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Television and SHORT-WAVE WORLD

FEBRUARY, 1938.
No. 120. Vol. xi.
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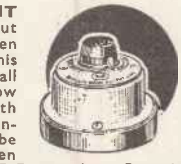

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No. 120 VOL. XI FEBRUARY, 1938

TELEVISION and SHORT-WAVE WORLD

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COMMENT OF THE MONTH

Programme Problems

IN the past we have refrained from any criticism of the television programmes for it was evident that for several months the period would necessarily be one of experiment. Now, after more than twelve months' experience, there is no gainsaying the fact that programme production and presentation has not kept pace with technical development and on the whole the material that is presented to television viewers is sadly disappointing. Lack of finance and suitable accommodation are the two chief reasons put forward to account for this but in our opinion if when more money becomes available it is used to provide more pretentious shows of the same type as at present, the programmes will, from the point of view of interest, be foredoomed to further failure.

Television programmes can never hope to compete with even third rate films and it follows that when any sense of novelty wears off they will cease to interest. The real role of television lies outside the Alexandra Palace and every effort should be made to place before viewers events which cannot be shown by any other means. These events need not necessarily be of national importance, on the contrary they should be included in practically every programme so that viewers will appreciate that only by means of television can they keep so closely in touch with topical events. Present tendencies seem to be to emulate, in but limited time and with limited resources, shows which have taken months to organise and prepare. The studios at Alexandra Palace should, in our opinion, for the most part be used chiefly to provide stop gap material. Such a course may not be possible at present, though there are no serious technical difficulties in the way, but we do contend that it should be the ultimate aim and object, and that if money is spent on extensive studio development it will ultimately be wasted.

A great deal of spade work will have to be done before television can provide the topical news pictures of the day, but we suggest that a start could be made with news films of pictures which could easily be obtained, particularly during the summer months, and with it would come material which could be televised direct and which no doubt would steadily increase in amount as time goes on. Television would thus become a topical picture magazine of current events and eventually be of such importance that few people would care to be without a receiver. Entertainment should, of course, have its place, but it should, we contend, be obtained from outside sources whenever possible. The entertainment side of television most decidedly lies *outside* the Alexandra Palace and every effort should be made to get it outside.

AMERICA'S FIRST MOBILE TELEVISION STATION

America's first mobile television station, to be used by N.B.C. engineers in experimental pick-ups of outdoor news events, is shown as it was delivered to the National Broadcasting Company at Radio City.

AMERICA'S first mobile television station, soon to be used in experimental television pick-ups of outdoor news events, has now been delivered to the National Broadcasting Company.

The new unit, consisting of two large motor vans containing television control apparatus and a micro-wave transmitter, has been built by the R.C.A. Manufacturing Company at Camden, N.J. It will be operated by the National Broadcasting Company in connection with the present N.B.C. television transmitter on top of the Empire State tower.

The first use of the mobile transmitter will be for experimental purposes and the National Broadcasting Company contemplates the experimental televising of outdoor sports, parades, news events and other subjects. After being relayed by micro-wave to the Empire State transmitter, the televised events will be broadcast throughout the Metropolitan area to receivers in the hands of N.B.C. engineers and those built by radio amateurs.

The new mobile unit consists of two large motor vans. It will be operated by a staff of ten engineers. One van contains complete pick-up apparatus, including cameras, for both picture and accompanying sound. The vision transmitter, to operate on a frequency of 177,000 kilocycles, is mounted in the other. A special directional aerial, to be raised on the scene of operations, will be used in connection with the mobile unit. In the Metropolitan area, where the steel framework of many skyscrapers impedes ultra-high frequency transmission, the normal working range of the new unit is expected to be about twenty-five miles.

The van containing the pick-up equipment is the mobile equivalent of a complete television studio. Apparatus in the van, all mounted in racks extending down the centre of the vehicle, includes the synchronising generators and rectifiers for supplying Iconoscope beam voltages, amplifiers for blanking and deflecting potentials and line amplifiers. The principal sound apparatus consists of microphone amplifiers and sound mixing panels.

The control room is also located in this van. Here, in semi-darkness, engineers are able to see the picture as it is actually being transmitted, and also the image being picked up by the second Iconoscope camera preparatory to transmission. Control engineers may switch at will from one camera to the other.

The Cameras

Two Iconoscope cameras, connected with this vehicle by several hundred feet of coaxial cable, are the instruments which pick up the scene being televised. Mounted on tripods, they resemble standard studio cameras, except that they are somewhat smaller and lighter in weight. Engineers check camera focus by looking directly on to the photo-sensitive plate in the Iconoscope or "electric eye." In the studio camera used for N.B.C. focus is checked through a separate set of lenses. The microphones used for sound pick-up include several parabolic microphones developed in the N.B.C. laboratories.

The second van, connected to the first by 500 feet of coaxial cable, when in operation, contains a complete micro-wave relay transmitter. The principal apparatus here is the radio frequency unit, generating the carrier wave for picture signals, and modulating apparatus for imposing picture signals on this carrier. Because of the great amount of heat generated by some of the large valves used, this vehicle contains an air-conditioning unit and a water cooler to maintain the valves at suitable operating temperatures.

A NEW OPTICAL METHOD OF TELEVISION RECEPTION

By Dr. Okolicsanyi, of the Scophony Laboratories

A SYSTEM WHICH DISPENSES WITH SCANNING DEVICES

A SHORT account of a recent Scophony development was given in the November, 1937, issue of this journal.[1] It has also been explained previously how the modulated supersonic wave train represents a large number of picture elements. The cell may be made long enough to contain the elements of a whole picture line. Finally, different methods were indicated for projecting the picture line on to the screen without the aid of a high speed rotating polygon.

Fig. 5.—Complete experimental receiver shown diagrammatically by Fig. 3.

In the course of experimental work two of these methods were found to be of special interest. The first of them will be explained by the following in conjunction with Figs. 1 and 2 and referred to briefly as the "flash light" method; the second is based on the optical combination of two supersonic cells (Figs. 3, 4 and 5) and represents the "two-cell" method.

In Fig. 1 a wave train, produced by the picture signals of a whole line, and existing in the supersonic cell (A) is illuminated for a very short time by light passing through the Kerr cell (B). The picture lines are each in turn projected on to the screen by flashes from the Kerr cell. The efficiency of this arrangement may be enormously increased by employing a high pressure mercury lamp flashing in sympathy with the Kerr cell. In the ideal case when the light flashes only for the duration of a picture element, the Kerr cell is unnecessary.

(*) The expression saw-toothed in line 9, 2nd paragraph (*Television and Short Wave World*, 1937, p.652) was given in error and should have been "sharply shaped."

For definition of present-day standards in the stroboscopic methods the light source must flash for a period of less than one microsecond. For a greater duration than this the movement of the picture modulated wave train through the supersonic cell and hence of the picture line across the screen will be rendered visible as a lack of definition.

A mirror oscilloscope placed at the bar D (Fig. 2)† and synchronously oscillating with the line frequency may be used to compensate the movement of the line across the screen. This is analogous to the "follow-up" principle used by Scophony with the high speed polygon. The amount of compensation is not limited in the case of the tuned oscillating mirror but is variable since the amplitude of swing of the mirror may be varied. Moreover, any instability in synchronism is visible not as a wobbling or slipping of the picture but only as a lack of definition. Although the oscillation of the mirror is sinusoidal, only that portion of its swing where its velocity is sensibly constant (i.e., approximating to its mean position) is used in conjunction with a "flashing" light. Full definition may still be maintained even with a light source flashing for a duration of seven or eight microseconds.

The Two-cell Method

In Fig. 3 another very simple experimental arrangement is shown. The cell A contains a small group (one picture element) of supersonic waves producing interference fringes at the slot B. The light from the fringes passing through the slot and lens B projects an image of the cell A on C, and the light spot from A scans in an opposite direction the picture modulated

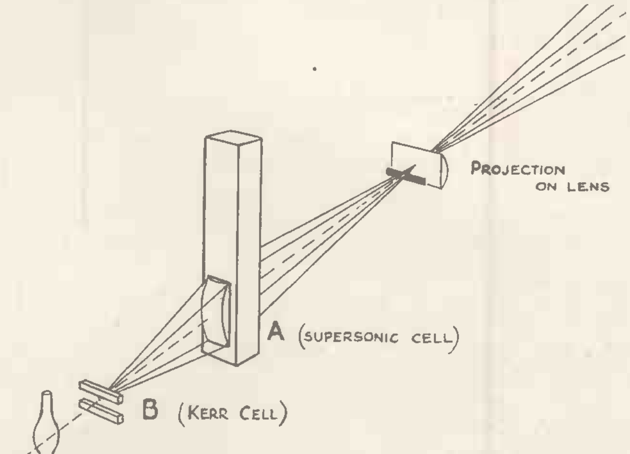


Fig. 1.—This drawing shows the scheme for the new stroboscopic (wave and slot) television method. The Kerr cell B, acting as a shutter, projects an immobilised image of the wave-train in A by a flash of illumination at the end of each line period.

† British Patent No. 477604 Scophony Limited and F. Okolicsanyi.

train moving through C. Cylindrical lens D projects cell C on to the screen via a slow-speed mirror drum. The picture definition depends upon the size of the group of waves in the "wave-slot" cell.

In both the stroboscopic methods and the "wave-slot" case although the picture line is scanned, the linearity of scanning depends not on any electrical apparatus, e.g., time base circuits, but on the velocity of the wave train through the liquid.

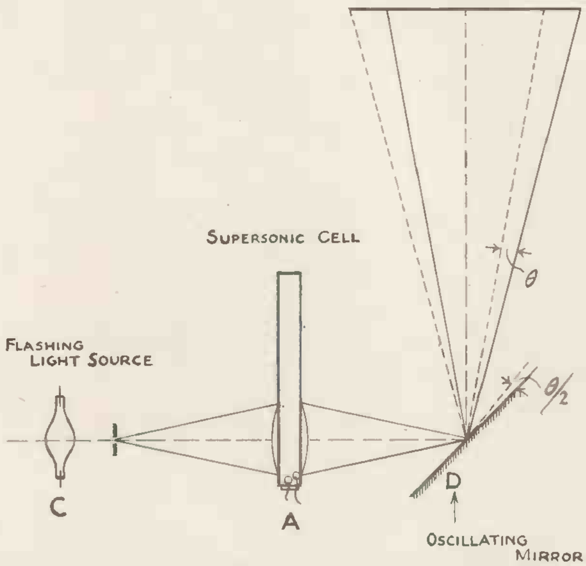


Fig. 2.—The momentary illumination can be effected with the light source (C) itself, the whole of the light energy being concentrated in a short time interval, determining the rough definition. By the small oscillatory movement of D the full definition is attained.

Observations

In all the above mentioned methods the line synchronising signals are used only to provide impulse for a supersonic cell, Kerr cell or to "trigger" a flashing light. No high-speed mirror drum is driven from the signals and the only mechanical component—the small oscillating mirror—is used not to provide scanning but to improve definition. The velocity of the wave train through the supersonic cell is constant. Thus is combined the linearity of mechanical-optical systems and the flexibility and ease of synchronisation of electronic methods.

In addition it must be noted that the small group of waves travelling through the supersonic cell of the "wave-slot" example may be used to effect scanning in a transmitter. The group once formed travels with constant velocity from the crystal. Scanning is therefore linear.

The theory and also the common features of both methods described above and shown on Figs. 1-5, can be best understood by analogy with the problem of immobilisation in the technique of snapshot photography. If a sharp picture is required from a quickly moving object a high speed shutter is necessary. Some of them, as used in most of the cameras are in the plane of the lens and permit a simultaneous illumination of the whole plate but only for a very short time. This can be compared with the "flash light" method used in obtaining sharp snapshot of the supersonic wave trains.

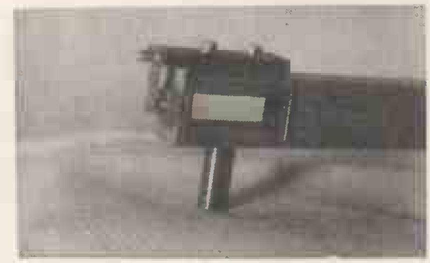


Fig. 4.—The Scophony supersonic cell.

On the other hand focal plane shutters are also used for photographic cameras. The sharpness of the image depends in this case on the product: width of slot of the shutter times shutter-speed. The analogy between this method and the picture-line-formation of Figs. 3 to 5 (two-cell method) can at once be seen.

It is, therefore, a common feature of all the above "wave-slot" methods that the fixed elemental areas of one line are periodically and momentarily illuminated at the line frequency. In the first case simultaneously, in the second case, in succession.

The *light efficiency* of the two cell method (Fig. 3) is inversely proportional to the number of elements in a line. This can be overcome with the flash light method, but the research work concerned with the development of the corresponding light sources for the simple method of Fig. 1 meets with certain difficulties. To get the full *sharpness* with this simple method the duration of illumination must be restricted to a fraction of a microsecond. The design of the present apparatus is therefore based on the modified form, Fig. 2, where neither the light efficiency nor the sharpness is dependent on the number of lines (definition) used.

An easily realised flashing lamp alone, with the vibrating oscilloscope mirror switched off, gives an immobilisation effect, but the sharpness will not exceed that of a 20-line picture.

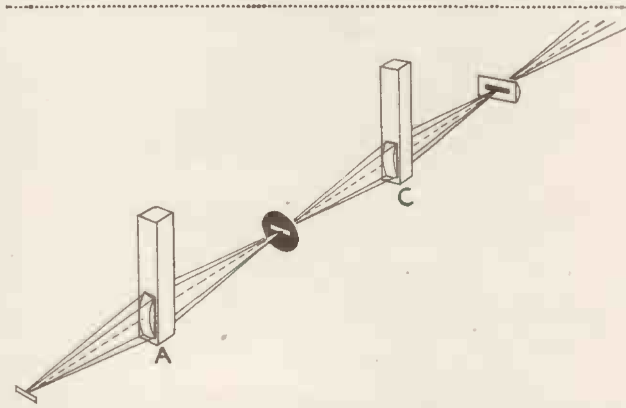


Fig. 3.—This drawing shows the "wave-slot" reception method with two supersonic cells as used for the first researches in the Scophony laboratories. Cell A is fed with the line impulses, cell C with the picture impulses.

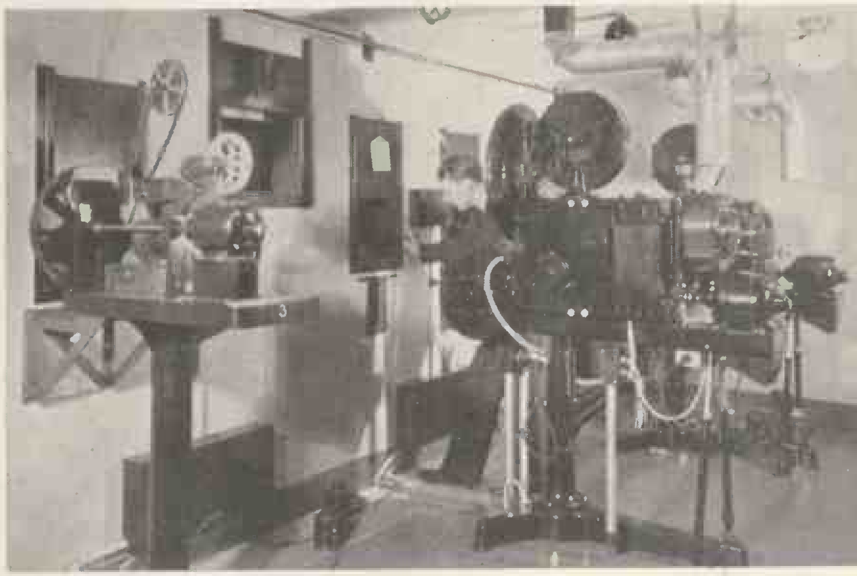
The full sharpness for any desired definition can then be realised without any loss of light, by a very small vibration of the oscilloscope mirror.

While the rotating scanners can work with light control devices representing a fraction of a line only, the above oscilloscopes are used to project a full line, but the movement produced by the oscilloscope is only a fraction of the usual scanning movement.

(1) British Patent Scophony Ltd., and F. Okolicsanyi 474970 and 477604.

N.B.C. TELEVISION IN PICTURE

Although only experimental transmissions are being made by the National Broadcasting Company of New York, the equipment is of a full-scale type as these photographs show.



Above: The Film Scanning Room. Experimental television programmes of the National Broadcasting Company are of two types—studio p.ck-ups (with live talent) and motion picture film. This picture shows the latter. The film is focused on an Iconoscope camera, which is at the other side of the partition and not shown in the photograph. This is virtually identical with those used in the television studio.

Below: Models wearing summer styles were recently tested for television by the National Broadcasting Company. In the foreground are the Iconoscope cameras. The television stage is brightly lighted from above and all sides. The microphone is overhead, suspended from a swinging boom.

Top: The N.B.C. television aerial is more than 1,250 feet above Fifth Avenue in New York City. It is expected that the transmission range will be fifty miles. The erection of this aerial foreshadows the greatest programme of experiment in the history of American television.

Above: Irvin S. Cobb, famous author and a favourite N.B.C. broadcaster, was a recent visitor in the N.B.C. television studio where experimental programmes are being presented to test RCA's television equipment.

FOR THE BEGINNER.

WHAT IS " BRIGHTNESS LEVEL " ?

THE D.C. COMPONENT SIMPLY EXPLAINED

Another article in the " ABC" series in which the use of the D.C. component in television transmission is explained by G. Parr. Without it the pictures lack life and the difficulty of synchronising is considerably increased.

IT is not not too much to say that the success of the present British system of television is due to the method used in radiating the signal, and this fact has been acknowledged by engineers from America and the Continent who have visited this country.

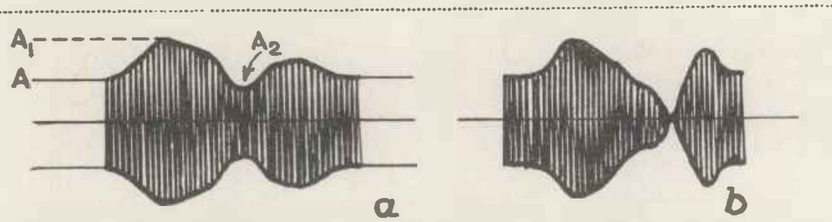


Fig. 1. An ordinary modulated carrier wave (a) and a carrier wave modulated 100 per cent (b).

The method is known as " D.C. working " and the reason for this name will be seen on understanding the characteristics of the television signal.

In ordinary sound broadcasting we have a carrier wave which is modulated by audio frequencies, the effect of the modulation being to alternately increase and decrease the amplitude of the carrier wave. Thus, in Fig. 1a, the average amplitude of the carrier wave may be A without a signal being transmitted. When the audio frequency is impressed on the carrier the amplitude may rise to A_1 or fall to A_2, but it will return to A when the sound which is producing the modulation ceases. The carrier wave is thus of a constant height, except when modulated. If the depth of modulation is 100 per cent., the troughs of the wave will reduce the carrier amplitude to zero, as in Fig. 1b, and in this case it will be seen that the amplitude of the modulating wave is exactly half the amplitude of the carrier. Under these conditions the maximum amount of energy is being transmitted in the form of signal.

In television transmission on the Baird 30-line system (and in some present-day systems) the same method of modulating was used, the only difference being that the alteration in carrier amplitude was due to light fluctuations instead of sound vibrations. Since the current in the photo-cell is a maximum when the light from the scene is brightest it follows that the troughs in the carrier wave will correspond to maximum light and the wave will rise to its maximum value when black is transmitted.

The wave of Fig. 1a could therefore equally well represent a television signal under the 30-line system or, for that matter, the modern American system, the only difference being that no provision is made for the synchronising signal. This has to be fitted in at the end of the line and is usually done by suppressing a portion of the vision signal and allowing the carrier to rise to maximum amplitude.*

Brightness Level

In transmitting a television scene as distinct from sound broadcasting we are, however, concerned with a factor which does not have an equivalent in the latter. This is the illumination of the scene as a whole, apart from the fluctuations of light and shade which go to make up the picture. For example, in photographing a scene in bright sunlight the final picture has an overall appearance of brightness which tells us immediately the conditions under which it was taken. If a photograph is taken of a dull interior the same effect appears in the finished print. In order to make a televised scene appear natural the same effect must be applied in the transmission—the overall brightness of the screen must vary according to the subject and the conditions under which it appears. This can be done by making use of the carrier wave itself to convey the " brightness," while the depth of modulation conveys the light and dark variations in the picture.

We can then make the height of the carrier proportional to the brightness of the scene, so that maximum height will give maximum brightness and each tone of the picture is associated with a definite value of carrier amplitude. This is the system which is known as " D.C. working " and to understand it better we can take the simple case of a black and a white square outlined against a background of varying shade, as in Fig. 2.

When such a picture is scanned a current will be produced in the photo-cell device proportional to the brightness, and this current is shown by the curve adjacent to each picture. In the top case, marked (1), a grey background gives a value of current half-way between black (zero current) and white (maximum current).

These extremes are marked by the letters B and W. As soon as the scanning spot reaches the white square in the centre of the frame the cell current rises to the maximum "W" value, falling immediately afterwards to the baseline as the black square is scanned. After leaving the black square the current resumes its average value proportional to the brightness of the background.

Now take the case of (2) in which the background is much lighter, the

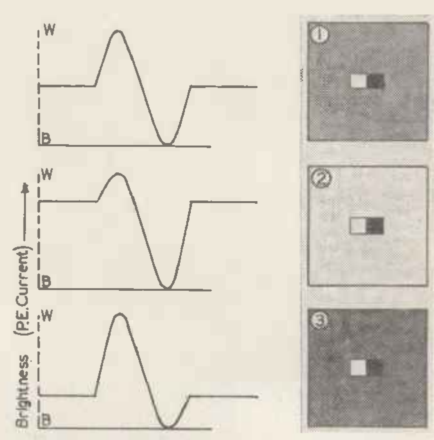


Fig. 2. A simple black and white pattern scanned with different brightness of background showing change in photo cell current.

* See p. 403, July 1937.

squares remaining as before. The average cell current will be higher and nearer the "W" value. On scanning the two squares the extremes of current will be as before, but after passing the black square, the cell current will rise to a higher steady value than in (1).

Finally, in case (3), where the background is very dark, the normal cell current is low, rising to the peak on white and falling to zero on black as before.

Fig. 3. The signal given by a blank line, showing how the mean potential across a condenser rises until equal areas are obtained on each side of the line.

A.C. and D.C.

In each case we have a pulse rising or falling from a steady value, and we can represent this as an alternating current superimposed on a direct current, the value of the direct current corresponding to the brightness of the background. The alternating current conveys the variations in the individual parts of the picture: the direct current conveys the intensity of illumination of the scene. Without it there would be nothing by which we could convey the brightness of the scene as a whole, although the individual variations in the scene could be transmitted as an ordinary modulation of the carrier wave as Fig. 1.

The name " positive modulation " is sometimes given to this type of transmission in which the carrier amplitude is varied continually, negative modulation corresponding to the wave shape of Fig. 1a.

Practical Considerations

The handling of a signal which combines D.C. and A.C. in the way shown above is complicated by the fact that the usual types of coupling between valves only respond to A.C. In the resistance-capacity coupled amplifier such as is used for television signal amplification the impulses are applied to the grid of the valve through a condenser. If we apply a waveform of, say, 50 cycles per sec. to the condenser the variations in potential across the condenser are applied to the grid of the valve without appreciable distortion. If, however, the waveform is superimposed on a D.C. component as in Fig. 2 the variations will be applied to the grid, but the D.C. potential will not.

Suppose we have no picture being transmitted, but the carrier wave only. If the background is very dark the signal waveform will appear as in Fig. 3, a plain line broken at intervals by the synchronising pulses. If this is applied to the condenser, after a few lines the potential across the condenser will rise to a mean value as shown by the right hand waveform in which the areas on each side of the centre line are equal. Now, if a sudden white line occurs in the picture a momentary impulse will be given to the condenser which will raise its potential slightly above that to which it would attain if its mean potential had not increased. The effect can be summarised thus:

Whatever the amplitude of the unmodulated carrier, after a few lines the condenser will take up a mean potential such that the area of the wave on each side of the centre-line is the same.

If a sudden " white " impulse is transmitted it will appear brighter than it should on the screen owing to the fact that the condenser potential is above the normal level.

At first sight it would appear that the advantages of D.C. working could not be realised in practice owing to the method of coupling between the valves. There are special amplifiers in which the valves are directly coupled together, known as D.C. amplifiers, but it is difficult to assemble more than two stages when connected in this way. In direct coupling, the grid of the second valve is connected to the anode resistance of the first, the condenser being omitted. Such a connection would, of course, apply a high positive potential to the grid which would be fatal to the working of the valve, and it is therefore necessary to apply a potential to the grid which is of sufficiently high value to oppose the potential across the anode resistance and to apply the necessary bias to the grid at the same time.

This is usually done by connecting the valves to various tappings along a potential divider which is connected across the H.T. supply, but the design and operation of such amplifiers make them unsuitable for use in ordinary television receivers.

Fortunately, it is possible to retain the D.C. component in the receiver until the last stages and it is then possible to " restore " it if the condenser coupling has suppressed it.

On examining the circuit of Fig. 4 we can see how the signal progresses through the receiver and the points at which the D.C. component is liable to be lost. In the radio frequency stages the whole carrier is amplified and this reaches the detector in the same form as it was received by the aerial.

After passing through the diode rectifier D the rectified signal consists of the modulating voltage variations plus a steady potential which corresponds to the rectified carrier wave. The load resistance R in the diode circuit therefore contains the D.C. component and the potential across it is a true indication of the brightness of the scene transmitted.

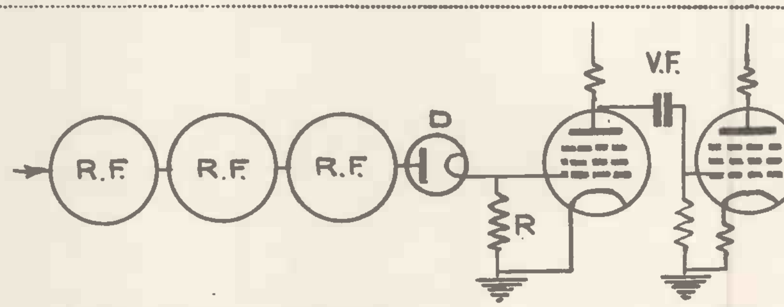


Fig. 4. Diagrammatic arrangement of vision receiver. The D.C. component is stopped by the condenser in the V.F. stages.

Now we have one or more stages of amplification for the modulation signal—the video-frequency amplification. If the diode is connected to the video-frequency valve through a condenser the D.C. component is immediately lost, but this condenser is not really necessary as there is no high positive potential on the load resistance. The first valve can there-

(Continued on next page)

ADJUSTING THE TIME BASE OF THE LOW-COST TELEVISOR

By S. West.

In an article last month instructions were given for operating and adjusting the complete "Low Cost Televisor." This article, whilst being explicit, by reason of its comprehensiveness occupied some four pages and it is felt many constructors will like a more concise description of the time base adjustments. Accordingly, the following instructions have been prepared. It is recommended that the adjustments are made in the exact order as written. Little difficulty will then be experienced in arriving at the correct settings.

IN the diagram below the various controls are shown for the time base. These are, for convenience, numbered 1-9 respectively. By so doing the need for cross reference to the time base article is avoided.

The potentiometers Nos. 1, 2, 3 and 9, are set about half way round their full travel.

The potentiometer No. 7 is turned full clockwise. The position for this control will depend on the manner in which it has been connected. It is implied when it is advised to turn it full clockwise that the slider is then nearest to the earthed end.

With the control No. 5 increase the raster brilliance so that it is possible to observe the effect of each subsequent adjustment to the remaining controls.

If the raster is very small it may be enlarged with adjustment to the controls Nos. 2 and 3. With control No. 4 approximately focus the light spot. This condition is reached when the raster edges are clean and the flybacks are plainly visible.

At this stage the raster may be approximately centered. This is performed with the controls Nos. 6 and 8. The final accurate centering is postponed until the picture, correctly synchronised and having the correct dimensions, is obtained.

Set control No. 1 for the least raster width. Adjust control No. 2 so that the raster is half the final width of the picture which can be accommodated on the screen. Turn the control No. 1 so that the raster assumes the correct width.

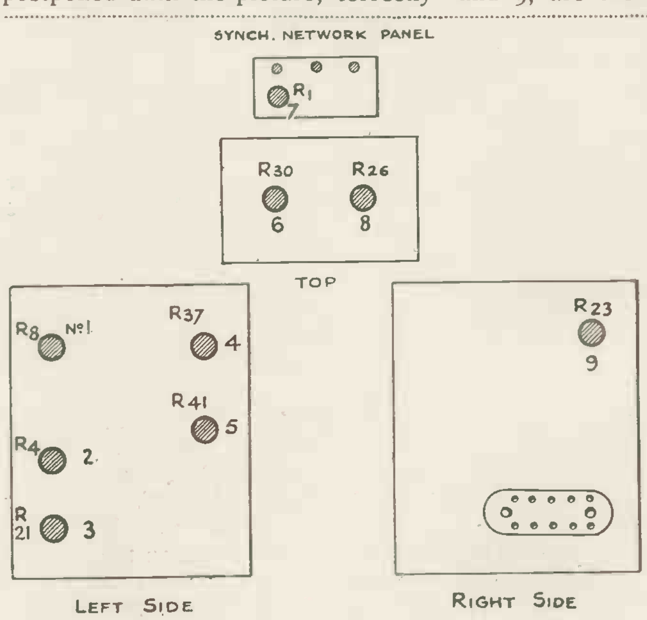
With control No. 9 reduce the raster to its minimum height. With control No. 3 adjust the height so that it is approximately equal to half the screen's diameter, i.e., 5 in. for a 10 in. tube, etc. With control No. 9 increase the height so that the raster edges extend to the screen edge limits.

These latter instructions referring to the settings for controls Nos. 3 and 9, are the frame time base adjustments. When modulation is applied to the tube and synchronising pulses to the time bases, the picture should at once lock into synchronism for this dimension. If, when the adjustments have been made, there is a tendency for the picture to bounce vertically as a whole, or for it to "blink," i.e., to alternatively be large then narrow, an adjustment of control No. 3 should correct the fault. Failing this, re-adjustment of the synchronising control R38 on the vision unit may be required.

If it is found impossible to effect a cure a synchronising pulse application potentiometer is advised in place of the fixed resistances R12 and R14 in the synchronising pulses application network. This potentiometer can have a value of about 30,000 to 50,000 ohms. It is connected in the same manner as is the potentiometer for the line circuit.

Slowly rotate control No. 2 until a single picture is formed. This adjustment is facilitated if the control No. 7 is rotated so that the slider is about ½ in. from the earth end. With the single picture correctly formed, this control (No. 7) may be more accurately set.

The correct picture dimensions may be restored with adjustments to the controls Nos. 1 and 9. Also the light spot may be more accurately focused with the control No. 4. The setting of this control is correct when it is possible plainly to see each individual line composing the raster over the whole picture area.



This diagram shows the time base controls numbered for easy reference to the adjusting instructions.

"WHAT IS BRIGHTNESS LEVEL"

(Continued from preceding page.)

fore be directly connected to the diode as shown and the D.C. component will then appear in the anode voltage variations. From thence the signal can either be applied to the cathode-ray tube direct or through another stage of video-frequency amplification. In either case we can no longer avoid the use of a condenser, and it therefore becomes necessary to see how we can restore the D.C. component after the first video amplifying valve. The method will be explained in the next article.

Telegossip

A Causerie of Fact, Comment and Criticism

By L. Marsland Gander

BEHIND the office-doors of Alexandra Palace plans are in the making—plans on paper, plans at the idea stage. Over the whole television station broods the air of secrecy and tension a little like that behind the lines before a Big Push.

And television's Big Push is nearly due. There has been much talk of the need for extra studio accomodation at Alexandra Palace before hours can be extended. Actually the problem reaches farthur than this—there is need for more dressing room accommodation, more offices, more staff, and more everything. The station needs doubling in size.

In fact I should not be at all surprised if those very secret plans envisaged the taking over of another chunk of Alexandra Palace. But the tragedy is that conversion of the empty shell will take so long. When I remember that the B.B.C. Russian steam-roller methods took eighteen months—or was it two years?—to build and inaugurate the station in the first instance I feel pessimistic about the prospects of speedy developments.

What is the reason for secrecy and delay? It is because nobody knows how much the Government will give the B.B.C. for television. Estimates have varied from £50,000 to £500,00. I split the difference and make it £250,000.

Though I do not wish to be a prophet of gloom I see a grave danger that a large proportion of the money allotted may be swallowed up in constructional costs, before the television staff have a chance of tackling the main trouble—improvement of programmes.

Sunday Programmes

But when recently I had a chat with Mr. Gerald Cock, the Director of Television, he gave me one heartening piece of news. "We shall have Sunday programmes soon," he said. I gather that there will be one hour of transmission. When I tried to persuade Mr. Cock to define what he meant by "soon," he declined to be drawn even to the extent of sa whether it would be weeks or months.

I gather that another studio hour on week-days will follow in addition to outside broadcasts. There will be no summer "close-down" this year.

Now more about these plans. The project for the conversion of St. George's Hall has been temporarily shelved. But I happened to catch a glimpse of a small model of St. George's as adapted for television. The idea is to leave it as a theatre with ordinary wings and a central ramp in front of the stage up and down which the camera could be tracked.

The A.P. Theatre

As regards the Alexandra Palace theatre there are two alternative suggestions on paper. One is that camera and control positions should be arranged in a circle in the centre of the floor; the other that it should be kept as a theatre.

Coming O.B.'s

But Mr. Cock is building most of his hopes on the television vans. These vans have been docked for nineteen days for repairs and tuning up. After that it will be non-stop work for them throughout the spring and summer. The biggest events of the summer will, it is hoped, be the televising of the Derby from Epsom and of the Australian Test matches from the Oval and Lord's. Telescopic lenses will show the Australian Test giants at the wicket and will do more to popularise television than a hundred other transmissions.

