 4-turn coil centre tapped. The diameter of this coil is ⅜ in with a winding space of 1 in.

A third coil of 7 turns with the same diameter as coil two covers 2-4.4 metres and is also centre tapped. A 14-turn coil wound to a length of 1¼ in. and a diameter of ⅜ in. covers 4 to 6.8 metres. This coil is tapped at the 6th turn from the grid end and the tap plugs into the cathode by-pass pin jack.

The largest coil consists of 14 turns ⅝ in. diameter wound to a length of 1⅛ in. It is tapped at 5 turns from the grid and so arranged that with this coil only the high frequency choke is not in circuit.

This coil covers up to 11.8 metres so that it is suitable for the 10-metre amateur band. With all these coils 14-gauge wire is used and it is suggested that enamelled wire should be used instead of tinned copper in order to reduce the skin effect.

A THREE-RANGE VALVE VOLTMETER

In the March 16 issue of the *Sydney Bulletin* was an interesting design of a valve voltmeter applicable for amateur and service use. It embodies an 0-2 mA. meter as an indicator which is capable of precision measurements. The circuit is shown in Fig. 2 from which it can be seen that the instrument is entirely A.C. operated using an AF7 pentode connected as a triode and operated as an anode bend detector. The grid is biased negatively by the tap on the resistor R5. This voltage divider has a comparatively low resistance so that bias values remain almost constant with anode current changes.

In this particular circuit a negative bias of 13 volts is just sufficient to cut off anode current and for the 0-5-volt range the valve is so adjusted as to be used on the most favourable portion of the curve. An input of 5 volts will produce a reading of 2 mA. For measurement of higher voltages the range of the meter would be exceeded and grid current would flow. In order to permit the measurement of 50 volts, and still to limit the current reading to 2 mA. the grid bias must be increased to at least 70 volts. Fixed bias is not altogether suitable as only the higher input voltages would produce anode current. In order to avoid this difficulty automatic bias is used. A switching arrangement has been used to incorporate bias resistors in the cathode circuit for the two higher voltage ranges. Resistance R2 is used for the 50-volt position and R3 for the 15-volt position. For a no-signal position the fixed bias of 13 volts across R5 reduces the anode current to practically zero, so that there is no potential drop across the cathode resistor in the circuit.

As the input voltage increases the grid is driven less negative so that anode current flows. The increasing anode current causes a rise in voltage across the cathode resistor so that a measure of compensation is effected. So for the 15 and 50-volt ranges sufficient

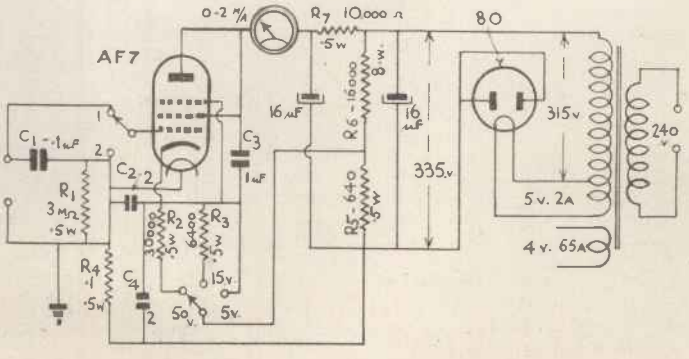


Fig. 2. This valve voltmeter is highly sensitive and retains its calibration despite the fact that it is mains operated.

A Single-control Transmitter

additional bias is produced to limit the current reading to 2 mA. for maximum deflection in both ranges.

To obtain a suitable operating characteristic the voltage applied to both anode and screen is in excess of normal rating, but as the anode current is limited to 2 mA. the use of this high anode voltage is permissible. The H.T. supply is filtered by two 16-mfd. condensers plus the resistance R7 which has a value of 10,000 ohms. This resistance makes it unnecessary for an L.F. choke to be used and also serves to protect the meter by current limitations.

A.C. calibrations can be made by connecting an A.C. voltmeter in parallel with the input terminals to indicate the supply voltage. The A.C. voltage for the meter should be varied in sufficient steps to calibrate from zero to 50 volts. The filter system C1 and R1 isolates the meter when measuring D.C. input.

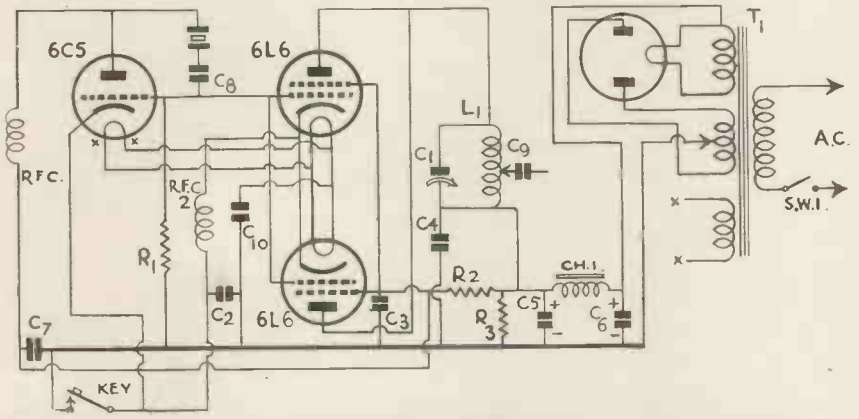


Fig. 3. The Simplest transmitter one could possibly imagine. It uses but one tuning condenser and is crystal controlled.

A SINGLE-DIAL TRANSMITTER

We noticed in the latest Thordarson manual a most interesting transmitter very suitable for the beginner for although three valves are used there is only one tuning control. It is very cheap to build, can be made on a small chassis of 8 in. by 8 in. square and uses the minimum of components. The circuit of this transmitter is shown in Fig. 3 while there is also a suggested layout for the components in Fig. 4.

It can be seen from Fig. 3 that the transmitter consists of two stages. The first is an untuned Pierce oscillator and the second a conventional stage using 6L6's in parallel. The only tuning control is used to bring L1, the tank coil, into resonance. The efficiency is quite good and a high R.F. output can be obtained on all bands. Even on 10 metres with a 40-metre crystal there is quite sufficient R.F. output for long-distance communication purposes.

The values for the components are as follows:

R1 50,000 ohms 1 watt.
R2 20,000 ohms 25 watts.
R3 20,000 ohms 25 watts.
C1 150-mmfd. variable.
C2 .001-mfd. 500-volt mica.
C3 .001-mfd. 500-volt mica.
C4 .001-mfd. 500-volt mica.
C5 8-mfd. 450-volt.
C6 8-mfd. 450-volt.
C7 .001-mfd. 500-volt mica.
C8 .0001-mfd. 500-volt mica.
C9 .001-mfd. 500-volt mica.
C10 .001-mfd. 500-volt mica.
T1 type T-70R62 Thordarson transformer.
CH1 T-49 C91 Thordarson choke.
RFC1 2.5 mH. R.F. choke.
RFC2 12 turns number 18-gauge wire ¼ in. dia.

No difficulties should be experienced in building this transmitter for the layout of the components is not particularly important. As there is only one tuning control the constructor merely has to adjust the coil, L1, until it resonates to crystal frequency.

However, the following coil data will help constructors and as five coils will cover five wavebands this little transmitter can be used for multi-band operation with the minimum amount of trouble.

All the coils are wound on 1½ in. formers and have the following numbers of turns.

For 160 metres, 40 turns 18-gauge wire close wound. On 80 metres, 25 turns of 16-gauge wire, again close wound. 17 turns of 16-gauge wire wound to a length of 1¾ in. will cover the 40-metre band, with eight turns of 16-gauge wire wound to a length of 1½ in. for 20 metres and four turns of 16-gauge wire wound to a length of 1½ in. for 10 metres.

Special Apparatus.

There are very many constructors who need complete apparatus for some particular purpose which is quite unobtainable from the normal sources of supply. We have in many instances taken advantage of the development laboratory run by the well-known consulting engineer Paul D. Tyers.

Readers who find that the components they require are unobtainable, should get in touch with Paul D. Tyers, Development Laboratory, Bridle Path, Watford.

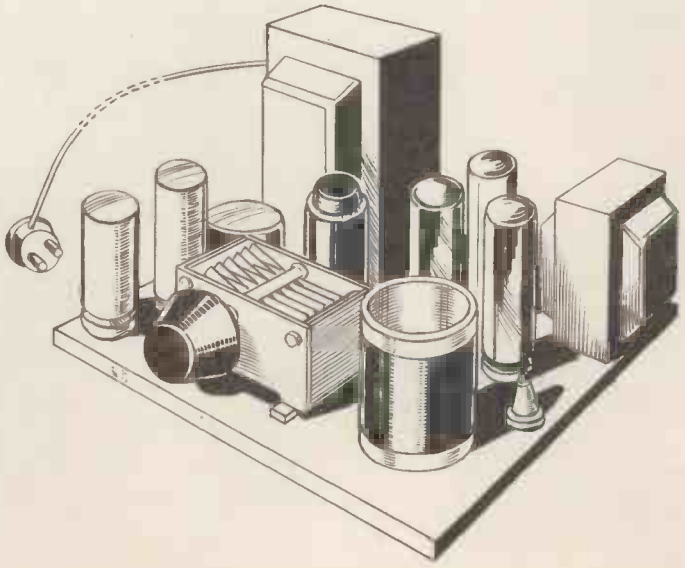


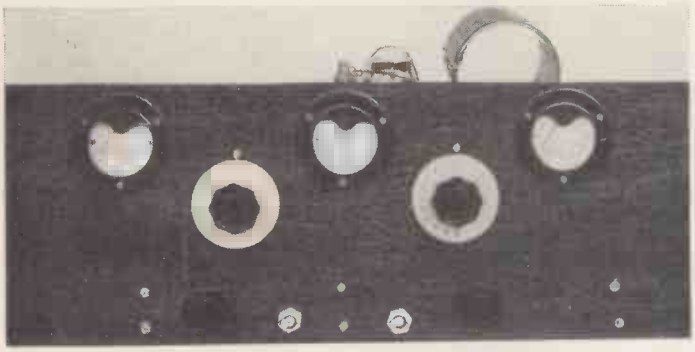
Fig. 4. This is a suggested layout for the components. In the foreground is the tuning coil while behind it are the four valves and the mains transformer. On the left-hand side can be seen the electrolytic condensers.

A Multi-band C.O.-P.A.

This transmitter will operate with a high degree of efficiency at inputs of between 10 and 30 watts. It is complete with modulator and only two coils are required for each band. The designer **Kenneth Jowers** *is using this transmitter on 160, 40 and 20 metres with great success.*

MOST amateurs, generally speaking, prefer to use British made equipment and components if they are able to obtain what they required at reasonable prices and with a degree of efficiency equal to that of the American counterparts. During the past few months, British manufacturers have produced all manner of interesting components and valves which are especially suitable for amateur use.

This applies to condensers, valves, meters and, in fact, all the components associated with amateur equipment. This has enabled me to build a complete transmitter with speech amplifier and modulator using British made parts throughout. The price of the completed equipment is as low as it possibly can be and actually a little lower than if all American components were used.



The three meters are of the latest Sifam type and read the CO anode, P.A grid and P.A. anode current.

A special transformer made by Premier has been used which provides all the H.T. and L.T. supplies so that one power unit is sufficient for both the transmitter and speech amplifying equipment. This also enabled me to use two chassis both made of wood and to construct a very simple and compact rig which should suit many amateurs who only require low power and a single ended output stage.

In addition, those who are newly licenced and have not had very much experience with tuning and operating transmitters will appreciate that there are only two controls, both of which require little adjustment, while the switching of the power supply has been reduced to a very simple operation, so cutting out the need for complicated relays.

I consider that any amateur, no matter how inexperienced, should be able to build this equipment and to obtain satisfactory results without any trouble whatsoever. The components used are all available from stock, while there is nothing special or awkward about them, so that slight modifications can be made to suit individual requirements.

Amateurs would be well advised to consider the transmitter as three separate units which can be made individually, athough both the transmitter and the speech equipment are mounted on the same wooden chassis.

It is also quite a good scheme to build the power supply first as this is the easiest section and can be tested on its own before the remainder of the equipment has even been laid out.

This power unit consists of a single mains transformer, a 150 mA. smoothing choke, a double condenser consisting of two 8-mfd. condensers, a mains input block-cum-fuse-holder, one switch in the primary of the mains transformer and a stand-by switch between centre tap of the H.T. winding and earth.

The rectifying valve is of a special type recently produced by Osram, which with 500 volts R.M.S. on each anode will provide 500 volts D.C. at a current of 250 mA.

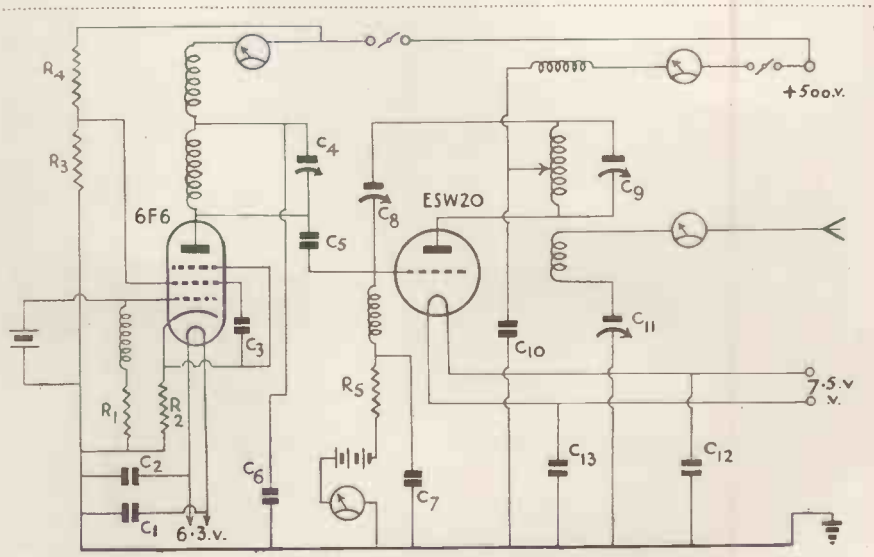
Building this power unit took less than an hour from the original design, so that it can be checked and tested very quickly. The wiring is simple, as can be seen from the theorectical circuit.

Heavy flexible leads are used to take the 6.3 volt and 7.5 volt windings from the transformer up to the chassis above. These leads can be connected directly to the terminals on the mains transformer and terminated on soldering tags on the transmitter chassis. It must be stressed that these leads should be of heavy gauge and capable of carrying the full heater current without appreciable voltage drop,

The high-voltage output from this unit is taken to two terminals so that they can readily be connected to two similar terminals on the rear of the top chassis carrying the R.F. section.

Next assemble the panel on the R.F. section. This is 19 in. wide, so fitting the standard relay rack, and has a height of 7 in. Three meters have to be mounted symmetrically, leaving space for two dials, two switches and the volume and tone controls. In order to reduce space, no brackets are used for mounting the condensers. Instead a large hole is drilled in the panel and behind it is fitted a 1½ in. square strip of Trolitul, onto which is mounted the condenser. In this way, losses are kept to a minimum while there is a saving in space of at least 1½ in. on the baseboard.

So that the valves should not be much above the height of the panel, both the 6F6 oscillator and the E.S.W.-20 have their valve holders mounted underneath the chassis to a depth of 1½ in. These valve holders are merely supported by means of two lengths of 4 B.A. brass studding, which makes a most satisfactory mount.



Only two valves are used in this arrangement but the 6F6 will drive the ESW-20 on two bands.

The Speech Amplifier

This also reduces the height of the anode connection of the ESW-20 and enables much shorter leads to be obtained between the neutralising condenser, tuning condenser, coil and anode. It will be noticed that the final anode coil is mounted on stand-off insulators so as to level it up with the top of the valve.

Special stand-off insulators have been used with socket connections so that the P.A. coil can be plugged in and out of circuit quite quickly. It will be noticed from this that to change wave bands one merely has to plug in two coils and

Two special transformers are required in the speech amplifier which consists of two 6L6's in class-A push-pull.

a new crystal, an operation which takes less than five minutes altogether.

The majority of the components with the exception of R_5 are mounted underneath the base board, but it was found much more convenient actually to terminate R_5 to one side of the grid meter than to attempt to suspend it in the wiring. Unfortunately, the other resistors are not so well placed, so it is advisable to use 14-gauge connecting wire in order to obtain rigidity.

Testing

The R.F. section of the transmitter can be checked before the speech amplifier and modulator has been constructed. For 160 metre operation wind on 50 turns of 22-gauge enamelled covered wire onto a standard 4-pin 1½ in. former without any gap.

The tank coil was especially made for me by Peto-Scott, and consists of 70 turns of 18-gauge enamelled covered wire, on a 2¾ in. former wound to cover a distance of 4½ in. This coil is centre tapped and provided with two soldering tags to carry a link coil which has to be fitted by the constructor.

10 Watts

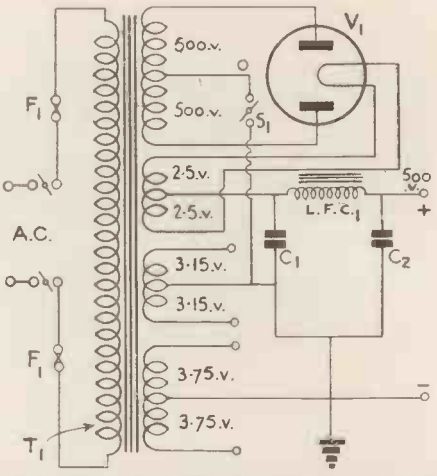
On 160 metres the input must be kept down to 10 watts, which means that the anode current of the ESW-20 when connected to the aerial should not exceed 20 mA.

With the H.T. voltage removed from the oscillator increase the grid bias to the ESW-20 until the anode current drops to zero. This will be in the region of 50 volts negative. When making adjustments to the bias always disconnect the H.T. supply, otherwise the total anode current in this circuit will be very high and may cause damage to the valve.

After the final valve has been biased to cut off, reconnect H.T. to the oscillator and adjust this until a reading of 10 mA. is obtained in the grid meter. At this time the H.T. should be removed from the ESW-20.

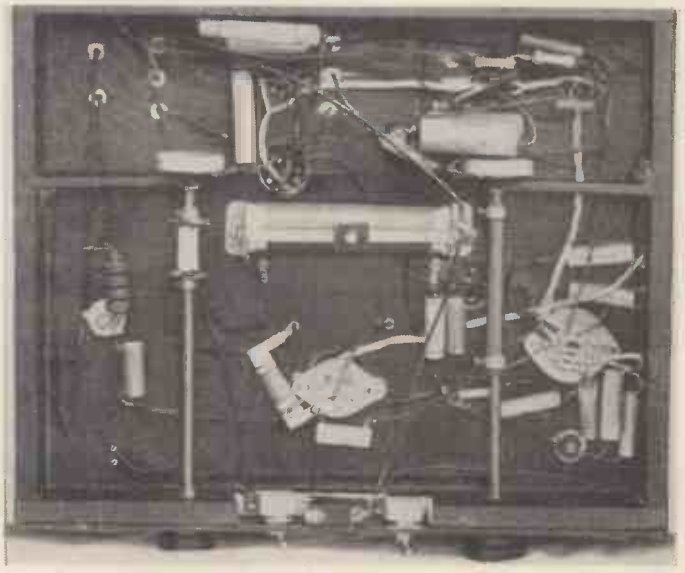
When the oscillator has been correctly adjusted and sufficient drive has been obtained, connect H.T. voltage to ESW-20 and tune C_9 until the anode current in the final stage is reduced to the lowest possible value Again disconnect the H.T. to this valve and readjust C_9 slightly to either side of the resonant point, and at the same time, continually readjusting C8. When the correct adjustment of C8 has been found it will be noticed that the reading on the grid meter will remain absolutely constant. During the period that C8 is incorrectly adjusted, then any movement of C_9 will cause a variation in grid current reading.

These are all the adjustments that need be made to the transmitter, for it is then ready to couple to the aerial. It can either be link coupled by means of two or three turns round the centre of the tank coil to an aerial coil located at



One power unit supplies both the transmitter and the speech equipment. This also includes the total filament supply.

a distance from the transmitter or else it can be coupled by means of an aerial coil close to the tank coil. The first suggestion is the more satisfactory one for it does help to reduce interference on local stations.



Four valves are used in the speech amplifier and modulator which gives good quality with a high wattage output.

Plug-in Coils For Any Band

The Speech Amplifier

Next comes the construction of the speech equipment. From the theoretical circuit it can be seen that this consists of two speech amplifiers feeding into a pair of 6L6G's in class A push-pull. This arrangement provides sufficient audio output to modulate the ESW-20 up to an input of 30 watts.

There is not sufficient gain for a microphone directly into the input circuit unless it is of a high output type. The intention is for constructors to use a single stage pre-amplifier. The input valve is a 6C5G triode, with a volume control across its grid earth circuit. This valve is R.C. coupled to a 6J5, a medium impedance triode, which gives sufficient audio output to drive the two 6L6G's.

The inter-valve transformer is of the push-pull split-secondary type made for me by Bryan Savage, while the output transformer is also of a similar make, suitable for an anode-to-anode load of 6,000 ohms. The secondary, of course, has to be wound to the operating impedance of the ESW-20, and this depends entirely on the wattage which is to be used.

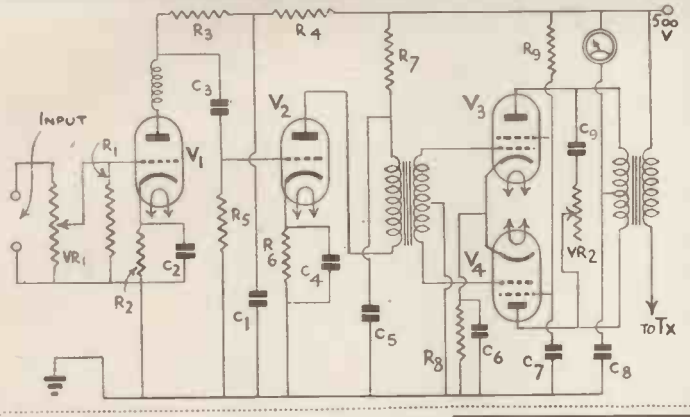
The speech amplifier and modulator sections follow normal practice, and if the layout shown is used there should not be any difficulty in removing all traces of hum, while instability was not noticed even in the experimental hook-up.

The meter included for reading the anode current of the 6L6G valves is quite optional, and it is suggested that if one be used it is mounted on the power pack chasis so as to leave ample space on the panel of the R.F. circuit.

Although the 6L6G valves are rated for a D.C. input of 400 volts, the extra 100 volts supplied is nearly all lost in automatic bias and through the resistance of LFC1, so that the slight extra voltage can be ignored.

So far I have assumed that this equipment is going to be used on 160 metres and limited to an input of 10 watts. On 40 metres, with a 40 metre crystal, the P.A. valve can be driven up to a grid current of 20 mA. and a D.C. input of up to 30 watts. On 20 metres, with a 40 metre crystal doubling down in the C.O. circuit, the input is reduced to approximately 20 watts with a grid current of 16 mA. Should any constructor wish to obtain greater output on the 20 metre channel, it is suggested that the 6F6 crystal oscillator be replaced by an 6L6, in which circumstances the input of the final valve can then be increased up to 30 watts. When, however, the C.O. is being used for fundamental operation it is advisable to use the 6F6, for the 6L6 would give rather too high a crystal current in the circuit shown.