Cricket, which offers a stationary batsman as the central figure, has to my mind more possibilities than football, which demands that the camera should try to follow a fast-moving player in the dim days of winter. Other items on the programme are the finish of the Boat Race, Hurlingham Polo, Trooping the Colour, a day's routine at Croydon aerodrome, and, of course, Wimbledon tennis again.

O.B. Quality

The all-important point is, however, improvement of the quality of these outside relays. Candidly I found 50 per cent. of the transmissions from the Olympia circus disappointing, a poor reward to enterprising Philip Dorté and his staff who had slaved endlessly at the job of putting them over. A few extra lights had been introduced over the ring but they did not provide sufficient illumination.

The chief trouble, however, was altogether unexpected. For the first time the engineers at Alexandra experienced a curious interaction between the incoming signals from Olympia and the outgoing signals from the Palace. Readers will recall that pictures transmitted from the van are picked up on a tiny mast which surmounts the main mast, plumb in the centre of the "dead" area. Steps have now been taken to guard against a repetition of this trouble.

An important addition to the vans will be a telescopic aerial which, on the fire-escape principle, will reach to a great height. If there ever was any doubt on the subject it has now been firmly established that height is the all-important factor in the aerial used for the vans.

Personalia

Passing to personal affairs, viewers will be delighted to hear that they will, after all, continue to see Leslie Mitchell as the compère of "Picture Page" and probably in other parts of the programme. Though he is carrying out his intention of resigning to become a commentator for the British Movietone News Reel he will work for the B.B.C. on a programme contract. In other words, he will reverse his former method, now making television the spare-time job while the news reel becomes his main occupation.

This is a tribute to one who not only established himself as the first man television announcer but also showed conspicuous ability and originality in developing his work. How much "Picture Page" is dependent upon him becomes apparent when he is away.

Then I hear that Cecil Lewis is back from Hollywood and Tahiti. In the early days of television at A.P., as the first to be in charge of outside broadcasts, his screen personality made a most agreeable impression upon the small pioneer audience. Mr. Cock tells me that he is prepared to

BRITISH AND CONTINENTAL COMPARISONS

make another offer to Mr. Lewis, but he will not be rejoining the staff at present.

"Wanted—a Chief Sub-Editor." I suggest this advertisement to the B.B.C. Television Department, because the fact is that there seems a general disinclination to cut programmes to reasonable proportions. Some producers, I feel, show themselves incapable of distinguishing between a good idea and good entertainment.

I take one example. There is a queer form of modern art which produces objects called "mobiles." One particular product consists of coloured cardboard discs attached to wires, all mounted on a central pedestal. These things wave about in the breeze.

An interesting and amusing idea—possibly the art form of the next century. It would be given two minutes in a magazine film. But bless me! the B.B.C. devoted fifteen minutes to it on the home screen. After three minutes the novelty was over; after five it was like a bad dream; after ten I began to see it as a slide of blood under a microscope. Never once did I obtain the glimpse of cosmic space intended. What marvellous entertainment for the million!

A Success

In contrast I come to "Rush Hour" and offer my warmest congratulations to the producer, Mr. Stephen Thomas, who because of a tendency to plump for minority programmes has not had the credit that is his due. Herbert Farjeon's revue, of which the television screen gave a pre-view before its presentation on the stage under another name, is easily the best light entertainment given by television.

But it took three weeks to rehearse it. Is there any hope then, of bringing up the staple diet of television to these standards? Ten sets were used altogether, all but one in the same studio. In the cramped space of the studio such a production is a miracle of organisation.

I was present in the original Marconi-E.M.I. studio; half the floor taken up by orchestra and apparatus and four other sets, constantly in a flux, crowded into the narrow space remaining. This revue is witty, topical, satirical and tuneful. The Shakespeare theme songs are brilliant—"I've got a mania for Titania," "Gloomy Dane," etc. Edward Cooper was turned into Othello by the simple expedient of transmitting a negative.

Improved Lighting

Enormous improvement in the quality of studio transmissions has been effected by a complete revision of the lighting arrangements. The whole responsibility for lighting has been handed over to D. R. Campbell, one of the engineers of 30-line days in Portland Place. During "Rush Hour" I watched him at work and I understood. He needs to be more than an artist and an enthusiast with the patience of Job. He must be an athlete as well. Mr. Campbell dived about under the camera lens during shots, he threaded his way through the scrum of studio assistants and scene shifters.

Once I thought that the main trunk of the Forest of Arden carried uncertainly across the floor by a scene shifter would crown him as he leaped about intent on his work. One of these days we shall marvel at the results produced in what is nothing more than a box by comparison with a full-size film studio.

The British Lead

Britain is not good at "telling the world" its television achievements. As an illustration, I notice that in connection with the Paris International Exhibition, two television prizes were won by Germany.

One was awarded to the Reich for demonstrations of the great technical and practical development of its television and visual telephone services. The second was awarded to an important German firm for apparatus remarkable for accuracy in re-transmitting images and for its small compass.

I visited the Paris Exhibition and also the Berlin Radio Exhibition. I cannot admit that German television is in any respect superior to Britain; it is in many ways inferior. The difference between 405-line definition and the 441-line definition used by the Reich is so slight as to be imperceptible. In the matter of programme presentation Britain has an easy lead.

I wonder what those who grumble at British programmes would say if they were asked to endure the unsophisticated German fare? It is common knowledge that Britain has led the whole world by giving a public service to the home for more than a year on high definition, without any challenge by a foreign country.

Yet German showmanship is so superior that she annexes the television prizes at an International Exhibition where British television is only represented anonymously and is an "also ran." I had almost said "where British television was not represented at all." But that would have been incorrect for in the grounds of the exhibition I myself was televised with an Emitron camera made at Hayes. This did not, however, figure as a British exhibit but had been purchased for demonstration purposes.

The New Berlin Studio

After learning of these awards a description of the new Berlin headquarters for television makes exceedingly odd reading. These new premises are situated in the Deutschlandhaus on Hitler Square. As they will not be completed until April, 1938, I presume the intention is to use them to feed programmes to the three new mountain stations of the Reich.

Yet the official description runs: "Near the actual stage is the stage manager's room and a waiting room with only a dim blue light, where artists assemble before going on the stage to accustom themselves to the semi-darkness in which they must act." In other words Germany is still using a system discarded here twelve months ago.

A New Type of Entertainment

I ran into Reginald Smith, one of the producers at Alexandra Palace, the other day. He was singing the praises of Charles Heslop, an artist for whom Mr. Smith has unbounded admiration, and who is consequently booked in many programmes.

There is a new type of entertainment in store for viewers. Mr. Smith has persuaded Dante, the illusionist, to come to the studio to explore in order to discover whether he can reproduce any of his great illusions there. I know nothing about stage magic but I suppose the difficulties will be lack of trap-doors, etc.

FURTHER NOTES ON THE POSSIBILITIES OF SMALL TUBES

By S. West

The small-tube receiver has been proved by experiment to give almost all the detail produced by large tubes and for small audiences is entirely satisfactory. This article deals with considerations of design which are very simple.

RECENTLY the writer dealt with the possibilities of television receivers employing small cathode-ray tubes.*

It was pointed out then that large constructional economies can be effected by the use of the Mullard A41/B4 or G4 tube. This tube has an unusual electrode system and the arrangement employed permits the application of an unbalanced deflection voltage to one set of plates.

The characteristics of the tube are suited to television picture reproduction. A modulation voltage easily obtainable with a normal output arrangement will fully control the tube between the limits of maximum useable brightness and light spot extinction.

It is claimed by the makers that an extremely small light spot can be secured due to careful electrode disposition, and tests substantially confirm this to be so. Finally, the deflection sensitivity is high and calls only for reasonable sweep voltages. The tube is available with a white screen, type A41/4.

A description of a practical double time base for use with the tube already has been published.†

Partly because of the simplicity of the time base, but mainly due to the low final anode voltage required for the tube it becomes possible to design a complete high-definition television receiver capable of furnishing first class pictures and indeed having nearly all the attributes of a conventional large-tube receiver but with a great reduction in complexity of apparatus.

Simplifying the Vision Receiver

With a suitable time base and accompanying power pack already evolved, it very naturally followed that some thought be given to the design of a vision receiver unit, comparable in simplicity to these units and which, together with adaptations of the already designed time base would comprise a televisor possessing those very desirable features—simplicity and low cost. There is little doubt that such a design is awaited and is assured a welcome by a large number of constructors who require a design within their ability to construct and operate and that conforms to the limits set by their pockets.

Before further considering the types of vision receiver that we can use, let us briefly review the form of double time base that has already been found entirely satisfactory for the 4 in. tube.

Four-valve Time Base

Earlier reference has been made to the unusual arrangement adopted for one set of deflector plates of the tube, an arrangement permitting an unbalanced output for one scanning direction. A number of tests revealed that this set of plates are best used for the line scan. This is partly necessitated by the need, in accordance with the tube maker's recommendation, for connecting the D2 plate direct to the final anode.

For some time during the preliminary tests of the tube some difficulty was experienced with the picture aspect in the frame direction. There was a tendency for it to compress at the bottom. Finally, it was decided deliberately to encourage non-linearity of the charge voltage for the frame relay. At once the picture assumed an excellent balance. It then was found possible to employ a simple time base having a total of only four valves. Furthermore, an H.T. voltage of 500 volts proved adequate permitting a reduction in the voltage rating for the various condensers thereby reducing their cost.

H.T. Economies

A voltage of a little over 1,000 volts is required for the C.R. tube operation. Almost no current is, however, indeed, that taken by the potential divider, furnishing the various tube's electrodes voltages, accounting almost entirely for the power consumption. Accordingly we may well use the same H.T. source to provide power for the time base, particularly as the current required by this is low. With the adjustments correctly made it is less than 10 milliamps.

As we require 500 volts only the excess voltage may be dropped across a resistance in series with the load thereby providing adequate smoothing. Thus, excluding any arrangement required to delay application of

* "Television and Short-Wave World" November 1937, p. 657.
† "Television and Short-Wave World" December 1937, p. 712.

HOW ECONOMIES CAN BE EFFECTED

H.T. whilst the various valves' heaters attain normal operating temperature (actually a Mazda DLS1 vacuum delay switch proves very suitable for this purpose) a total of five valves will provide the necessary scanning arrangements and in addition the voltages for tube operation.

Super-het or Straight?

Now if we are able to achieve similar simplicity for the receiver unit, we shall have a complete outfit that will conform to the requirements of a large number of constructors as has previously been remarked.

Several receivers were constructed, both superheterodyne and straight types and the salient features of these receivers were carefully analysed. It became obvious that a straight set conformed better to our requirements.

Considering first the super-heterodyne type. The feature of this class of receiver is that high I.F. amplification is possible! however, the frequency changer stage is a passenger from the point of view of amplification, indeed it can attenuate. Also as wide frequency response is essential for a vision receiver, the high gain that can normally be obtained at the I.F. frequency is impossible as the circuits necessarily are heavily damped. Also with the super-heterodyne class of receiver it is preferable for various reasons to employ at any rate one stage of R.F. amplification.

Now it is obvious that we are not likely to achieve anything particularly simple by adhering to the superheterodyne principle, particularly when it is remembered that if a reduction in number, from the usual number, of I.F. stages is contemplated, and this would appear the obvious course to pursue in order to simplify. There remains, therefore, little reason for going to the trouble of converting the signal to a new frequency, for the principal feature of this class of receiver for television reception purposes is that a large degree of amplification at a convenient frequency is made possible.

So we come to consideration of the straight receiver.

The Straight Receiver

Now it is within the capabilities of the amateur to construct straight receivers for use on television frequencies with, up to, four R.F. stages.

Receivers employing this number of stages are not simple, but nevertheless with care it is possible even with limited facilities successfully to construct such an arrangement.

Three stages are much more simple, but there still remain certain difficulties, chief of which is the ever present possibility of instability. A straight receiver that is not inherently stable can have extremely disconcerting traits. Changes of aerial arrangements and slight differences of the components layout or values in the receiver can result in complete unmanageability.

If sufficient gain is possible with two stages only we would at once decide on this number. Unfortunately, however, due to the heavy damping imposed by the valves at ultra high frequencies, the gain per stage is very low.

Actually, without entering into an involved account concerning the difficulties of getting good dynamic resistance for the tuned circuits and other effects, it will here suffice to say that the gain through two stages is likely to be something between forty to sixty times, assuming reasonable care with the construction.

Let us leave this section of receiver design temporarily and consider what can be achieved with post detector amplification. Naturally we are referring to video frequency amplification.

Now a V.F. amplifying stage can be extremely efficient. Quite high gains are easily secured without difficulty. Also, with suitable choice of constants the response between the two extreme limits is linear, and phase shift can be kept within reasonable limits.

It can be said that excluding devices at present restricted to the laboratory, the V.F. amplifying stage is the most efficient for television purposes.

Assuming that we can use two stages what gain may be expected after fixing the permissible upper and lower attenuation and phase shift limits to which it is required we adhere.

These limits are not dealt with here for the question is a rather involved one and is actually further involved because of the small tube that we are to use.

It is sufficient to state that tests were conducted and these limits determined by actual observation of the received picture. A high standard of definition was demanded, indeed the full capabilities of the tube were utilised. In spite of this a gain of over twenty for each stage was easily obtained.

The majority of amateurs are well acquainted with the circuit arrangement for a V.F. stage. Many types exist but in its customary form the V.F. stage is almost identical to the familiar R.C. coupled audio stage. The main difference being the inclusion of a small inductance in series with the valve's anode load resistance, the effect of which is to maintain the response at the high frequencies. Also care with the valve's cathode circuit is required.

With two stages, unless we employ directly coupled circuits, which is undesirable, it will be obvious that by reason of the coupling condenser the D.C. component is lost. If the absence of the D.C. component affected only the quality of the received picture we might tolerate this loss. It can be shown, however, that it is essential we retain the D.C. component in connection with synchronisation for perfect synchronism cannot be obtained when it is absent.

Fortunately by a very simple subterfuge, involving little additional apparatus, we are able to restore it quite accurately. The writer already has referred to the manner in which this may be done and a brief description of the manner of operation has been given.*

Now not only does this ability artificially to restore the D.C. component permit us to use normal capacity coupled V.F. stages, it also simplifies considerably the choice of a synchronising pulse filter. We will later deal briefly with the form this synchronising filter can take.

In the meantime let us recapitulate the arguments set out and see what form of receiver will result with adherence to the reasoning above.

We have seen already that if two R.F. stages will prove sufficient, this section of the receiver will prove simple to construct and operate.

* "Television and Short Wave World" December 1937, p. 728.

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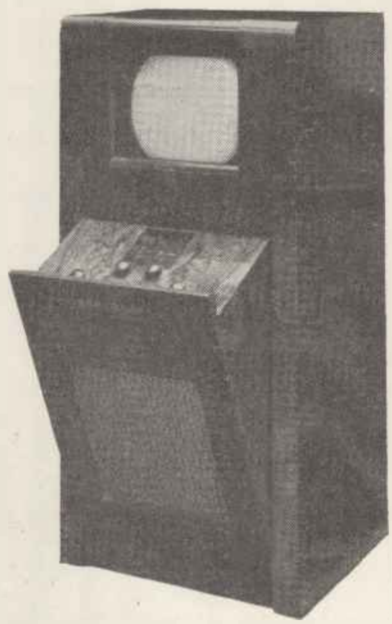

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Another important development is the Baird Multiplier Photo-electric Cell, of which there are various types. The Baird Multiplier is a chain of electron permeable grid stages, and under service conditions very high current gain factors can be obtained. Cathode sensitivity is approximately 30 microamps per lumen. These Multiplier Cells are suitable for all television and sound on film work, together with many industrial applications where high gain, coupled with sensitivity and extremely high signal to noise ratio, is essential.

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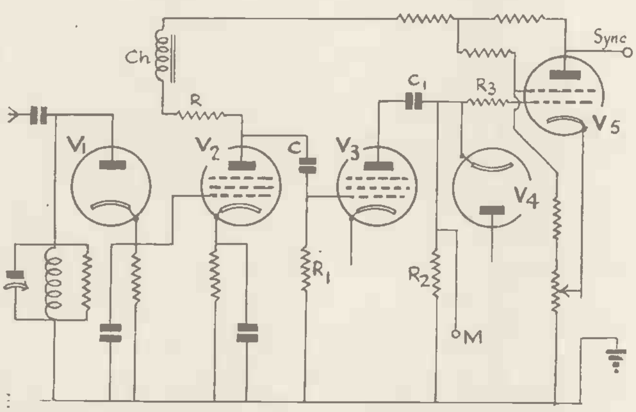
In this connection there are three points to consider: (1) Will the selectivity of two stages be sufficient to exclude the sound carrier. (2) Are we able to secure sufficient post detector amplification to ensure bright pictures. (3) Will the input to the detector valve be high enough to ensure efficient rectification. Speaking practically the answer to all three points is, yes.

Excellent Pictures up to 35 Miles

Using an arrangement consisting of two R.F. stages, diode detector and two V.F. stages excellent pictures are obtainable up to 35 miles.

Doubtless a single V.F. stage will suffice in locations close to the transmitter and we can bear this in mind when designing the chassis so that without radical alteration of the layout a V.F. stage may be omitted.



Skeleton circuit of the vision unit of the small-tube receiver.

The aerial will require to be fairly efficient and it is important that it be accurately constructed to resonate at the wavelength of the vision carrier. It is not difficult to understand why this is so if it is borne in mind that field strengths as high as 1-30 millivolts-metre exist at locations between 10-40 miles radial distance from the transmitter and the overall gain of our receiver is, even conservatively estimated, in the region of 17,000 times.

Simple Power Unit

A straightforward power unit will cater for this receiver. The only usual requirement being efficient smoothing necessitated by the high post detector magnification.

Up to the present then our design comprises a total of eleven valves which is very reasonable, but we have not considered that important feature, separation of the synchronising pulses.

Already we have revealed that the D.C. component is simply restored by means of a diode valve and it only remains to separate the synchronising pulses from the signal.

An excellent way of effecting this is with a screened grid valve adjusted to have a short characteristic with an extremely abrupt cut-off. Such a characteristic is easily secured and regular synchronising pulses of constant amplitude are readily obtained. Moreover the filter effect of such a valve stage may be further augmented by including a high-value resistance in the grid circuit. This is easy to understand if the character of the grid signal is examined.

The modulation content due to the picture is positive and in the absence of negative synchronising pulses grid current will flow, causing attenuation of the applied signal across the grid stopper. This effect, however, is absent for the negative synchronising pulses.

A complete vision receiver has been constructed embodying the features outlined in this article and extensive tests have revealed its suitability for the amateur. Bright pictures having perfect detail are obtainable up to 35 miles and even at greater distances with efficient aerial systems. The construction is straightforward and the operation simple.

Due to the simple design and reduction in the number of valves the cost is very low.

Full constructional details of this complete vision receiver will be given in a series of articles. The first of which will appear in next month's issue of TELEVISION AND SHORT-WAVE WORLD, and will deal with the construction of the vision unit. The diagram shows the arrangement adopted when two stages of V.F. amplification are used. It is pointed out that the diagram is not complete. Certain omissions are made in order to simplify it.

The valve V1 is a diode which rectifies the signal. This diode is directly coupled to the first V.F. valve V2. No coupling condenser is required here as is obvious from a study of the circuit.

The resistance R is the load resistance of the valve V2. The inductance Ch is in series with this load resistance. It has no effect at low frequencies, at high frequencies, however, it maintains the response. There is an optimum value for the circuit's " Q " when the response is maintained substantially linear up to extremely high frequencies and transient distortion is minimal.

The amplified signal is passed to the grid of the second V.F. valve V3 through the coupling condenser C. Due to this condenser the D.C. component is lost. Both the condenser and the resistance R1 require to be carefully chosen if phase shift and attenuation at low frequencies are to be avoided.

The anode circuit of V3 is identical to that of V2. For this reason it is not completed in the diagram. The further amplified signal from V3 is passed to the synchronising pulse filter valve V5, which is adjusted so that it has a short grid axis. The resistance R3 augments the synchronising pulses filter effect by attenuating signals sufficiently positive to cause grid current, i.e., signals with picture content.

The valve V4 is a diode which restores the D.C. component. It performs this function by rectifying the applied signal potential thereby reducing the load proportionately to the increase in signal amplitude.

The resistance R2 serves the multiple purpose of load resistance for the diode valve V4, as the grid leak of V5, and as the C.R. tube's grid return.

Modulation for the C.R. tube is available at the point M of the diagram.

The synchronising pulses available at the anode of V5 are fed through simple selective networks to the time bases.

Scannings and Reflections

THE DON LEE TELEVISION BROADCASTS

THE Don Lee television station, W6XAO, is now operating daily except Sundays and holidays. The evening programmes start at 6.30 p.m. and continue until 7.15 p.m. or later. The daytime programmes work on the following schedule: Mondays, 9 to 10 a.m.; Wednesdays, 11 to 12 a.m.; Saturdays, 2 to 3 p.m. Test transmissions are often made in addition to those scheduled and these are announced at the conclusion of the preceding scheduled transmission.

The visual images are broadcast on a frequency of 45,000 kilocycles (6⅔ metres). The accompanying sound is broadcast on a frequency of 54,300 kilocycles (5½ metres).

A simple line image of constant intensity and an accompanying 1,000-cycle tone are broadcast at the beginning and end of each transmission on the visual and aural transmitters, respectively. This image appears as 38 parallel horizontal bright bars in the field of view.

The image broadcast is 300-line sequentially scanned with a frame repetition frequency of 24 per second. Synchronising pulses are transmitted at the end of each line (7,200 per second) and at the end of each complete image (24 per second). These pulses are of opposite polarity to the image signal variations.

"UP, THE GUNNERS!"

"Up, the Gunners!" is the title of a revue which will be presented early in February. "Up, the Gunners!" will be built around Charles Heslop, one of the star comedians of television. Michael North, one of the famous "Co-Optimists" and a member of the "Television Follies," is now working on the music, and the story is being written by Moore Raymond. "Up, the Gunners!" will be seen on February 3 and 5 in the evening and afternoon programmes.

VISION AT 100 MILES

Up to the present it appears that the greatest distance at which consistent reception is possible is approximately seventy miles. Reports are, however, constantly coming to hand of good pictures at distances in excess of this, as, for example, Norwich, Birmingham (100) and Beccles (110). Usually reception at these distances is only possible at night time.

Mr. W. R. Parkinson, technical director of the Radio Gramophone Development Co., Ltd., Birmingham, has constructed a receiver on which he obtains regularly the transmissions from Alexandra Palace—at Solihull, Warwickshire, 100 miles away.

The height of the aerial above ground is 55 feet and approximately 450 feet above sea-level. Mr. Parkinson has demonstrated the receiver to many Birmingham radio enthusiasts, who vouch for his claim that the signals are received every day and are not an example of "freak" reception.

SUNDAY TELEVISION IN APRIL

It is understood that the first Sunday transmissions from Alexandra Palace are likely to take place early in April. This will be the first step by the B.B.C. towards a general improvement in the service. No time has as yet been decided upon when the transmissions will take place but it is expected that they will be in the late afternoon—that is some time before the ordinary hours of church service in order to conform with the present policy of the B.B.C.

A RIVAL SHOW

The Physical Society's exhibition has a rival this year in the Science Masters' exhibition, which was held at the same time in the same building. It provided a welcome change for those who were disheartened at the cost of some of the elaborate research apparatus and enabled them to see what could be done with bits of string and tins.

All the exhibits were home made and were generously displayed to give science teachers a chance of copying each other's bright ideas.

One impression that was gathered from the exhibition was the meanness of some of our education authorities, if the masters are reduced to making their apparatus in such a crude form as some of the bits and pieces shown. For example, several had optical experiments shown by little lamp boxes made out of cigar box wood or cocoa tins when a commercial firm alongside had a perfectly good optical kit for about £2 10s.

Television is barred from the exhibition and can only sneak in under a heavy disguise, like "Research on the Production of Variations in Light and Shade by Alteration of Bias applied to a Cathode-ray Tube." This may have disappointed some people who will remember the early demonstrations of the Marconi 120-line (or was it 180-line?) system which was shown at the exhibition some years ago. It was then in the nature of pure research and as such was admitted, but the Council of the Physical Society have decided that purely commercial applications are barred, and the exhibits are confined to new instruments and research on specific problems.

AMATEUR CONSTRUCTION

On January 19, Mr. West attended the meeting of the Television Society to talk about his receiver which has been published in this paper. At times it looked as though an argument would develop into super-hets. v. straight.

One of the champions of the straight set is Mr. Parr, of Ediswan, but as his location is practically on top of the Alexandra Palace aerial, his judgment was probably biased by several hundred millivolts at the start. There is a lot to be said for the Murphy scheme of issuing two types of receiver in which the amplification is slightly varied at the expense of the response. For distant customers they recommend the more sensitive type and the falling off in detail is hardly noticeable. In any case no one would object to a slight loss in the finer points of the picture if they were sure of getting reliable

MORE SCANNINGS . . . .

reception at a distance. In the "Murphy News" early in January there was a sarcastic rejoinder to certain remarks which implied that the brightness of their picture is due to the cathode-ray tube having been "pepped up." The reply is "Would the tube be guaranteed for a year if it was overrun?" The operating voltage is certainly within the maker's rating.

"R.U.R."

"R.U.R.," Karel Capek's masterpiece, is to be televised in a forty-minute version which will give an impressionistic rendering of scenes in Rossum's Universal Robot factory. Jan Bussell, who is producing the play for television, will build up the atmosphere of vast mechanism and inhuman machinery by means of quick close-ups and changing camera angles, instead of attempting big scale scenery which might strain the television medium. This method will, it is hoped, prove specially effective in depicting the robot rebellion.

"R.U.R." will be seen in the afternoon and evening programmes on February 8 and 11 respectively.

SOME BAIRD TESTS

That consistent and excellent reception is possible in all the places situated within the normal service area has been proved by the Baird Company, who have carried out tests in the following districts. In every case excellent pictures were received and many of them it will be noted are well beyond the accepted range.

Croydon
Golders Green
Woolwich
Harrow
Edgware
Sanderstead
Eastbourne
Oxford
Margate
Brighton
Wembley
Cheam
Rickmansworth
Charlwood,
Winchmore Hill
Povey Cross
Kingswood,
Southgate
Greenford
Enfield
West Wickham,
Reigate
Wimbledon
Sutton, Surrey
Slough
Hounslow
Luton
Sunninghill,
Esher
Kingston-on-Thames
South Nutfield,
Richmond
Maidstone
Beckenham
Gravesend
Radlett, Herts.
Oxted
Sidcup, Kent
Weybridge
Teddington
Chigwell, Essex
Maidenhead
Pirbright,
Guildford
Windsor Forest
Chesham
Hendon
Romford
West Byfleet
Totteridge
Hampstead
Chiswick
Crystal Palace
Beddington,
Lewisham
Blackheath
Clapham
Coulsdon
Carshalton
Campden Hill
Highgate
East Dulwich
Ware, Herts.
Uxbridge
East Ham
Stratford
Amersham
Mill Hill
Hemel Hempstead
Ealing
Brooklands
Reigate
Rochester
Woking
South Kensington
Honor Oak Park
South Woodford
Thornton Heath
Petts Wood,
Bayswater
Wandsworth
Jordans, Bucks.
South Norwood
Westminster
Tudor Street, E.C.
Welwyn
Bromley, Kent
Anerley
Chipstead
Elizabeth Street.
Putney
Sydenham
Barnes
Enfield
Wanstead

RUSSIAN TELEVISION

Listeners to Radio Luxembourg will probably have heard the television signals that are being transmitted on Sunday evenings from Moscow. These signals are of sufficient intensity to interfere with the Luxembourg programmes, but are not sufficiently strong to be picked up on a vision receiver.

At a rough guess these vision transmissions are of the low-definition 60-line variety. It would be very interesting to know the reason for the continuation of these low-definition transmissions in view of the fact that high-definition transmitters are already in use in Russia.

In the early days of the B.B.C. 30-line transmissions many more people over a much wider area were able to experiment with quite simple apparatus. As cathode-ray tubes and associate equipment is not too easy to obtain in Russia this may be the reason for the continuation of a low-definition system.

ENGLAND-AUSTRALIA ON 5 METRES

It is interesting to note that Don B. Knock, VK2NO, has again been able to transmit ultra-short wave signals to England. Mr. C. Mellanby, of North Wales, who heard VK2NO on 5 metres a few weeks back has been maintaining a schedule to see whether the original performance was freak or could be repeated very often. For the second time he has been able to verify the reception from Australia so that now England-Australia on 5 metres can be taken as an accomplished fact.

BAIRD TELEVISION AT THE B.I.F.

Baird Television will feature a very comprehensive range of television receivers and equipment at this year's British Industries Fair (Olympia Section).

Models T.11 and T.12 will be shown together with Model T.14, representing a very high technical achievement in combined television and radio entertainment for the home. This model T.14 is a completely new receiver.

Television demonstrations will be given daily on the stand by actual radio reception from Alexandra Palace. Each television receiver incorporates a Baird "Cathovisor" cathode-ray tube, which can be supplied separately.

A rack for television and all-wave relay reception in flats will also be shown together with a complete layout of a modern block of flats. Vision and sound are provided on tap for any room required.

Another outstanding development which will be shown is the Baird multiplier photo-electric cell of which there are three types. The Baird multiplier is a chain of electron permeable grid stages and under service conditions a very high gain factor can be obtained. Cathode sensitivity is approximately 30 micro-amps. per lumen. These multiplier cells are suitable for all television and sound-on-film work together with many industrial applications where high gain, coupled with sensitivity and extremely high signal-to-noise ratio is essential.

Television lecture equipment for use in colleges and technical schools is another of the company's activities. Apparatus for this purpose will be shown to all interested visitors. Many other examples of the manufacture of television equipment will be featured.

AMERICAN AMATEURS AND TELEVISION

The R.C.A. Company of America are encouraging to the maximum the amateur in the development of television. They are advertising very

. . . AND MORE REFLECTIONS

extensively in all magazines read by amateurs and experimenters and have produced the tubes and other components required. This is in striking contrast to the policy adopted elsewhere when new components are only available to manufacturers and new developments are kept very secret.

It does seem that if British manufacturers were to modify their policy on R.C.A. lines it would very greatly increase the interest in television in this country and ultimately result in a big increase in receiver sales. In any event this is the ultimate aim of the manufacturers and it seems obvious that the more interest there is the greater will be the possibility of increased television receiver sales.

POOR SHORT-WAVE RECEPTION

Although at the present time amateurs are finding reception conditions on ultra-high frequencies particularly quiet, quite a number of useful contacts can be made owing to the freedom from interference from other stations. It appears from this that when conditions are comparatively bad the average efficient station can make more interesting contacts than when conditions are good.

However, during 1938 it has been ascertained that there will be peak periods for long-distance transmission and reception. for the first half of 1938 these periods come February 8-14, March 7-13, April 2-8, April 30 to May 6, May 26 to June 1, and June 22-28.

TELEVISING THE DERBY

Many unauthorised statements have appeared in the Press to the effect that the British Broadcasting Corporation are to televise the Derby. The B.B.C. wish to make it quite clear that from a technical aspect they hope that a transmission will be quite satisfactory. The local authorities have now been approached and asked to allow space for the mobile equipment vans.

If this request is granted it will then be necessary to apply to the Epsom Grandstand Association for permission to televise the race. The main point, however, is that the transmission is technically possible.

OPERA TRANSMISSIONS

One of the most ambitious efforts of the television producers was a transmission of "Tristan and Isolde" on January 24. This was rather lengthy, but in view of the fact that the leading parts were duplicated it was particularly interesting and to date, proved one of the star transmissions. There were several interesting innovations in operatic scenery. Hunting scenes, specially filmed out of doors, were incorporated in the action and whereas, in the stage versions, the action is confined to the front of a castle, in the television version the actors moved freely through the forest while their parts were sung off-stage.

TRANSMISSIONS FROM PARIS

Transmissions from Eiffel Tower take place daily on week-days from 4.15 to 5.30 p.m. or until 6.30 p.m. on Sundays. The transmissions are not always on the same system for at the present moment the authorities are endeavouring to decide on the best system to use as standard. However, all the transmissions make use of the aerials on top of the Eiffel Tower.

Vision is on 46 mc. and the sound on 42 mc. Although the range is officially 30 miles tests have shown that these transmissions are receivable on the south coast of England.

It is expected that French television will ultimately be on 455 lines with frequency response up to 2.5 mc.

BAIRD TELEVISION PROGRESS

THE eighth ordinary general meeting of Baird Television, Ltd., was held on December 29, 1937.

Sir Harry Greer, D.L. (chairman of the company), presided, and in the course of a long speech said:—I think it proper that I should bring your minds back to the meeting held here last year, when we all genuinely believed that the stage of experimentation had nearly passed, that the era of television had arrived, and that we could safely anticipate a growing sale of home receivers.

We all appreciate that the B.B.C. had very limited resources to draw upon for the purpose of transmissions, and I am not going to quarrel with them. The programmes they have produced they claim to be consistent with the financial resources at their disposal. We are deeply concerned with this, as it cannot be denied that the programmes broadcast up to date, with few exceptions, have not been sufficiently interesting to attract the public and particularly the type of public who are able and eager to provide themselves with home television receivers. The inconvenient hours at which the services are broadcast constitute a further serious drawback.

Television cannot stand still and those responsible for transmissions to the public must be imaginative in their conception and provide what is topically interesting. By that I mean the programmes must arrest interest at the time when the events televised are taking place.

One cannot expect at a time when the bulk of the population is at work any great enthusiasm to be shown for morning and afternoon broadcasts. The interest of the public in television must in the main depend on entertainment and it must be available to them when they have the leisure to enjoy it.

Those who have been entrusted by the Government to deal with these problems must provide a standard of entertainment consistent with public requirements.

When you consider that there are about eight and a half million wireless licences in Great Britain, when television is in full swing and programmes of popular appeal are broadcast, and that at convenient hours, the potentialities of this business can easily be visualised, but it is manifestly unfair, taking into consideration the enormous sums spent by private enterprise to perfect this great are—and a purely British art at that, possessing unlimited possibilities—that it should be cramped and possibly stultified by the parsimony of the Government.