This transmitter will give a very good account of itself and it is quite suitable for average amateur use. It must be remembered, however, that it cannot be constructed unless a Post Office permit has been obtained, full details of which will be given by the Engineer in Chief, Radio Division, Aldersgate Street.



Most of the components are beneath the baseboard as can be seen from this illustration. Four soldering tags are used to take the filament supplies from the separate power unit.

Components for a Multi-Band C.O.-P.A.

R.F. SECTION

CHASSIS AND PANEL.
1—Wooden chassis 15 × 10 × 2 in.
1—Wooden panel 19 × 7 × 5/16 in.

COILS.
1—4-pin type CT4 home-built to specification (Raymart).
1—P.A. coil wound to specification (Peto-Scott).

CONDENSERS, FIXED AND VARIABLE.
1—.002-mfd. type 4601/S (C.1) (Dubilier).
1—.002-mfd. type 4601/S (C2) (Dubilier).
1—.01-mfd. type 4601/S (C3) (Dubilier).
1—.00016-mfd. type TRO16OT (C4) (Premier)
1—.0001-mfd. type HV tubular 500v. (C5) (Dubilier).
1—.002-mfd. type HV tubular 500v. (C6) (Dubilier).
1—.002-mfd. type 4601/S (C7) (Dubilier).
1—Type 1088 (C8) (Eddystone).
1—.00016-mfd. type TRO16OT (C9) (Premier).
1—.002-mfd. type HV tubular (C10) (Dubilier).
1—.00016-mfd. type TRO16OT (C11) (Premier).
1—.002-mfd. type 4601/S (C12) (Dubilier).
1—.002-mfd. type 4601/S (C13) (Dubilier).

CHOKES, HIGH FREQUENCY.
2—Type SW68 (Bulgin).
2—Type 1022 (Eddystone).

CRYSTAL.
1—Standard crystal with enclosed holder for either 1.7 mc. or 7 mc. as required (Q.C.C.).

DIALS, ETC.
2—Type 1099 (Eddystone).
2—Type 1089 (Eddystone).

HOLDERS, VALVE.
1—Octal chassis type less terminals (Clix).
1—4-pin type American less terminals (Clix).
1—4-pin type V1 less terminals (Clix).

METERS.
1—0-100 m/A. type E66M (Sifam).
1—0-30 m/A. type E66M (Sifam).
1—0-200 m/A. type E66M (Sifam).

PLUGS, TERMINALS, ETC.
2—Insulating pillars type 1095 (Eddystone).
2—Insulated terminals type B marked H.T. x and H.T. (Belling-Lee).
1—Top cap connector for ESW-20 (Bulgin).

RESISTANCES, FIXED.
1—50,000-ohm 1-watt resistor (R1) (Erie).
1—500-ohm resistor type 3-watt (R2) (Erie).
1—10,000-ohm resistor type PR11 (R3) (Bulgin).
1—10,000-ohm resistor type PR11 (R4) (Bulgin).
1—10,000-ohm type R45 (R5) (Bulgin).

SUNDRIES.
4 oz. 18-gauge enamelled covered wire (Webb's Radio).
3 doz. ½-in. round-head screws.
4 lengths 2-mm. sleeving (Premier Supply Stores).
6 yards 3-mm. rubber covered wire (Premier Supply Stores).

SWITCHES.
2—Toggle type S80T (Bulgin).

VALVES.
1—6F6G (Tungsram).
1—ESW-20 (Ediswan).

POWER UNIT SECTION.

CHASSIS AND PANEL.
1—Wooden chassis 15 × 10 × 2 in.
1—Wooden panel 19 × 10 × 5/16 in.

CONDENSERS, FIXED.
1—8 × 8 mfd., 800 volt working type BE362 (C1)and C2 (Dubilier).

CHOKE, LOW FREQUENCY.
1—Type 150 m/A. (Premier Supply Stores).

FUSES AND HOLDER.
1—Type F11 complete with two 1-amp. fuses (Bulgin).

HOLDER, VALVE.
1—4-pin type V1 less terminals (Clix).

SWITCH.
1—S80T (Bulgin).
1—S88 (Bulgin).

TRANSFORMER, MAINS.
1—Type SP503 (Premier Supply Stores).

VALVE.
1—Full-wave type U52 (Osram).

MODULATER SECTION.

CONDENSERS, FIXED.
1—2-mmfd. type LEG (C1) (Dubilier).
1—50-mfd. 12-volt type 402 (C2) (Dubilier).
1—.05-mfd. type 4602/S (C3) (Dubilier).
1—50-mfd. 50-volt working type 3004 (C4) (Dubilier).
1—2 mfd. type LEG (C5) (Dubilier).
1—50-mfd. 50-volt type 3004 (C6) (Dubilier).
1—2-mfd. type LEG (C7) (Dubilier).
1—2-mfd. type LEG (C8) (Dubilier).
1—.01-mfd. type HV tubular (C9) (Dubilier).

CHOKE, HIGH FREQUENCY.
1—Type SW69 (Bulgin).

HOLDERS, VALVE.
4—Type octal less terminals (Clix).

RESISTANCES, FIXED.
1—100,000-ohm type ½-watt (R1) (Erie).
1—200 000-ohm type 1-watt (R2) (Erie).
1—75,000-ohm 1-watt (R3) (Erie).
1—25,000-ohm 1-watt (R4) (Erie).
1—.25-megohm 1-watt (R5) (Erie).
1—500-ohm 1-watt (R6) (Erie).
1—10,000-ohm type PR11 (R7) (Bulgin).
1—200-ohm 5-watt (R8) (Premier).
1—10,000-ohm 15-watt (R9) (Premier).

RESISTANCES, VARIABLE.
1—5-megohm type B less switch (VR1) (Dubilier).
1—10,000-ohm type B less switch (VR2) (Dubilier).

TRANSFORMER, INTERVALVE.
1—Power type split secondary transformer (Bryan Savage).

TRANSFORMER, OUTPUT.
1—Split primary 6,000-ohm A-A (Bryan Savage).

VALVES.
1—6C5G (Tungsram).
1—6JFG (Tungsram).
2—6L6G (Tungsram).

Stable Power Supply

By Paul D. Tyers

IN a broadcast receiver, variation in the voltage of the mains supply or variation in the power consumed by the set has very little effect. Even in a Broadcast receiver working on fairly

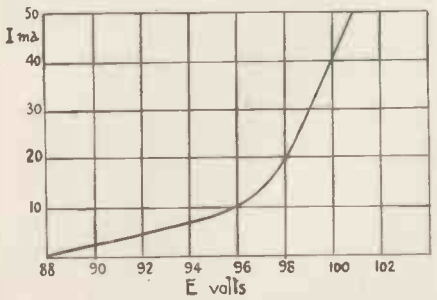


Fig. 1. A typical curve of a neon stabilising tube.

short waves, it is important, however, to maintain the operating conditions of the oscillator valve in a superheterodyne receiver as constant as possible. Where ultra short wave working is concerned, the matter is one of vital importance. In the case of certain measuring instruments the problem is even more important.

Recently the writer had occasion to produce some particularly stable operating conditions in an electric network, and the results obtained were so satisfactory, that it is worth while describing the system in detail as it should have many extremely useful applications in the radio field. There are two very convenient stabilising devices in the form of gas discharge tubes and barretters and it was by a combination of these that the desired regulation was obtained at a very low cost and moreover without complication.

Should the regulating action of the gas stabilising tube not be fully understood, its action will be briefly described. The gas tube consists of two electrodes arranged in an envelope containing a certain quantity of neon at a definite pressure. If a voltage is applied to the electrodes nothing occurs until a critical burning or striking voltage is reached. At this voltage the tube becomes conductive and a certain current will pass. The relationship, however, between the current and voltage is by no means linear and a small increase in applied voltage gives rise to very rapid increase in current. A typical curve of a neon stablising tube is shown in Fig. 1, where it will be noted that a small increase of voltage between certain limits, produces a very much larger change of current than on the earlier part of the curve. Actually a change of 5 milliamps is obtained for approximately half a volt on the curve shown.

If therefore the tube is connected as shown in Fig. 2 which shows a load resistance R_2 across which it is desired to maintain a fairly constant voltage, the operation is as follows. In the first place the tube has to be supplied through a series limiting resistance and operated at a higher voltage than the necessary striking voltage. The tube can be considered as another resistance R_3 in parallel with R_2, and for a given voltage V_1 across the points, the voltage V_2 across the load is arrived at by Ohms Law in the ordinary way. When V_1 varies, however, we see from Fig. 1 that R_3 will vary, and it is not a difficult matter to arrange the operating voltages and load resistances in such a way that the required voltage V_2 across the working load is maintained reasonably constant. The regulation obtained depends entirely upon the tube and the operating conditions, and regulation of a few per cent. is obtained. Now such a regulation for many radio purposes would not be adequate.

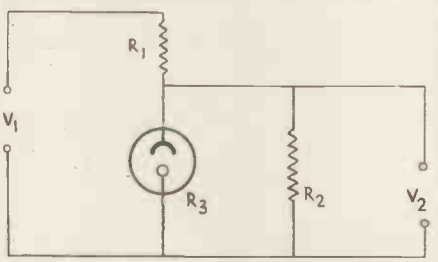


Fig. 2. Fundamental circuit for neon stabilising tube.

It is obvious that if the voltage reaching the tube could be maintained more constant, better regulation would be achieved. This can be done by replacing the fixed resistance by the other regulating device that is, the barretter tube, consisting of a metallic filament in gases such as iron wire and hydrogen. The characteristic of this arrangement is shown in Fig. 3. Here is will be seen that the barretter has the property of passing a substantially constant current when the applied voltage is changed. Once more this action is only obtained on the critical part of the characteristic and this is again determined entirely by the tube. Luckily, however, the characteristics of the barretter are far more flexible and barretters are available operating over a very wide range of currents and voltages.

It is very obvious therefore, that if the plain resistance Fig. 2 is replaced

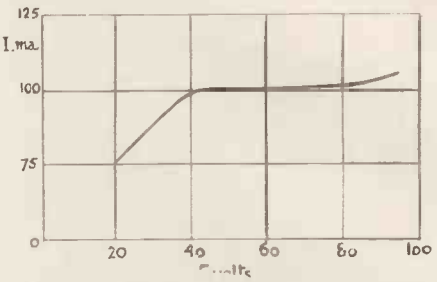


Fig. 3. The regulation characteristic of a barretter valve.

by a barretter, better regulation will be obtained. Actually we can go a step further by the inclusion of other barretters in our network and a cascaded arrangement of barretters and neon stabilising tubes, gives exceptionally good stability.

The description of a particular problem which was solved in this way, should serve to indicate how the principle may be applied to other requirements. The problem was that of maintaining a constant output of 50 volts across a load, a variation of approximately 0.01 volt only being permissible for an increase of 10 volts on the mains supply. This, of course, is a regulation far beyond the capabilities of either a single barretter or a single neon tube. The network also had to include a rectifier system, the regulation of which also would tend to affect the voltage stability. The mains supply was connected through a barretter RT_1 to a transformer feeding a full wave rectifier and smoothing system. The barretter employed in this position was actually a Philips C1 tube, a very moderately priced tube frequently used for universal receivers. The characteristics are such that about half the mains voltage was dropped across this, and accordingly the transformer was designed to work at the operating voltage which appears across the primary, whilst the primary current had to be such that it suited the operating conditions of the barretter. The secondary winding of this transformer,

(*Continued on page 366*)

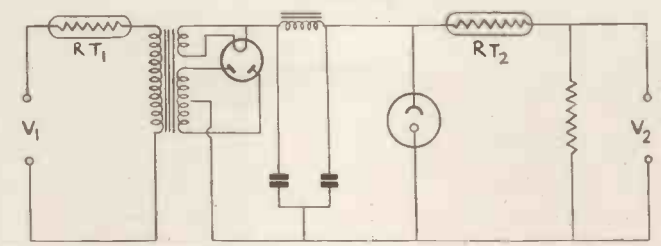
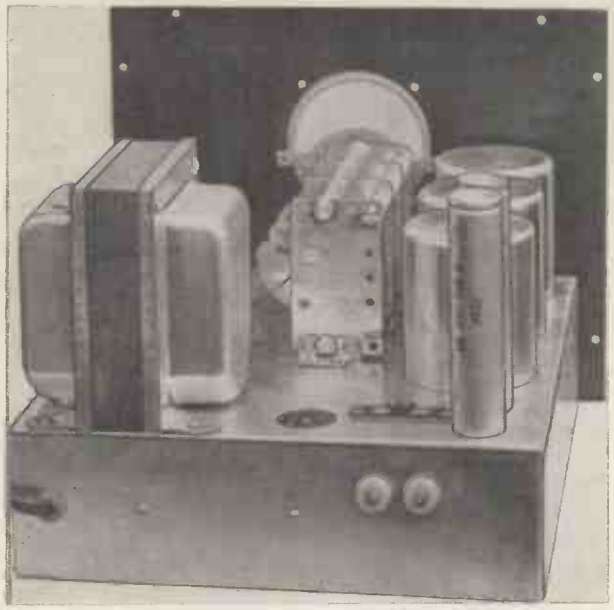


Fig. 4. Suggested circuit for stable power pack using the scheme suggested by the author.

Variable Frequency Control

This frequency control unit built by the Meissner Corporation of America is virtually a small 15-watt transmitter. It can be used as such or as a drive stage for a final amplifier. Single dial control permits operation of any frequency in the amateur bands.



The Meissner "Signal Shifter" is entirely self-powered and is coupled to the final amplifier by the normal link circuit. Provides 15 watts output on the 80, 40 and 20-metre amateur bands and slightly less than this on the 10-metre bands.

IT appears that congestion on amateur bands is even worse in America than it is in Europe. To counteract to a certain extent this difficulty, a very interesting gadget has been produced by the Meissner Manufacturing Co., which enables the transmitter to be used on amateur bands and for the frequency to be controlled from the operating position by merely adjusting one condenser drive.

This "Signal Shifter" is an instrument of convenience as well as general utility and has many advantages which cannot be obtained with the ordinary type of variable-frequency crystal.

This unit is a variable-frequency electron coupled exciter unit which will drive a transmitter in such a manner that the operator may instantly move to a clear frequency in the band whenever his signal is being interfered with by another transmission. It is coupled to a buffer or the final stage of the transmitter and supplies ample driving power to excite a pair of two 10's, 802's RK 20's 35-T's, or similar valves operated on fundamental frequency. If a high power output stage is being used, it will be necessary to include a neutralised buffer stage between the Signal Shifter and the final stage to obtain sufficient excitation. However, as the exciter will provide 15-watts on three wavebands and 10 watts on the fourth waveband, the British amateur will find that a complete transmitter can be made by merely adding a final output stage to the Signal Shifter.

Convenience of operation has been designed into the equipment by providing automatic relay operation of the stand by switching and providing a switch on the front panel of the unit to control the H.T. supply whether the unit is self-powered or a separate H.T. supply is used.

Coils are so designed that each amateur band is spread over approximately 90 degrees of the dial scale. They furnish an output signal in accordance with the labelled nominal bands except with the 10-metre coils, which furnish a 20-metre signal, so that the output from the Shifter has to be doubled once in the transmitter. The bandspread for 20 metres is different to that for 10 metres, so for this reason two sets of coils are supplied operating on 20 metres, one for actual 20-metre transmission and the other for 10-metre transmission.

Circuit

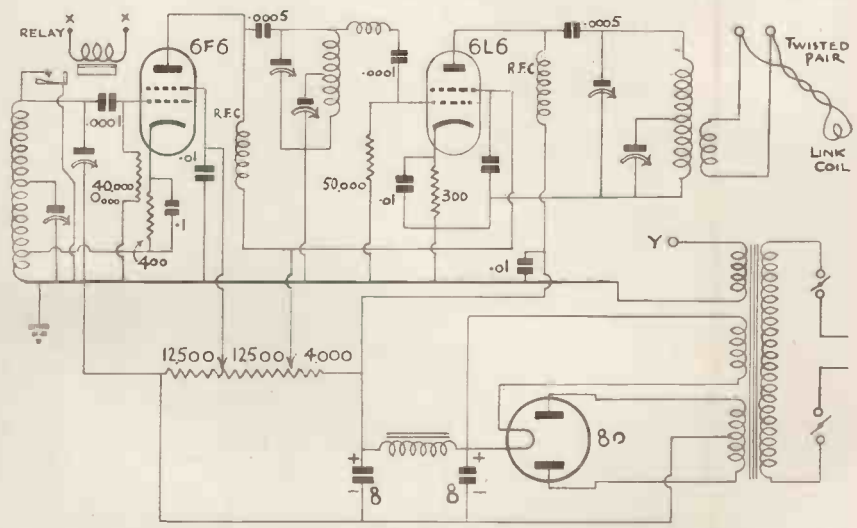
The essential circuit of the Signal Shifter is shown on this page. As can be seen it is an electron-coupled oscillator, type 6F6, and has its grid circuit tuned to one frequency by a high-capacity tank condenser which can be varied by a relatively large bandspreading condenser connected to a point on the coil so that narrow coverage is obtained.

The anode circuit is tuned to the second harmonic of the grid circuit by a similar condenser arrangement. The voltage developed across the anode tank circuit excites the grid of the 6L6 valve the anode circuit of which is tuned by another coil and condenser combination in the same way as with 6F6. The value of inductance, however, in the 6L6 circuit is very much smaller for the purpose of efficient frequency doubling.

When used on 160 metres, the 6L6 valve acts as a neutralised amplifier instead of as a doubler. To change from neutralised amplifier on 160 metres to doubler operation on 80 metres and lower wavelengths one merely has to plug in coils of the correct type. The connection to the neutralising condenser is open on all coils lower in wavelength than 160 metres.

Stability

An extremely high order of frequency stability is achieved in the oscillator circuit by the use of a valve exhibiting the minimum of thermal frequency drift in combination with components of minimum temperature



Only two valves are used in the actual R.F. section, these being a 6F6 and 6L6. Notice the relay circuit.

15-watt Output

characteristics. It is also a point to notice that the stand-by switching circuit keeps the anode current flowing during periods of operation.

During a 21-day test at W9WWI on the 80-metre band the maximum drift of calibration observed in frequent checks against harmonics of an oscillator set to zero beat with WLW was 300 cycles.

Coupling

Coupling of the Signal Shifter to the transmitter can be made to any one of a number of points to suit individual requirements. In a medium or low-power transmitter, the exciter may be link coupled to the grid tank of the output stage which final stage will be keyed for CW or modulated for telephony operation.

If the transmitter has crystal control with the grid of the output stage capacitively coupled to the crystal anode tank, the link coupling can be conveniently made to the crystal anode tank circuit. Merely remove the CO valve and retune the anode circuit. The Shifter may even be coupled into the circuit formerly occupied by the crystal if proper precautions are observed. Numerous other methods of connection will possibly suggest themselves to individual operators.

The no-load output of the Signal Shifter is approximately 25 r.m.s. volts. This may be used directly or may be kept down by correct impedance matching devices or voltage dividing resistances. Where resonant circuits are used it is imperative that consideration be given to prevent self-oscillation in any of the circuits following the exciter. Otherwise, they may control the frequency of the transmitted signal.

Automatic Standby

A standby relay is incorporated in the Signal Shifter which permits automatic standby of the oscillator when the transmitter-receive switch is thrown to the "receive" position.

The switching sequence provided by the relay is controlled by a three-position switch on the right-hand side of the front panel permitting three types of operation; "automatic standby," "continuous operation" and "manual standby."

In the "automatic" position of the switch the relay is connected to the twin-terminals near the rectifier. For automatic operation these terminals should be connected across any line in the transmitter where the voltage is controlled by the transmitter standby switch.

In appearance this "Signal Shifter" is comparable with a normal short-wave receiver. On the left is the on-off switch and on the right the control switch.

In the "on" position the relay is held down by the mains supply voltage from the power cord of the self-powered unit, or on a line brought into the externally powered unit for that purpose. In this position of the switch continuous operation results whether the transmitter is operating or not. This position is useful for calibrating the Signal Shifter or for furnishing a local signal for use as a heterodyne frequency-meter to check the frequency of any received signal.

In the standby position of the control switch, the relay short circuits the oscillator, so preventing oscillation. This permits crystal control operation of the transmitter but still keeps the unit at operating temperature ready for use.

Power Output

The power output from the Signal Shifter is ample for driving a pair of valves from 210's up to 35-T's. The tuning can be varied by merely adjusting the single control on the Shifter and generally speaking the loss in R.F. when the Shifter is radically changed owing to the transmitter itself being mistuned is quite slight except on 160-metres. If, however, both the Shifter and the transmitter are re-adjusted then the output can be varied to almost any frequency without loss of radiation.

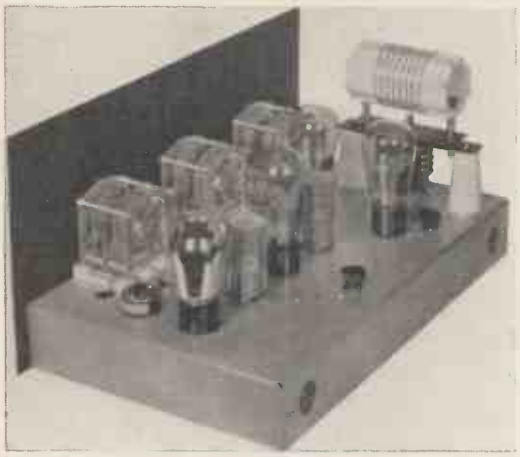
During our tests we found this very useful to be able to change 20 or 30 kc. instantaneously without radio frequency power loss. These Signal Shifters are being handled in this country by The Anglo-American Radio Co., Albion House, New Oxford Street, W.1, and the price including valves and coils is £12 10s. 0d.

"Stable Power Supply"

(*Continued from page 364*)

also had to give such a voltage that the D.C. output from the rectifier suited both the operating conditions on the regulating tube N and the barretter RT2.

The variety of barretter tubes is such that it is possible to obtain regulation over an extremely wide range of voltages and currents, and it is not a difficult matter to select suitable tubes for the various parts of the circuit, each tube used giving greater stability. It may be wondered what has to be done in the case of a fairly high voltage output when it has been mentioned that the neon tube must operate somewhere within the region of 90 volts. Actually a number of neon tubes can be connected in series and the experimenter should find it a very easy matter to arrange a suitable combination of barretters and neon tubes in the manner described, whereby exceptionally fine regulation can be obtained under any desired conditions. It is a very simple matter by examining the characteristics of the neon tube and the barretters, to arrange the operating conditions, so that each device functions on the correct portion of the curve, the calculations involving little other than the simple application of Ohms' Law. Reference, of course, must also be made to the multiple glow gap discharge tube which whilst being an exceptionally useful device, is somewhat expensive and is not always found amongst experimenters equipment. As the use of comparatively every day cheap neon tubes and barretters enables such excellent regulation to be obtained, it is felt that their use in the manner described is amply justified.



This is the R.F. section of the R.F.-60 transmitter. It is suitable for inputs of between 10 and 60 watts.

A Transmitter Kit for Constructors

We feel sure that constructors will be interested in these transmitter kits designed specifically for amateur use on amateur bands. They are professional in both appearance and efficiency but low in cost.

IN recent years amateurs have been building their simple transmitting equipment more on generally commercial lines. This has not only improved the appearance of the average station but the efficiency is greater at the present time than ever before.

There are still, however, a very great number of amateurs who have not the time to devote to the construction of a rack transmitter or who would prefer to build equipment designed by acknowledged experts. We know that a very great number of amateurs are only remotely interested in transmitter design and have obtained their licences purely to conduct extensive tests with aerial systems.