Large Screens in Theatres

There is one development, however, which we have had in hand for some little time which I can mention —for the first time in history tele-

LIGHT-RAY TRACING

AN EXPLANATION OF THE THEORY OF REFRACTION

ALL lens systems depend for their functioning on refraction, which in simple language means the bending of light rays when they pass from one medium to another of a different refractive index. Refraction of light rays is affected by water, glass and other transparent substances.

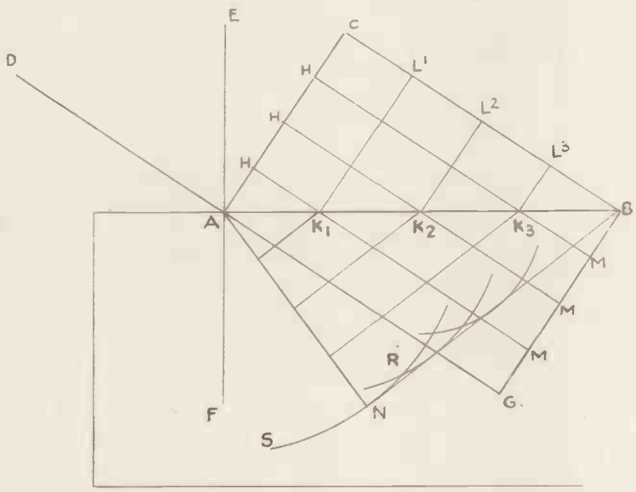


Fig. 1.—Huygens' explanation of refraction by the wave theory of light.

Although the effects of refraction were appreciated in the second century it was not until the seventeenth that explanation of the phenomena was forthcoming when Huygens advanced his wave theory of light. Fig. 1 shows Huygens' explanation of how a wave is refracted or bent in passing from one transparent medium to another across a common plane bounding surface. This explanation is fundamental of that part of the science of optics which is concerned with lenses and prisms.

In the figure the line AB, is the plane surface of a block of glass, into which light is passing from the air above. The wave AC, moving in the direction DG, then falls upon the flat

Huygens' Explanation

surface AB obliquely, so that when the lower end A of the wave considered is just about to enter the glass, the end C has still a distance CB to travel before it reaches the glass, whilst the waves are passing over this distance CB in air, the wave produced at A in glass has travelled at a lower velocity, through a shorter distance, therefore, AN, the direction of which we do not at present know. Obviously at the instant the light-wave reaches B, the disturbance produced at A in glass, as the light-wave was passing through C, must be somewhere on the circle struck from A with a radius AN.

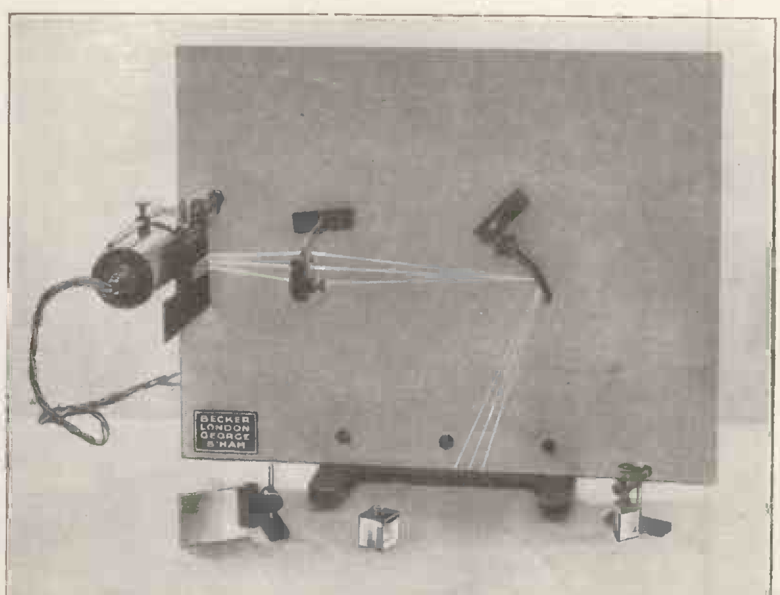
Similarly, it will be seen that when the wave AC has reached the position K_1L_1, the distance away of the wave starting from K_1, in glass will, when the element of the wave at L_1 reaches B, be such that it bears the same ratio, to the length L_1B_1, that the distance AN does to the length CB, and so on for all wavelets which may be looked up as originating at all points between A and B; and, since the line BN is a common tangent to these wavelets, it is the trace of the wave into which the wave AC passes on refraction.

Further, since a ray is a normal to a wave-front, we may say that the ray DA, in air, incident upon the glass surface at A, is bent or refracted into the direction AN in glass.

In the early days of optical manufacture lens systems, such as those required for microscopy and photography, were almost entirely produced by workshop trial-and-error methods, which often led by long and expensive experiments to useless results. By the modern method of designing, however, which is based upon the trigonometrical tracing of rays, workshop trial-and-error work is rendered unnecessary—trial-and-error work is still required, but it is done on paper only.

Ray Tracing Apparatus

Messrs. F. E. Becker & Co., of Hatton Wall, have produced a piece of apparatus which will permit of the easy demonstration of lens systems in a graphical manner. This apparatus is shown by the photograph and it will be seen that the light ray from the source passes through three slits which divide it up into three rays and it is so arranged that the rays pass



The " Nivoc " light-ray tracing apparatus.

along the plane surface of the background and are clearly revealed. In the path of the ray lenses and mirrors can be placed and held in any desired position by magnetic contact with the vertical metal screen. The rays of light show up clearly on the white screen and enable the various phenomena to be observed. Figs. 2 to 10 show a few of the traces that can be obtained by the use of various lenses and prisms. The apparatus is, of course, equally suitable for the demonstration of plane and curved mirrors.

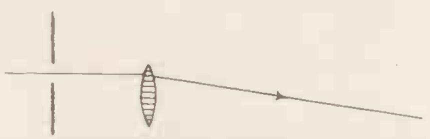


Fig. 2.—Showing the deviation of a ray at different points on the lens surface.

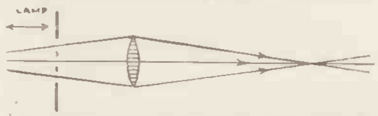


Fig. 3.—Divergent pencils: By sliding the lamp to and fro the variation of the focus with variation of object distance can be seen.

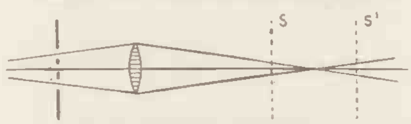


Fig. 4.—Chromatic aberration demonstrated by placing the ground-glass screen at S or S' the coloration of the edges of the images of the slits (outer edges red at S, blue at S') is shown.

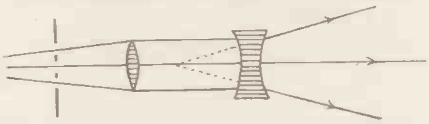


Fig. 5.—Using a convex lens to produce a parallel pencil, this may then be passed through the concave lens, illustrating the divergence produced by such a lens.

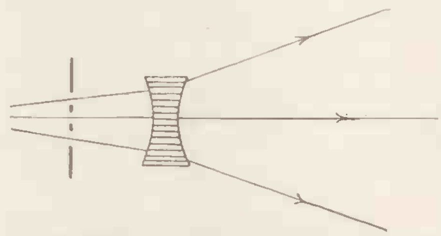


Fig. 6.—With a divergent pencil the still greater divergence due to this lens is shown.

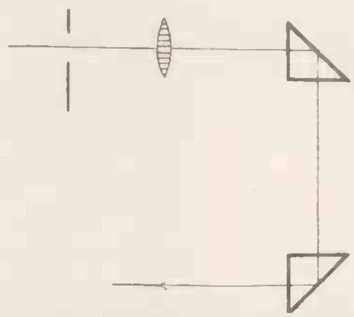


Fig. 7.—Demonstrating the principle of inverting prisms, of prismatic binoculars.

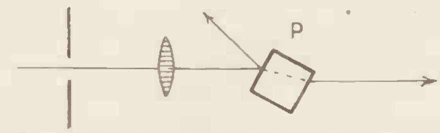


Fig. 8.—Rectangular prism showing lateral displacement of oblique ray and partial reflection from first surface.

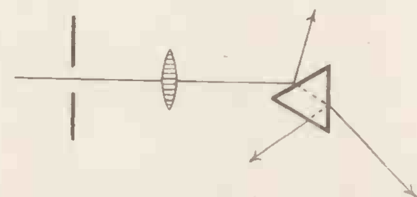


Fig. 9.—Triangular prism: The angle of incidence may be varied by rotating the prism and the angle of minimum deviation thus shown.

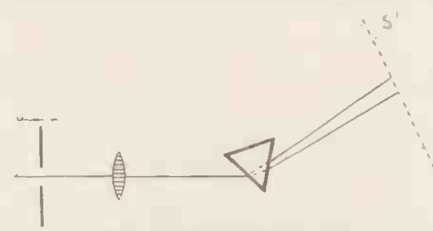


Fig. 10.—By means of a single pencil, prism and ground-glass screen, S', a spectrum is produced on the latter, the relative deviations of red and violet rays being shown.

"BAIRD TELEVISION PROGRESS"

(*Continued from page* 84)

vision was shown in a theatre on a large screen, in a normal way, received from the Alexandra Palace.

The Gaumont Company and their associates are anxious to have Baird installations forthwith in their circuit of cinema theatres so that a wide community may enjoy in full measure and in suitable surroundings the visual transmission of events of the day. Difficulties may be in the way, but it is the obvious duty of the Government, represented by the Post Office and the Television Advisory Committee, to make available the facilities which may be necessary so that every one will be able to share to the full the benefits of this new science.

Mr. Baird's Speech

Mr. Baird: At our last meeting I emphasised the importance of large-screen television to our company, and I am pleased to say that during the past year we have made great advances in this branch of our work. Twelve months ago we gave demonstrations of large-screen high-definition television as part of the regular programme at the Dominion Theatre. While these were of an experimental nature, they were nevertheless the first of their kind ever given and marked an important step forward. Intensive development work was concentrated on large screens, and we have recently demonstrated a greatly improved screen 8 ft. by 6 ft. in size, showing the regular B.B.C. programmes. Arrangements are now being made to install similar screens in a number of public cinemas. I cannot overestimate the importance of this step. The fact that we are first in the field and the doubly important factor of our association with the Gaumont British cinema group may, I think, assure us of a foremost place in this supremely important field.

Television in Colour

Another development to which I would like to refer is television in colour. Within the last year we have succeeded in transmitting large-screen television images by wireless in colour. It is the first time this has been done. While the new process still requires much development, I am convinced that in time colour television will supersede the present black-and-white pictures. I, therefore, consider that the transmission of colour represents an extremely important development.

The Chairman then announced that in recognition of the valuable services of Mr. J. L. Baird to the company and to the art of television the directors had decided that so long as he remained a director of the company he should be designated president of the company.

THE PHYSICAL SOCIETY'S EXHIBITION

The 28th Annual Exhibition of the Physical Society held at the Imperial College of Science closed on Jan. 6. The following survey shows that there is always something of interest to the television engineer and readers are advised not to miss an opportunity of visiting it on future occasions.

TO the research engineer the Physical Society's exhibition is more attractive than the Radio Exhibition, and there is an often expressed regret that it does not last longer in order to provide adequately for both scientific gossip and viewing the exhibits! Judging from the little groups that congregated in the corridors of the Imperial College there is as much pleasure in renewing scientific acquaintances in a calm uncommercial atmosphere as in seeing the advances which have been made in all classes of scientific instruments.

Fig. 1.—Cossor oscillograph with divided beam.

As usual the Exhibition was divided into Trade and Research Sections, the latter consisting of 37 stands in a separate room.

Among the trade section were many old friends of the radio industry—Avo, Dubilier, Ediswan, Cossor, Erie, Marconi-Ekco, Standard Telephones and a host of others.

Cossor

One of the most interesting stands was that of Messrs. Cossor who showed for the first time the complete range of their cathode-ray research equipment.

In addition to standard tube equipments with high vacuum and gas-focused tubes the paraphase D.C. amplifier attracted attention. This consists of two valves direct coupled in paraphase connection, the output being directly connected to the plates of the cathode-ray tube. Owing to the absence of condensers the response curve is flat from zero frequency to over 10 kc. A frequency compensated input potentiometer is provided and the whole unit is self-contained for operation from A.C. mains.

A new type of large tube oscillograph employs a special tube in which the beam is divided, each half being controlled by a separate pair of deflecting plates. It is thus possible to observe two phenomena simultaneously on a common time scale. A view of the instrument is shown in Fig. 1.

Another novelty was an automatic brilliancy control unit for use in recording wave forms in which the speed of the spot varies considerably over the cycle. As is well known, such a trace is difficult to photograph successfully as the film is liable to fogging where the speed is low if the correct exposure for high speed is given. When the unit is used in conjunction with a high vacuum tube the spot is automatically reduced in brilliancy when moving at low speeds and increases in intensity as the writing speed increases. A uniform photographic record is thus obtainable with widely differing writing speeds. Among the other units shown were pressure recorders, ganging oscillators for radio receiver tests, drum cameras for recording, and photo-cell equipment.

Ediswan

Next to the Cossor stand the Edison Swan Co. were showing new types of magnetically focused cathode-ray tubes and new transmitting valves. Details of these will appear in due course.

A noteworthy exhibit was a new high-vacuum high-tension switch for short-circuiting condensers on switching off the H.T. transformer. As many readers have no doubt felt to their cost, the condensers in a high-voltage circuit are liable to retain their charge for an unexpected length of time after the main transformer has been switched off, and this switch will prove a boon to the television experimenter and amateur transmitter alike. It consists of a small glass tube containing a fixed and a sliding contact, the movement of the latter being controlled by a coil surrounding the tube and connected to the rectifier winding or suitable winding on the main transformer. When the set is switched on the coil holds the contacts apart, but on switching off, the upper contact falls and can thus be arranged to discharge the condensers through a resistance of medium value. The switch can also be made to open circuit under certain conditions. The consumption of the solenoid coil is 0.8 amp. at 4 volts and the switch will effectively carry a short circuit peak current of 1.0 amp. at 6,000 volts. The price is 7s. 6d. without coil, a very reasonable figure to pay for protection against shock or burns. (Fig. 2.)

The same firm also showed miniature Mazda valves of a new type fitted with the new British octal base, particulars of which are given elsewhere.

Standard Telephones

In addition to a new small diameter cathode-ray tube (3 in.) this stand contained a variety of new

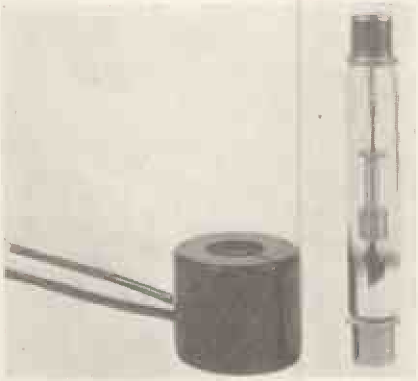


Fig. 2.—The Ediswan new automatic high-tension shorting device is a protection against shock.

measuring apparatus and transmitting valves. The 1,000 watt pentode type VLS412 was shown in addition to the 4069A (100 watt) and 4052A (50 watt).

An exhibit of great interest was the range of new selenium rectifiers which consist of nickel-plated iron discs with a coating of specially treated selenium assembled on a shaft in the usual manner. It is claimed that the high efficiency and

MARCONI-EKCO :: AVO : BALDWIN :: WESTON

relatively high temperature that the selenium will withstand make it unnecessary to use any special means for cooling, and the size and weight of the rectifier unit is less than that of the copper oxide type.

The efficiency varies from 65 per cent. to 85 per cent. according to the method in which it is employed and varies little over the full range of load conditions. The mean d.c. voltage on no load is 90 per cent. of the

Fig. 3.—The Marconi-Ekco direct reading valve voltmeter.

r.m.s. input voltage, and at full load 77 per cent. The following are the sizes available:

.04. .075, .15, .3, .6, 1.2, 2.0 and 5.0 amps. for half-wave working, with double these values for bridge connection. Complete rectifier equipments are also available.

Marconi-Ekco

Next to Standard Telephones the Marconi-Ekco stand displayed a wide range of laboratory and test apparatus which included a new valve voltmeter (Fig. 3). This is a direct reading instrument of high input impedance suitable for frequencies from 20 cycles to 150 mc./sec. The range is from 0.1 volt to 150 volts r.m.s. and the voltage to be measured is rectified by a small diode mounted as a "probe" and connected to the main instrument by a short flexible lead. The accuracy is ± 2 per cent. of full scale reading at all ranges.

The new standard signal generator by the same firm (Type TF430) has an improved performance in the range 50 kc. to 50 mc./sec. The modulation is applied to a r.f. amplifier stage to eliminate frequency modulation, and the output is continuously variable by means of a low impedance attenuator, the input to which is read on a valve voltmeter.

"Avo"

Another firm exhibiting a new oscillator was the Automatic Coil Winder and Equipment Co. Their oscillator was of the inexpensive type covering a band 95 kc./sec. to 35 mc./sec. by means of coils mounted in a rotary turret selector. The calibrated range is further extended into 70 mc. by the use of a second harmonic of the highest frequency band. The output is 1.0 volt max. into a load of 90 ohms and a slide-wire attenuator enables a variable output to be obtained down to 50 mV.

A smaller compact oscillator is also made by this company which fits into a case 6 in. by 4 in. by 3 in. and is ideal for a radio service engineer's tool case.

Baldwin Instrument Co.

The Baldwin Instrument Co.'s resistance bridge was remarkable on account of the exceptionally neat construction of the dial.

As the figure shows (Fig. 4) it is mounted at the edge of the case and the resistance reading appears at the top edge under a hair line on a transparent scale. Three range switches in conjunction with a logarithmic dial enable a range of resistance to be

Fig. 4.—The Baldwin resistance bridge: note the neat dial arrangement.

covered from 0.5 ohm to 0.5 megohm. The batteries are self-contained and the whole instrument is robustly made for workshop use. The price is £9 10s. od.

The apparatus for the teaching of bridge methods which was shown on the same stand will have an appeal to teachers of radio engineering. The units are mounted on a teak baseboard and correspond in position to the arrangement of the theoretical circuit diagram. The complete equipment, including a vibration galvanometer, costs £30.

Weston Electric Instrument Co.

This well-known instrument company have recently joined forces with the British Sangamo Co., of Cambridge Arterial Road, Enfield, and in addition to the usual wide

Fig. 5.—The Weston service analyser.

range of measuring instruments the stand had a display of Sangamo time switches and stop watches for precision meter calibration. An example of stop watch mechanism had a pointer which made a complete revolution of the dial in 3 seconds (£4 10s. od.). The most striking features of the stand were the high resistance multi-range test set and a D.C. microammeter reading 5.0 microamps. for full scale deflection.

The test set, an illustration of which is given by Fig. 5, has the phenomenally high resistance of 20,000 ohms per volt! The ranges covered are 10 mA. to 5 amps. D.C., 2.5 volts to 1,000 volts A.C. and D.C. and resistance measurements from 10 megs. to 100 ohms. In addition the instrument will measure output power and capacities from .002 to 10 mfds. on 50 cycle supply. Truly a remarkable instrument and reasonable in price considering its unique properties (£16 16s. od. to the trade).

Other Exhibits

Space does not permit a detailed description of the many other interesting meters and pieces of apparatus, but mention must be made of the new Metropolitan-Vickers' product

"Tensovic." This is a specially treated and impregnated wood developed by the Met.-Vick. Research Department, which has a remarkably high tensile strength and is sufficiently hard to be turned like metal. Threads can be cut in wooden rods, and the material can be obtained in sheet form. Its electrical properties and moisture resistance are such that it could form a satisfactory and economical substitute for paxolin.

In the upper floor was an exhibit of miniature ball-bearings by International Technical Developments, the smallest of which, a complete ball-race, measured only 2 mm. in diameter! The Cambridge Instrument Co. showed an improved type of mirror galvanometer in which the scale sloped in a pleasing manner to enable readings to be taken when mounted on the bench.

Messrs. Taylor, Taylor and Hobson showed lenses suitable for television picture projection and a super tele-photo lens used by a cine firm in photographing the Coronation.

The Erie Resistor Co. showed the complete range of their resistances and a neat range-changing switch for instruments ("Shallcross type"). For heavy duty the "Berco" resistances are available wound toroidal fashion with resistance values up to 17,000 ohms.

Dubilier

Two very interesting demonstrations were given on the Dubilier stand. One of these was to show by means of capacity measurement the increase in capacity for given physical dimensions of etched foil condensers compared with plain foil condensers. The difference as shown on the scale of the measuring instrument was quite remarkable, the limiting factor being largely heat dissipation. Heat dissipation was the subject of the second demonstration and it was shown how it influences the physical dimensions of electrolytic condensers.

A number of interesting new condenser developments were seen on this stand, which included ceramic condensers of high stability including small tubular types with wire connections for radio and television receivers, and also ceramic tubular condensers with special terminal connections for low-power transmitters.

Moulded metallised mica condensers with electrodes atomically deposited upon the mica dielectric and moulded in special low loss bakelite material were shown. Of particular interest were the "Drilitic" condensers, a special type of electrolytic condenser of greatly reduced physical dimensions for use in circuits where the A.C. ripple component is small. Metallised resistances in ranges of 20 to 10,000 mA. for use up to 500 volts and 2 to 100,000 mA. for use up to 1,000 volts and constant-impedance potentiometers comprising double forms of volume control were also shown.

Research Section

In describing the research exhibits, tribute must first be paid to the technical attendants at the various stands who explained the experiments with tireless enthusiasm to the hundreds of visitors who passed through. Many of the experiments were demonstrated by the actual research worker concerned in their development and there were unique opportunities of obtaining first-hand information on the various problems of research and industry involved.

Passing Ilford's stand and noting an improved form of voltage stabiliser developed in their own laboratories, the visitor was attracted to the exhibit of Mr. Corkling, F.T.S., who demonstrated his method of determining the balance of rotating bodies with a cathode-ray tube. The reaction of the rotating test specimen is conveyed through a piezo-electric pressure device to the plates of a cathode-ray tube. The beam is given a circular movement by the conventional phase-splitting circuit in synchronism with the rotation of the shaft or test specimen and the varying pressure on the bearing appears as an impulse superimposed on the trace of the beam.

Improved Screens

It is known that certain types of cathode-ray tube are liable to glass charges and extraneous effects which cause the "raster" to vary in intensity when the screen of the tube is touched. The Edison Swan Co.'s television laboratory showed how this defect could be overcome by special treatment of the screen material, and also showed an investigation on the "ion burn" in screens (see "T. & S.W.W.," November, 1936, p. 626).

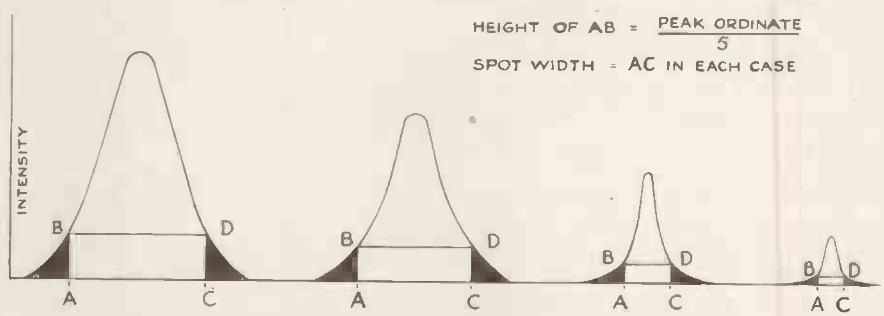


Diagram illustrating G.E.C. research on spot size and tube characteristics.

G.E.C.

The General Electric Co.'s Wembley Research Laboratory showed apparatus connected with almost every branch of light electrical engineering and proved the wide scope of their research organisation. Of particular interest to television engineers was the apparatus for investigating the most acceptable picture characteristics for reproduction. This apparatus, incidentally, was first demonstrated at the Illuminating Engineering Society and subsequently at the Television Society, and the Journal of the societies should be consulted for full details.

A most interesting exhibit was the investigation into the spot size and characteristics of cathode-ray tubes. The effects of spot shape and size are intimately bound up with the picture definition in the television receiver, and the importance of control of both these characteristics by suitable design has long been recognised. The demonstration given showed

ELECTRON PATH EXPERIMENTS

the electron distribution across the cathode-ray tube spot as a trace, approximately Gaussian in character, on the screen of the auxiliary cathode-ray tube.

The change in the shape of the distribution as the focus voltage was varied by turning the focus control was most marked, particularly when on the L.T. side of the control unit the focus voltage was lowered. Generally, the curves flattened and broadened. Visitors who worked the control knob were much impressed by the sharpness of the focus as well as by the critical value of the focus voltage.

A further demonstration of the effect of modulation of the beam showed the phenomenon of spot swelling which is partly associated with the increased beam intensity.

With the spot demonstrated, the ratio of spot width at full and quarter modulation was about 2/1. A full set of actual curves taken on an experimental system supplemented the visible demonstration. The swelling is evident from the diagram.

Another interesting effect which could be observed was the degree of "astigmatism" of the spot, i.e., there was a noticeable difference in the line width as measured across two diameters at right angles. This could be demonstrated simply by scanning the spot across the slit (at right angles to the first) on the face of the Faraday cage.

Neon Tube Protection

Dr. H. M. Barlow's patent device for automatically switching off neon signs in the event of a fault attracted great attention.

As soon as an open-circuit, short-circuit or leak to earth appears in the installation the primary winding of the transformer is automatically switched off. There would appear to be a definite demand for Dr. Barlow's apparatus, and no doubt fire brigades would welcome the fitting of such a safety arrangement.

Post Office, Dollis Hill

The Post Office Research Station at Dollis Hill is another example of the application of a research organisation to a wide field. In addition to the experiments on line telephony, coaxial cables and various measuring devices an exhibit showed how to count the number of stamps in a roll without any trouble by passing them in front of a photo-cell! It is not surprising that the automatic stamp vending machines have seldom been known to yield two stamps for the price of one with Dollis Hill to investigate their performance!

Electron Paths

Two companies have been investigating the paths taken by electrons in valves and cathode-ray tubes—the G.E.C. and the B.T.H. The former had a demonstration in which the electrostatic field between electrodes was simulated by stretching a sheet of rubber and altering its height according to the configuration of the electrode structure. Small ball bearings were then run over the surface and showed the paths of the electrons by their direction.

The British Thomson-Houston exhibit under the direction of Dr. Gabor also used stretched rubber to imitate the potential field, but a beam of light from a thin filament was shone across the rubber through a number of horizontal slits and the shape of the field was shown by the shadows on the rubber.

The same company exhibited their shield-grid thyratron in which the grid current is reduced to a very low value by the introduction of a "screen-grid" between the control grid and the anode. By this means a thyratron rated at 75 amps., 2,000 volts can be controlled direct from a photo-cell without amplification.

Before concluding this brief account of the research section and its activities, special mention must be made of the beautiful patterns produced by the vibration of flat plates in contact with solid carbon dioxide.* Miss Waller, who demonstrated the effect, stated that it was first suggested to her by a Wall's ice cream vendor who noted that his bicycle bell rang when touched with the carbon dioxide "snow" in his carrier. From this suggestion a technique has been developed for producing a range of intricate patterns which can form the basis of designs for the wallpaper industry and embroidery.

A particularly useful trigger circuit was shown by a member of the University College, which will release up to 20 mA. at 200 volts on the application of less than one microampere to the input. Full details of the circuit are shortly being published in the Journal of Scientific Instruments. The exhibit was particularly noteworthy for the ingenuity of its designer in using inverted baking tins as chassis for mounting valves!

* A variation of the well-known 'Chladni figures.'

Book Review

Television Reception Technique, by Paul D. Tyers (Sir Isaac Pitman & Sons, Ltd., price 12s. 6d.). This book is essentially practical and it differs from all others previously published in that it does not deal with the historical side of television nor with any system of reception that is not in commercial use. In fact the entire book is devoted to the design, operation and testing of cathode-ray receivers and coming as it does at a time when many amateurs are building receivers it fills a decided want. The basic principles of electronic television reception are dealt with in the first chapter and the following chapters deal with such matters as aerial systems, signal amplification, cathode tube practice, time base circuits, synchronising circuits, the vision receiver and finally vision receiver faults. This last section is particularly valuable for it is copiously illustrated by photographs of faults that may occur and their remedies are dealt with in the text. The amateur and service man will find this information of particular value for it is given more fully than has hitherto ever been attempted. The book will also be found of value to the ordinary owner of a television receiver who wishes to have some knowledge of its operation.

The "Inventors' and Patentees' Diary" for 1938, issued by Kings Patent Agency, Ltd., of 146a Queen Victoria Street, E.C.4, contains a special section of notes which summarise very clearly the main facts of British patent law and procedure. The notes outline the manner of applying for a patent and the progress of the application before the Patent Office as well as references to the sale of patents, searches, foreign patents, etc. The price is 1s. 9d., post free.

TELEVISION AND SHORT-WAVE WORLD

FINDING AND REMEDYING TELEVISION RECEIVER FAULTS

In this article routine tests easily made in order to locate faults occurring in television receivers particularly as applicable to the "Low Cost Televisor," are dealt with and the necessary steps required to correct them are explained.

WITH a wiring diagram and various drawings to guide him, it is not a difficult matter for an amateur to construct, even elaborate receivers.

If, however, for any reason, the finished receiver fails to function, or if its performance is mediocre compared to what the constructor is justified in expecting from the particular arrangement employed, he finds himself in difficulties.

With luck he may persuade the outfit to function correctly by employing "hit or miss" methods. But it is more preferable to test each circuit and thereby localise the fault or faults.

Routine Testing

Most amateurs are acquainted with the procedure best adopted for routine testing, but in spite of this it has repeatedly been observed that even knowledgeable amateurs tend to forget the excellent rules underlying routine testing when confronted with a "dead" television receiver. They are apt to be side-tracked by reason of their refusal to appreciate that a television receiver conforms identically with normal radio practice.

The complete outfit admittedly is complex but, if isolated for purposes of testing analysis, it is simple to apply normal test procedure to any television receiver.

The following notes particularly refer to the "Low Cost Televisor" constructional details for which have appeared in recent numbers of this journal, though most of the tests herein described are also applicable to the majority of vision receivers. For this reason it is hoped they will prove of value to the rapidly increasing body of amateurs who are finding that television is the most absorbing hobby ever presented.

For purposes of fault location a television receiver is conveniently divided into various units. As most amateurs are familiar with the testing procedure for the sound receiver this is not here dealt with.

The vision signal receiver unit and its power pack can comprise the first unit, the time base and its power pack the second, and finally the C.R. tube and its associated potentials network and high voltage power supply.

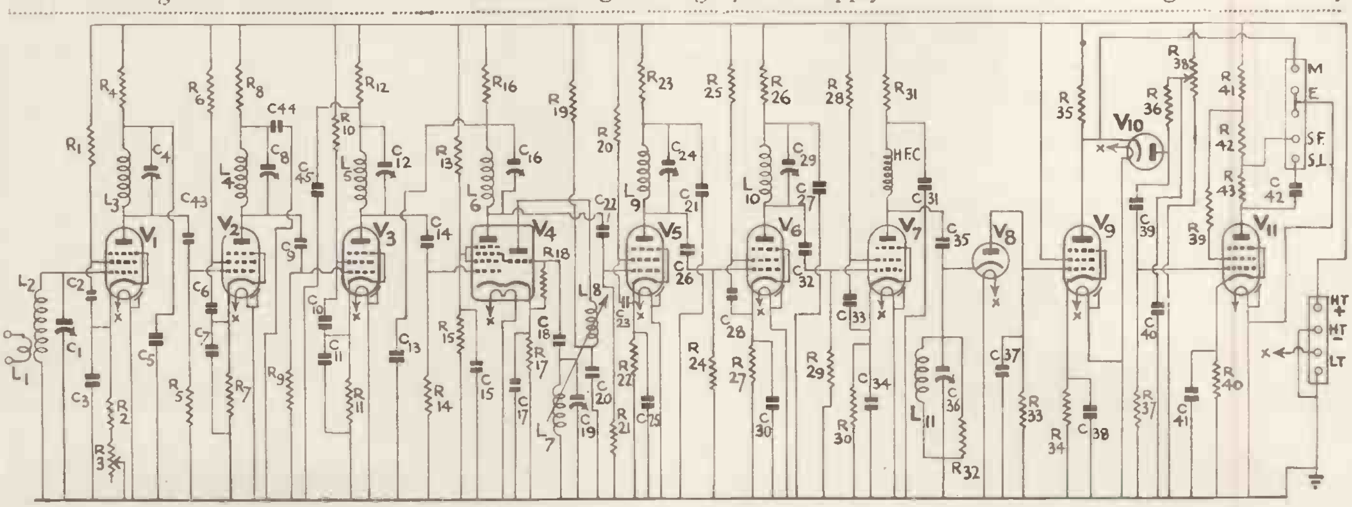


Fig. 1. A typical super-het receiver circuit.

The Vision Unit

Considering first the vision unit. Fig. 1 reproduces the circuit of this. Obviously the first thing will be to satisfy ourselves that the various voltages exist at their respective points and that they are correct.

These tests are so simple that there is little need to describe them in detail. However, it may prove of assistance to disclose that the voltages present at the anodes of the Mazda AC/SP3 valves (leg 2 of the valve holder) should be about 250 volts at the screens (leg 7 of the holder) about 175 volts.

It is well also to check the heater's voltage, particularly for those valves remote from the terminal strip for, due to the comparatively heavy heater current, an excessive voltage drop easily can occur. It should also be borne in mind that as one side of the heaters are connected to chassis it is impossible to earth the centre tap of the heater winding.

An accurate figure for the voltage drop across the cathode resistances of the AC/SP3 valves, i.e., the grid bias for the valves, is not easy to give. Measured in the original receiver this voltage is 2.5 volts. If the measured voltage is sensibly similar to this it may be assumed to be in order.