A 60-watt Kit

This type of transmitting amateur should appreciate the new designs introduced by G5NI (Birmingham), Ltd. They have produced several very professional looking transmitters which includes the most popular R.F.-60 kit. This transmitter is made up of three separate units, being a three-stage transmitter, a four-stage modulator and a two-section power pack.

Some idea as to the appearance of the radio frequency section can be obtained from the illustration on this page. It consists of a type 47 crystal oscillator, capacity coupled to a neutralised 46 buffer or as a doubler as the case may be, which in turn is capacity coupled to a pair of 46's in parallel. These 46's in the final stage are used with triode connections and are suitable for an input of 10 watts with one valve in circuit or up to 60 watts with two in parallel.

Band Changing

Plug-in coils and crystal enable the transmitter to be used on almost any band while coil changing is extremely simple enabling the operator to change frequencies very quickly. There are only three controls which are clearly marked on the panel while one meter only is required to monitor the entire transmitter..

C.W. Operation

A plug and jack system is included so that the meter can be connected into grid or anode circuits as required. There is also provision for keying in the grid circuit of the final amplifier.

Wherever necessary ceramic insulation is employed while the tank coil in the final stage is wound on one of the new low-loss plug-in formers.

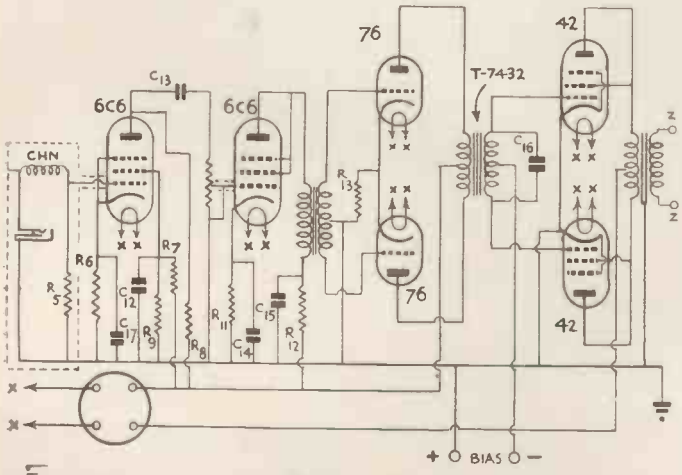
Low Cost

Both neutralising condensers are mounted through the chassis with knobs so arranged for easy operation.

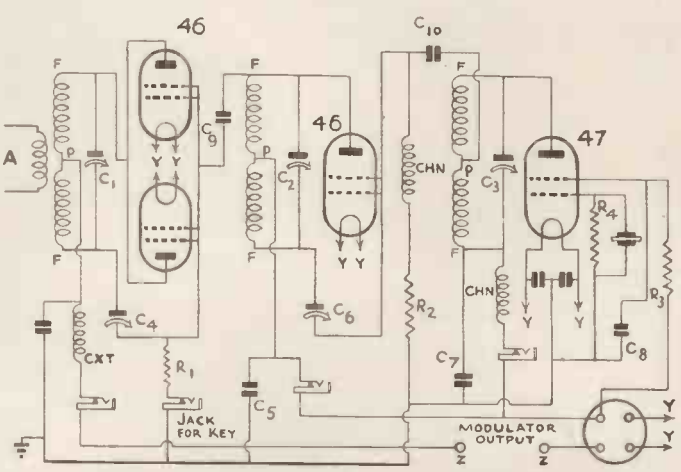
The price of this transmitter with coils for one band but less valves and crystal is only 5 guineas, which includes a steel chassis, completely drilled, a crackle finished panel, engraved instrument dials, all brass tuning and neutralising condensers, and, of course, complete constructional details.

The modulator is connected into circuit by means of a two-position socket and this modulator provides ample audio output, fully to anode modulate

(*Continued on page 370*)



This modulator has been specially designed so as to permit of trouble-free telephony operation.



Four valves are used in the R.F. section but only one 46 is required for low power operation.

A Doublet Aerial for Short Waves

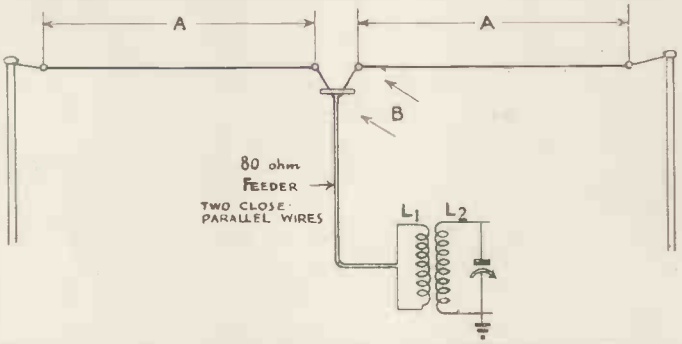
SHORT-WAVE enthusiasts who are particularly keen on receiving out-of-way stations are often asking what type of aerial is the most satisfactory for use with their short or all-wave receiver. Although this point is very often a matter of personal opinion, and depends largely on local conditions, there can be no question that, generally speaking, the most satisfactory receiving aerial is the tuned doublet fed with low-impedance cable.

The fundamental arrangement of this aerial is shown by the drawing on this page, where it can be seen that the aerial consists of two symmetrical halves fed in the centre by a low-impedance twin-wire feeder which is terminated in the coupling coil L1.

Distance A, in each case, depends on the wavelength which is of the utmost importance, and as maximum signal strength is generally required on the lower wavelengths, it is suggested that the aerial be cut to provide maximum gain at 20 metres.

This, of course, will not provide maximum gain at 40 metres, but the loss will be very much smaller than if the aerial were cut for 40 metres, and then used mainly on 20 metres. In any case, the shorter length required for 20-metre operation will provide greater selectivity and less noise pick-up, while with the average modern receiver, there is very little need to use more than 30 to 35 ft. aerial.

It is suggested that the length, A, in each case be made 16 ft. 6 in. long, while the distance from A to B should be approximately 5 in., so that in the centre is a triangle having two wire sides of 5 in. and a rope top also 5 in. The triangle should be kept symmetrical by means of insulating bars or wooden dowel well covered in paraffin.



A typical doublet aerial. The ends of the two sections A are connected together by means of either a 5in. insulator or rope.

The junction between the end of the triangle and the beginning of the feeder should also be arranged so that it will not fill up with water during bad weather.

If the aerial is to be used for reception of a particular station, then the exact length of A can be caculated from the following simple formula:—

$$L = \frac{468{,}000}{f}$$

where L is the length of the aerial in feet and f is the frequency of the station to be received in kilocycles. Another simple formula is

$$L = 1.56 \times \lambda$$

where L is the aerial length in feet and λ is the wavelength in metres. It is not necessary accurately to cut the top length for variations up to 10 per cent. will not have any appreciable effect. With regard to two coils, L1 and L2, L2 is the normal grid coil in the receiver, while L1 is merely a small link coil wound on top of L2. This link coil should have one or two turns, but more can be added if additional signal input is required.

If this aerial is above 35 ft. in height the amount of noise picked up will be negligible, for it must be appreciated that noise is generally picked up by the lead-in wire, a trouble which is completely overcome by the use of this low-impedance cable which can be obtained from Messrs. Belling-Lee.

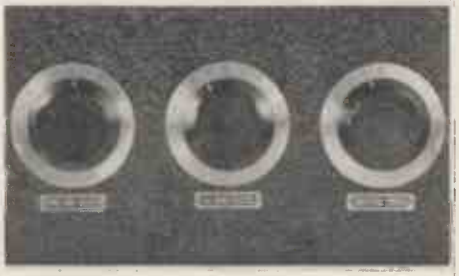
"A Transmitter Kit for Constructors"

(*Continued from page* 368)

the two 46's in the final stage. It has a gain of over 110 db. so being suitable for the most insensitive crystal microphone. The frequency response of x or −2 db. from 32 to 650 cycles, or three db. up to 8,500 cycle with a negligible hum level. Thordarson transformers are used throughout while the components are so arranged that in case of breakdown repairs can be carried out quite quickly. In the modulator stage are six valves, being a 6C6, R.C. coupled to a 6C6. transformer coupled to a pair of 76's in push-pull, which are in turn transformer coupled to a pair of 42's in push-pull. The modulation transformer is of a special type for matching the working impedance of the two 46's and is quite rattle free in operation. This modulator can be used for many purposes and the kit complete, less valves, is 5 guineas, to which must be added the price of six receiving type valves.

Power Units

A special power pack has been designed consisting of two units, one for the radio-frequency section of the transmitter and the other for the modulator. Actually, these power packs are made in two types, one recommended for CW. operation and the second with additional smoothing for hum-free operation when using phone. The first pack for CW. operation is £3 15s. The second for phone operation is £4 10s., while a de-luxe pack, complete with modulator power supply, is priced at £6 15s.



There are only three controls on the R.F. unit, these being oscillator tuning, buffer or doubler tuning and the final amplifier. Three jacks are provided for metering.

Any constructor will be able to build this transmitter with the very minimum of difficulty and as the coils are already wound the transmitter should be operated within a very few minutes of being finally wired and checked.

The user of this equipment can rely on having an efficient rig on both CW. and phone without having to do any experimental work. This leaves the constructor all his time free to make his aerial tests. The three units in rack formation take up very little room as all of the panels fit the standard relay rack.

10-60 Watts Input

Another interesting point is that should the operator be licensed for 10 watts the transmitter is suitable for this input with only one 46 in the final stage.. As increased power permits are obtained the input can be increased up to a limit of 60 watts. The efficiency of this input is extremely high so that the carrier power developed is sufficient to permit of successful phone operation to almost any part of the world.

A variation on the R.F.-60 is the R.F.-100, which uses a 42, a 6L6G, and a pair of T-20's. The price of this

(*Continued on page* 383)

Two Interesting Communication Receivers

Two most interesting receivers are discussed in this short article. Both of the receivers appear to be about the best of their type in their respective ranges.

This is the popular R.M.E.-69 which is rapidly becoming a standard receiver amongst the world's services.

DURING the past few months we have been operating one of the R.M.E.-69 receivers which was loaned to us by Messrs. A.C.S., Ltd.; of Bromley. The results obtained made us realise that with the modern type of communication receiver a short test is not satisfactory for it does not enable the operator fully to appreciate the finer qualities of the instrument.

The Best Receiver

Most amateurs know of the R.M.E. receiver even if many have not had the opportunity of testing one under working conditions. As a communication receiver covering all amateur bands with switched coils it probably stands alone for many reasons.

The noise level is very low which accounts for the number of reports we have given of R3 QSA5. During the past few weeks when conditions have been bad we have been able to carry on quite well when so many amateurs have migrated to the 40 metre band.

Calibration of the main dial is quite accurate while once the markings are familiar the band-spread dial can also be calibrated on the amateur bands.

Selectivity

Selectivity is such that with another station operating less than one mile away contact could be maintained with only a separation of 12-Kc. between the local and DX station. This was on telephony and without the crystal filter in circuit. Very helpful and accurate reports could be made on signal strength by means of the R meter which is calibrated in dB. and R points. Increases in signal strength which could not be detected by ear could be read down to less than half an R point.

Although there are many controls these are very easy to handle and do enable the operator to obtain maximum gain on the very weak stations. On many occasions we have heard DX stations replying to G test calls which have not received any reply showing that many receivers are at fault.

It appears to be the ideal communication receiver for both phone and C.W. use for the crystal filter can be used for phone reception if required.

Another feature not generally found on amateur sets is the provision of a built-in monitor which enables the operator to check his own transmissions. For this purpose, however, a small separate aerial has to be used.

The stand-by switch is part of the volume control and one merely has to pull the control knob out when transmitting. This cuts off all H.T. supply to the receiver.

We cannot find one bad feature on this receiver and consider, without any qualifications, that an amateur using an R.M.E.-69 would be able to hear any station on the band, if it were at all possible.