Frequency Changer

The voltages for the frequency changer valve (X41) should be as follow.

The oscillator anode (leg 1 of the valve holder) approximately 100 volts, the mixer section anode (leg 7) approximately 250 volts, the mixer section screen (leg 3) about 80 volts.

We will later deal with the test for the oscillating condition for this valve.

The magnifier valve V9 should have about 200 volts for the anode, this is when using a 3,500-ohm load resistance and 250 volts for the screen.

The voltage requirements for the synchronising pulse filter phase reversing and pulse amplitude control valve (V11) are not critical, about 40 volts for the anode and 50 volts for the screen may be deemed satisfactory.

It can be remarked at this juncture that a close approximation to the correct setting for the potentiometer R38 may be made by adjusting this so that the voltage present at the slider end of the resistance R36 is similar to that of the measured voltage at the anode of V9. The reason for this will be apparent when we come to a consideration of the operation of the diode valve V10.

Now let us consider the procedure best adopted when for some reason as yet unascertained the receiver either is not functioning at all or if it is, only poorly.

Headphones are connected between the "M" terminal of the output terminal strip and earth. A condenser having a value of approximately 0.1 mfd. will require to be included in series to exclude the D.C. high-tension voltage of the valve V9. If the grid of V9 is now touched, a distinct hum should be heard. If this is the case it may be assumed that this stage is functioning.

The two stages comprised by the valves V8 and V9 are easily jointly checked by applying a small voltage across the coil L11. That obtainable from a flash lamp cell will suit admirably. A very distinct click should be heard in the 'phones.

Having satisfied ourselves that the second detector and the V.F. stage are functioning correctly we may direct our attention to the I.F. stages.

Fortunately these stages are very easily tested. We can simply deal with them stage by stage by attaching an aerial to each preceding valve's anode. It is well to remove the frequency changing valve during these tests.

For each stage signals of some description will be heard. At some times of the day this signal may only be the characteristic noise due to car ignition systems, but it will suffice. A stronger signal should be obtained as the number of stages in circuit is increased.

We will here deal with the possibility of instability occurring. It is pointed out that these remarks as directed to the I.F. stages equally will apply to the R.F. stages. For this reason the cures for instability in those stages will not later be dealt with when we are considering that part of the unit.

Instability

All are well acquainted with the effects of instability but it is not generally realised that in a large number of cases a cure is effected by the drastic action of reducing the gain. It is implied by this statement that it is not sufficiently appreciated that instability is a function of gain. It is possible to stabilise almost any amplifier simply by reducing the gain. This is, however, the incorrect procedure to adopt.

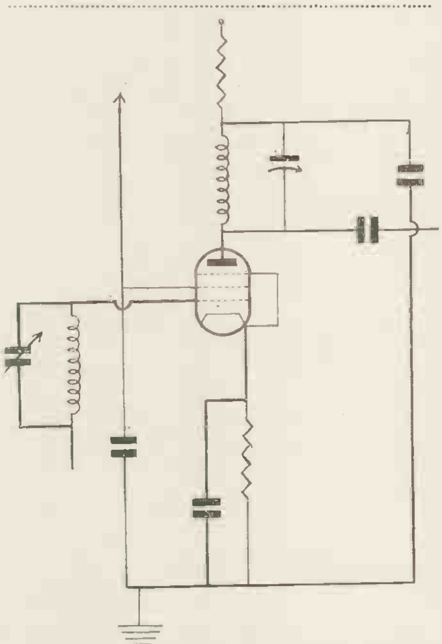


Fig. 2. Diagram explaining the prevention of instability.

It is not easy to give any precise advice in connection with the prevention of instability, but if the following points are observed and are intelligently applied in conjunction with the information conveyed by the diagram Fig. 2, no serious difficulty in securing very stable conditions will be encountered.

The first and probably the most important consideration is that all "hot" leads (these leads are shown by the heavy lines in the diagram) require to be short and well isolated.

All earth connections must be well made and these are all preferably taken to the same earth point.

It should be borne in mind that, in general, instability is due to feedback from the anode circuit to the grid circuit and care is required with the disposition of these circuits' associated leads. This remark equally applies to the multi-stage amplifier when the feedback often is by devious routes conveyed to the earlier valves.

If in spite of care with the layout and wiring, and it is also ascertained that the components are all in order (this will particularly apply to the various decoupling condensers) instability occurs, then the following procedure should enable the cause of the feedback to be located.

By increased the circuit damping or alternatively by increasing the valve's bias, although care must be exercised here as the valves have not var-mu. characteristics, the gain of the amplifier is reduced to a point when instability only just occurs. This slight instability is then prevented by rearranging slightly the components layout.

Having achieved this, the damping is reduced so that the original condition again is engendered. This new instability is then cured as in the previous case. If this procedure is continued the correct stable condition at maximum gain is very soon achieved.

Actually for general cases it is, of course, usual also to increase the decoupling if this is found necessary. However, for the particular receiver under discussion the decoupling included should prove adequate to ensure stability.

Oscillator and Mixer

Let us now proceed to tests of the oscillator and mixer section.

In the first place the coupling for the coils L7 and L8 will require to be close. The windings for these two coils is in the same sense, i.e., both anti-clockwise or both clockwise.

A simple check for oscillatory condition with this stage is conducted as follows: Leads from a sensitive voltmeter are attached to the oscillator section anode and to earth. If the oscillator coil L8 is now shorted across, a slight decrease of voltage should be indicated. If this is the case it may be assumed that the oscillator section is functioning.

(*Continued at foot of next page*).

Our Readers' Views

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

Provincial Enthusiasm

SIR,

Lately we have been told by various manufacturers of television receivers, through the Press, etc., that sales have not come up to expectations. Certainly the limited number of hours that the possessor of a receiver can use it is about one hour per day at present and is a very great obstacle from the sales side.

From our experience and knowledge of nearly six years of the sale of television apparatus, we would strongly point out to you that at no time since the first 30-line television transmissions were in operation has the London public had much interest in reception in comparison with the north country districts.

The largest number of amateurs and experimenters have been from the early days of television and up to the present, anywhere but within 50 miles of London. Counter attractions will probably account partly for this, therefore it follows that the greater number of potential buyers of commercial receivers will be in the northern districts.

Had the wise men who determined that transmissions should first be from London been aware of these facts, and a start from the Midlands been made as a try out, surely a different tale would have been told to-day.

We would estimate from our experience of the industry that approximately 80 per cent. of the reception and experiment of the old days of television was in the Midlands. This is very easily explained, for the greater mechanical and experimental population live and work in the latter part of the country and are always keen to investigate a new science.

There can be no doubt that it must be very disappointing to a vast number of potential buyers of receivers in the Midlands and the North of England that they are outside the range of the transmissions.

H. E. SANDERS & Co.

Regular Long-distance Reception

SIR,

I note in your current issue that Mrs. Westhead, of Brighton, is said to be the most distant regular television viewer.

As a most ardent "Televisionist" I should rather be interested to know whether Dedham or Brighton is the farther? In any case we are the farther from Wimbledon, Pinewood, Elstree and, I suppose, Olympia.

Since early June last we have had an H.M.V. set installed here and have had perfect reception. So good that we have not had to bother the engineers once to come and adjust anything, which. I think, speaks well for them also. We have had all the O.B.'s with wonderful clarity and saw the interruption at the Cenotaph and this week all the thrills of the Circus to the delight of all concerned.

G. F. VALLANCE
(Dedham, Essex).

"Finding and Remedying Receiver Faults."

(Continued from preceding page)

This stage may now be finally checked by attaching an aerial at the anode socket of the valve V3. This valve preferably is removed during this test. Rotation of the oscillator tuning condenser C19 should now reveal that the section of the receiver so far dealt with is operating correctly. Even if the sensitivity of this section of the receiver is insufficient to enable the signals of the Alexandra Palace transmitter to be heard, that the receiver is correctly functioning is indicated by the increase in pick up noise for two settings of the oscillator condenser.

We may now proceed to tests of the R.F. sections. The procedure to adopt here is almost identical to that employed for the I.F. stages.

Each stage is checked in a similar manner. Perhaps greater care is desirable by reason of the higher frequency involved. Also it may be remembered that for certain settings of the trimmer condensers instability may be provoked. In spite of which with the correct adjustments made for an optimum picture the R.F. amplifier is perfectly stable.

This will complete the tests for the actual receiver and there only remains to mention that there usually is an optimum aerial connection, therefore reversal of the aerial feeder can be tried.

(To be concluded.)

A New German Television Handbook.

Fernsehen. Edited by Dr. Fritz Schröter. Published by Julius Springer, Berlin. 248 pp., 228 illustrations and diagrams. Bibliography.

This book contains sections each written by a well-known authority on television and cathode-ray tube technique. The names of Banneitz, Schröter, Müller, von Ardenne and others equally noted are sufficient guarantee of the excellence of the matter contained in the book.

The introductory chapter on the development and present position of German television, by Dr. Banneitz, deals with the usual problems of television engineering and briefly describes modern developments such as the co-axial cable and the Berlin-Leipzig television-telephone.

Dr. Schröter, of the Berlin Technical High School, who has collated the material in the book, has himself contributed a chapter on physical principles underlying television, including a description of light relays, scanning, etc. Dr. Möller, of Fernseh, who is known to readers of TELEVISION AND SHORT-WAVE WORLD for his work on mechanical systems, deals with the problems of mechanical scanning.

A number of illustrations of Fernseh apparatus are shown, and the Scophony system is briefly described together with the Mihaly-Traub.

Dr. Brüche's article on electron optics gives a concise summary of the underlying theory of electron lenses and the various distortions encountered. Dr. Knoll describes the application of the tube to television with excellent illustrations taken from actual photographs. The next chapter is on transmission, by W. Buschbeck, with a section on neutralising transmitters, phase distortion, and a brief account of the new Witzleben transmitter.

Von Ardenne's chapter on receivers embodies the results of his own research on circuits and also describes the scanning circuit. Two useful nomograms in this chapter give the relations of C and f for a given amplitude of scanning potential developed across the condenser.

The concluding section by Dr. Karolus discusses the problems of large projection pictures and gives several examples of mechanical large screen systems

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

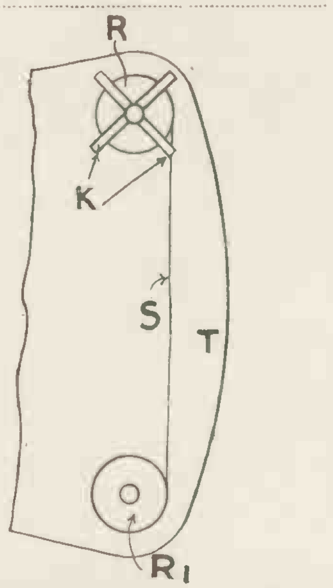
Specially Compiled for this Journal

Patentees : Baird Television, Ltd., and J. L. Baird :: A. M. F. P. de Limelette :: N. V. Phillips, Gloelampen-fabricken :: V. and A. Zeitlene and Kliatchko :: Marconi's Wireless Telegraph Co., Ltd. :: R. J. Kemp and D. J. Fewings :: Baird Television, Ltd. and G. R. Tingley :: Baird Television, Ltd. and V. Jones

Movable Fluorescent Screens

(Patent No. 470,480.)

ONE of the factors which limit the normal life of a cathode-ray tube is the fluorescent screen, which tends to lose some of its original sensitivity after a period of active service; also, it is liable to be accidentally "burnt out" by the electron stream.



Movable fluorescent screen. Patent No. 470,480.

The inventors accordingly propose to replace the ordinary "fixed" screen by a length of suitably-prepared fluorescent material S, which, as shown in the figure is mounted on end rollers R, R1 at the bulb end of the tube T. The active or exposed part of the screen can then be periodically replaced, by rotating the soft-iron end-piece K by means of a magnet from outside the tube, so as to bring a fresh surface into use.—*Baird Television, Ltd.*, and *J. L. Baird.*

Seeing in Dark

(Patent No. 470,524.)

Objects hidden by fog, or by darkness, are made visible by acting upon the infra-red rays which they normally radiate. The rays are collected by a concave mirror and focused through a scanning device on to a photo-electric cell, in the same way as though televising a visible scene.

The modulated current from the cell is then fed to a television receiver in which the obscured object is made visible on the fluorescent screen. The receiver can be located at a considerable distance from the region to be explored, the object being shown in contrast with its immediate surroundings, so that its size and approximate distance can be estimated.—*A. M. F. P. de Limelette.*

Projection Tubes

(Patent No. 472,240.)

The usual fluorescent screen of a cathode-ray television receiver is replaced by a film of highly-refractory metal, such as tungsten or molybdenum, which is made so thin that it becomes incandescent when bombarded by the electron stream from the cathode of the tube. A film of tungsten, for instance, 6 microns thick, will glow at each point of bombardment, and then cool down in a fraction of a second, so that details of each picture can be shown separately and distinctly in varying degrees of incandescence.

In order to impart the necessary velocity to the electrons, the anode potential must be of the order of 10,000 volts or upwards. The size of the screen is only six centimetres square, but the picture reproduced on it is so brilliant that it shows up in satisfactory detail when projected by optical methods on to a viewing screen one metre square. The reduced dimensions of the screen makes it possible to use a cathode-ray tube of much smaller diameter than usual. —*N. V. Phillips' Gloeilampen-fabrieken.*

Electro-optical Systems

(Patent No. 472,539.)

The electrode arrangement in a cathode-ray tube is designed in part to secure a large illumination of the fluorescent screen, and in part to modulate the intensity of the electron stream. In this connection, it is important that the process of modulation should not cause the size of the spot on the screen to vary, because this tends to distort or "blur" the details of the picture.

Accordingly the modulating electrode is deliberately extended beyond the usual accelerating anode, so that the signal voltages are applied, in part, beyond the anode. Here they automatically compensate for the defocusing action which usually tends to produce undesirable blurring. In other words, the size of the spot on the screen is kept constant whether it is producing a high-light or a low-light detail of the picture.—*V. and A. Zeitline*, and *Kliatchko.*

Separate Line and Frame Signals

(Patent No. 472,923.)

As a general rule, both the "line" and "frame" synchronising signals are transmitted as "blacker than black"—that is, they are of greater amplitude than the normal picture signal which represents the blackest point on the picture being televised. Also the frame signals are of longer duration than the line signals, and this fact is used in reception to separ-

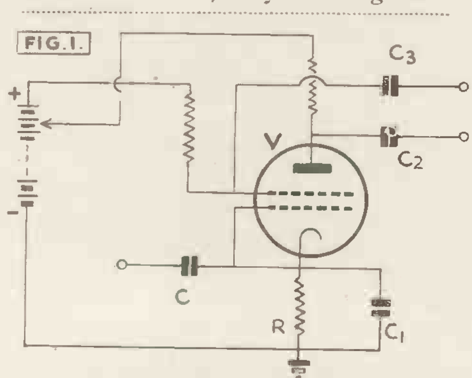


Fig. 1.—Separating line and frame signals. Patent No. 472,923.

ate the two by means of tuned circuits or filters.

As an alternative method of separation, the inventors apply both signals to a screen-grid valve V, Fig. 1, which is so biased that its characteristic curve has the form shown in Fig. 1A. If now the line synchronising impulses are applied as shown at L in Fig. 1A, the output current will fall from the point A to the point C, producing a pulse in one direction.

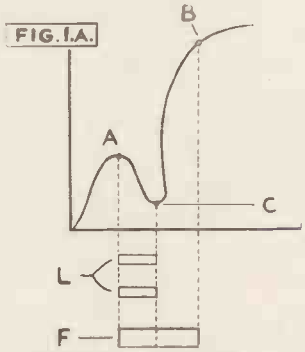


Fig. 1a.—Separating line and frame signals. Patent No. 472,923.

On the other hand the frame impulses applied as shown at F will carry the output from the point A to the point B, giving an effective current pulse in the opposite direction.

The incoming synchronising signals, of different duration, are applied to the screen-grid valve V, Fig. 1, at C and are converted by the circuit C1, R into impulses of different amplitude, as shown at L and F in Fig. 1A. The corresponding output currents, of different polarities, are taken off through a condenser C2, and then separated by means of suitable rectifiers (not shown); or one set can be taken off from C2 and the other from a condenser C3 coupled to the screen grid.—*Marconi's Wireless Telegraph Co., Ltd., R. J. Kemp, and D. J. Fewings*

Time-base Circuits

(Patent No. 472,645.)

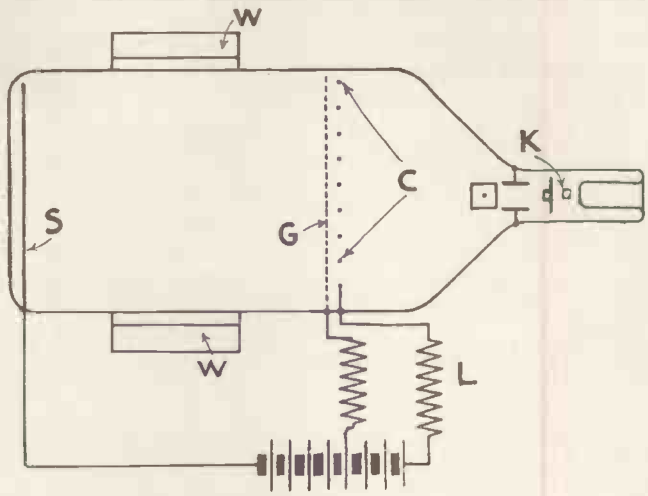
In order to cut down the number of valves used for the synchronising signals in a television receiver, both the " line " and " frame " impulses are handled by one multi-grid valve.

One set of impulses is produced between the anode and the grid nearest to it, whilst the second set occurs between the other two grids.—*Baird Television, Ltd.,* and *G. R. Tingley.*

Cathode-ray Transmitters

(Patent No. 473,006.)

The picture is first projected optically on to a photo-electric screen S, and the electrons set free are focused by an external winding W on to a " storage " grid G which is made up of a " mosaic " of small conducting particles.



Cathode-ray transmitter. Patent No. 473,006.

Charges are accumulated on the grid to form an electric image of the original picture. This is then scanned by the electron stream from the cathode K at the other end of the tube. Between the cathode K and grid G is inserted a " collector " C which consists of a series of wires set sufficiently far apart to let the scanning stream through. The secondary electrons collected from the grid G under the action of the scanning stream are fed to a coil L, where they appear as signal currents.—*Baird Television, Ltd.,* and *V. Jones.*

Summary of Other Television Patents

(Patent No. 472,274.)

Means for synchronising the driving motor used for intermediate-film television.—*Baird Television, Ltd.,* and *G. Dovaston.*

(Patent No. 472,562.)

Stereoscopic system of television in which the right and left eye pictures are interlined and viewed through a screen.—*P. Eisler* and *F. Pevny.*

(Patent No. 473,166.)

Scanning system in which a controlling electric field is so varied that only one picture element is allowed to pass at a time.—*P. M. G. Toulon.*

(Patent No. 473,303.)

Receiver for a two-colour television system in which use is made of a doubly-refracting prism to separate the two " coloured " signals.—*Baird Television, Ltd.;* and *J. L. Baird.*

(Patent No. 473,836.)

Time-base circuit in which the oscillation generator is back-coupled through an iron-cored transformer.—*Ferranti, Ltd.,* and *E. G. O. Anderson.*

(Patent No. 473,907.)

Optical scanning system in which the intensity of the reflected ray is maintained constant.—*Scophony, Ltd.,* and *J. H. Jeffree.*

(Patent No. 473,910.)

Scanning system of the kind in which a rotating reflector co-operates with a number of fixed reflectors.—*E. Traub.*

(Patent No. 473,427.)

Amplifier designed to handle combined picture and sound signals and to give substantially equal amplification to each.—*W. S. Percival.*

(Patent No. 473,464.)

Television system in which an electron image of the picture is first formed on a screen covered with a film of high-resistance photo-conducting material, such as mercury iodide.—*Electrical Research Products, Inc.*

(Patent No. 474,296.)

Electron discharge device for use in television in which the emission from a sensitised " gauze " cathode is controlled by an auxiliary fine-wire grid.—*Baird Television, Ltd., T. M. C. Lance,* and *V. Jones.*

A NEW SYSTEM OF LARGE-SCREEN PROJECTION

By E. P. Rudkin

The writer of this article is E. P. Rudkin, inventor of the system described, and he is desirous of getting into touch with manufacturers with a view to commercial development of the system, which, it is claimed, will provide an intensely bright picture suitable for projection without the use of high voltages.

IN the cathode-ray system of television reception the image formed on the fluorescent screen is produced by the action of a single spot of light varying in intensity with extreme rapidity, and traversing or scanning the viewing screen with high velocity. On account of this high velocity of movement of the light spot and the persistence of vision of the human eye a complete picture appears to be produced, although in reality only a single spot of light is present on the screen at any instant.

The limitations imposed by this system are that the intensity of illumination of the resulting picture can only be made equal to the spot brightness which is in turn determined by the gun or projection voltages employed and the durability of the fluorescent screen in withstanding high electron bombardment. Furthermore, since at any given instant during the frame scan the majority of the surface area of the fluorescent screen is blank the intensity of illumination is further reduced.

Advantages of Picture Retention

It is clear that if means can be found for retaining the picture as it is formed by the scanning spot, very considerable advantages would result, as the screen would be covered by a complete picture instead of a rapidly moving spot of light. In this case flicker is not only reduced or eliminated, but also the effective intensity of illumination of the picture is greatly increased. In fact, with a picture retention system operating in conjunction with suitable means for blackout, the nature of which will be explained later, it can be shown that the intensity of illumination of the resulting picture becomes sufficiently high for large screen projection to be satisfactorily obtained. Moreover, this is achieved with a screen of ordinary fluorescent material, whilst specially high gun or projection voltages are not required.

Various attempts at picture retention have been made, but the writer believes that the main line of development has been confined to storage or condenser systems, the action of which is limited on account of the discharge characteristic of the condensers, after the removal of the initial charging influence. In this article, an entirely new system of picture retention developed by the writer will be described which provides a means of obtaining large screen high intensity pictures. This system enables complete retention of the picture frame to be secured and the mode of operation is such that the retained picture may be destroyed or blacked out to make way for the new pictures of succeeding frames. A special advantage is that the resulting picture is increased in tensity by secondary emission multiplication, in addition to the great increase in effective intensity derived from retention of the picture.

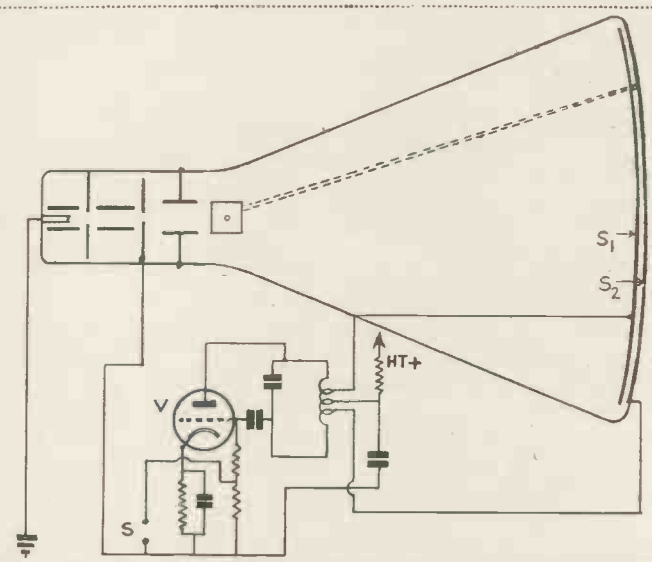


Fig. 1. — Simplest cathode-ray tube arrangement in which picture retention is secured by sustained reciprocal secondary emission.

How the Picture is Retained

In the new system picture retention is secured by sustained reciprocal secondary emission between two parallel secondary emitting surfaces, suitably arranged within the cathode-ray tube. The fundamental action of the system is based on the formation of auxiliary or artificial electron beams, which are produced initially by the main scanning beam. These auxiliary beams are proportional in intensity to the main or exciting beam and are maintained after the removal thereof, by the action of secondary emission. These artificial beams, which are produced in the space between the secondary emitting surfaces, continue to bombard the fluorescent screen after the removal of the main or exciting beam, and so produce retention of the picture.

In operation, the main scanning beam triggers or relays a multiplicity of closed chains of secondary emission into action and these closed chains comprise the artificial beams. Furthermore, these closed chains of secondary emission may be quenched instantaneously to produce blackout of the picture frame either as a whole or in sections.

The simplest type of cathode-ray tube construction employing sustained reciprocal secondary emission, is shown by Fig. 1, and comprises the

PICTURE RETENTION

usual electrodes for producing and projecting an electron beam, together with the X and Y scanning plates, which are supplied with saw tooth oscillations from the frame and line time base generators respectively.

The two secondary emitting surfaces S_1 and S_2, are arranged parallel, and at the far end of the tube. These surfaces are at the same D.C. potential which should preferably be higher than the maximum projection voltage. As will be shown, the second surface S_2 requires only a very low coefficient of secondary emission, and in practice, this surface also conveniently forms the fluorescent screen. The first surface S_1 is in the form of a fine wire mesh or gauze and its high secondary emitting properties are produced by coating with caesium or a similar substance. A source of high frequency oscillations which serves to sustain the secondary emission, is connected across the surfaces S_1 and S_2, and in Fig. 1, comprises a valve oscillator V_1.

In operation, the main beam scans the high secondary emitting surface S_1. The picture signals being applied to the control electrode of the tube, it follows that an electron picture is formed on the first secondary emitting surface, which is reproduced as a light picture on the surface S_2 or the fluorescent screen, this picture being retained by means of secondary emission.

Relative Degrees of Secondary Emission Necessary for Surfaces

Without the incidence of the scanning beam on the surface S_1 the arrangement of the system is such that no secondary electrons exist in the space between it and the surface S_2. This result is secured by critical adjustment of the amplitude of the high-frequency oscillations supplied to the surfaces, and by providing them with critical coefficients of secondary emission. It will be shown for correct working to be secured, that the coefficient of secondary emission possessed by the second surface should be equal to or very slightly less than the reciprocal of that possessed by the first surface.

Considering the electron beam in its position at the commencement of the frame scan, and that at this point the picture be of such intensity that N electrons per second bombard the surface S_1, then NE_1 secondary electrons are produced at this point. The frequency of the externally applied H.F. oscillations is arranged to be sufficiently high so that a complete cycle occurs whilst the main scanning beam traverses only a very small distance, not greater than the cross section of the scanning spot.

Hence assuming a positive half cycle to be applied to the surface S_1 at the instant under consideration, then NE_1 secondary electrons are attracted to this surface, and produce a

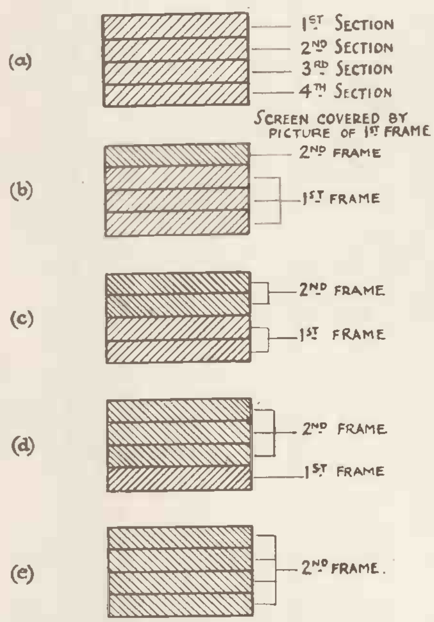


Fig. 2.—Diagrams illustrating the principle of sectional blackout.

spot of light which forms the first element in the picture frame. Simultaneously, NE_1E_2 secondary electrons are produced at this point on the second surface, which are now attracted back to the first surface by a succeeding half cycle of the applied oscillations. By this time the scanning beam has taken up an adjacent position in the first line, and the returning secondary electrons from the first point set up further secondary electrons at the first surface. These are again attracted back to the second surface or fluorescent screen, by a still further half cycle of the applied oscillations.

The number of secondary electrons reaching the second surface at the first point is now $N(E_1)^2E_2$, and it will be clear that this reciprocal secondary emitting process is repeated and maintained. Furthermore, in order for the first element in the picture to be retained at its original intensity, the number of secondary electrons per second arriving at this point on the second surface must be equal to the initial supply provided by the main scanning beam.

Hence $NE_1 = N(E_1)^2E_2$
or $E_1 E_2 = 1$

that is, for complete retention of the picture $E_2 = \frac{1}{E_1}$ the inverse of the secondary coefficient of the first surface.

It is clear that the process occurring for the first picture point is repeated for the succeeding points as the beam traverses the succeeding lines comprising the frame scan, and as a result the picture is fully retained as it is formed. By arranging the coefficient of secondary emission of the second surface to be slightly less than that of the first surface, the picture points can be made to die away slowly. In fact, it is possible to arrange for the period of attenuation of the picture points to be equal to the frame period, when it will be seen that the picture of any given frame dies away just in time for the formation of the succeeding frame, and that this effect occurs progressively from the top of the frame to the bottom, as the beam traverses the frame scan. This is the simplest method of utilising the system since no special blackout means are necessary, and gives considerably increased intensity of picture together with reduced flicker.

Since with this method the retained picture is attenuated during the frame scan, the resulting picture intensity and freedom from flicker is not so great as can be secured by fully retaining the picture in conjunction with suitable means for instantaneous blackout.

Further Considerations of Fundamental Picture Retention Process

Before proceeding to discuss these more advanced methods of blackout, however, the fundamental process of picture retention will be examined in more detail.

For instance it might appear that the secondary emission would tend to equalise over the screen surface,

INSTANTANEOUS BLACK-OUT

with the result that only a blur of light or a blurred reproduction of the original picture would be retained. It can be shown that this effect does not occur, since the secondary emission at any given point takes place under conditions of saturation of the surfaces. That is, the intensity of the artificial or sustained beam produced at any given point through the reciprocal secondary emission process described is determined entirely by the intensity of the main scanning beam when traversing that point and not by the maximum possible degree of secondary emission. Furthermore, it is clearly important to maintain the movement of the secondary electrons in a direction at right angles to the secondary emitting surfaces, since an oblique movement would result in the secondary electrons corresponding to one point in the picture bombarding an adjacent point, where the secondary emission corresponding thereto would become changed in intensity and so produce amplitude distortion with resultant blurring of the picture.

The required movement of the secondary electrons may be readily achieved by arranging the secondary emitting surfaces as close together as possible, and by arranging matters so that the ratio of the projection force at right angles to the cathode, to the dispersion force parallel to the cathode, due to mutual repulsion of the electrons, is as large as possible. A large amplitude of high frequency oscillations applied across the surface leads to this result, although there is a critical value for the oscillation amplitude, since the coefficient of secondary emission obtaining at the surfaces depends on the velocity of the incident electrons, and therefore on the amplitude of the applied oscillations which control the movement thereof.

In this connection, adjustment of the amplitude of these applied oscillations offers a convenient method of obtaining fine adjustment of the degree of secondary emission so that it is possible to secure picture retention when E_2 is only approximately equal to $\frac{1}{E_1}$: this, of course, depending on the primary electron velocity at which E_1 and E_2 are initially measured. Should the applied oscillations be caused to exceed a certain critical value such that E_2 is greater than $\frac{1}{E_1}$ then the picture points no longer retain their original intensity, since the secondary beams build up from their initial to a maximum value, which is equal over the screen surface. In this case, instead of the picture being retained, it would rapidly build up in intensity until the screen becomes illuminated throughout at maximum brightness, and hence this condition of operation should clearly be avoided. The desirability of using an oscillator of stable amplitude is therefore indicated, so that once the correct amplitude has been arrived at for any given pair of surfaces no further adjustment is needed.

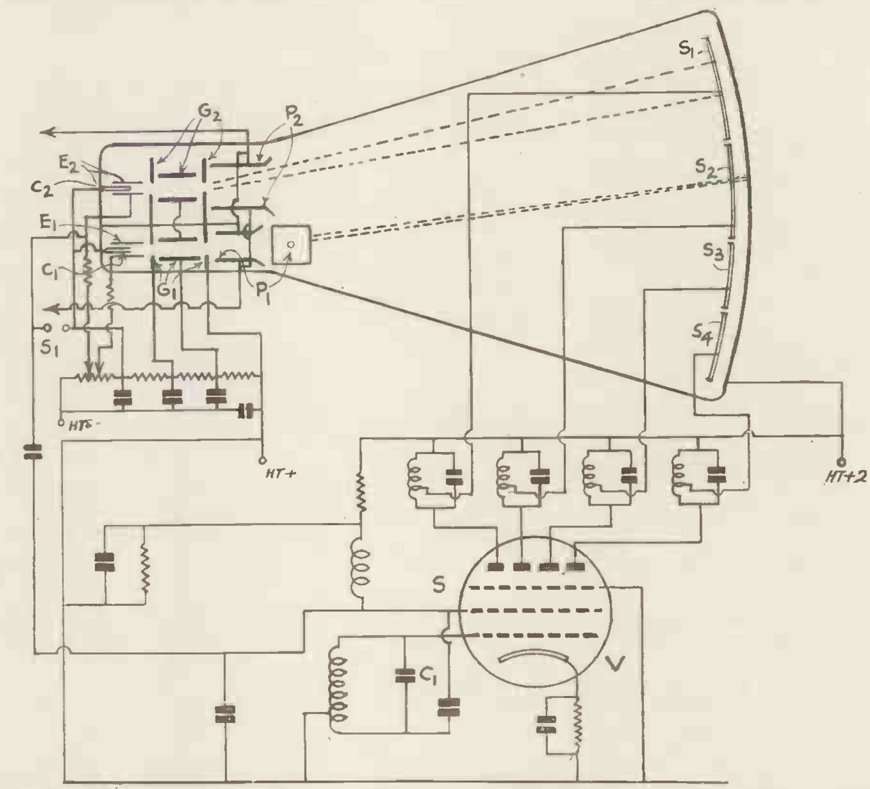


Fig. 3.—A practical cathode-ray tube arrangement employing picture retention by means of sustained reciprocal secondary emission operating in conjunction with sectional blackout.

Value of Applied Frequency

It has been shown that for correct picture retention the secondary electrons should pass forwards and backwards between the surfaces once at least whilst the scanning beam moves a distance not greater than the diameter of the scanning spot. In other words the applied oscillations should execute a complete cycle during this time and in the limiting case where this is equal to the time of movement taken by the scanning beam to traverse a distance equal to the spot diameter it is possible to calculate the lowest permissible value of the applied frequency.

Taking the existing standard of definition at 405 lines 25 frames per sec. the time taken for the scanning beam to traverse the line distance is $\frac{1}{25 \times 405}$ sec. and to traverse the spot distance $\frac{1}{25 \times (405)^2}$ sec. $= 244 \times 10^{-9}$ sec. This represents the period of a complete cycle and corresponds to a frequency of 4.1×10^6 cycles per second, or 4.1 meg./cs.

Instantaneous Blackout

It has been shown that by arranging $E_2 = \frac{1}{E_1}$ that the picture may be

ADVANTAGES OF SECTIONAL BLACK-OUT

fully retained as it is formed. Considering the beam at the end of the frame scan, a complete picture is present on the screen and this must be destroyed or blacked out in readiness for the succeeding frame. This is most readily secured by quenching the applied H.F. oscillations at the end of the frame scan which is in turn achieved by applying the frame synchronising pulses, as negative voltage, to the grid of the generator V in Fig. 1, so that quenching occurs periodically at the end of each succeeding frame.

With this system of frame blackout a picture of increased brilliancy results, which is practically free from flicker, but possesses the disadvantages that the first line in the frame is retained throughout the frame period, whereas the last line is destroyed practically instantaneously. The result of this is that the intensity of illumination decreases progressively towards the bottom of the picture whilst the degree of flicker increases.

This trouble may be overcome by suitably grading the degree of fluorescence of screen surface, or by the use of optical filters, but these methods unfortunately reduce the intensity of illumination of the picture. A further method of securing uniform illumination with frame blackout which does not possess these defects, is to scan succeeding frames in opposite directions, but this method is impracticable at present, as similar modification is required at the transmitter.

A further important and valuable feature of this system of picture retention is that picture brightness is still further increased by the action of secondary emission multiplication at the first surface, which may be as great as ten times. It is readily seen, therefore, that the resulting picture intensity arising from this effect together with retention of the picture is of a sufficiently high order to enable large screen projection to be satisfactorily secured.

It should be observed, however, that where considerable electron multiplication at the first surface is utilised to increase the picture brightness, that a fluorescent screen of increased durability is required, and it is further desirable to raise the potential of both surfaces considerably in excess of the maximum gun potential.

The full advantages of picture retention, however, cannot be fully obtained without specialised systems of blackout, which will now be discussed.

Picture Retention and Sectional Blackout

In order to secure absolute uniformity and maximum intensity of illumination, together with complete absence of flicker, it is necessary to retain each part of the picture without attenuation and for exactly the same time. Since it is clear that any given part of the picture comprising one frame must disappear just in time to make way for the corresponding part in a succeeding frame, the period of retention for all parts of the picture frame should be equal to the frame period after which instantaneous blackout must occur.

This result is most readily achieved by blacking out the picture in sections in the path of the scanning beam. Theoretically, the number of sections should be equal to the number of lines but in practice four sections can be made to give highly satisfactory results with the advantage that less complicated apparatus is necessary to secure blackout.

The operation of sectional blackout is shown diagrammatically in Figs. 2(a), (b), (c), (d) and (e). Considering the case of sectional blackout where four sections are employed the method of operation may be more clearly understood as follows. At the end of the first frame a full picture is retained on the screen (Fig. 2(a)) and at this instant the scanning beam flies back to commence the formation of the second frame. Simultaneously, however, the top quarter of the first frame is blacked out to make way for the top quarter of the second frame, which is now formed by the main scanning beam and is fully retained (Fig. 2b). Immediately on the completion of the formation of this section of the second frame, the second quarter in the first frame is blacked out, when the second quarter of the second frame is formed, and retained (Fig. 2C).

This operation continues until the first frame has been completely blacked out, and the screen is covered by the picture of the second frame (Fig. 2e). The process is repeated for succeeding frames in exactly the same way. The especial advantage of the system is that the maximum blank part of the screen during the frame scan does not exceed a quarter of the picture surface, and as a result the intensity of illumination together with the degree of flicker absence is greatly increased over the existing method of cathode-ray tube picture production where over 99 per cent. of the screen surface is always blank. Further, since each section of the picture is retained for exactly the same time the intensity of illumination from the top to the bottom of the picture is practically uniform. Since, however, the top part of each section is retained for a period equal to a quarter of the frame period longer than the bottom part, the top part of each section will appear somewhat brighter and the effect will be registered as faint striae on the receiving screen. However, the top part of any given section is retained for the full frame period, whereas the bottom part is retained for a full three quarters of this period, so that the effect is only slight and may be readily offset by grading the screen.

The difference in retention time between the top and bottom of each section is reduced as the number of sections is increased, so that by sufficiently increasing the number of sections the formation of striae can be effectively obviated.

Spot Black-out

A further method of causing disappearance of a given frame to make way for a succeeding frame is the use of spot black out. In this case, the picture of the preceding frame is blacked out at a fixed distance in front of the scanning spot, the minimum such distance being determined by the period of afterglow of the fluorescent screen. This method gives perfect results from the points of view of intensity and uniformity of illumination, together with absence of flicker, from the theoretical standpoint. In practice, however, the result is somewhat more difficult to achieve than in the case of sectional blackout.

Some practical applications will be discussed, incorporating the sustained reciprocal secondary emission process of picture retention.

(*Continued on page 126*)

Image frequency Interference on Short Waves

This article describing three methods of eliminating image frequency interference in super-het receivers is by E. S. Darlington of the G.E.C. stations W2XAD and W2XAF Schenectady, New York

SEVERAL complaints have been recently received in Schenectady from listeners to international broadcast station W2XAF regarding the subject of C.W. or telephone radio stations operating on or near the assigned frequency of W2XAF, or 9,530 kilocycles.

Upon investigation, however, it was found that the stations mentioned as the cause of the interference were not operating within this channel assigned internationally for international broadcast stations, namely, from 9,500 to 9,600 kilocycles, but were operating in full accordance with and abiding by the international agreements on frequencies between 10,440 to 10,460 kilocycles, which lie within the 9,600 to 11,000 kilocycle band assigned for commercial fixed services.

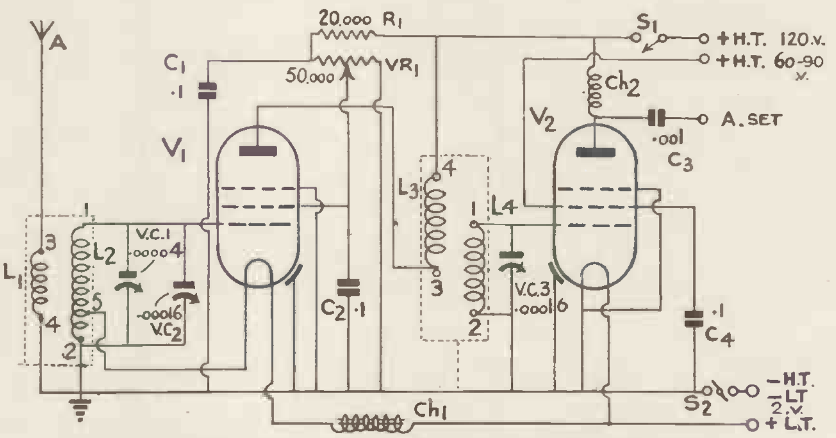
Interference on W2XAF from such stations in a superheterodyne receiver is generally due to the "image response" of the receiver itself. "Image response" may be defined as the increase in response, in such a receiver, at a frequency higher than the oscillator frequency.

In a modern superheterodyne receiver, the intermediate frequency is usually 465 kilocycles, which has been adopted as the general standard. The "image" of a station appears at a point on the dial of twice the intermediate frequency subtracted from the fundamental frequency of the station causing the "image" to appear. For example, twice 465 kilocycles is 930 kilocycles, and this subtracted from 9,530 kilocycles (the fundamental assigned frequency of W2XAF) gives a reading of 8,600 kilocycles on the dial, if the receiver is fairly accurately calibrated and aligned.

There are several ways to reduce such interference in short-wave reception caused by stations operating near the image frequency of the receiver when tuned to a desired signal. If the desired station is operating on 9,530 kilocycles (W2XAF), the oscillator, in most modern receivers, operates at a higher frequency, namely, 9,530 kilocycles plus the intermediate frequency (usually about 460 kilocycles) or 9,990 kilocycles. If the radio-frequency selectivity for frequency conversion is inadequate, an incoming signal above the oscillator frequency at 9,990 kilocycles plus 460 kilocycles, or 10,450 kilocycles may produce an audible beat note with the desired signal.

The image response ratio for a receiver without a radio-frequency amplifier preceding the converter averages about 44 at 10,000 kilocycles. This means that the image signal would have to be four times as strong as the normal desired signal to produce the same audio output from the receiver.

With a radio-frequency amplifier preceding the converter, the image response ratio increases to about 140 at the same frequency in typical all-wave receivers. An additional radio-frequency amplifier would increase the image response ratio to about 5,000. Therefore, one or more radio-frequency stages before the converter adds radio-frequency selectivity to discriminate against a signal at the image frequency. In addition, increased sensitivity also results, and this may be desirable for improving the signal-to-noise ratio in a receiver not having a radio-frequency amplifier.



A pre-amplifier of this kind generally overcomes image interference.

Methods of Reducing Interference from Stations to Image Frequency

First, a tuned pre-selector may be added for the high-frequency band used. This should reduce the interfering signal by a factor of 35. Adding such a device requires an additional tuning control.

Second, by shifting the intermediate frequency about 10 kilocycles either way. This will eliminate interference only from a particular signal, and requires careful alignment of all circuits of the receiver to hold substantially the same scale calibration. This change should be made by a competent serviceman who has the necessary instruments and equipment.

When the intermediate frequency is shifted 10 kilocycles, the image frequency is shifted 20 kilocycles. This should be sufficient except for very high keying of the interfering signal. It is important that the intermediate frequency is not shifted too much, as this may seriously affect the tracking of the radio-frequency and oscillator tuned circuits.

450 Kilocycles

Third, propably the simplest method for reducing image frequency interference is to add a wave trap in the antenna circuit. This will be fairly effective if the intermediate frequency is above 450 kilocycles.

A Suitable Wave Trap

The trap may consist of a good quality midget variable air condenser having a maximum capacitance of 100 micromicrofarads, and an inductance of about 4.5 microhenries. The inductance should be of the "low-loss" type. It has been found that a 1 in. diameter thin bakelite threaded form (12 turns per inch) wound with 14 turns of No. 18 B. and S. bare copper wire to be about right for tuning out interfering signals from 7,000 to 18,000 kilocycles.

Depending upon the antenna used and receiver coil constants, the trap may be connected with the coil and condenser in series from the antenna post to the chassis, or the coil and condenser may be connected in parallel. This shunt circuit is then connected in series with the antenna lead.

A slight decrease in the strength of the desired signal may be found when the trap is tuned to the image, depending upon the losses in the wave trap coil.

Flat-top Beam Antennas

By

John D. Kraus, W8JK.*

The practical data in this article on high-gain small-area beam antennas should be invaluable to British amateurs. The antennas described can also be used for reception.

ALTHOUGH beam antennas possess many advantages, their use is frequently limited by their size. Directional antennas having a high gain require considerable space for their installation, and even beams of moderate gain are often inconveniently large. Accordingly, any beam antenna which is economical of space should be helpful. Through the use of closely spaced elements, the flat-top beam[1] gives an excellent gain for its size and might be called a "space saving" directive antenna.

The flat-top beam is characterised by the use of two closely spaced parallel wires driven with currents 180 degrees out-of-phase. Brown[2] has shown that this is a practical condition to use. At right-angles to the plane of the wires the radiation is very small But in the plane of the wires and at right-angles to them, the radiation is a maximum and is actually more in this direction than from a single wire having the same power input.

Beam Sections

Fig. 1 shows the top view of eight types of flat-top beams. The dimensions given are for fundamental operation in the 14 mc. amateur band. For fundamental operation on 28 mc. the dimensions should be halved. One-eighth wavelength spacing between the elements is used. This separation is not at all critical but is about optimum for the phasing used. All the elements of the antenna are driven, the proper phasing being provided by the cross-overs.

The antennas of Fig. 1 are divided into two groups. Those to the left are centre fed (at F, F) and those to the right are fed at one end. The antenna of Fig. 1C is not strictly centre-fed but rather fed on one side of centre. The type of Fig. 1A is a half-wavelength long and because of its small size is well suited for use as a rotary array. The radiation is a maximum in both directions broadside to the antenna and minimum off the ends. This antenna when operated on its second harmonic (28 mc.) will have approximately the same bi-directional horizontal pattern and somewhat more gain than on 14 mc. The quarter-wave spacing causes but little difference in performance. All the other antennas of Fig. 1 have the bi-directional pattern only on their fundamental frequency. When operated on the second or higher harmonics, the horizontal radiation pattern will have four main lobes.

The antennas of Fig. 1 are arranged from top to bottom in order of increasing number of sections. The types of Fig. 1A and E are single-section (2-element) antennas, B and F are 2-section (4-element) antennas. C and G 3-section, etc. Due to the difference in location of the feed point, the recommended dimensions for the centre and end-fed beams of the same number of sections are different in most cases. The recommended spacing lengthwise between sections is two feet.

Construction

Suggested methods of constructing the antennas are shown in Fig. 2. Long wooden (1 by 1 inch) or bamboo spreaders are used. Since the impedance at the current nodes in a flat-top beam is very high, good insulation is extremely important. The centre cross-over on centre-fed antennas is made by using two insulators (such as 6 inch feeder spreaders) one fastened horizontally at the centre of the wooden spreader and the other vertically half-way to one end. The feeders come up from below and connect to the centre insulator. Where extra sections are used one vertical insulator is placed at the middle of the wooden spreader.

Ordinarily, the centre-fed flat-top is the preferable arrangement since it is a symmetrical system. The 2- and 4-section types of Fig. 1B and D are particularly to be recommended. The end-fed antenna is, however, often a convenience. When using end-fed flat-tops of 3 or 4 sections, it is possible to switch from the flat-top operation with maximum radiation broadside to a condition where the radiation is mostly in the general direction of the ends. This is done by connecting both feeders to-

* Arlington Blvd., Ann Arbor, Michigan.

[1] Small but effective flat-top beam, J. D. Kraus, RADIO, March and June, 1937.

[2] Directional antennas, G. H. Brown, Proc. I.R.E., Jan., 1937.

[3] Rotary flat-top beam antennas, RADIO, Dec., 1937.

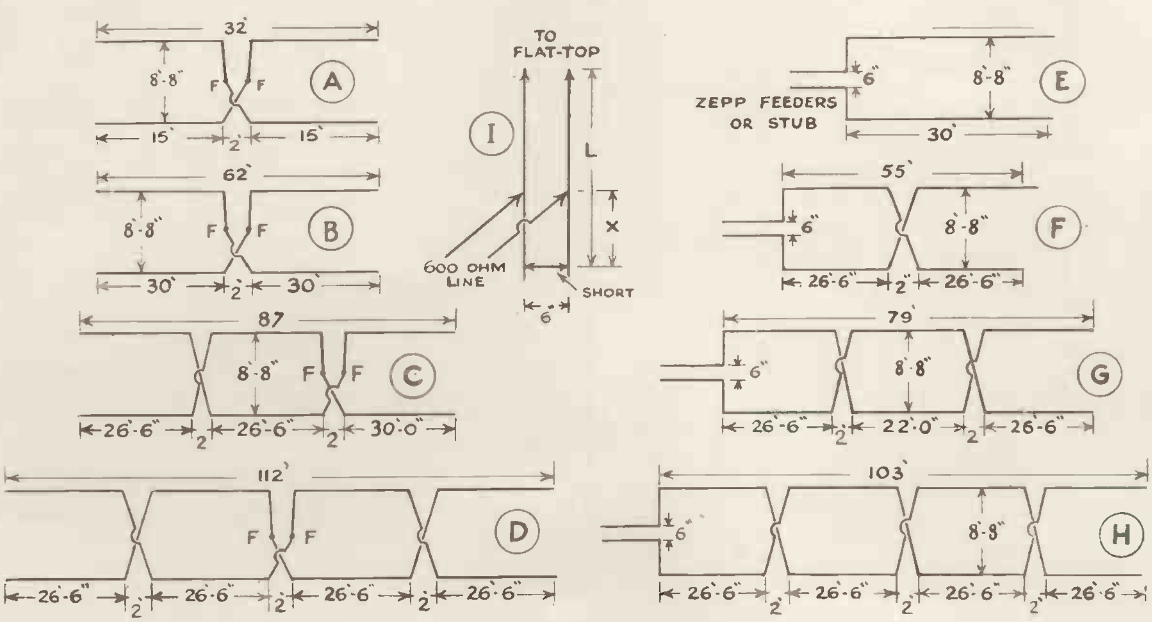


Fig. 1. Eight types of flat-top beam antennas with recommended dimensions for use on 14 Mc. For fundamental operation on 28 Mc. the dimensions should be divided by 2, or for 7 Mc. multiplied by 2. "I" shows the arrangement for a matching stub.

End-fire or Broadside Radiation

gether at the transmitter and operating the array as a long wire antenna.[4]

The flat-top beam antennas are usually used horizontally. If vertical polarisation is desired, however, the 1- and 2-section end-fed types are suited for turning so that the elements are vertical, putting the feeders at the lower end.

Either resonant (Zepp) feeders or a matching stub and transmission line of about 600 ohms can be used to feed the antennas. Although the resonant feed is the easier to adjust since the tuning-up is all done at the station end, the matching stub and 600-ohm line are preferable where the antenna is more than a wavelength or two from the transmitter. Good 6-inch spreader insulators are recommended for use throughout the Zepp feeders or stub and transmission line. With the exception of the antenna in Fig. 1A, all the arrays of Fig. 1 may have either a one-quarter or three-quarters wavelength matching stub. Zepp lines for these antennas can be an odd multiple of a quarter-wave long, using series tuning at the transmitter. Since the type of Fig. 1A is fed near a current loop instead of a current node on 14 mc. the stub for it should be either one-half or one wavelength long. Or resonant feeders of about these lengths can be used, with series tuning at the transmitter.

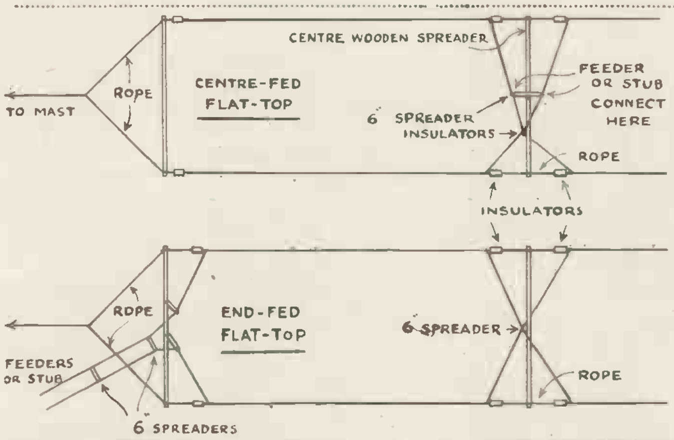


Fig. 2. Top view of flat-top beams showing construction used in both centre and end-fed types. In the centre-fed types the feeders come up from below and hook on at the centre spreader.

When the beams of Fig. 1 are used as multi-band antennas and Zepp feeders are used, series tuning may be employed at the transmitter on 14 mc. and parallel tuning on 28 mc. When changing from 14 to 28 mc. with a matching stub, it is necessary to move both the short and 600-ohm line about 8 feet either up or down the stub.

The dimensions of the antennas are not critical since they are resonated to the frequency used by tuning at the station end with Zepp feeders or by adjusting the short on the stub when a 600-ohm line is employed. Thus, the dimensions of Fig. 1 are suitable for any frequency in the 14 mc. band. It is even possible, where space is limited, to reduce the length of the 2-section type of Fig. 1B by cutting as much as five feet off each wire. The effect of such a change is to push the standing waves farther down the feed line. In the case of a stub, this results in a lowering of the short by a distance about equal to the amount cut from each end of the antenna. The dimensions for the other types should not be shortened in this fashion.

Use a Stub

In tuning-up the antennas using a matching stub, the short in the stub is adjusted up and down for a maximum of current through it while shock exciting the antenna from another nearby antenna or by loosely coupling to it. The 600-ohm line is then connected on and adjusted up and down for a minimum standing wave condition on the 600-ohm line. It is, of course, very important in all cases that the antenna and feeder systems be well insulated from the transmitter high voltage.

Fig. 1I shows the arrangement for a stub for either end or centre feeding a flat-top. Dimensions for a stub to feed the type of Fig. 1B on 14 mc. are L equal approximately to 13 feet for a quarter-wave stub or about 48 feet for a three-quarter wave stub. The distance X, from the short to the 600-ohm line, is about 2 feet on 14 mc. With the 3- and 4-section types the stubs are about the same length, but the distance X is a foot or so more. With the one-section types, X is roughly one-and-a-half feet on 14 mc.

The vertical directivity of a flat-top beam has the effect of pulling down the high angle radiation to lower, more effective angles. Since much of the gain of a flat-top beam comes from vertical directivity, the horizontal coverage is large for the gain obtained. The measured horizontal radiation pattern for a 2-section flat-top beam is shown in Fig. 3. The plot is made in decibels and the curve is adjusted so that the minimum observed signal is taken as 0 db. It is apparent that the signal is very good over an angle of 60 degrees in each direction broadside to the antenna. Even at an angle of as much as 40 degrees off the line of the beam, the signal is about the same as the broadside signal from a horizontal half-wave antenna with the same power input. Beyond 40 degrees the signal drops off rapidly and reaches a very low value at 70 degrees. The signal off the ends is very small. The pattern for a single-section flat-top is similar but is a bit broader and the gain a bit less. Conversely, the 3- and 4-section types have narrower beams and higher gain. When

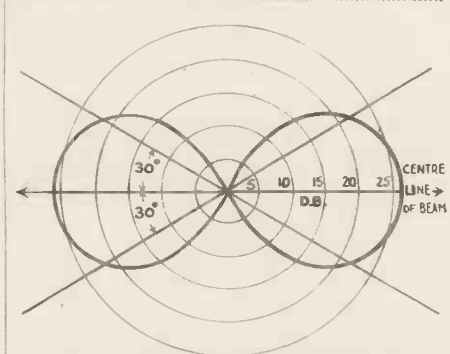


Fig. 3. Measured horizontal radiation pattern of a 2-section flat-top beam, showing broad coverage at right-angles to the antenna and small radiation off the ends. The field strength is plotted in decibels above the minimum observed signal.

compared to the best broadside signal of a half-wave horizontal antenna at the same height and with the same power input, the gain of a single-section flat-top beam is probably about 2½ fold in power, the 2-section about fourfold, and the 4-section about sevenfold. The height above ground is important, particularly for long-distance communication, and a height of three-quarters to one wavelength on 14 mc. is recommended.

Since a flat-top beam gives a substantial gain over a wide horizontal angle, one antenna will give good coverage both transmitting and receiving over a large area. A 2-section flat-top oriented at London, for example, so that the broadside direction is 25 to 30 degrees north of west, would have good coverage of most of North America in one direction and much of Europe, Western Asia, and Eastern Africa in the other direction. Thus, a couple of 2-section flat-top beams properly oriented could cover most directions of interest.

[4] Directivity-switching with a flat-top beam, Sprole and Kraus, RADIO, Jan., 1938.

An X65 5-10 Metre Converter

By Kenneth Jowers

This converter has been designed for use with all-wave receivers that do not tune below 10 metres. It is also suitable for reception of television sound signals in conjunction with a standard broadcast receiver.

COMPARATIVELY few British all-wave receivers tune below 12 metres, while some of those which have a 5-12 metre channel are not always suitable for amateur communication use. This point is not restricted to British built receivers for a very high percentage of the American receivers at a reasonable price terminate at 13 metres. One or two individual models covering a 10-metre band have not proved satisfactory so that generally speaking an all-wave receiver covering from 5 metres upwards is difficult to obtain unless one is prepared to spend between £30 and £40.

This is probably the reason why I have had so many requests for a method of picking up ultra-high frequency signals with an ordinary receiver. Providing a converter is carefully designed there is absolutely no reason why a normal broadcast set should not give as good an account of itself on the ultra-high frequencies as an expensive receiver designed specifically for the purpose.

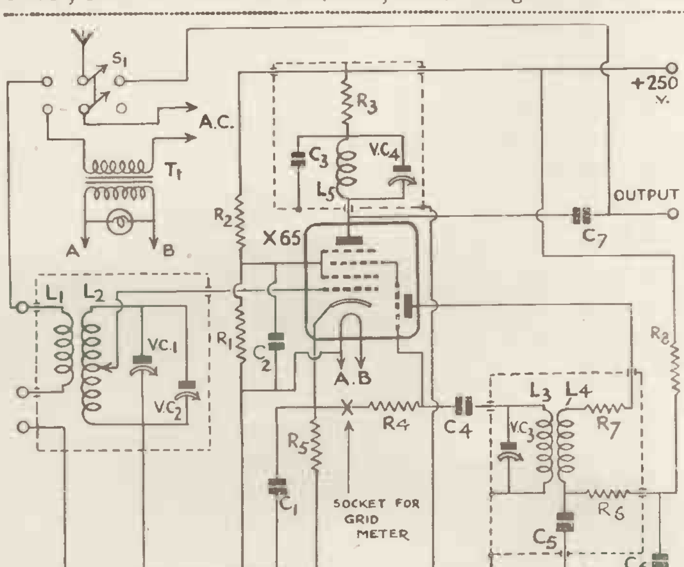
The average autodyne converter is only satisfactory on the higher wavelengths, while very few converters include band-spreading of a degree that will allow for calibration under 10 metres.

Being temporarily in a position of requiring an alternative receiver for 5-10 metre working I have spent considerable time designing a converter that is satisfactory in every respect. It can be added to almost any type of receiver, either all-wave or broadcast, and cannot in any circumstances be considered as a makeshift.

It uses a special triode-hexode frequency changer of a new design by Osram which is ideal, and oscillates freely down to $4\frac{1}{2}$ metres and probably lower in a satisfactory circuit.

A considerable number of frequency changers were tried, and although several others oscillated quite freely, and were apparently quite efficient, final tests showed that the X65 gave the best overall performance despite its low conversion conductance figure. This was accounted for by the fact that the input impedance is so very high, while due to the electrode design the positive grid current effect on short waves is negligible. In the circumstances the actual stage gain is extremely high resulting in a good signal to noise ratio.

The type of dial used is a matter of personal taste. This Indigraph is very popular but the Eddystone 1070 has the advantage of twin ratios. The left hand control is the master switch while the trimmer condenser is on the right.



The resistors and condensers have the following values. R1 and R2 10,000-ohms, R3, 1,000-ohms, R4, 100,000-ohms, R5, 300-ohms, R6 30,000-ohms, R7, 100-ohms, R8, 1,000-ohms. C1, C2, C3, C5 and C6 all .1-mfd., C4 is 2.0001-mfd. and C7 .001-mfd.

Once the type of valve had been selected the next problem was the tuning arrangements. It would have been quite a simple matter to include high capacity band spreading condensers so as to give good frequency coverage, but this would have meant that amateur bands would have been cramped so preventing accurate logging of stations.

However, by obtaining the correct value of inductance and capacity a tuning arrangement was evolved which enabled a wavelength range of almost 6 metres to be covered.

Also by the addition of a small capacity padding condenser there is no difficulty experienced in balancing the coils L_2 and and L_3. It will be noticed that L_2 is centre tapped so as to decrease the damping on the control grid of the X65. This point is most important

Low Noise Level :: High Gain

particularly towards the higher frequencies.

Provision has been made for using a doublet aerial, while by shorting the earthy end of the aerial coil L1 to earth the conventional aerial system can be used.

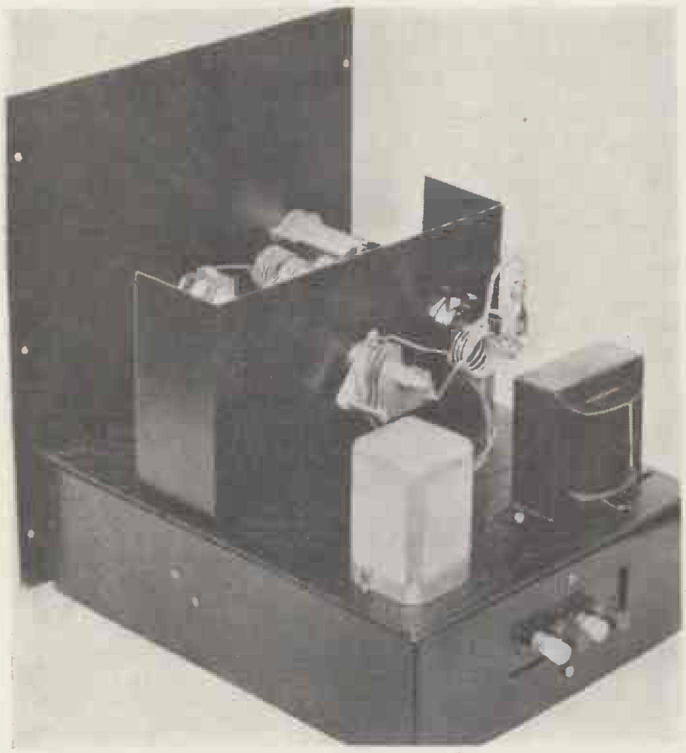
In order to prevent stray wires and accidental pick-up the unit was built on a steel panel and chassis the whole being mounted within a steel box. A special filament transformer designed by Keston was mounted on the chassis so that the unit was virtually self-contained with the exception of one lead to the parent receiver to provide 250 volts.

Resistances R1 and R2 both have a value of 10,000 ohms and should have a rating of 10 watts. This low value of resistance network is essential in order to provide a stable voltage to the screen of the triode-hexode.

Usually the weak point with converters is the matching arrangement between anode circuit and the input to the following receiver. In order to overcome this defect the tuned circuit L5 and VC5 is included. This tuned circuit covers a wave-band of 150 to 200 metres, so that it can be matched up to the aerial circuit in the main receiver. This small improvement over the usual untuned choke arrangement effected a big rise in stage gain.

As the unit only covers one channel the four coils are soldered directly to the rotor and stator plates of the ganged variable condensers. Coils L2 and L3 are wound with 14 gauge tinned copper wire at $\frac{3}{4}$ in. diameter and spaced in such a way that the ends conveniently solder on to the tuning condensers.

Coil L2 is centre tapped and theoretically should have a higher inductance than L3, but in view of the fact that the trimming condenser VC2 is wired in parallel the slight extra capacity of this condenser enables L2 to match L3 despite the fact both coils consist of six turns.



In this view can be seen the aerial circuit with coupling coil. The aerial coil is mounted directly across the tuning condenser with the tapping taken to the grid of the X65.

The aerial coupling coil L1 is made of one m/m rubber covered wire wound in the centre of L2. Only one turn is needed, and this should be adjusted to give the required degree of coupling.

Anode coil L4 is wound in a similar way to L1, but requires two turns which also have to be carefully adjusted to provide sufficient coupling.

The tuned circuit in the anode follows conventional broadcast practice. A 2 in. length of paxolin $1\frac{1}{2}$ in. in diameter is wound with 80 turns of 28 gauge enamelled covered wire. The former is screened by the square can that can be seen in the plan view of the chassis. The tuning condenser VC4 which is of the mica type can either be mounted through the top of the screening can or under the chassis.

If it is known to which frequency the main receiver is to be tuned, then VC4 can be pre-set and left in the required position. On the other hand, should the converter be used with a number of receivers then it would be advisable to mount VC4 in a position where is can easily be adjusted.

When constructors adhere very closely to the original layout. VC1 and VC3, the two tuning condensers are mounted in the centre of the chassis one actually to the front panel and the other to the dividing screen.

VC2 is mounted under the chassis on the right-hand side of the panel and is controlled by the small 1 in. knob. There is no need on this condenser to use a slow motion drive.

If it is intended to use the converter on higher wavelengths than those recommended, then by connecting high-capacity condensers across L2 and L3 a much wider wave range can be covered. Just how these condensers should be mounted can be seen from the sub-chassis illustration.

In order to cut the unit out of circuit without having to remove numerous connecting wires, a simple switching system has been employed. A Bulgin double-pole double-throw toggle switch is mounted towards the rear edge of the chassis. This switch is controlled from the front by means of an Eddystone extension outfit and switches on the mains

Components for AN X65 5-10 METRE CONVERTER

CHASSIS, PANEL AND CABINET.
1—Special cabinet finished crackle black with chassis, panel and screens (A.P.A.).

COILS.
4—Built to specification by constructor.

CONDENSERS, FIXED.
6—.1-mfd. type 4603/S (Dubilier).
1—.0001-mfd. type 690W (Dubilier).
1—.001-mfd. type 690W (Dubilier).

CONDENSERS, VARIABLE.
1—7-mmfd. (Apex).
2—15-mmfd. (Apex).
1—.0005-mfd. type 2093 (Jackson Bros.).

DIALS, SLOW MOTION.
1—Type 1070 (Eddystone).
1—Pointer knob and dial type 1044 (Eddystone).
1—1 in. knob type 1086 (Eddystone).

HOLDERS, VALVE.
1—Octal less terminals (Clix).

RESISTANCES, FIXED.
2—10,000-ohms type R45 (Bulgin).
1—300-ohm type 1-watt (Erie).
1—1,000-ohm type 1-watt (Erie).
2—100,000-ohm type $\frac{1}{2}$-watt (Erie).
1—30,000-ohm type 1-watt (Erie).
1—10,000-ohm type 1-watt (Erie).
1—100-ohm type 1-watt (Erie).