If there is a better set we do not consider that it could show any all-round improvement on the R.M.E., and any amateur who invests in this receiver can rest content that his receiving installation is beyond reproach. The standard model with crystal filter costs £38, while a special model with noise silencer is priced at £41 10s.

The standard model tunes from 10 to 550 metres and is identical with the special model except for the noise silencer.

A Cheaper Receiver

As a great number of amateurs cannot afford to buy expensive receivers, but at the same time want all they can get for their money, The Hallicrafters have produced a new receiver which is very good value for money. In fact if we had not actually examined one of these new sets we should have considered it almost impossible to produce an 8-valve receiver for as little as £15.

The Hallicrafter Sky Champion is a set that is good as money can buy at anywhere near the price. It covers 44Mc. to 545Kc. in four bands with a separate band-spread dial which can be easily calibrated.

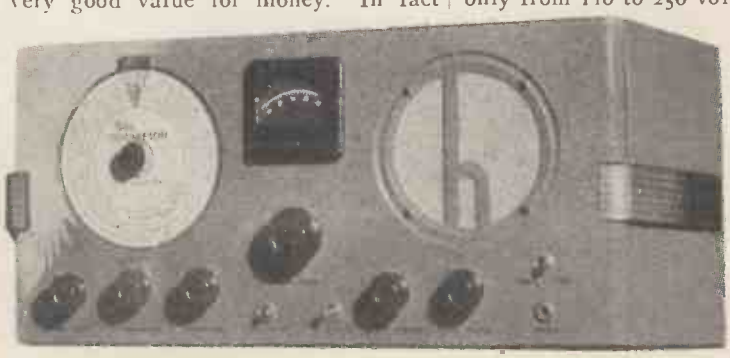
Built-in Speaker

There is, of course, a B.F.O. and a built-in loudspeaker so that there are no further parts to buy. The A.V.C. is switchable, while there is both an R.F. and A.F. gain control.

This type of receiver will give a very good account of its self particularly on the higher frequency bands. We have not so far had an opportunity of testing the receiver under good conditions, but the sensitivity figures we have obtained indicate that the performance is well above the average for a receiver in this class.

The eight valves are—6K7 R.F. amplifier, 6L7 first detector, 6J5 H.F. oscillator, 6Q7 second detector, A.V.C. and first audio, 6F6 pentode output, 80 rectifier and 6J5 B.F.O.

At £15 this receiver is wonderful value for money and is cheaper than the average B.C.L. medium-wave set. We inspected this receiver at Webb's Radio, Ltd., where amateurs can test it for themselves. The Hallicrafter Sky Champion is for A.C. mains only from 110 to 250 volts.



A new receiver that has only just arrived in this country is the Hallicrafter Sky Champion.

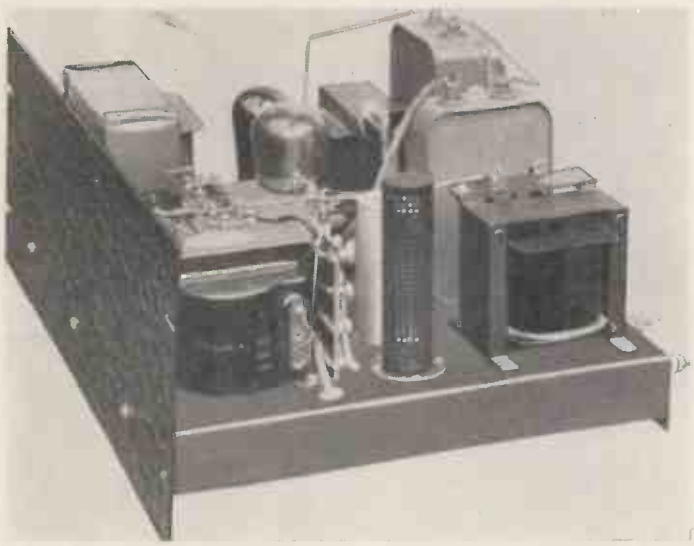
TRANSMITTING STEP-BY-STEP

By Kenneth Jowers, G5ZJ, and Malcolm Harvey, B.R.S., 1636

A Power Unit for the T-40 Transmitter

This short article completes the design of a simple modern transmitter which can be built in easy stages. This power pack is for the T-40 output stage, the sub-amplifier and the crystal oscillator.

CONSTRUCTORS who have so far proceeded with the building of the three-stage T-40 transmitter should by this time be in a position to make use of the power unit. This unit consists of two quite separate circuits, one giving 800 volts at 150 mA., and the second giving 350 volts at 120 mA. The 800-volt supply is for the T-40 and TZ-20 valves, while the 350-volt supply is for the oscillator only.



A very good idea as to the component layout can be obtained from this illustration. In the foreground is the lower voltage pack, while the Premier 800-volt transformer and the mercury rectifying valves can also be seen.

Both power packs can be mounted on a standard Premier steel chassis and the photograph on this page gives the suggested lay-out which has been found to be quite satisfactory. It should be noticed, however, that the Premier transformer has been mounted upside down and the terminals and terminal board omitted. This keeps the leads much shorter and enables all of the components to be mounted on top of the chassis without protruding above the top of the panel.

It will be seen from the circuit diagram that the two high voltage transformers have their primaries connected in parallel and switched quite separately from the two filament transformers which are also in parallel. The idea of this is that the heaters of the rectifying valve can be warmed up and the H.T. voltage supplied only when required. It will be seen, therefore, that this H.T. transformer switch can be used as an actual make-and-break transmitter switch. In the 800-volt supply there are two chokes, the first being of the special swinging inductance type designed to follow mercury vapour rectifying valves.

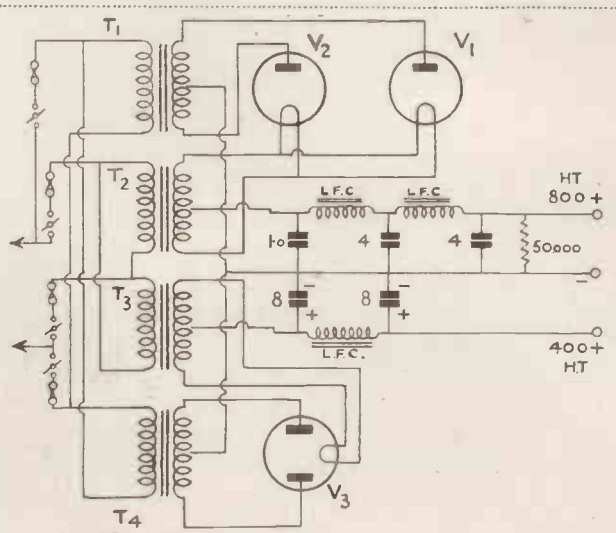
In normal circumstances no condenser should precede this choke, but owing to the fact that grid bias is being obtained automatically a slightly higher voltage was required than could be obtained from a choke input circuit, so, for this reason, the rectifying valves feed into a 1-mfd. condenser.

Across the output of the 800-volt supply a bleeder resistance of 50,000 ohms, which helps to stabilise the output and at the same time discharges the three condensers.

In the 350-volt supply circuit there is only one choke which is by-passed with two 8-mfd. condensers. These two condensers are mounted within one tubular case, so saving quite a consider-

CHASSIS AND PANEL.
1—Standard steel chassis finished black (Premier)
1—Standard steel panel 10½ in. high (Premier).
CONDENSERS, FIXED.
2—4-mfd. type 951B (Dubilier).
1—8-8-mfd. type 9203E (Dubilier).
1—1.0-mfd. type 951B (Dubilier).
CHOKES, LOW FREQUENCY.
1—150 m/A. (Premier Supply Stores).
1—150 m/A. swinging choke (Sound Sales).
1—100 m/A. smoothing choke type 30 v. (Sound Sales).
HOLDERS, VALVE.
2—4-pin type V1 less terminals (Clix).
1—Type octal less terminals (Clix).
RESISTANCE, FIXED.
1—50,000-ohm 50-watt bleeder resistance (Webbs Radio).
TRANSFORMERS, MAINS.
1—800-0-800 at 150 m/A. (Premier Supply Stores).
1—350-0-350 at 120 m/A. type M25 (Sound Sales).
TRANSFORMERS, FILAMENT.
1—2-0-2 volt, 6 amp. (Premier Supply Stores).
1—2.5-0-2.5 volt, 2 amp. (Premier Supply Stores)
VALVES.
1—5Z4 (Tungsram).
2—MU1 (Ediswan).

(*Continued on page* 383).

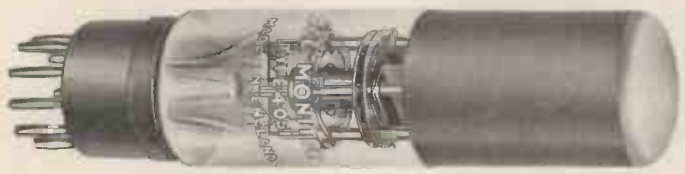


This is the circuit of the two power units built on one chassis. It is quite self-contained and provides 800 and 350-volts output at high current.

The New G.E.C. Monitor C.R. Tube

We are glad to be able to announce the introduction of a British made miniature cathode-ray tube at a price within the reach of the average amateur. This tube is for monitoring or general oscilloscope work.

IT is very interesting to note that the General Electric Co., Ltd., have produced a small cathode ray tube having a screen diameter of approximately 1½ in. This tube is somewhat similar to the R.C.A.913, with the exception that it is a little larger both in diameter and overall length, has separate connections for the four deflector plates, so that push-pull scanning can be used if required, and has a standard English 4-volt heater.



This illustration gives some indication of the appearance of the new G.E.C. monitor tube. It has a diameter of approximately 1½ ins.

This miniature tube type 4051 is of the hard vacuum type with indirectly heated cathode and is designed for electrostatic focusing and scanning.

Readers will find it of particular use for monitoring purposes, for use in portable oscilloscopes and, of course, for all phases of radio servicing. It also is sufficiently small to be embodied in amateur transmitting equipment so as to provide a permanent and accurate check of modulation percentage.

The screen is of the medium persistence type with green fluorescence so that it is suitable for all purposes which call for a visual means checking.

The characteristics are as follows:—

Heater Voltage	4.0 volts
Heater Current	0.9 amp.
Accelerator (Anode No. 2) voltage	250 to 500v max.
Focusing Electrode (Anode No. 1)	50 to 100v
Control Electrode (Modulator)	0 to -20 volts

Deflection Sensitivity

(1) Plates next Accelerator (X1, X2)	$\frac{82}{V}$ — mm. per volt
(2) Plates next Screen (Y1, Y2)	$\frac{73}{V}$ — mm. per volt

where V = voltage on accelerator (Anode No. 2)

Maximum overall length 160 mm (provisional)

Power supply for the tube can be obtained from any conventional power pack operating from a.c. mains, and only quite a low total anode current is required. The tube, however, must be magnetically shielded by means of a soft iron tube to avoid distortion of the wave trace should the tube be in the field of any of the transformers, etc., in the power unit. This point is of particular importance when the tube is being buit into a miniature portable oscilloscope.

A basic circuit is shown on this page for the 4051 tube and is complete with a suggested time base arrangement. This includes a gas-filled relay type GT1C which is controlled by means of an Osram screened pentode type MSP4. The screen voltage on the MSP4 is varied by means of a potentiometer across the H.T. supply, the valve screen voltage determining the frequency of scan.

The relative value of anode to grid voltage of the GT1C is adjusted by means of a potentiometer which determines the amplitude of the scan. A three-way switch which incorporates condensers of .01-mfd., .1-mfd. and .01-mfd. enables the range of the time-base frequency to be adjusted. The frequency range of these three condensers is approximately 4 to 4,000 cycles. Actually the .01-mfd. condenser covers 400 to 4,000 cycles, the .1-mfd. condenser 40 to 100 cycles and the 1.0-mfd. condenser 4 to 40 cycles.