SUNDRIES.
1—Mica pre-set condenser type SW95 (Bulgin).
$\frac{1}{4}$—lb. 14 gauge tin copper wire (Webb's Radio).
1—oz. 20 gauge double-cotton covered wire (Webb's Radio).
6—ins. $\frac{1}{2}$ in. celluloid rod (Webb's Radio).
2—ins. $1\frac{1}{2}$ in. diameter paxolin former (Webb's Radio).
1—Aluminium screening can $2\frac{1}{2}$ by $1\frac{3}{4}$ by $1\frac{3}{4}$ in. (Bulgin).
1—Extension outfit type 1008 (Eddystone).

SWITCH.
1—Rotary D.P.D.T. type S114 (Bulgin).

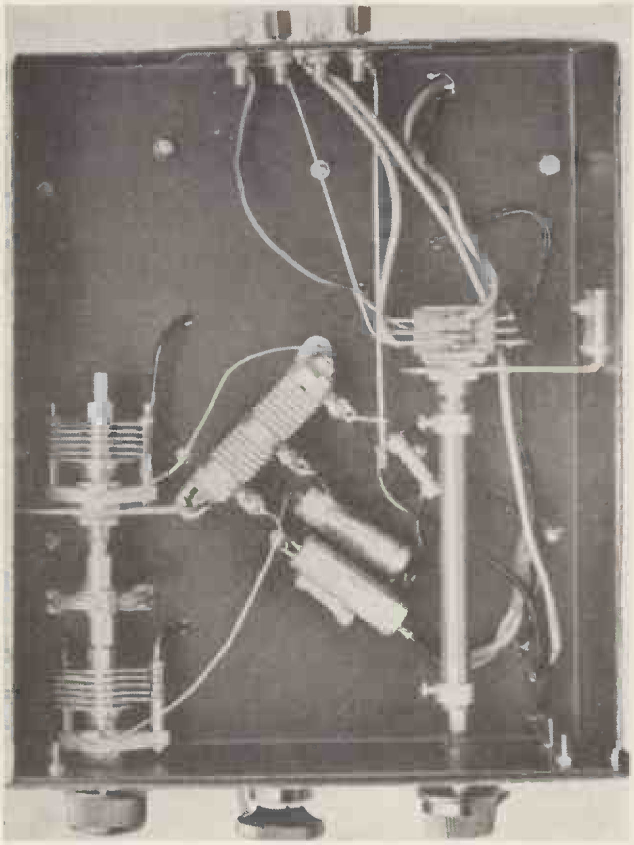
TRANSFORMER, FILAMENT.
1—6.3 volt C.T. .3 A (Keston Manufacturing Co.).

VALVE.
1—X65 triode-hexode (Osram).

How to Cover Higher Wavelengths

to the filament transformer, connects the aerial to the converter or switches off the mains and transfers the aerial to the main receiver.

In this way the converter can be left



If required, band setting condensers can be included as shown. This will enable the converter to cover a considerably higher maximum wavelength. Screen resistors R1 and R2 can either be separate units of 10,000 ohms each or a potentiometer of 20,000 ohms.

permanently connected to the main receiver.

As the X65 is comparatively a new type of valve constructors should memorise the ten connections. An Octal base is fitted as standard and electrodes are taken to the following pins :—No. 2, Heater. No. 3, Anode. No. 4, Screening Grid. No. 5, Oscillator Grid. No. 6, Oscillator Anode. No. 7, Heater. No. 8, Cathode. The control grid taken to the top cap, while pin No. 1 is left blank. The valve has a 6.3 volt heater and takes .3 amperes.

The correct voltage is automatically applied to the anode of the oscillator section by applying 250 volts through 30,000 ohms. The screen voltage that is to pin No. 4, should not exceed 125 volts, while optimum gain is obtained with 100 volts.

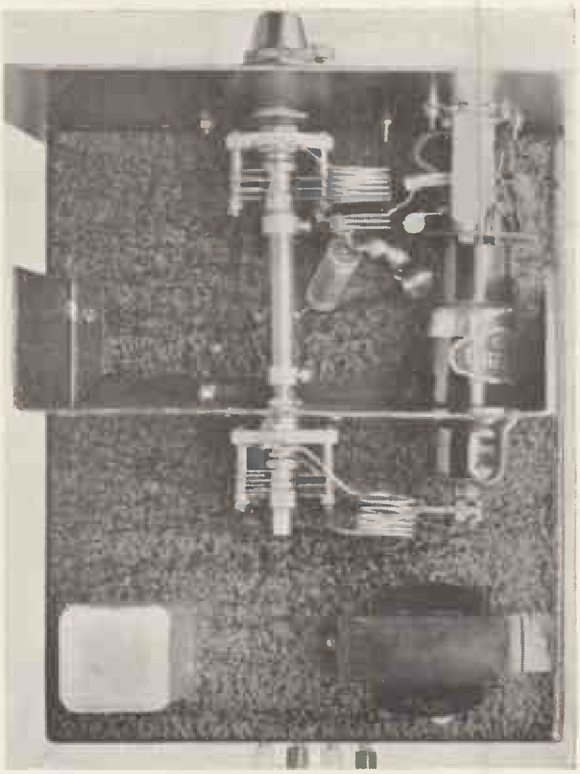
It will be noticed that a heater transformer is not centre-tapped. It was noticed during preliminary tests that with a centre-tapped heater transformer a certain percentage of modulation hum was unavoidable. However, by earthing one side of the heater directly to chassis, this modulation hum was removed

Resistance R7 should be adjusted for optimum grid voltage, but generally speaking 100 ohms will be approximately correct. However, experiments can be made with a view to determining whether this value is correct for the particular valve used.

When the converter is being used in conjunction with a normal broadcast receiver, the receiver should be left tuned to a wavelength of 200 metres with VC4 and L5 also tuned to this wavelength. It will be found, however, that on five metres the unit is much smoother in operation with the parent receiver tuned to 150 metres.

For those who do not wish to construct their own converter a finished instrument wired and tested can be obtained from Messrs. Scott's Sessions. Receivers can also be obtained from stock from Messrs. Webb's Radio, Ltd., who are also arranging for kits of components to be available.

For those interested in normal short-wave broadcasting an alternative model is being prepared to cover approximately 12 to 200 metres, and this will be published in our March issue.



This plan view shows how the top components are arranged and also how the oscillator coil is connected. The square can in the corner of the chassis screens L5.

New Bulgin Midget Transformers

A new range of no less than eleven midget transformers have just been introduced by Messrs. A. F. Bulgin and Co., which are very suitable for inclusion in amateur built receivers and amplifiers.

Transformers are available for direct or shunt feed according to type with either straight or tapped secondaries for push-pull operation. Transmitting amateurs will also be interested in a new input transformer for moving-coil microphones with a ratio of 1-60.

Midget chokes to line up with the new transformers are also ready so that constructors can build small and compact receivers on commercial lines. Full details can be obtained from the makers at Abbey Road, Barking.

A 6-band 10-watt Transmitter

This interesting Harvey transmitter will provide at least 10-watts of carrier on six wavebands, and is crystal controlled on five wavebands. The results of our tests are described in this article.

This Transmitter is quite complete with modulator, microphone transformer and energising current and is supplied with a power-pack in a separate container of similar dimensions.

AT a recent lecture organised by the International Short Wave Club was demonstrated a new commercially built Harvey transmitter which created an enormous amount of interest. In view of this we have obtained full information on this very interesting unit which is designed specifically for amateur and general portable use.

This transmitter, the Harvey UHX-10, is designed to have an input of 20 watts with C.W., M.C.W. and phone on any frequency between 1,500 and 60,000 kc.

Under these conditions it gives a crystal controlled carrier on all bands up to 30 Mc., of at least 10 watts, which can be fully modulated by means of a Class B amplifier fed into the anode circuit of the final valve.

The circuit consists of a 6L6 tritet oscillator driving a 6L6 power amplifier. The tritet oscillator is quite straighforward, being capacity coupled to the grid of the power amplifier. There are three main tuning circuits, these being in the cathode of the oscillator, anode of the oscillator, and anode of the power amplifier.

Plug-in coils are used throughout, although when the circuit is operating on fundamental frequency, the cathode coil is switched out of circuit by means of a special shorting plug supplied.

Coils are supplied to cover all frequencies, but between 40 and 10 metres ceramic coil forms are used, under 10 metres air-spaced coils, and above 40 metres, conventional plug-in formers of the low-loss type. An ingenious modulator consisting of two double-triodes type 6N7 provide more than sufficient audio output fully to modulate the strongest carrier provided by this transmitter. A microphone input transformer is also included, while energising for a carbon type microphone is automatically provided from the power supply circuit.

During our tests we were very surprised to find that the R.F. output was higher on 20, 10 and 5 metres than it was on 40 metres, when running from a 40-metre crystal, while also a minimum of 6 m/a of grid current in the final valve was readily obtainable.

The transmitter is very simple to tune and can be compared with the average three-valve receiving set. Both stages are completely stabilised, and to give some idea of the ease with which the transmitter can be operated, the coils can be changed and the transmitter retuned so that six bands can be covered in less than five minutes.

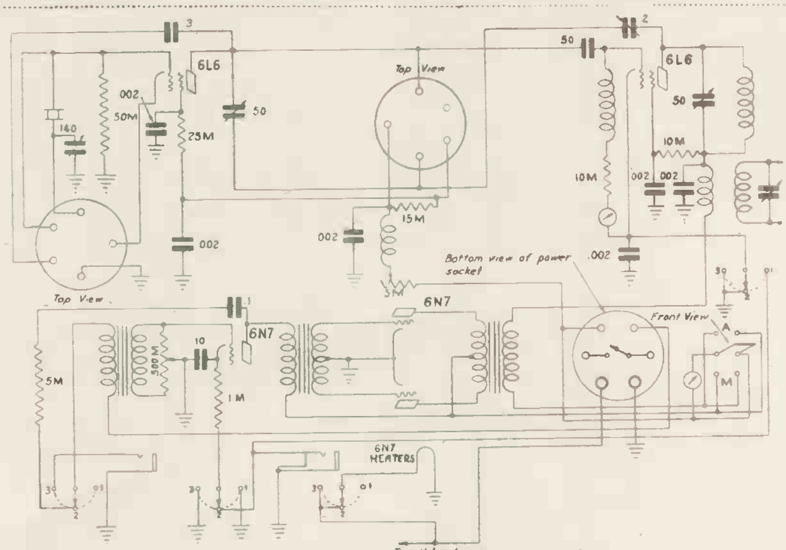
The final tank coil is wound on a ceramic former and is also fitted with a coupling coil with a built-in parallel tuned condenser. In the circumstances, if the correct type of feeder is in use, this feeder can be connected directly to the two stand-off insulators provided. But should it be necessary to use series-tuned, then the two wires from this parallel condenser can be removed quite quickly.

The milliammeter in the final stage can be switched to read P.A. anode current or modulator anode current, while a multi-contact switch enables C.W., M.C.W. or phone to be used at will.

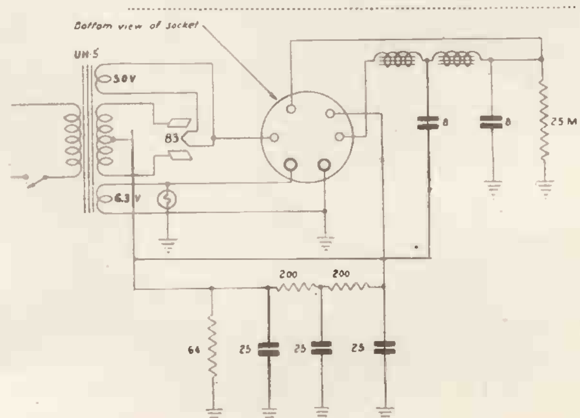
Neutralising holds on all bands with one setting, while four or five 6L6 valves were tried and all of a similar make were neutralised with the original setting.

We consider that it would take less than ten minutes to put this transmitter on the air from the time it was received from the makers, excluding, of course, erecting the aerial.

(*Continued on page 120*)



Two 6L6 valves are used on all wavelengths, one being a tritet crystal oscillator, the second a conventional power amplifier. The complete circuit of the transmitter is shown above.



On the right is the power unit for A.C. operation. A variation, however, is obtainable using an accumulator to drive a rotary converter.

With the Amateurs

By G5ZJ

The 10-metre band and the frequencies used are discussed in this article with some news about new receivers and the radio clubs.

AMATEURS are particularly active in Ireland, both Northern and Irish Free State. The new Honorary Secretary of *R.S.N.I.* is Mr. C. Taylor, 2AOB, of 2 York Crescent, Shore Road, Belfast. At the last meeting the prize winners for the various trophies won during the season were presented. The Leonard Trophy was won by EI2M, the Sevenson Trophy by GI5OY, and the Robinson Trophy by 2AQU. On the committee for this season are such well-known amateurs as GI8MI, GI5OY, GI8GK, GI6TK and GI5HU.

In the Irish Free State some of the active stations are E18B, who is on 10 metres, E15F, who has worked W3 and F on 10 metres, EI7F, EI8G, EI9J, and perhaps the most famous of all, EI2L. EI2L has worked ZS on phone on 28Mc. and is now working duplex telephony on both the 7 and 14 Mc. bands. He has a very elaborate aerial system with a beam array, which probably accounts for his signals being about the most consistent from Europe that are heard in America.

It should be noted by those who intend to make more extensive use of the 28 Mc. band that this channel has been built up into several sections by the United States Government to avoid interference between amateur stations. The following frequencies are being used: 28,000 to 28,500 kcs., C.W. only; 28,500 to 30,000 kc., C.W. and telephony. This leaves 500 kcs. clear of local telephony as far as the U.S. amateurs are concerned. It is hoped that European amateurs will operate between 28,600 and 29,900 kcs., so leaving a small part of a wide band clear of local telephony for local stations still using C.W., and who wish to work long distance.

EI8G, who has been most successful on 10 metres, is using a 33 ft. aerial with which he has worked ZS1AH, VU2FH, and AZS6.

For those who like picking up unusual stations, a transmitter has been installed on the Schooner *Morrisey*, which is on an expedition somewhere off the coast of Labrador. This vessel has the call sign W10XDA and operates on 20 metres.

Another new station which is being regularly received in this country is VE3THE located, at the moment, in British Guiana. This station sponsored by the American Museum of National History for the Perry-Holden party uses an RCA ACT/200 transmitter with an input of 200-watts. It is operated by the American amateur Bill Hungerford, who asks for reports from British listeners and who is also on the look-out for contacts with G Amateurs.

Frequency in use is 14,300 kc. with an alternative of 13,740 Kc when QRM is particularly bad. All reports or cards should be sent to Bill Hungerford, N.B.C. RCA Buildings, Rockefeller Centre, New York City.

The RK 25

During the past few weeks I have been keeping my eye on new receivers and components as they arrive from America, and there seems to be quite a number of items of particular interest to Amateurs. For example I have been looking for a good doubler or sub-amplifier that does not require neutralising and the solution seems to be the RK25 or 23.

One of the most useful valves for high-frequency work is the RK-35. Notice the side contact Grid pin.

These two pentodes are identical with the exception of filament voltage and do provide a very high R.F. output on the higher frequencies.

They are a vast improvement over the 6L6 and RF-T39 as regards neutralising, although the output is not quite so high as from the RKT-39. However, they seem to be the most suitable valves for following a 6L6 crystal oscillator and will drive a final stage when using valves such as a pair of T20's.

The Ediswan Company have produced a new triode suitable for ultra-high frequencies and designated the ESW-20. It has a 7.5. volt heater, a top cap anode connection and is identical in characteristics with the American T20.

I have been testing some early samples of these valves and in push-pull they will provide a comfortable 40 watts of carrier on 5 metres.

The Best Receiver

Many readers have been asked which is the best of the American communication receivers available in this country. This query is very difficult to answer for there are so many points which have to be considered. During 1937 the general impression was that the RME-69 was about the best receiver of its kind, but this is rather queried by the introduction of the New Hallicrafter SX16.

This receiver is rather cheaper than the RME, but includes really excellent band-spreading without any trace of backlash. In addition the receiver is excellently calibrated and covers all wave-bands down to 5 metres.

I have been making some laboratory checks on two of these receivers and many interesting points have come to light.

The I.F. amplifiers are very carefully aligned and particularly selective while the "broad" position is quite symmetrical. With maximum audio gain the total output is slightly over 17 watts into a resistive load.

The signal strenugth meter is accurately calibrated with an interval of 6db between points while of course

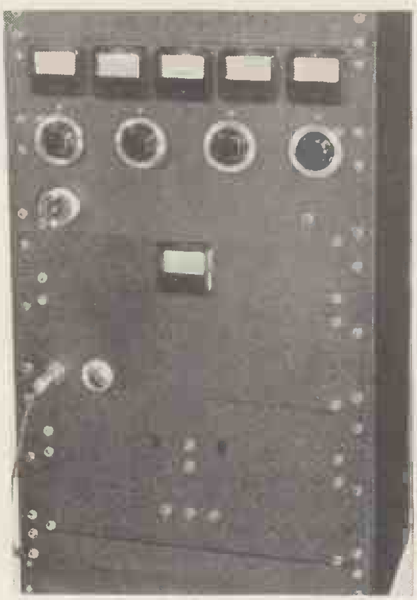
A key plus hummer of this type is very helpful for the beginner for the hummer produces a note similar to the morse code heard on a radio set.

Club News :: An Interesting Transmitter

AVC action is excellent as it is with all Hallicrafters.

As regards efficiency at various frequencies the following figures speak for themselves.

Set on Frequency of -kc. and band spread at Zero.	Frequency in kc.	Lowest C.W. sig. readable (m/V.) QSA. 3.	Sig. to give 6 × noise voltage at 500 cps. beat.	Signal to give 50 milli watts at 400 cps. (m/V.).	S9 sig. (m/V.)
600	599	1.55	5.7	9.1	210
1500	1507	1.0	7.0	4.7	93
2000	2000	0.5	8.7	2.5	47
2500	2507	0.8	1.8	6.0	52
3000	3000	0.7	2.4	5.7	62
4000	3994	1.2	4.0	8.9	74
5000	4481	0.4	2.0	8.2	100
6000	6000	0.5	1.8	13.5	100
7000	6970	0.5	1.9	11.0	160
8000	7790	0.7	2.0	2.7	52
14000	13670	1.0	2.0	6.0	80
28000	27680	9.0	100.0	30.0	87



A good example of transmitter design using a pair of T-55's in push-pull. Smaller valves can of course be used with the same method of construction.

I also hear that a new Super Hallicrafter type SX17 has made its appearance in America and is credited to be the best amateur communication set available. It is complete with two RF. stages, a built-in Lamb noise silencer and of course all the usual refinements.

A new edition of the Call Book has just come to hand from G5KA and this gives a complete list of G8 call signs and appears to be very up-to-date as regards the new DX stations that have been heard just recently.

Australian Transmissions

New transmission times have been scheduled by the three Australian stations for February. VK2ME Sydney on 31.28 metres is radiating from 0600-0800, 1000-1400 and from 1400-1600 all on Sundays only.

VK3ME Melbourne on 31.5 metres operates each week-day from 0900-1200 while VK6ME Perth operating on the same wavelength as Sydney radiates each week-day from 0900-1100 all times G.M.T. Reports on these transmissions are requested and should be sent to Amalgamated Wireless (A/SIA), Ltd., 47 York Street, Sydney, Australia.

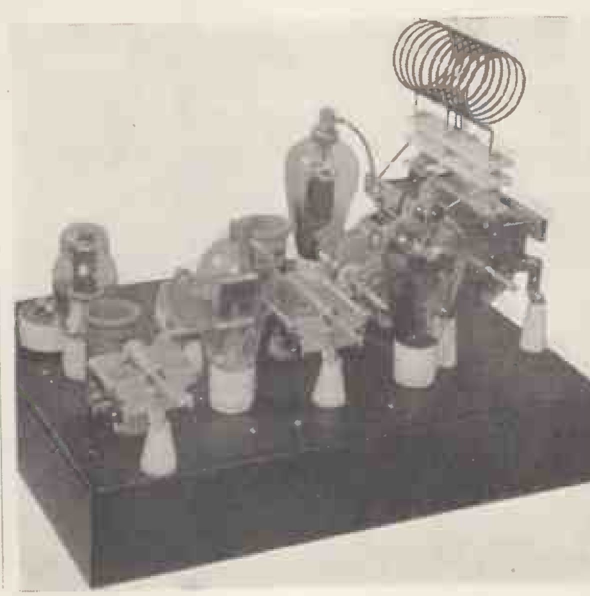
Frank A. Robb, GI6TK, tells me that the city of Belfast radio club is now very active, for A.C. supply has been installed in the club room and the transmitter has been entirely rebuilt. This transmitter is operating CW only on 40 and 20 metres, but telephony will shortly be used. There are no less than 17 operators licenced by the G.P.O., while the total membership is now over 70.

The International Short Wave Club are to hold their fifth annual dinner and dance at Maison Lyons, Shaftesbury Avenue, W.1, on March 5. Tickets are available from the Secretary at 100 Adams Gardens Estate, S.E.16.; price 6s. 6d.

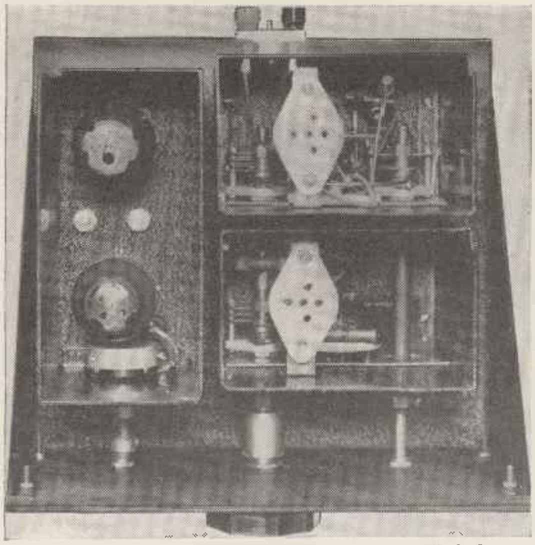
On January 7 was held the annual general meeting of the Eastbourne and District Radio Society when Mr. J. P. Glickman, of "Kersal," Brodrick Road, Hampden Park, was elected honorary secretary to the society. Readers in the Eastbourne district should get in touch with this very live society, for an interesting programme has been arranged for the next few months.

The Maidstone Amateur Radio Society is now affiliated to the R.S.G.B. and the secretary, P. M. S. Hedgeland (2DBA), of 8 Hayle Road, Maidstone, is keen to supply details of the society to all interested in short waves who are in the Maidstone area. The new Clubroom is at 244 Upper Fant Road, Maidstone, Kent.

One of the nicest valves that I have handled just recently is the new RK35, which is a triode having a very low minimum capacity and a top cap anode connection and a side contact grid connection. It is interchangeable with the T20, but is suitable for a maximum voltage of 1,000, so that if a higher input is required, the use of these valves would cause the minimum amount of alteration to the transmitter. With a 1,000 volts H.T. and grid driving power of 6.5 watts the power input is approximately 97 watts with a carrier power of 70 watts. 60 per cent. of this rating is permissible at 2½ metres, while it can also be used for Class B Audio work. The rated anode dissipation is 35 watts.



The entire transmitter suitable for an input of up to 450 watts can be accommodated on this single chassis 17 in. wide.



This illustration quite clearly shows the coil holders taking coils L1, L2, L3 and L4.

Britain's 1-10 Unique

A New Ultra-high Frequency Receiver Covering 1-10 Metres with a Four-valve Super-regenerative Circuit

In our January issue we published the constructional details of Britain's first 1-10 metre receiver designed for constructors. The designers of this receiver E. Van Rhee, Kenneth Jowers and H. R. Adams, G2NO, in this article deal with the construction of the tuning coils.

FROM correspondence received it appears that very few readers are experiencing constructional difficulties with our 1-10 receiver details of which were given in the January issue.

Those who have bought sets of coils from the recommended agents have found the receiver particulary easy to operate and comparatively easy to calibrate. Many constructors, however, have wished to build their own coils, which is a very ticklish job without the necessary data, particularly on the higher frequencies.

As can be seen from the illustrations in this page a five-pin ceramic valve holder is used as a coil socket. Another special ceramic disc fitted with pins is used as a coil mount. The special discs are obtainable from Messrs. A.P.A. after which it is a comparatively simple matter accurately to wind coils required.

In this circuit four coils are needed to cover each waveband, but two or these coils are merely simple primaries. To cover all wavelengths from one metre up to 11 metres a set of 12 coils are required. Coil 1 is the aerial coil for the highest frequencies consisting of a two turn primary and a three turn secondary, the latter being centre tapped. The primary is wound with 28 gauge double silk covered wire and the secondary number 20 gauge double silk covered wire. The coil diameter is $\frac{1}{8}$ in. with the primary wound in between the turns of the secondary.

Coil 1A is the grid coil and the primary L3 consists of two turns $\frac{1}{2}$ in. diameter with the secondary of 4 turns centre tapped. In series with the centre tap is HFC2 an additional choke required on this channel which is wound to cover a space of $\frac{5}{8}$ in. with 28-gauge wire and a diameter of 3/16 in.

The second coil in the range type 2A is a $\frac{1}{4}$ in. diameter with a two-turn primary and a four turn secondary which is centre tapped. For an inter-valve coil 2B which also has a $\frac{1}{4}$ in. diameter coil is made up of two primary turns and four secondary turns. The secondary has connected to it an HF choke of the same dimensions as the choke used with the coil type 1A.

Coil 3A has one primary turn and $2\frac{1}{2}$ secondary turns which are centre tapped, both coils $\frac{1}{2}$ in. diameter. On coil 3B there are two primary turns and $2\frac{1}{2}$ secondary turns. An HF choke as previously made is mounted on the coil base and connected directly to the anode side of the coil.

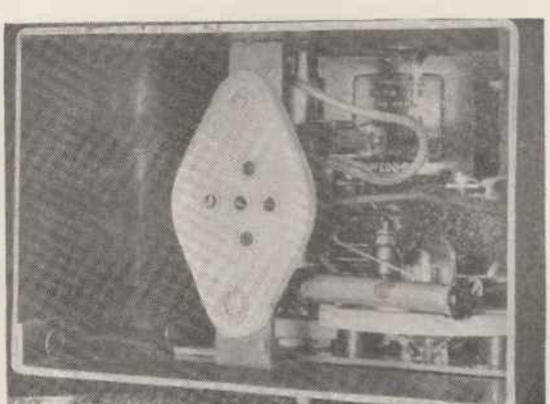
Next comes coil 4A which has one primary turn and four secondary turns both of $\frac{1}{2}$ in. diameter. Coil 4B has two primary turns, five secondary turns with a tapping point one turn from the anode end.

The next coil is rather larger and 5A has two primary turns and 6.5 secondary turns of $\frac{1}{2}$ in. diameter with the secondary tapped one turn from the anode end. The grid coil for this range, No. 5B, has four primary turns and seven secondary turns both of $\frac{1}{2}$ in. diameter, and with the secondary tapped one turn from the anode end.

Coil 6A is also $\frac{1}{2}$ in. diameter with three primary turns and eleven secondary turns, the tapping being four turns from the anode end. On coil 6B there are five primary turns, fourteen secondary turns, the tapping points being three turns from the anode end.

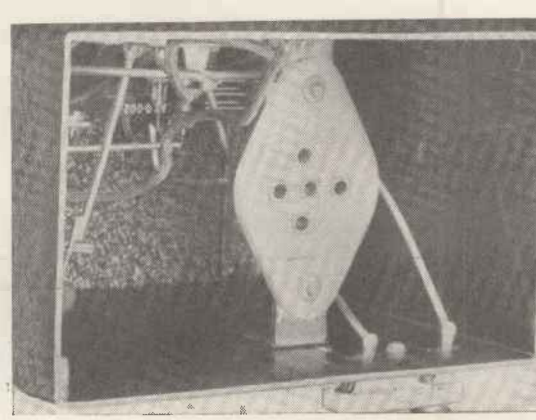
All primary coils are wound with 28 gauge wire with all secondary turns of 22 gauge wire all D.S.C. The high-frequency choke where required is wound with 28 gauge enamelled covered wire.

In view of the high-frequencies covered by this receiver it is absolutely essential that the coils be rigid and that the coupling between primary and



Left: In this compartment is the super regenerative detector using an acorn triode.

Right: This shows the RF section with the coil holder for L1 and L2 and the leads from a doublet aerial.



Britain's 1-10 Unique

secondary cannot vary. For this reason it is absolutely essential that the turns be kept in position by means of coil rope or amyl acetate which can be obtained in small quantities from chemists.

Constructors will appreciate that it is almost impossible accurately to give the exact frequencies covered by these coils, but in the original receiver 12 coils cover the following frequencies.

Series 1, 1.06-1.70 metres. Series 2, 1.6-2.4 metres. Series 3, 2.2-3.3 metres. Series 4, 3.1-5.6 metres. Series 5, 4.8-7.5 metres. Series 6, 7-10.9 metres. These wavelengths can be adjusted quite easily to suit individual receivers, and those who have not an accurate frequency metre can very soon construct one by means of Lecher wires previously calibrated from a self-excited oscillator.

We have previously mentioned that the wiring in both the HF and detector stages must be kept as short as possible. Several constructors have completely built their own receivers and from those which we have so far seen are allowing far too wide a gap between components. Endeavour if possible to inter-connect components without any additional wiring, for example the soldering tag on the tuning condenser can be soldered directly to the appropriate pin on the coil base. No resisters or condensers need be connected with additional wiring other than that supplied with components.

We must also stress that you do not in any circumstances solder directly to the contact on the acorn valves, in fact it is advisable to remove the valve from the socket when soldering to the connection from the valve holder, otherwise considerable amount of heat can be transmitted to the valve itself, which is likely to cause damage.

There is absolutely no advantage to be gained by increasing the H.T. voltage beyond 200, in fact most readers will find that the maximum gain and ease of operation is obtained with a maximum supply voltage of 180.

After the coil has been constructed, if the receiver should be difficult to operate on the higher-frequencies and shows a tendency to go out of oscillation this trouble can be cured by loosening the coupling between L1 and L2 and L3 and L4.

There should not be any need to experiment with the coil covering 5 to 11 metres, but under five metres it is advisable to compress or extend L2 and L4 to cover the required band and to vary the coupling between L1 and L2 and L3 and L4 in order to obtain smooth oscillation.

In certain instances where regeneration has been rough, readers have been able to effect a cure by connecting the condenser having a capacity of 0.001-mfd. across a primary of T1.

We shall be glad to hear from any constructors who have experienced difficulties or have noticed any peculiar results with this 1-o receiver and we will endeavour either to reply personally if a stamped addressed envelope is enclosed or in future issues.

Components for A FOUR-STAGE 1-10 METRE RECEIVER

CABINET.
1—Steel, 11 in. by 8 in. by 9½ in. with lid, finished black (A.P.A.).

CHASSIS AND PANEL.
1—Chassis with brackets 9½ in. by 10 in. by 2½ in. finished black (A.P.A.).
1—Aluminium panel ⅛ in. finished black 11 in.

COIL HOLDERS.
2—Special ceramic 5-pin (A.P.A.).

COILS.
10—To cover 1-11 metres (A.P.A.).

CONDENSERS, FIXED AND VARIABLE.
1—20-mmfd. type Apex (C1) (Webb's Radio).
1—20-mmfd. type Apex (C2) (Webb's Radio).
1—.002-mfd. type 620 (C3) Dubilier).
1—.0003-mfd. type 620 (C4) (Dubilier).
1—.005 mfd. type 4802 (C5) (Dubilier).
1—.003-mfd. type 620 (C6) (Dubilier).
1—.5-mfd. type 4608°S (C7) (Dubilier).
1—10-mfd. type 401, 50-volt working (C8) (Dubilier).
1—10-mfd. type 401, 50-volt working (C9) (Dubilier).
1—.1-mfd. type 4603°S (C10) (Dubilier).
1—.00005-mfd. type 4601/S (C11) (Dubilier).
1—5-mmfd. type Apex (C12) (Webb's Radio).
1—.5 mfd. type 4608/S (C13) (Dubilier).

CHOKE, HIGH-FREQUENCY.
1—Type 1011 (RFC1) (Eddystone).

CHOKE, LOW-FREQUENCY.
1—Type 20-henry to specification (LFC1) (Keston Manufacturing Co.).

DIAL, SLOW-MOTION.
1—Type 1085 (Eddystone).

HOLDERS, VALVE.
2—Type ceramic Acorn (Clix).
1—5-pin type V1, less terminals (Clix).
1—7-pin type V1, less terminals (Clix).

PLUGS, TERMINALS.
1—Ceramic terminal block, type 1046 (Eddystone).
1—5-way socket type 1260 with plug (Belling-lee).
1—2-way terminal strip type P54 (Bulgin).

RESISTANCES, FIXED AND VARIABLE.
1—35,000-ohm type ½ watt (R1) (Erie).
1—50,000-ohm potentiometer wire wound (R2). (Reliance).
1—20,000-ohm type 1 watt (R3) (Erie).
1—700-ohm type 1 watt (R4) (Erie).
1—100,000-ohm type ½ watt (R5) (Erie).
1—.5-megohm type ½ watt (R6) (Erie).
1—420-ohm type 1 watt (R7) (Er e).
1—500,000-ohm potentiometer (R8) (Reliance).
1—20-megohm type ¼ watt (R9) (Erie).