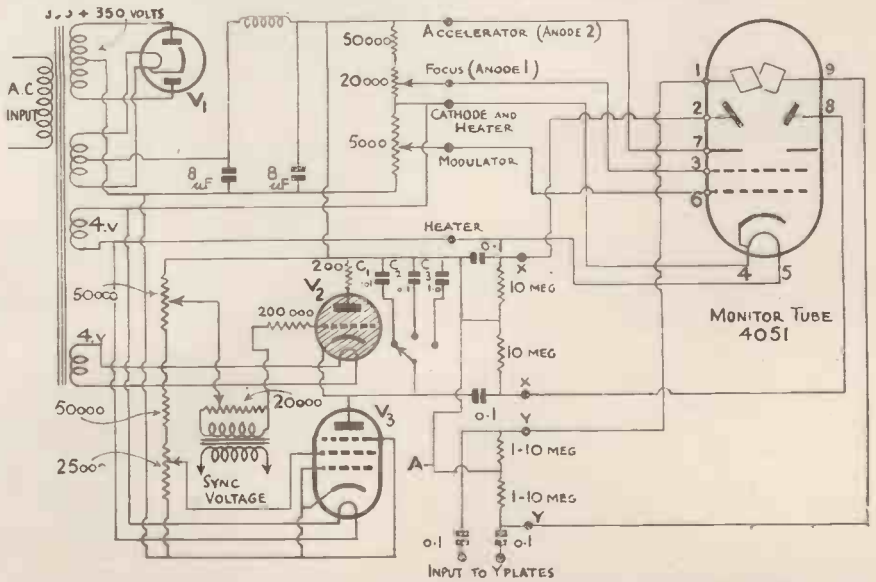
A type MU14 indirectly heated rectifier provides an adequate d.c. output, and this valve in connected in the conventional full-wave circuit with 350 volts R.M.S. to each anode.

The manufacturers suggest that pick up of interference may be reduced by transferring the anode centre tap A of the Y plate directly to one of the Y plates. The .01.mfd. input condenser to the Y plates may be omitted provided the input is separate from the tube power supply.

Standard 9-pin base is used with the following connections:—

1. Y1, deflector plate.
2. X1, deflector plate.
3. Focusing electrode (anode No. 1).
4. Heater and cathode.
5. Heater.
6. Control electrode (modulator).
7. Accelerator (anode No. 2).
8. X2, deflector plate.
9. Y2, deflector plate.

As this tube is priced at 45s. it is within the reach of every amateur. Also, in addition to the low price, the accessories required are quite cheap. Full information on this tube can be obtained from Osram Valve Department, The General Electric Co., Ltd., Kingsway.



Typical linear time base circuit suggested for use with the Tube. A practical working circuit arrangement will appear in a later issue.

Co-axial Cables for Amateur Use

FEEDER lines for use on the higher frequencies have made rapid strides in the past few years. The introduction of television also helped amateurs very considerably for several manufacturers developed cables for ultra-high frequency use which were also adaptable for amateur transmission.

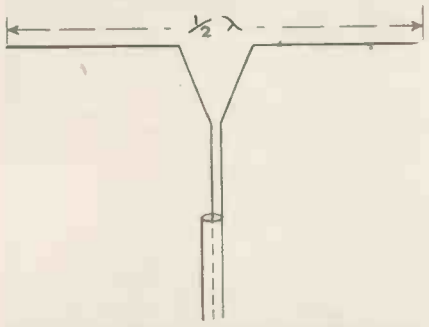


Fig. 1. A doublet aerial with matching section from 73 to 100-ohms.

The fact remains, however, that amateurs generally have not taken to the new type of cable as quickly as they might owing to the fact that so far the cables have not been more efficient than the very popular 600 ohm spaced line. This point is particularly evident on 10 and 5 metres should long lengths of transmission line be required. On the other hand, despite the very low attenuation figures for spaced lines, in wet weather the losses increase very considerably so that for general all-round use the low impedance cable had much to recommend it.

We have been testing some of the new Telcon co-axial cable which is suitable for amateur use. We believe that this is the first low impedance cable to have an attenuation figure lower than that of the normal 600-ohm line up to distances of 100 ft. or so.

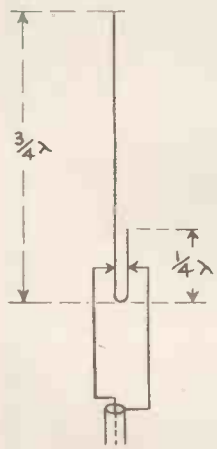


Fig. 2. An interesting arrangement whereby a correct impedance match is obtained.

Co-axial cables suitable both in design and price for amateur use are now being made in this country. These cables have a lower attenuation figure for a 65-ft. length than the normal 600-ohm spaced line.

In addition, the weight of the cable is comparatively low, while it is cheaper than any co-axial cable of American manufacture.

A length of AS5C cable has been in use at our laboratory feeding two half-waves in phase. The cable approximately 110 ft. in length, has proved an

Interesting view of the construction of Telcon co-axial cable.

excellent conductor and has solved the problems which untuned 600 ohm lines did not overcome. There must be many amateurs who wish to feed an aerial at a distance, but do not find it convenient to use spaced lines. The co-axial feeder is the solution to the problem.

A second sample of this cable type AS5L is available which is similar to the AS5C, except that it has a solid .036 conductor in place of the 14/.0076 conductor in our sample. It is, therefore, to be expected that the solid conductor will be more efficient than the standard conductor on higher frequencies.

There appears to be some doubt as to the best method of using this cable, so Dr. E. W. Smith, of the Telcon Company, has made some interesting suggestions.

He points out that as the impedance of the co-axial cable is approximately 100 ohms it can be fed directly into a doublet aerial with its 73 ohm centre impedance without any attempt at exact matching. The results in such circumstances are generally satisfactory because the two impedances are sufficiently near together to obviate serious losses from mis-match. Also, as the impedance of 73 ohms which is generally accepted for half-wave aerial, is only a theoretical estimate not often realised in practice, then the mis-match is only likely to be a very small one.

If, however, the aerial is in absolutely free space so that the impedance is not likely to be affected by near-by buildings, etc., advantage can be obtained by fanning out the cable connections to a distance of 6 in. or so, as shown in Fig. 1.

Fig. 2 illustrates a vertical aerial three quarter-waves long having a quarter-wave matching section, at its lower end, bent up and spaced about 6 in. from the main length. Contact with the inner and outer conductors of the cable is made at two opposite points on the looped up section as shown. The best position can be found by trial and error in conjunction with a check for standing waves on the feeder.

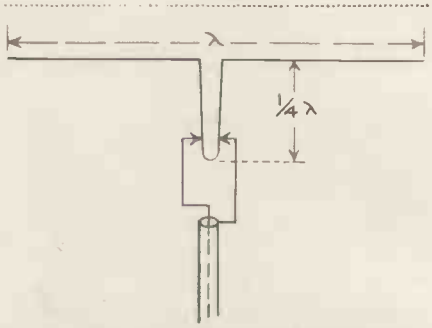


Fig. 3. This is a conventional quarter-wave matching stub to which the co-axial cable can be readily connected.

With this arrangement the impedance of the aerial varies from zero at the bottom end of the loop to maximum at the open end.

An alternative loop contact arrangement is shown in Fig. 3. This is quite straightforward in operation and is merely the matching section, the correct length of which has to be found by varying the length until resonance is obtained the aerial, of course, being excited by a near-by aerial.

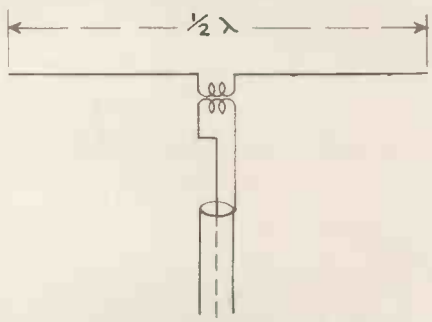


Fig. 4. This transformer matching system is only satisfactory if a suitable transformer is available.

A transformer method of matching is shown in Fig. 4. The ratio of primary to secondary turns being 73/100.

The attenuation figures for this cable 65 ft. length are :—

.04 db.	at 7 Mc.
.07	14 Mc.
1.3	28 Mc.
2.4	56 Mc.

"With the Amateurs" (*Continued from page* 356).

most. It is also sufficiently small to be put up in any direction in the average small garden.

Even with highly selective modern receivers, it is rather difficult to stop the blanketing effect of a heavily modulated local station. Being in between two stations who are very consistently on the air, I found that even an R.M.E.-69 and a dB-20 had to be carefully tuned when the modulation percentage of the local stations was very high. It was possible to cut them out very quickly after about 11 or 12 Kc., but the slight splutter often persisted.

I invested in a Meissner amateur band wave trap. This trap covers the 20, 40, 80 and 160 metre amateur bands, and can be connected either in series with the aerial or directly in series with the grid lead of the first valve. This is much the best way of doing it and local stations can be cut out without any difficulty.

This scheme works most effectively on simple receivers providing the trap is fully screened, is sharply tuned, and is as close as possible to the grid terminal of the first valve. So successful has this scheme proved that I have built a receiver, a simple T.R.F. arrangement, with a 5-band trap in the first stage which is switchable and can be adjusted to eliminate local stations. The scheme works very well and gives new life to the straight receiver. It even works on single circuit receivers such as the All-world Two.

Any amateur with an efficient ultra short-wave receiver should keep an eye on the new Swedish station SM5SN which is operating every day including Sundays between 07.30 and 16.00 B.M.T. The transmitter is crystal controlled with a frequency of between 56.0 and 57.5 mc. A carrier wave is being transmitted which is automatically tone modulated with a morse text including the call sign SM5SN. The aerial power is, approximately 25 watts.

These transmissions will continue for the rest of the year with a probable interruption between June 25 and July 18. Reports on these transmissions are required and should be directed to Mr. G. Siljeholm, A.-B. Hammarblylampan, Stockholm, 20, Sweden.

During the recent A.R.P. black-out at Slough, Bucks, radio control was used with great success. Three main control points situated at the Town Hall, Lascells Road, and Langley were in constant communication by radio telephone and reports of aircraft flying in the vicinity were directly communicated to the Town Hall and Lascells Road stations by the Langley station.

T. G. R. Dowsett, the honorary secretary of the Eastbourne and District Radio Society, 48 Grove Road, Eastbourne, tells me that a very successful lecture was given by Mr. E. Morey, of Belling-Lee, Limited, on general interference suppression work. He explained the principles underlying the design of a noise suppression aerial and indicated how they should be erected. Any readers interested in 5-metre work should make a point of going along to the meeting on June 13, when a 5-metre set will be operated by the members.

The Wirrall Amateur Transmitting and Short-Wave Club are to produce their own monthly magazine which is circulated free of charge to members. At the last meeting of the club G3CK, delivered an interesting talk on antennas, giving many interesting formulæ. The honorary secretary of this society is J. R. Williams, 13 Harrow Grove, Bromborough.

There are now no less than four fully licenced members and 6 A.A. licence holders in the Edgware Short-Wave Society. On May 18 Mr. Geoffrey Parr lectured on the construction of television receivers and deprecated the use of superhet circuits owing to the difficulty of lining up the multitude of circuits. This society meets at the Constitutional Club, Edgware, each Wednesday evening at 8 p.m. and each Sunday morning at 11 a.m.

Some alterations have been made to the executive of the West Sussex Short Wave and Television Club. The new honorary secretary is G2ZV, Aubretia, Seafield Road, Rustington, Sussex. A complete series of lectures has been arranged, and would advise any of our readers who are in that area to get in touch with the honorary secretary of this live society.

The Dual-purpose Communication Receiver

This is the concluding article on this receiver.

THERE still appears to be a considerable amount of confusion amongst non-technical users of this receiver as to why the beat-frequency oscillator is included.

We have already mentioned that this feature is essential in communication receivers, but is only used when receiving morse code signals. This beat-frequency oscillator should in all circumstances other than this be switched out of circuit.