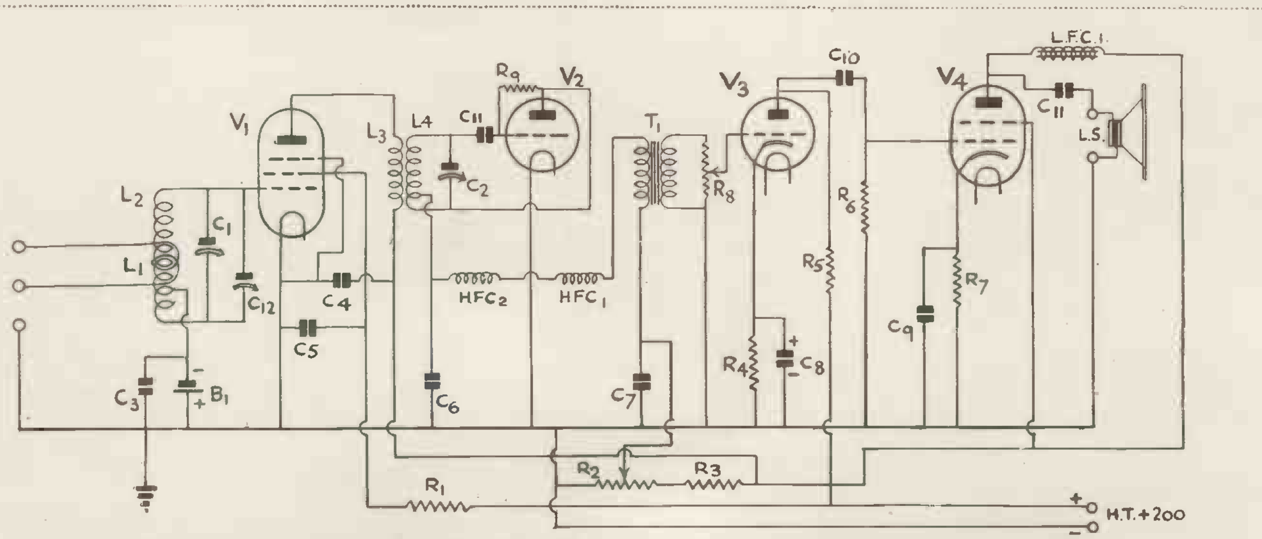
SUNDRIES.
2—Coil mounting brackets (A.P.A.).
2—Extension outfits type 1 (Eddystone).
3—Special 1-in. knobs (Eddystone).
2—Coils Quickwyre (Bulgin).
2—Dozen 4 B.A. roundhead bolts, nuts with washers (Webb's Radio).

TRANSFORMER, LOW- FREQUENCY.
1—Special type 1°4 ratio (T1) (Keston Manufacturing Co.).

VALVES.
1—ffA1 Acorn R.F. Pentode (V1) (Osram).
1—HA1 Acorn triode (V2) (Osram).
1—MH4 (V3) (Osram).
1—KT42 (V4) (Osram).

HEADPHONES.
1—Pair supersensitive (Ericsson).

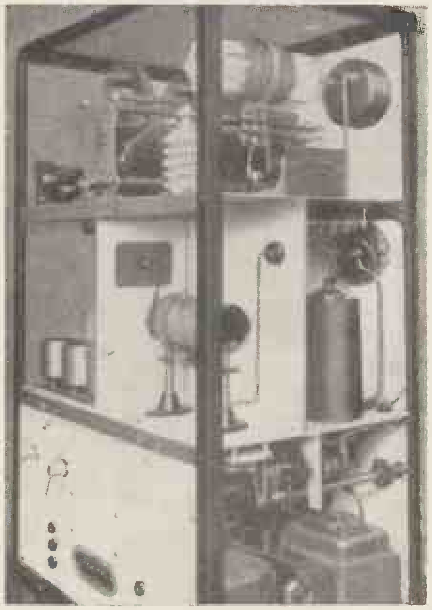
A Complete Kit of Components and Completely Assembled Receivers obtainable from : WEBB'S RADIO, 14, SOHO STREET, W.1.
Assembled Radio-Frequency and Detector Units and wired receivers obtainable from: MESSRS. A.P.A., LTD., 171C, BATTERSEA PARK ROAD, S.W.8.



This is the circuit for our 1-10 receiver. In the constructional data coil 1 refers to L1 and L2, while coil 1A refers to L3 and L4 and so on throughout the series.

Amateur Radio, HA4A

We feel sure amateurs will be interested to compare the design of HA4A with that of other British high-power amateur stations.



The master oscillator which is crystal controlled.

VERY few amateur operators who have worked on 20 metres just recently can have failed to have heard the Hungarian station HA4A located in Budapest. What with a comparatively high input coupled with high level modulation the phone signals from this station have reached all over the world in a very short space of time. When conditions have been at all suitable signal strength in this country averages R9, while judging from the number of reports received from America, the signal strength on that continent averages R8.

Until this year very few Hungarian stations have been at all prominent, although HA4A was one of the first amateurs to bring Hungary to the fore in short-wave radio.

In view of the interest created in the tremendous signal transmitted by HA4A we have obtained a considerable amount of interesting data on the transmitter used at this station.

In this page will be found the theoretical circuit of the radio-frequency units and associated power packs, from which it will be seen that the input can be in excess of 50 watts. The transmitter can be operated in the 20, 40 and 80 metre amateur bands, while in addition three crystals can be switched in circuit for use on these three bands. So as to obtain maximum radiation on these three wavelengths, three separate aerials can be used independently, these being a half-wave end-fed Zepp on 80 metres, and for 40 and 20, two centre-fed half-wave doublets.

The transmitter consists of three separate metal framed boxes plus a separate audio-frequency pre-amplifier. In these boxes are housed the modulator, radio-frequency power amplifier, master oscillator and R.F. amplifier stages. With the exception of the first two audio stages the transmitter is entirely operated from 50 cycle mains, while all valves are fed separately in order to eliminate R.F. feed-back between stages. For example, the two rectifiers supplying anode voltages to the R.F. power amplifier and modulator are equipped with RG250/1,000 hot-cathode mercury vapour rectifier in order to obtain the best possible regulation. Also it will be noticed that precautions have been made to eliminate voltage fluctuation in the Class A.B. modulator circuit.

The first choke in the two-stage filter preceding the first filter condenser determines the rectified voltage output. By varying this inductance in sympathy with the current taken, a voltage regulating action is obtained. To this end the choke coil has an auxiliary winding through which the anode current returns to earth and adds to the D.C. magnetising of the iron core. It will be appreciated that when magnetic saturation is approached the inductance decreases and with 50 M/a anode current the inductance is 12 henries, while the maximum average anode current brings down the inductance to 4.6 henries.

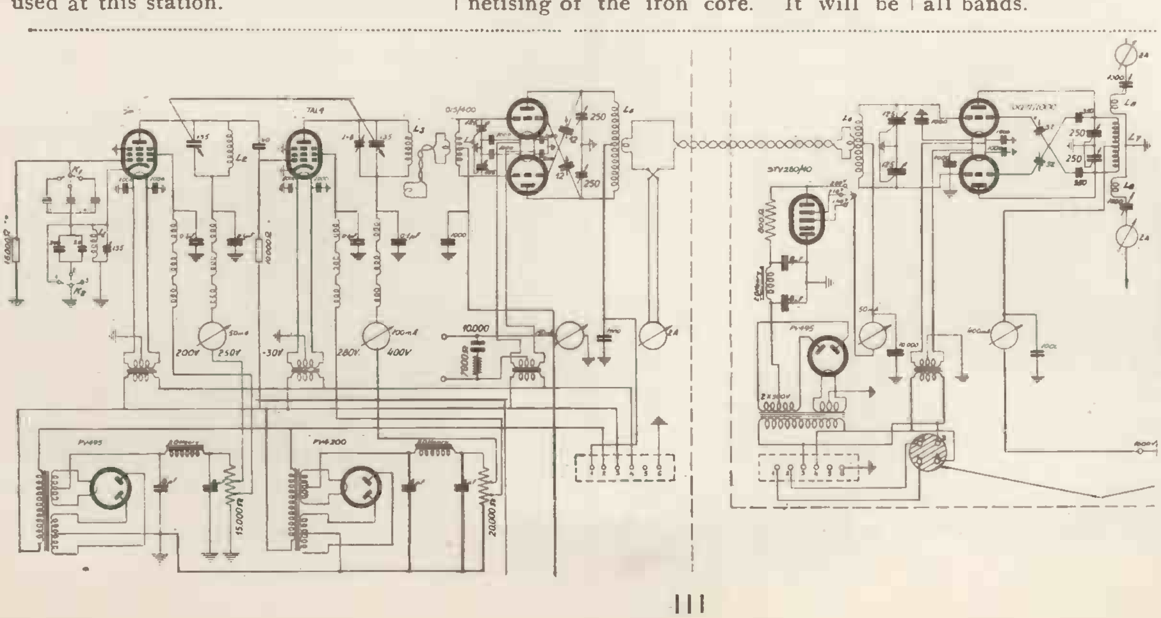
A tritet master oscillator is used with a pentode valve type APP4C connected in the following manner. Grid 1 as oscillator grid, grid 2 oscillator anode, grid 3 tied to chassis. The anode circuit can either be tuned to the frequency of the cathode circuit or to double that frequency, so that this one valve contains two distinct circuits, a master oscillator, an amplifier or frequency doubler, which is shielded from the oscillator.

Crystals have been chosen so that they are in harmonic relation in the amateur bands, so overcoming the need for a 20 metre crystal.

As the grid-plate capacity of the APP4C pentode is 1.3 mmfd. which is well in excess of the normal capacity for a valve of this type, it is particularly suitable for use as an oscillator for it does not require any external capacity. The first radio-frequency stage also uses an APP4C with an anode voltage of 375 and an anode current of approximately 25 m/a.

In the second R.F. stage are two 015/400 in a neutralised push-pull circuit. This stage has been built symmetrically both electrically and mechanically. The result is that once neutralised the neutralising holds for three wavebands. These two valves operate with 450 volts on the anode at a current of less than 150 m/a.

Careful screening has been carried out between the oscillator and R.F. amplifiers in order to retain the one setting for the neutralising condenser on all bands.



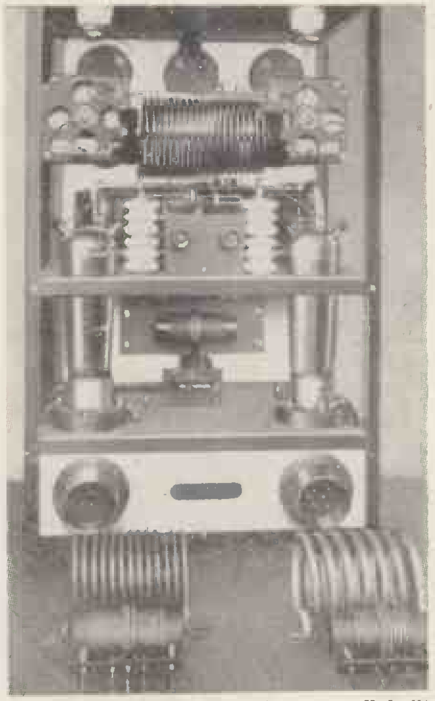
This is the complete radio-frequency section and power pack for the HA4A transmitter. The Class A-B modulator and power supply is completely separate.

In the P.A. circuit is used a conventional push-pull arrangement using triode valves of the OQ71/1,000 type which are very stable in operation even on the higher frequencies providing both ends of the filaments are earthed to R.F. by means of .001-mfd. condensers.

Coupling between coils is adjusted by rotating one in the field of the other, and one setting holds good for each band. Grid bias in this stage is taken from the rectifier with a glow discharge stabilising valve which keeps the voltage applied perfectly constant. A selector switch enables the bias voltage to be adjusted for phone or C.W. operation as required.

Class A.B. anode modulation is used in the final stage, the modulator valves being a pair of 075/1,000 triodes. In the first section of this, however, is a microphone pre-amplifier which provides an output of 6 watts. This is followed by a driver stage feeding into the output triodes. At the moment the pre-amplifier is battery operated in order to minimise any ripple that might be noticed owing to the extremely high gain of the amplifier.

As HA4A puts out such a trouble-free and reliable signal it shows that the precautions taken are well worth while. Despite the multiplicity of stages operation is comparatively simple, and it will be noticed that the coils in the anode of the master oscillator and first R.F. amplifier are ganged in order to reduce the number of controls. Similarly as neutralising holds over all bands and coils are of the plug-in type it is no trouble to change from, for example, 40 to 20 metres fairly rapidly.



The R.F. amplifier section is very well built and carefully screened in order to obtain straightforward operation on three wavebands.

The power supply circuits are rather ambitious, and to British amateurs, probably expensive, for we in this country do whenever possible utilise one power pack with a resistance network to supply all stages.

This is the first time that we have published any comprehensive data on continental amateur stations, but the data shows that not all the large model stations are situated in America. Although at the present time the transmitter is rated for 50 watts input, it is quite capable of being utilised for quite high power when required. This also applies to the modulator system which is capable of fully modulating the strongest carrier produced from the R.F. output valves.

Making the Most of a Crystal Filter

By G2NO.

As many communication receivers are now including a crystal filter as standard equipment it is surprising how many amateurs are dissatisfied with the results obtained when the crystal gate is in circuit. Most of the troubles are due to lack of knowledge on how correctly to use a crystal filter.

Most receivers have a knob controlling a switch marked " off " and "on." With the switch in the " off " position, the quartz crystal filter is out of circuit, so that the receiver uses a straight I.F. stage. With switch in the " on " position the crystal gate operates normally and is controllable by either a phasing or balancing condenser.

When the crystal filter is cut in it should not have any affect on the tuning adjustments although it materially affects the overall response characteristics of the receiver. A neutral or elimination control should be set at a centre position, somewhere in the middle of the scale, but this position varies in different receivers, but the point can be accurately determined in the following way.

Tune in a *steady* carrier (unmodulated if possible) with the switch in the " on " position. Detune the receiver slightly to produce a very high beat note, say, 5,000 or 6,000 cycles. It will be necessary to advance the gain control considerably in order to make such a beat note audible. Then adjust the elimination control until this beat note is weakest and note the pointer reading. Repeat this process using approximately the same beat note on the *other* side of zero beat and note the pointer reading. These readings will, in general, be about one division apart, and exactly half-way between them will be the neutral position, which should be carefully noted, since it is the setting which affords normal crystal filter action.

The elimination control is extremely useful in overcoming very powerful heterodyne interference with which the normal selectivity of the filter is unable to cope. After tuning the desired signal as accurately as possible with the elimination control at neutral, it should be rotated slowly until the heterodyne interference is lower or higher in frequency than the signal but also on the pitch of the heterodyne itself. Interfering waves of higher frequency than the signal will be eliminated with the pointer between 0 and the neutral point, whereas interference of lower frequency than the signal will be eliminated when the pointer is at some setting between neutral and 10. For high pitch heterodyne whistles the elimination setting will be found close to the neutral and *vice versa*.

While the sensitivity of the receiver *seems* to fall off greatly when the crystal filter is cut in, actually such is not the case. When a *pure* CW signal is tuned accurately with the crystal filter in circuit there is no noticeable change in noise accompanying the signal. Here, although the sensitivity of the receiver to the phone *carrier* remains unchanged, the demodulating effect due to the sharpness of the crystal filter is very great. It really reduces the percentage modulation to a very small fraction of its original value, and consequently results in a greatly diminished output from the loudspeaker. It is thus necessary to increase the setting of the volume control in order to impress a greater L.F. voltage on the grid of the second detector. This greater voltage even with its reduced modulation percentage will boost up the output.

A general word of caution is in order here. Due to the apparent drop in sensitivity with the crystal filter cut in, there is a marked tendency on the part of the operator to set the gain control too high. When this is done much of the advantage of the filter selectivity is lost. For this reason the best procedure is to tune in the desired signal first and then switch in the crystal filter. While this will in most cases result in the disappearance of the signal, it can be brought in again by carefully retuning. After some practice, it will be found possible to tune to the proper beat tone with the filter out, so that cutting in the filter will not cause the signal to disappear. Re-adjustment of the gain control will not be necessary when tuning pure C.W. signals by this method, and the same procedure is recommended for phone signals.

The Short-wave Radio World

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

DIATHERMY CONSTRUCTION

AMATEURS are taking an increasing interest in the design of short and ultra-short wave diathermy apparatus for mainly medical use. It is well-known that ultra-high frequency waves when properly applied to the body can cure or alleviate all manner of ailments. There is also another use for this type of apparatus in which moisture can be removed from seeds so as to retard germination. At the same time, by varying the amount of radio-frequency applied, the retarding effect can be changed into acceleration.

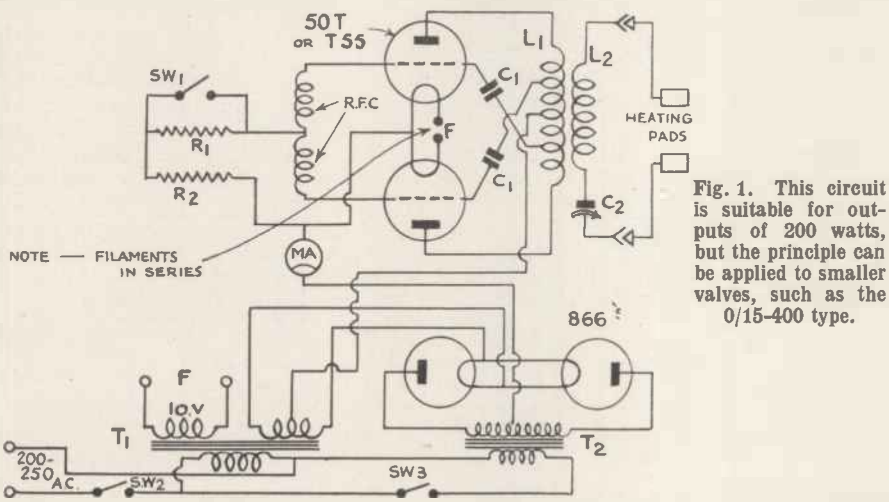


Fig. 1. This circuit is suitable for outputs of 200 watts, but the principle can be applied to smaller valves, such as the 0/15-400 type.

An interesting diathermy circuit was described in "Radio" being the design of W6VR. In common with American practice, a high input of 200 watts is used, but the circuit is fundamentally similar for lower inputs. For guidance we have experimented with valves of the 0/15-400 type with an input of 30 watts, which gave an extremely high R.F. output even down to 3 metres.

The conventional diathermy circuit shown in Fig. 1 consists merely of a self-excited push-pull oscillator, the R.F. output from which is taken either to a coil at the end of the low-impedence line, or to a pair of heating pads, as is the case in this instance. Variations in output are governed by means of coupling in the usual way.

It will be noticed that the high-voltage rectifying valve has the heaters connected in series, but this is merely as a matter of convenience in order to use a higher voltage transformer at only half the current.

Approximate component values are as follows: C1, .0001-mfd., C2, .0001-mfd. variable, RFC, pie wound to stand 100 m/a, R1, 25,000-ohm 25 watt, R2, 10,000-ohms 25-watts, T2, 1,400 volts at 250 m/a. Coil data is as follows: L1, 14 turns No. 10 gauge wire, 2½ in. diameter, spaced slightly more than the diameter of the wire, tapped at the centre turn and at the fourth turn each side of centre. L2 has only five turns of 10 gauge wire mounted inside the tank coil. The turns are spaced ¾ in., while the diameter is only 1½ in.

A controllable output of 200 watts is obtained with this circuit, but it should be emphasised that even with low power no personal experiments should be made unless some medical knowledge is first obtained. Experiments can be made, however, on heating test tubes of water which will boil very rapidly with even a low input. When a person is given diathermy treatment the affected part of the body is subjected to a very intense radio-frequency field, so that the tissues are heated by the flow of current. It is, however, essential that only the affected part be heated, so that it will be obvious that before this can be done that part must have a good blood circulation in order to cool the unaffected tissues.

A RECEIVER FOR LOW VOLTAGES

In a recent copy of the "Australasian Radio World" was a receiver that operates from a 12-volt H.T. supply, and according to the designer K. P. Mackinnon, of Sydney, the results are excellent and in every way up to that given by the more normal circuit. Valves used are of a special tetrode type, which are available in this country from any importers of American valves.

The circuit is quite straightforward, using a leaky-grid detector transformer coupled to a tetrode output valve. Throttle control reaction is included, which although is not very popular in this country has much in its favour, for it is most effective even on ultra-high frequencies. We can thoroughly recommend this type of circuit, particularly where constructors require a portable receiver when the biggest difficulty is obtaining adequate H.T. supply without using weighty high-tension batteries.

The circuit is shown in Fig. 2, and this will, to all constructors, be self-explanatory.

A CRYSTAL CONTROL ON ULTRA-HIGH FREQUENCIES

Now that supplies are available of the new 10-metre crystals the recommended circuit, using an RK34 described in the January QST is of particular interest. Before, however, dealing with the arrangement we should like to assure readers that the new 10-metre crystal units are not as fragile as would first be expected, for actually the crystals in question are 60-metre units, sufficiently active to resonate in the 10-metre band and to provide a good output.

Although Acorn or 6J5G valves can be used on 10 metres, the RK34 by virtue of it being a twin-triode, and of

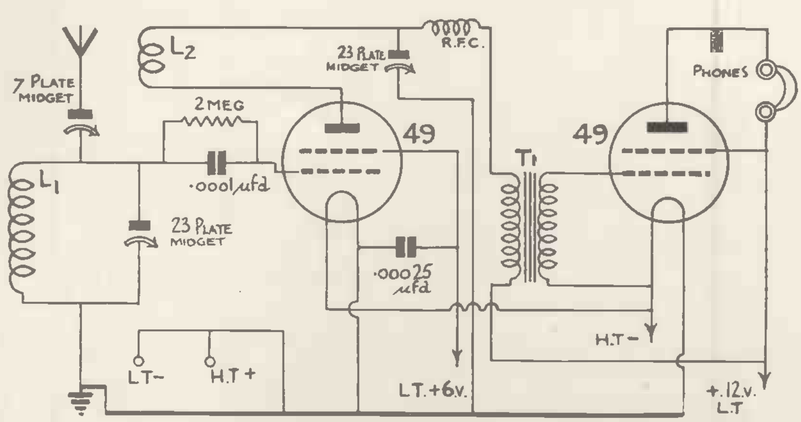


Fig. 2. As this receiver operates from a total H.T. supply of 12 volts it should be very suitable for portable and field day use.

5-metre Crystal Control

low-loss construction, is extremely good, for this single valve enables constructors to have either 10 or 5-metre output in the single stage. The circuit recommended is shown in Fig. 3, while

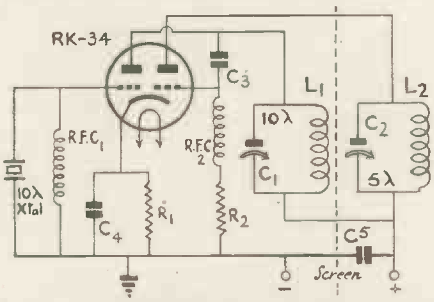


Fig. 3. The new high-frequency crystals should be used in a circuit of this type which gives quite an appreciable R.F. output.

the following component values are suggested. L1 6 turns, No. 12 wire, $\frac{3}{4}$ in. diameter. L2 4 turns No. 12, $\frac{3}{4}$ in. diameter. C1 75-mmfd. variable. C2 35-mmfd. variable. C3 100-mfd. Mica. C4 and 5 .005-mfd. R1 400-ohms. R2 30,000-ohms.

The 955 and 6J5G valves will provide $1\frac{3}{4}$ and $2\frac{1}{2}$ watts output respectively on 10-metres, while the RK34 will provide 3 to $3\frac{1}{2}$ watts on 5-metres, using the oscillator-doubler circuit. For those who are interested in ultra-short wave working, an excellent transmitter circuit is shown in Fig. 4, using a pair of RK34 twin-triodes with anode modulation. This arrangement is particularly simple, and provides at least 18 watts R.F. output on 5-metres, which can be 100 per cent. modulated by the 6L6. The total anode current drawn by both radio-frequency valves is 150 m/a, being 70 for the crystal oscillator and doubler, and 80 for the final amplifier. The components are of standard values, while coils which are self-supporting and air-spaced can be compressed in order to hit the band in the right spot.

Neutralising the RK34 valve is rather a problem owing to the low-capacity required, but if two discs are obtained, 1 in. in diameter and spaced $\frac{1}{8}$ in. this will give very approximately the required capacity. It appears that crystal control on ultra-high frequencies is now an accomplished fact even amongst the amateurs who cannot afford expensive equipment.

A REGENERATIVE DETECTOR CIRCUIT

A dual detector circuit, as used by W4DNA, is shown in Fig. 5. When careful built it is capable of reducing most effectively interference from an unwanted station. It consists of two identical regenerative detectors so arranged that the current in the anode circuits cancels out when both are tuned to the same frequency. One detector operates in the normal fashion, to pick up the wanted signal, the other being used to balance out the unwanted signal.

The original arrangement uses a straightforward circuit with a cathode tap so as to provide regeneration which is controlled by the screen voltage applied to the screen-grid detector valve. But those who already have detectors with Reinartz or similar types of capacity controlled reaction, can still make use of this scheme.

Both grid and coupling coils must be identical in construction, and, of course, inductance, as must be the coupling coils or primaries. The input circuit can come from either the aerial direct or from a tuned radio-frequency stage, for this will not affect the operation of the system.

It is essential that both detectors be very carefully screened from one another to prevent heterodyning. So for this reason two boxes with welded corners and tight-fitting lids are essential. Condensers marked C are ganged for one control tuning, while C2 is a vernier tuning condenser in the balancing circuit.

To use this equipment, set C1 at full capacity and C2 at minimum, and then tune in to the station. Regeneration control must be advanced until the detectors go into oscillation, after which reduce C1 to minimum, and if the signal is still heard, adjust C2 until it disappears, then bring it in again by means of C1. If the gang condensers are well matched no further adjustment of C2 will be necessary. Both detectors work on the same half-cycle of the signal. One detector receives the desired signal, and the other neutralises the interfering one. If the interference is on the low-frequency side, tune C1 towards maximum until the interference is reduced to a minimum, using the reverse procedure, of course, if the interfering station is on the high-frequency side.

Primary coils are shown connected in parallel, which appears to be most satisfactory, but they can be connected in series if required. Some readers will remember that this circuit is very similar to the one originally produced by Armstrong some years ago, and that it has been modified to suit existing conditions.

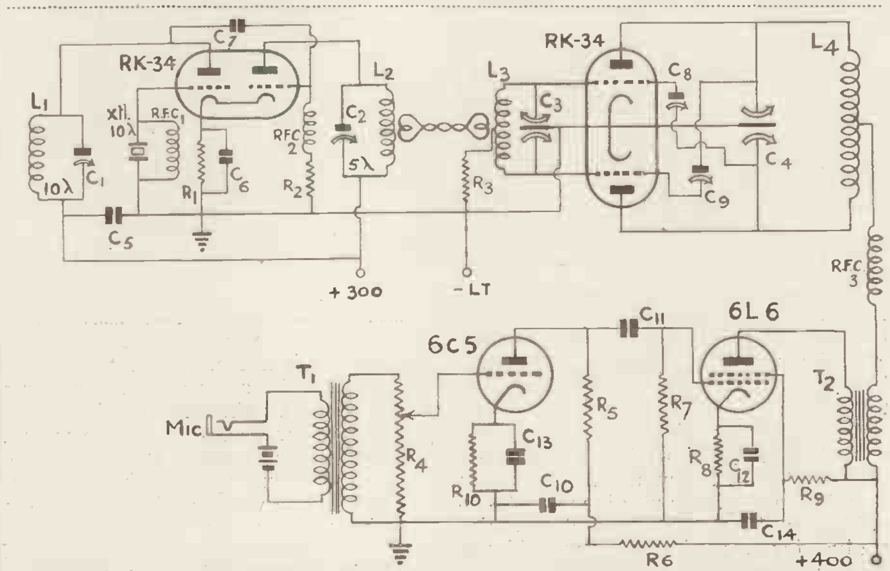


Fig. 4. Here is a suggested circuit for 10 and 5-metre operation using a 10-metre crystal.

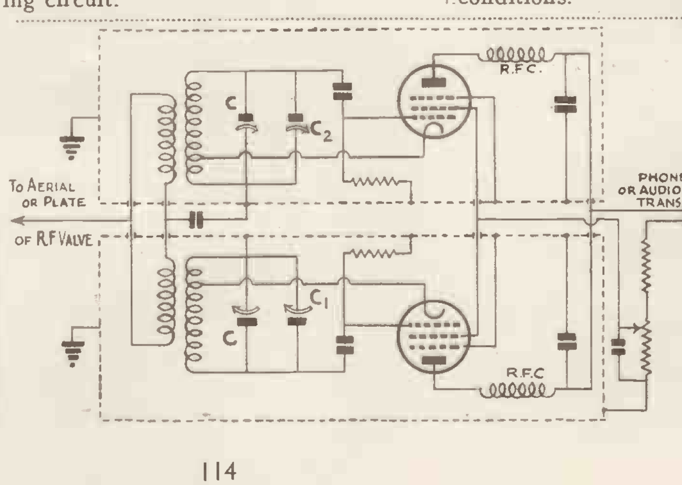


Fig. 5. An ingenious scheme for cutting out unwanted stations is described in the text. Here is the suggested circuit which is straightforward except that it requires very carefully constructing.

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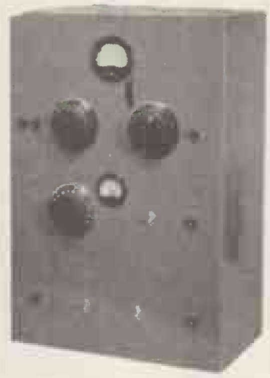
25-watt 'Phone Transmitter. 6L6G exciter Regenerative Crystal Oscillator Doubler. 801 Triode Amplifier. Grid neutralised grid and anode meters. Price complete with 6 Tubes and Crystal. **£21.**



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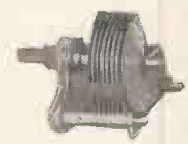

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120 volts	20 m/A.	25/-	Westinghouse Rectification.
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350 volts	120 m/A.	40/-	,, ,,
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Premier, 1938, 8-Watt Amplifier for A.C./D.C. mains. 3-stage, high-gain, with Push-Pull output. Complete Kit, with metal chassis, all parts and 5 matched Valves, **£4 4s.** Wired and tested, **£5 5s.**

Premier, 1938, 12-Watt P.A. Amplifier or modulator for A.C. mains. 2-Beam Power tubes in Push-Pull output, phase inversion high-gain, distortionless output. Complete chassis-built Kit, with 5 matched Valves, **£5 5s.** Wired and tested, **£7 7s.**

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HT8 + 9 or HT10 with 4 volts 4 amp., C.T. and 4 v. 1 a., C.T., 10/-. **250-250 v. 60 m/A. or 300-300 v. 60 m/A.,** with 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., 10/-. **350-350 v. 150 m/A.,** 4 v. 1 a., 4 v. 2 a., 4 v. 4 a., all C.T., **11/6. 350-350 v. 150 m/A.,** 5 v. 2 a., 6.3 v. 2 a., 6.3 v. 2 a., all C.T., **13/6.** Fitted with Panel and Terminals, **1/6** extra.

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Premier Filament Transformers. Primary 200-250 volts, 1,000 insulation test. 2.5 volt. 8 a. C.T., 8/6; 4 v. 5 a. C.T., 9/6; 5 v. 3 a. C.T., 8/6; 6 v. 3 a. C.T., 8/6; 6.3 v. 3 a. C.T., 8/6; 7.5 v. 3 a. C.T., 8/6; 10 v. 3-4 a. C.T., 11/6.

PREMIER METERS.—Moving Coil 0-1 m/A. full scale, resistance 100 ohms, 3½ in. diameter, flush mounting, **22/6. Multipliers, 1/- each.** Tapped shunts: —10, —50, —100, —200 m/A., 4/- each. **Moving Iron Meters,** 2½ in. diameter, flush fitting. Read A.C. or D.C. All readings from 0-10 m/A. to 0-10 amps., 5/9 each. 0-6 volts, 0-16 volts, 5/9 each. 0-250 volts, 8/6. **Telsen Multimeters.** Read A.C. or D.C., 0-6 volts, 0-16 volts, 0-250 volts; 0-30 m/A., 0-300 m/A., 8/6 each.

A Push-pull Transmitter for 5 and 10 Metres

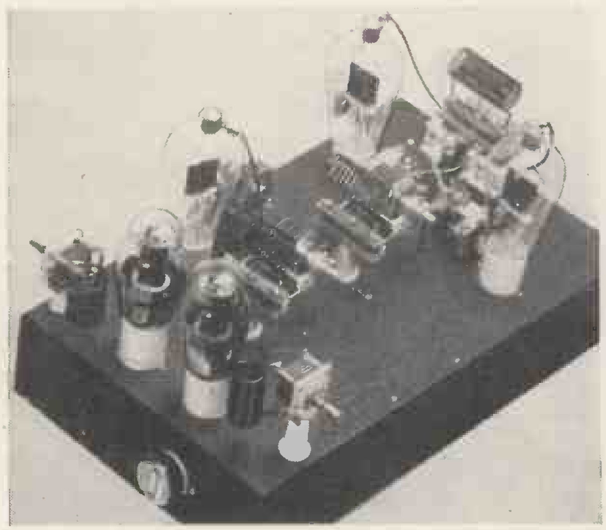
In view of the poor conditions existing on 20 metres and the increasing interest on ultra-high frequencies we give constructional details of an extremely efficient 5 and 10 metre transmitter designed by Rex L. Munger, W9LIP

THIS transmitter is designed to accommodate an input of over one hundred watts. With this input a carrier power of in excess of 80 watts on 10 metres and approximately 60 watts on 5 metres is obtained. This performance is extremely good and cannot be obtained on a multi-band transmitter unless the tank and other tuning condensers are of the incorrect capacities for the lower frequencies.

For those who do not require such a high input the transmitter can be terminated at the buffer stage so using a single T20 as a power amplifier. In such circumstances with a maximum input of 750 volts 75 mA. the carrier power would be between 35 and 40 watts.

In the final stage the T20's can be operated at their full rated input of 112.5 watts because the L/C ratios are correct and losses have been reduced to the minimum. In the circumstances efficiency is at a maximum and a figure obtained which is comparable to that given on lower frequencies.

The design is such that the transmitter can be built on to a single chassis approximately 17 in. wide so being suitable for the conventional relay rack which is 19 in. wide.



This is the original 5 and 10-metre transmitter in rack form without the panel and meters which were finally added. The whole transmitter can quite comfortably be mounted on a 17-inch chassis complete with three filament transformers. In the manner shown it is suitable for two-band operation with plug-in coils.