This beat-frequency oscillator is loosely coupled into the second detector circuit. It supplies a comparatively weak signal of a frequency similar to that of the tuned intermediate frequency transformers. If, for example, the I.F. transformers are tuned to 465 kc., then the beat-frequency oscillator is pre-set tuned to about this frequency. Actually, it is exactly tuned to 1,000 cycles above or below the frequency of the I.F. amplifier in order to produce a 1,000 cycle beat note in the output of the second detector. This enables an almost inaudible carrier to be brought up to audible strength.

Should the beat-frequency oscillator accidentally be left in circuit when trying to receive programmes, then there will be a continuous oscillation such as would normally be experienced in a straight set in a state of oscillation.

Another problem which has arisen is the method of connecting aerials to this receiver. Two aerial terminals are provided, in addition to the conventional earth terminal. When a Marconi aerial is used with a direct earth, then the earth is taken to the earth terminal, which is also connected to the aerial terminal next to it, while the aerial lead is connected to the remaining aerial terminal.

This arrangement, however, is not too satisfactory on the lower wavelengths, and in order to obtain maximum signal strength with minimum noise we strongly advise the use of a doublet. This type of aerial having twin feeders cannot be connected in the same way as the Marconi aerial.

The twin feeders are joined to the two aerial terminals provided, while the earth lead is taken to the earth terminal. Do not in any circumstances connect the second aerial terminal to the earth terminal.

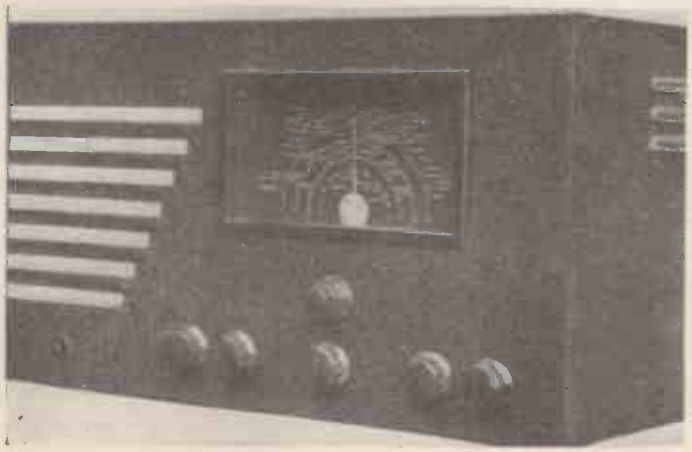
We are very interested in a report received from a prominent radio engineer who has had considerable experience with communication receivers. He has sent us an unbiased report. The receiver was tested on an aerial suitable for reception of 10, 20 and 40 metre signals, elevated to a height of about 40 ft. Also, when the receiver was tested, the conditions on the higher frequencies were not good. The following observations were made, however :—

" 10-metre band.—A striking feature was the late hour to which American amateur transmissions could be held, 10 metres being a normal daylight band. Car ignition interference rather bad in a locality with little car traffic.

" 20-metre band.—Generally good. On the amateur band its discrimination was gratifying. On one night, when a commercial 7-valve receiver could not hold W2XAD, this programme was listened to on the loudspeaker (without any readjustment of the receiver) for two hours at good programme value.

" 40-metre band.—Performance excellent with selectivity (very necessary on this band), as good as any receiver (without crystal gate) that I have ever tried.

" General.—(a) One H.F. stage is insufficient to completely eliminate second channel and this is present, but to a lesser degree than anticipated. (b) Freedom from microphony or any form of feed-back really gratifying. (c) Frequency drift (by some miracle !) appears totally absent. Excellent ! "



The beat-frequency oscillator referred to in this article is brought in to circuit when the switch on the extreme right is in the third position.

Trade News of the Month

Several more interesting components and accessories designed for amateur use are discussed this month. All are now available from stock.

SPECIAL equipment for amateurs still continues to come, both from British and American manufacturers. G5NI (Birmingham), Limited, has just introduced a most interesting range of ceramic materials.

Feed-through bushes suitable for 4 B.A. holes are priced at 2d., or for 2 B.A. holes priced 3d. There are also some excellent low-loss pillars measuring 1⅜ in. by ½ in., threaded each end 2 B.A. They are supplied complete with screws and washers for 6d.

We have been trying one of their Universal Test Meters, which is most suitable for amateur constructors and experimenters. It is a 1,000 ohm volt instrument to which the user fits his own shunts and resistors. This meter has a very wide open scale and is priced at 32s. 6d. for a full scale deflection of 1 mA.

It is unusual to hear of British built amplifiers designed specially for amateurs at really low prices. We have just checked one of the first samples of such an amplifier which gives an output of no less than 15 watts. It uses a KTZ-63, followed by a 6N7 paraphase driver into two KT-66. There is also a 5Z3 rectifier. This amplifier will operate directly from a crystal microphone and is priced at £11. Supplies are now available from stock and can be inspected at Messrs. Webbs Radio, 14, Soho Street, W.1.

Another interesting component we saw at Webb's was a beat-frequency oscillator unit all complete ready for adding to an amateur built receiver and suitable for frequencies of between 450 and 475 Kc. The price is 8s. 6d. Also they have a standard McElroy key which would suit the most fastidious and ardent CW fan. It is priced at 7s. 6d., a very low figure.

Bud crystal holders of the ceramic type with adjustable pressure are extremely good value for 8s. 6d. Messrs. Radiographic have a complete stock of these holders which take all normal sizes of crystal. The variable pressure is certainly a great advantage, particularly when crystals are rather difficult to start oscillating.

We have previously mentioned, but only very briefly, the new Premier transverse current microphone. One of these instruments is now in general use at our own station and has proved to be one of the most satisfactory of its kind. The price is 20s., which is well within the scope of the average amateur, while a suitable table stand can be obtained for 7s. 6d.

Amateurs have quickly taken to the new range of transmitting valves inrtoduced by the Mullard Company. In particular the PZO3-3 pentode with a 4 volt heater seems to be very popular. It has an anode dissipation of only 3 watts down to 15 metres, but will give an R.F. output of 3.5 watts to Class C.R.F. amplifier on CW.

There is also the PV05-15 which is very similar to the RK-23 and priced at 37s. 6d. This is the valve that is so satisfactory on the 5-metre band. Those who are interested in the RK20-A type of valve will find the Mullard PV1-35 a very satisfactory substitute. Prices are similar, being £4 15s.

The valves we are going to use quite extensively in the future is the TY1-50, a 50 watt triode of low capacity. This is suitable for use on the ultra-high frequencies, and a pair as push-pull self-excited oscillators on 1.5 metres provide an output of 33 watts.

"A Transmitter Kit for Constructors."

(*Continued from page 370*)

chassis in kit form, less valves, is only £6 15s., while it can be wired and tested for an additional 25s. This transmitter has sufficient R.F. output to permit of successful final stage doubling down to the 10-metre band.

These transmitter kits are extremely cheap and it would be very difficult to anticipate a lower price than £8 for a completely wired and tested 100-watt transmitter, but despite this the design and manufacture are extremely good. All components are of first-grade quality while the chassis are extremely robust and well-finished.

The P.O. Licence

We should like to point out that before contemplating the purchase of this equipment it is essential that a Post Office permit be obtained to operate it. Full details of this permit can be obtained from the office of the Engineer in Chief, Radio Division, General Post Office, Armour House, Aldersgate Street, E.C.

Full information on these and other transmitter kits can be obtained from G5NI (Birmingham), Ltd., 44 Holloway Head, Birmingham, 1.

"A Power Unit for the T-40 Transmitter."

(*Continued from page 374*)

able amount of space. Smoothing in this circuit is ample for it must be remembered that the supply is only to feed the oscillator valve. V3 is a 5Z4 full-wave valve rectifier with an octal base which provides more than sufficient D.C. output.

It is suggested that switching be arranged externally particularly with regard to the switch in the primary circuit of the H.T. transformer. If this switch is mounted on the operating bench alongside the receiver it will provide quite a simple remote transmitter control.

When this power unit has been finished, the constructor then has a complete modern transmitter capable of withstanding an input in excess of 100 watts. It is complete ready for CW operation, but in subsequent issues we will publish the design of a suitable modulator and ultimately of a high-power final stage with its own power pack.

The whole transmitter is being housed in one of the new Premier transmitting racks and any amateur can inspect the completed transmitter in order to obtain further or advance information. The transmitter is in use of the QRA of G5ZJ.

A 40-Metre Breadboard Transmitter (Continued from page 358)

to handle the off-resonance anode current of the final valves.

Actually in practice with a 250-volt power supply the beginner should not exceed a current of 40 mA. for the final two valves when the transmitter is actually coupled to the aerial. This gives the input of 10 watts, which is a good average input for the 45 type of valve.

It is also advisable to keep the anode current of the crystal oscillator fairly low until experience has been gained with this type of circuit, otherwise there is a possibility of damage resulting to the crystal. With 250 volts applied to the 47 crystal oscillator adjust the link coupling coil until the total current taken does not exceed 18-20 mA., that is approximately 5 watts.

The R.F. output even with this low D.C. input will be more than sufficient to extract the final two-valve, even on 20 metres. If further drive should be required, then the link can be adjusted on the C.O. anode coil until the current taken reaches approximately 30 mA., which should be taken at a maximum rating for the beginner, although it is nowhere near the maximum for the type 47 valve.

Practically all the wiring is on top of the baseboard, the only exception being the choke in the final anode stage, the by-pass condensers and the fixed resistors. As can be seen from the illustration the under baseboard wiring is very simple indeed, in fact the whole transmitter is just about as easy to build as an effective transmitter can be. On 40 metres the transmitter will give a very good account of itself and strong reports can be obtained from really long distances.

I have not built this transmitter for phone use, because that puts up the expense very considerably, but the constructor can modulate in the anode circuit quite simply, although it will mean a seperate power supply.

Components for A 40-METRE BREADBOARD TRANSMITTER

BASEBOARD.
1—Wooden baseboard 15 × 10 × 1 ins.

COIL FORMS.
2—4-pin type CT4 (Raymart).
1—Type BTX (Raymart).

CONDENSERS, FIXED.
6—.002-mfd. type 690W (Dubilier).

CONDENSERS, VARIABLE.
1—.00025 mfd. type TRO-250 (Premier Supply Stores).
1—.00016-mfd. type TRO-160T (Premier Supply Stores).
2—.000015-mfd. type TRO-15T (Premier Supply Stores).
1—.00004-mfd. type TRO-40T (Premier Supply Stores).

CHOKE, HIGH FREQUENCY.
1—SW69 (Bulgin).

CRYSTAL AND HOLDER.
1—7 mc. crystal with enclosed holder and base (Q.C.C.).

HOLDERS, VALVE.
2—Type 949 4-pin (Eddystone).
1—Type ceramic less terminals 5-pin American (Raymart).
2—Type ceramic less terminals 4-pin American (Raymart).

KNOBS, ETC.
3—Type K60 (Bulgin).

METER.
1—0-250 m/A. (Howard Butler).

PLUGS, TERMINALS, ETC.
2—Close-circuit jacks type J6 (Bulgin).
1—Plug type P1 (Bulgin).
3—Terminal slips type 1046 (Eddystone).
3—Mounting brackets type EH9 (Bulgin).

RESISTANCES FIXED.
1—20,000-ohm type 1-watt (Erie).
2—10,000-ohm type 3-watt (Erie).
1—10,000-ohm type 5-watt (Erie).
1—100-ohm CT (Premier Supply Stores).

SUNDRIES.
6—Yards push-back wire (Premier Supply Stores).
1—Strip Trolitul, 4 × 6 × ¼ ins. (Premier Supply Stores).

VALVES.
1—Type 47 Triad (Premier Supply Stores).
2—Type 45 Triad (Premier Supply Stores).

We have made arrangements for a complete kit of components or a ready wired and tested transmitter to be obtained from Messrs. Premier Supply Stores.