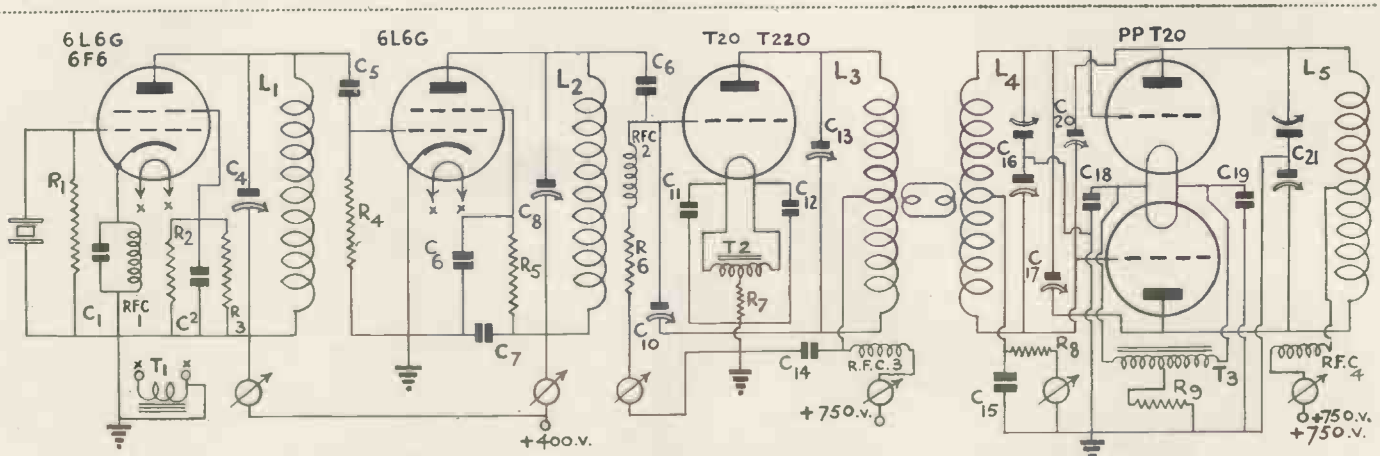
Four stages are used as shown in the circuit in this page. The crystal oscillator employs either a 6L6G for doubler operation from a 40-metre crystal or a 6F6 for fundamental operation. Following this is the 6L6G doubler which furnishes more than sufficient drive for the sub-amplifier even on five metres. For this reason if it is intended that the transmitter be used only on 10 metres then the intermediate stage can quite safely be omitted.

If a 40-metre crystal is used the 6L6G doubles down in the oscillator stage to 20 metres and gives a very high R.F. output. This excites the 6L6G doubler to drive the T20 or TZ20 as a buffer on 10 metres. The T20 operates most efficiently as it receives approximately 25 mA. of rectified grid current from the 6L6G.

We have shown as a doubler or sub-amplifier alternative valves either the T20 or TZ20. The T20 is primarily intended for use as an amplifier, although it doubles quite well, but for those who require maximum R.F. on five metres we strongly recommend the TZ20 which is specially designed for doubler use.

The exciter circuit provides more than sufficient drive for the two push-pull T20's in the final stage, in fact this stage can be modified to use valves of a higher input type such as the RK-35 or T-55 when an input of over 300 watts is possible.

Such a modification calls for anode and neutralising condensers suitable for



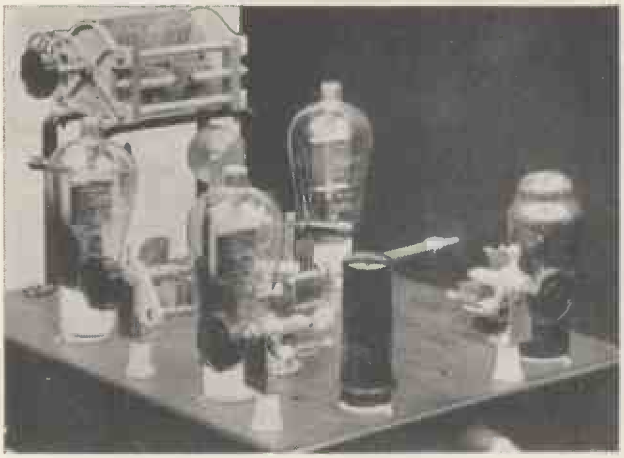
The circuit of the transmitter showing the optional T20 buffer or TZ20 doubler when used on 5 metres.

40 or 80 Watts Output

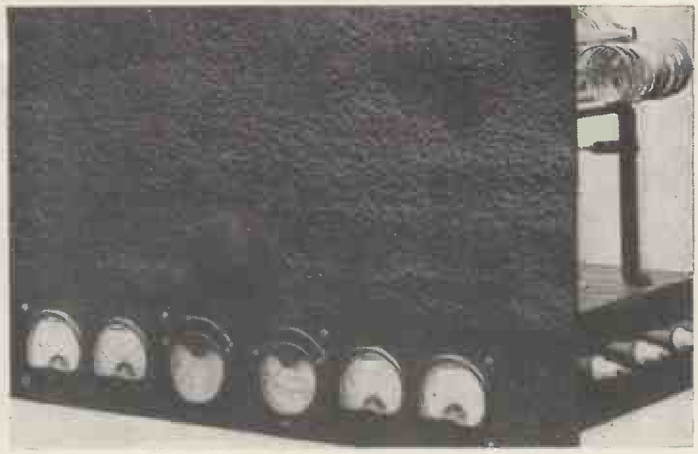
the higher input, and of course a voltage of 1,200 to 1,500.

All coils must be accurately wound. of $1\frac{5}{8}$ in. L2 should be 7 turns number 10 guage wire 1 in. diameter and $1\frac{1}{2}$ in. total length.

ever, the transmitter is going to be used on a single band, then the special mounting can be ignored with the coils



How the components are arranged can be seen from this illustration.



The meters read anode current in four stages and the grid current in the two final stages. The tuning control in the centre of the panel is the grid condenser in the PA stage.

L1 and L2 are permanently connected across the tuning condensers C4 and C8. L1 consists of 16 turns of 14 guage wire 1 in. diameter, and to take a space

Coils L3, L4 and L5 are interchangeable and are air spaced being terminated in banana plugs with sockets mounted on a low-loss strip. If, how-

wired directly across the correct tuning condensers.

For 10 metre operation the following coils are required. L3 14 turns No. 10 gauge wire, 1 in. diameter $2\frac{3}{8}$ in. long. L4 12 turns No. 10 gauge wire, 1 in. diameter $2\frac{1}{4}$ in. long. L5 16 turns No. 10 gauge wire 1 in. diameter $2\frac{3}{8}$ in. long.

On five metres L3 should be 6 turns No. 10 gauge wire 1 in. diameter $1\frac{3}{4}$ in. long. L4, 4 turns, No. 10 gauge wire 1 in. diameter 1 in. long. L5, 6 turns, No. 10 gauge wire 1in. dia., $1\frac{1}{2}$in. long.

With a TZ20-doubler operating with an input of a little over 50 watts, the anode should not colour providing the circuit is efficiently tuned. In such circumstances the TZ20 will drive the push-pull T20's to 40 mA. of grid current.

We have adopted a new system of construction with this transmitter particularly with the mounting of the smaller tuning condensers. These condensers are mounted on right angle brackets, which are in turn supported on Johnson insulators. These insulators are mounted through the chassis with length of studding through the centre. In this way the rotor plates of the condensers can be connected underneath the chassis to the correct points.

All filament transformers, which were specially designed for this transmitter by Messrs. Premier Supply Stores are also mounted under the chassis close to their respective valves so that the transmitter is complete with the exception of high-tension supply.

The 800-volt and 400-volt supplies are mounted on a separate chassis and connected into circuit via the stand-off insulators which can be seen on the side of

(*Continued on page 128*)

Components for A PUSH-PULL 5- AND 10-METRE TRANSMITTER

CHASSIS AND PANEL.

1—Special steel, cut and drilled to specification (A.P.A.).

CHOKES, HIGH-FREQUENCY.

1—Type SW69 (RFC1) (Bulgin).
3—Type 1022 (RFC2, 3, 4), (Eddystone).

COILS.

L1, L2, L3, L4 and L5, home built to specification. Wire from Webb's Radio Ltd.

CONDENSERS, FIXED AND VARIABLE.

1—Type 978 (C1) (Eddystone).
1—.01-mfd. type 4601/S (C2) (Dubilier).
1—.01-mfd. type 4601/S (C3) (Dubilier).
1—Type 900/40 (C4) (Eddystone).
1—.0001-mfd. Mica type 1,200 volt working (C5) (Dumont-Webb's Radio).
1—.01-mfd. type 4601/S (C6) (Dubilier).
1—.01-mfd. type 4601/S (C7) (Dubilier).
1—Type 900/40 (C8) (Eddystone).
1—.0001-mfd. Mica type 1200 volt working (C9) (Dumont-Webb's Radio).
1—Low-capacity neutraliser type 1088 (C10) (Eddystone).
1—.002-mfd. type 690W (C11) (Dubilier).
1—.002-mfd. type 690W (C12) (Dubilier).
1—TC40 (C13) (G5NI Ltd.)
1—.002-mfd. type 690W (C14) (Dubilier).
1—.002-mfd. type 690W (C15) (Dubilier).
1—.00008-mmfd. type E two-gang double-spaced (C16) (Polar).
1—Low-capacity neutraliser type 1088 (C17) (Eddystone).
1—.002-mfd. type 690W (C18) (Dubilier).
1—.002-mfd. type 690W (C19) (Dubilier).
1—Low-capacity neutraliser type 1088 (C20) (Eddystone).
1—50 plus 50 mmfd. type 1081 (C21) (Eddystone).

CRYSTAL.

1—Special mounted 40-metre (Valpey—Webb's Radio).

HOLDERS, VALVE.

2—Ceramic octal sub-chassis type less terminals (Amphenol—Webb's Radio).
3—Ceramic 4-pin sub-chassis type less terminals (Amphenol—Webb's Radio).

METERS.

1—0/100 m/a type 2 in. (Ferranti).
1—0/75 m/a type 2 in. (Ferranti).
1—0/30 m/a type E66M (Sifam).
1—0/150 m/a type 2 in. (Ferranti).
1—0/60 m/a type E66M (Sifam).
1—0/250 m/a type 2 in. (Ferranti).

PLUGS, TERMINALS, ETC.

4—Large type feed-through insulators (Johnson—Webb's Radio).
5—Small type feed-through insulators (Johnson—Webb's Radio).
1—Insulated resilient socket type 11 (Clix).
1—parallel socket type 8 (Clix).
1—Mains connector type 29a (Clix).

RESISTANCES, FIXED.

1—100,000-ohms type 1-watt (R1) (Dubilier).
1—35,000-ohms type 2-watt (R2) (Dubilier)
1—10,000-ohms type 8-watt (R3) (Premier Supply Stores).
1—50,000-ohms type 1-watt (R4) (Dubilier).
1—25,000-ohms type 8-watt (R5) (Premier Supply Stores).
1—5,000-ohms type 8 watt (R6) (Premier Supply Stores).
1—400-ohms type 8-watt (R7) (Premier Supply Stores).
1—2,500-ohms type 8-watt (R8) (Premier Supply Stores).
1—200-ohms type 8-watt (R9) (Premier Supply Stores).

SUNDRIES.

36—½ in. roundhead brass bolts with nuts and washers (Premier Supply Stores).
3—T20 anode connectors (Webb's Radio).
2—½ in. ebonite insulating bushes (Premier Supply Stores).
2—Mounting brackets for P.A. condenser (A.P.A.).
2—Extension outfits type 1008 (Eddystone).
5—1 in. knurled knobs (Eddystone).

SWITCHES.

5—Toggle type S80T (Bulgin).

TRANSFORMER, FILAMENT.

1—6.3 volt C.T. 1.8 A (Premier Supply Stores).
1—7.5 volt C.T. 1.75 A (Premier Supply Stores)
1—7.5 volt C.T. 3.5 A (Premier Supply Stores).

VALVES.

2—6L6G (V1, V2) (Tungsram Electric Lamp Works).
1—TZ20 (V3) (Webb's Radio).
2—T20 (V4, V5) (Webb's Radio).

The New British Octal Valves

Constructors will in the future have a new range of Octal Valves to consider. This range will include battery valves and tuning indicators.

A NEW series of valves using an Octal base has just been introduced by the Ediswan Co., Ltd., and although at first glance these appear to be identical with the American type of base, further investigation has shown that these new Mazda valves are the first to employ the recently developed British Octal base.

We are surprised that the International base introduced by two makers in 1937 has not been continued, but apparently improvements have been effected which make it rather essential for a new base to be employed.

One phase of present radio valve development is directed to the production of valves of smaller overall dimensions with the two-fold object of reducing chassis space in multi-valve receivers and also to reduce the length of electrode wires in order to keep to a minimum the lead wire inductance and coupling effects which are of great importance at high frequencies.

One of the most useful valve bases is the American Octal which has been in almost general use since the introduction of metal valves. There are, however, two detrimental features with the American base in its present form.

When the base is used with glass valves, the exhaust tube cannot be sunk into the spigot, because it is too small in diameter. Consequently the feature of shortened lead lengths and reduction of valve size cannot be utilised when this base is applied to a glass valve.

The base connections which have been standardised for use with the American Octal base are far from ideal, particularly when used with glass envelope valves, as no attempt is made to reduce undesired capacity effect between electrode contacts and connections. In fact, the pin connections employed for the heater render this almost impossible in any but the most elementary types of valves.

Many Advantages

Investigation shows that it would be impolitic to employ an American Octal base using different pin connections from those standardised by its sponsors, because: (a) Such different pin connections would give rise to operation dangerous to the user if metallised valves were plugged into a socket wired to American standards, or if American metal valves or metal-glass valves were plugged into a set wired for a different system. (b) Damage to valves and receivers could be caused by indiscriminate plugging-in of valves wired to a different connection system.

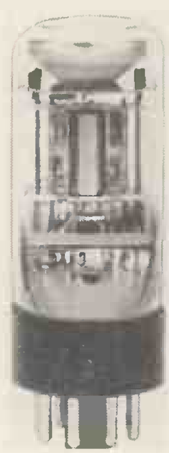
To overcome the disadvantages of the American Octal base, a new octal base has been developed specially for use with glass valves. The base has a larger diameter spigot so that the valve exhaust tube can be sunk into the spigot, the electrode leads shortened, the overall valve size reduced.

By reason of this change the new octal base is not interchangeable with the American Octal base; it has therefore been possible to develop a systematic arrangement of connections which meets the requirements of safety in operation, and minimises undesired capacitances between electrodes.

Heater Postions

Because the pitch circles on which the pins are located is not greatly different from the pitch circles of an American Octal base, a further positive interference has been provided by making the angle, subtended by the filament pins at the centre, greater than 45 degrees.

The British Octal base has eight pins arranged around a centrally disposed keyed spigot. This keyed spigot is designed to accommodate the exhaust tube of a glass valve, and is also used for providing correct location of the pins in the socket.



This is the tuning indicator in the Octal range fitted with either a 4 or 9 volt heater. The 9 volt heater is suitable for use in A.C. or D.C. receivers having the low current consumption of .2A

Battery and Mains Types

There is to be a complete range of both battery and mains operated valves using this new socket, although the first two available are tuning indicators type ME-91 and ME-41.

These are high vacuum indirectly heated indicators for tuning purposes shown by means of a flourescent target. It is essentially a voltage indicator and as such is particularly convenient as a non-mechanical means accurately to indicate the correct tuning point in a receiver.

The ME-91 and ME-41 indicators consist basically of a hot cathode which acts as a source of electrons which are attracted to a positively charged target coated with a flourescent material.

The electron flow on to the coated target cause it to glow while the extent of the flourescent area is controlled by means of an electrode placed between the cathode and the target.

When the potential of the ray-control electrode is increased from a low-positive potential the area of shadow produced is reduced. The ray control electrode is connected internally with the anode of a triode section and in use a high resistance is placed in a triode anode circuit so that it operates as a resistance coupled D.C. amplifier. Although the ME-91 and ME-41 are fundamentally similar the ME-91 has a 9.0 volt .2A heater, while the ME-41 has a 4.0 volt .5A heater.

Constructors will be glad to know that in this range are high-frequency pentodes with a top cap grid connection on the lines of A.C. operated pentodes. In the past there has not been any selection of top-cap grid contact pentodes for use in ultra-high frequency circuits.

In addition owing to the reduced size of bulb these valves will be suitable for use in portable and all types of receivers where space is of importance.

"6-band 10-watt Transmitter"

(*Continued from page* 106)

supply is a switch which applies A.C. to the power pack, while on the transmitter is a stand-by switch which cuts off the H.T. voltage, but leaves on the filament voltage. For those who are a little doubtful regarding the operation of tritet oscillators with tetrode valves, a regeneration control is fitted which, in the anti-clockwise position reduces crystal current to a very low order.

We have made several tests on the air with this transmitter and so far the results have been extremely satisfactory. Contacts have been made on 160, 40 and 10 metres, while we are going to concentrate on 20 and 5 metres, results of which will be published in our next issue.

As this transmitter gives a level 10-watts output, amateurs will find it very useful for general use, emergency work, or for a multi-band exciter for high power. A special power pack running from the accumulator is also available so that the transmitter can be used for portable work. Full information is obtainable from Messrs. Webb's Radio, 14 Soho Street, W.1.

The R.S.R. Clipper

AN American receiver using five valves and tuning from 3½ to 550 metres, is now available for experimenters in this country. Designed by A. J. Haynes and designated the R-S-R Clipper, it includes numerous ideas not generally found in receivers of this kind.

3·5 550 Metres

Seven separate tuning ranges are included, four of which tuning from 13½ to 550 metres are calibrated in frequencies, the remaining three being obtained by plug-in coils and covering 3½ to 12 metres.

A stage of radio frequency amplification is in use on all wavelengths, even down to 3½ metres, while the use of 6L6 beam power valve enables an audio output of between 6 and 8 watts to be obtained.

The entire receiver, including power supply and energised loudspeaker, is housed in a completely shielded metal cabinet. The designer has arranged for a circuit that precludes any possibility of frequency drift, even on the highest frequencies.

Two Circuits

A straight circuit is in use above 10 metres, which gives adequate gain, high selectivity and low-noise-level. On the ultra-high-frequency band the band selector switch is set at a position marked "super-regen." and by using special air-spaced coils, the receiver acts as a straightforward super-regenerator with a buffer high-frequency stage between 3½ and 10 metres. Incidentally the 10-metre band is covered by both coil ranges, so that stations can be received on either the super-regen, or straight circuit.

Transmitting amateurs will appreciate some of the unique features included. For example, there are separate tone and audio volume controls, while additional gain and selectivity can be obtained, if required, by switching in optional R.F. regeneration. Another point is the inclusion of a stand-by switch which cuts off the H.T. supply but leaves the heater voltage still applied. Also by plugging in headphones into the jack circuit, the loudspeaker is automatically switched out of circuit.

Gain can be increased or decreased to the loudspeaker or headphones independently of the radio-frequency gain, so that selectivity can be increased without the necessity of keeping the signal level above normal.

The complete circuit of this receiver uses five valves. All valves, with the exception of the 80 rectifier, are of the metal type. A 6K7 pentode acts as a speech amplifier at all wavelengths. This is followed by two of the new 6J5G super-triode high-frequency valves, the second of which feeds into the 6L6.

Coil Changing Overcome

The coil-switching circuit is quite straightforward, but is rather more complicated than normally experienced in British-built receivers, owing to the inclusion of cathode-taps on four coils to provide regeneration.

Changing over from straight to super-regenerative circuit is accomplished by switching, and also changing the pin jack from one socket to another.

The 6K7 radio-frequency amplifier is untuned but despite this gives quite an appreciable gain in addition to fulfilling its main purpose of isolating the varying aerial load from the main tuning circuit.

Hum level is negligible, being of the order of .6 volts r.m.s., which is unnoticeable on the loudspeaker and barely audible at reasonable volume on headphones. Incidentally the smoothing circuit merely consists of the loudspeaker field plus a 24-mfd. of capacity.

Low Hum Level

The circuit is, of course, for A.C. operation only, but the arrangement lends itself to modification for use with battery operated or D.C. valves.

A U.H.F. Emergency Transmitter

This low-wattage transmitter uses two 6L6 tetrode valves and is suitable for an input of 15 watts. It is powered by a 6-volt accumulator which drives a Mallory vibrator unit.

In our last issue, we published the preliminery details of an emergency transmitter operating on the ultra-high frequencies. The modulator section shown operates entirely from an accumulator so that it is suitable for all types of emergency or field day use.

Although for emergency use it would be very simple to construct a transmitter running from the public supply mains, the mere fact that it is to be used in an emergency makes it essential that it be self-powered in case of power supply failure.

The wavelength chosen should be between $1\frac{1}{4}$ and 5 metres, in the amateur bands, unless a special permit has been obtained to use another wavelength.

Two Stages

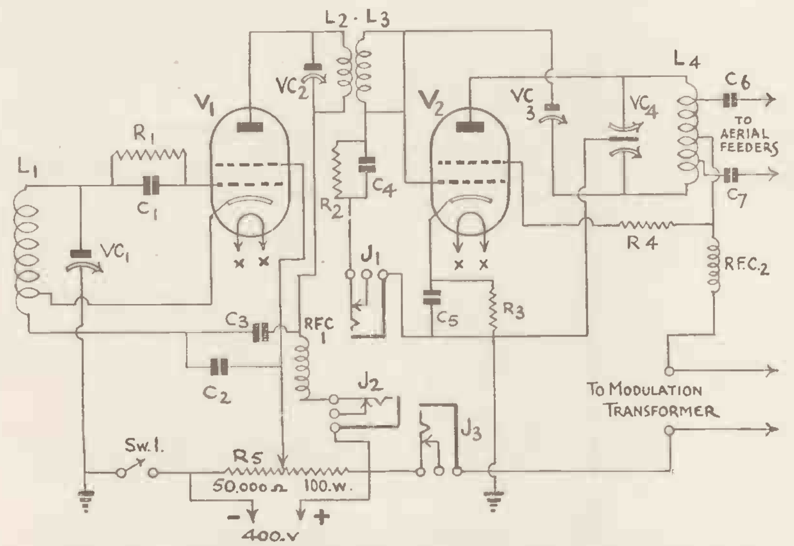
A simple two valve transmitter has been built which lends itself to operation on the higher-frequencies while at the same time it will provide sufficient output to have a reliable coverage of at least ten miles on 5 metres.

By reliable coverage we do not mean the maximum range for this depends so much on local conditions, and has been up to 100 miles with a very high aerial in use.

The circuit of the proposed transmitter is shown in this page where it will be seen that it consists of a conventional electron-coupled oscillator using a tetrode valve followed by a second tetrode as a power amplifier which is anode modulated.

Coil Data

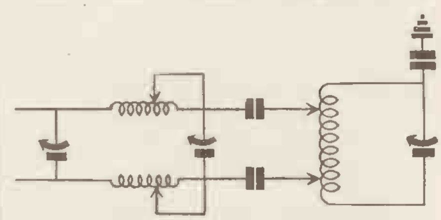
First of all consider the oscillator stage. The coil dimensions for L1 depend entirely on the wavelength to which the transmitter is to be tuned. As the first valve is an electron-coupled oscillator, L1 should be tuned to twice the frequency of L4. For example, with 5 metre operation L1 is tuned to ten metres with L2, L3 and L4 all on the harmonic at 5 metres. For $2\frac{1}{2}$ metre transmission, L1, is tuned to 5 metres with L2, L3 and L4 on $2\frac{1}{2}$ metres.



The circuit for the radio frequency section showing the line-up of the two 6L6's.

Component values are as follows:—VC1.0001-mfd., VC2.00015-mfd., VC3-.00002-mfd., VC4 a two-section condenser of 35-mmfd. per section. Fixed condenser values are C1.01-mfd., with the remaining condensers .002-mfd. Resistance R1 50,000-ohms, R2 10,000-ohms; R3 500-ohms, R4 10,000-ohms; R5 50,000-ohms.

It is suggested that a chassis 12 by 6 by 3 in. be employed so giving a space of 6 in. for each section. The tuning



The ever-popular Collins coupler which is very suitable for 5-metre operation.

condenser VC1 should be arranged so that L1 is bolted directly across the rotor and stator plates with a tapping taken directly to the cathode.

For 10-metre operation L1 should be approximately 9-turns of 12 gauge wire spaced approximately twice the gauge of the wire and the tapping point $1\frac{1}{2}$ turns up from the earthy end.

If the condenser is mounted on a feed through insulator the grid connection is automatically taken through the chassis with the minimum amount of loss.

Maximum R.F. output will be obtained with 400 volts on the anode of the oscillator and 275 volts on the screen. This voltage is extremely critical for there can be as much as a 25 per cent. rise or fall in the output with a variation of 25 volts on the screen.

It is also important that the screen voltage be constant so for this reason it is advisable to obtain the voltage from a low-resistance high wattage potentiometer across the 400 volt supply. This

Components for A U.H.F. EMERGENCY TRANSMITTER

MODULATOR SECTION

CHASSIS.
1—Special steel finished black $13\frac{1}{2}$ by $7\frac{1}{2}$ by 3 ins. (Bryan Savage).

CHOKE, LOW-FREQUENCY.
1—Shrouded type X32B (Bryan Savage).

CONDENSERS, FIXED.
3—25-mfd. type 3016, 25-volt working (Dubilier).
1—.5-mfd. type 1608°S (Dubilier).
2—.01-mfd. type 4601°S (Dubilier).
1—4 plus 4 mfd. 500 volt working type BE355 (Dubilier).

HOLDERS, VALVE.
3—7-pin less terminals type V2 (Clix).

PLUGS, TERMINALS, ETC.
2—Terminals type B marked Output (Belling-Lee).
1—Shrouded top cap connector type 1224 (Belling-Lee).
1—Two way connecting block marked plus minus (Andrew Bryce).
1—Microphone socket (Bryan Savage).

RESISTANCES, FIXED.
1—500,000 ohms type 1 watt (Erie).
1—1,000-ohms 1 watt (Erie).
1—100,000-ohms 1 watt (Erie).
1—25,000-ohms 1 watt (Erie).
1—50,000-ohms 1 watt (Erie).
4—100-ohms 1 watt (Erie).
1—20,000-ohms 1 watt (Erie).

RESISTANCE, VARIABLE
1—500,000-ohms potentiometer type L.A.B. (Erie).

SUNDRIES.
2—Coils Quickwyre (Bulgin).
1—5-way group board (Bulgin).
1—1P7 dial (Bulgin).
2—Dozen 4 BA roundhead bolts, nuts and washers (Webb's Radio).

TRANSFORMER OUTPUT.
1—Type 4250°6000 (Bryan Savage).

ACCESSORIES

MICROPHONE.
1—Special crystal unit (Bryan Savage).

TRANSFORMER, ROTARY.
1—Type 12-volt input 250-volt 80 M°a output (Electro Cynamic Construction Co.)

VALVES.
1—SP13C (Mullard).
2—7D8 (Brimar).

10-watt Carrier :: Rotary Beam

potentiometer only feeds the electron-coupled oscillator for it will be noticed that the screen voltage for V2 is obtained by means of a dropping resistance in series with voltage in the anode circuit.

The anode of V1 is coupled to the grid circuit of V2 by means of a transformer in which the secondary is untuned. Both L2 and L3 are tuned to five metres and consist of approximately half the number of turns used on L1. Coupling between L2 and L3 is adjustable and should be fixed at a point which gives maximum grid current when measured by a milliamp meter in J1.

The 6L6 tetrode output valve is automatically biased by means of the cathode resister R3 which is shunted by .002 mfd. condenser of C5. For guidance when the electron coupled oscillator is operating effectively the DC grid current measured at J1 should be approximately 8 mA.

At this point it is advisable to neutralise V2. With all circuits tuned to resonance and with a grid current of 6 or 7 milli-amps. at J1 remove the high-tension voltage from V2, but keep the heater in circuit. Then adjust VC3 and VC4 simultaneously until a point is reached where the grid current remains absolutely steady.

It should be possible to find a setting of VC3 where VC4 can be adjusted over about 10 per cent. of its capacity without causing any fluctuation in grid current. This 10 per cent., of course, should be either side of the resonance point.

After V2 has been neutralised the H.T. voltage should be applied and we notice that the total anode current in the final stage is considerably in excess of 100 milli-amps. When VC4 is correctly tuned this current should dip rapidly down to approximately 10 to 15 milliamps.

With the aerial cut to length and correctly adjusted it should be possible to increase the anode current of V2 to approximately 15-watts input. The carrier output in such conditions should be between 7 and 10 watts.

The 8-watt modulator with crystal microphone described in the January issue.

During these tests the two leads to the modulation transformer should be connected together, but when the R.F. section is operating satisfactorily they can be connected directly to the secondary of the modulation transformer in the amplifier. This transformer has the secondary wound to an impedance of 6,000 ohms, and if the final stage is correctly tuned this valve should have a working impedance of this figure.

Any type of feeder or aerial can be used, but preferably of the untuned type in order to prevent complications. In many instances a Reinartz rotary beam will be satisfactory for the signals can be transmitted to a given area with the maximum field strength.

Components for AN EMERGENCY TRANSMITTER

R.F. Section

CHASSIS.
1—Aluminium to specification (A.P.A.).

CHOKES, R.F.
2—Pi wound transmitting type (Premier Supply Stores).

COILS.
4—Home-built to specification.

CONDENSERS, FIXED.
6—.002-mfd. type 690W (Dubilier).
1—.01-mfd. type 691 (Dubilier).

CONDENSERS, VARIABLE.
1—.0001-mfd. type 1054 (Jackson Bros.).
1—.00002-mfd. type 2141 (Jackson Bros.).
1—.000015 mfd. type 2140 (Jackson Bros.).
1—.000035-mfd. 2-section type 2148 (Jackson Bros.).

DIALS.
3—Pointer knobs and dials type 1027 (Eddystone).

HOLDERS, VALVE.
2—Type Octal chassis mounting (Premier Supply Stores).

PLUGS, TERMINALS.
3—Closed circuit jacks (Bulgin).
1—Open circuit jack (Bulgin).
1—Plug (Bulgin).

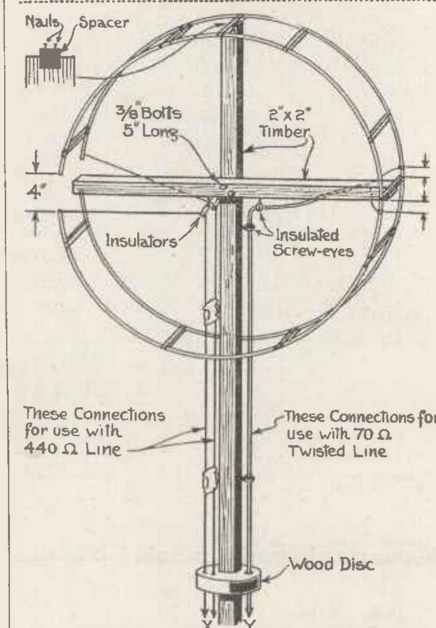
RESISTANCES, FIXED.
1—500-ohm 10-watt (Erie).
1—50,000-ohm 15-watt (Premier Supply Stores).
1—15,000-ohm 8-watt (Premier Supply Stores).
1—10,000-ohm 15-watt (Premier Supply Stores).
1—50,000 ohm 75-watt with tapping clip type Aerovox (Webb's Radio).

SUNDRIES.
4—Stand-off insulators type 1019 (Eddystone).
1—1046 (Eddystone).

SWITCHES.
3—Type S80T Toggle (Bulgin).

TRANSFORMER, FILAMENT.
1—6.3 volt 1.8 a. (Premier Supply Stores).

VALVES.
2—6L6G (Tungsram).



A rotary beam of this kind will provide a highly directional signal in any given area. It is ideal for ultra-short wave use.

Italian stations, which concentrate mainly on 25 and 31 metres, pick out the best programmes from their medium-wave broadcasters, so for this reason their programmes are more than usually interesting. They finish up most evenings around 12.15 a.m. with an international news bulletin, which is sometimes interesting, but more often humorous by reason of its biased outlook.

There are lots of little short-wave stations in South America, and occasionally some of them transmit really entertaining programmes. Most of them can be found between 45 and 50 metres and reach their peak strength between 10 p.m. and midnight.

"NEW SYSTEM OF LARGE SCREEN PROJECTION."

(*Continued from page* 99)

In Fig. 3 is shown a cathode-ray tube construction, in which sectional blackout is secured by means of an auxiliary blackout beam scanned in advance of the main beam in the direction of the frame deflection. In this arrangement the first secondary emitting surface is divided up into four sections S_1, S_2, S_3 and S_4; the second secondary emitting surface, which is also the fluorescent screen, being arranged parallel to and at a small distance from the first surface. The main scanning beam is projected from cathode C_1 and guns G_1, comprising three sections to form an electron lens, the beam being scanned over the first secondary emitting surface by means of the electro static line and frame deflection plates P_1.

The auxiliary or blackout beam, which is rectangular in cross section, is produced from a second cathode C_2, and projected by a second gun G_2, which is in the form of an extension of the first gun G_1, and is so shaped and arranged to project a fairly wide beam, the depth thereof being slightly less than the width of the sections into which the first secondary emitting surface is divided. Plates P_2 are provided for scanning the auxiliary beam in the direction of the frame deflection, and are connected directly with the corresponding plates for deflection of the main beam.

The externally applied frequency is generated by means of a high frequency generator valve V, having four output electrodes or anodes, each anode being connected directly to a corresponding section in the first secondary emitting surface, so that an ultra-high frequency voltage is developed across each of these surfaces, and the fluorescent screen. The required oscillations are generated by suitably back coupling an auxiliary electrode S, of the valve V. to the control grid circuit LC of this valve.

Tuned circuits set to the same frequency as the control circuit LC are directly connected in the circuit of each of the anode sections, and are respectively connected through suitable feeders, to each of the sections S_1, S_2, S_3 and S_4, comprising the first and secondary emitting surface. This arrangement has the special advantages of frequency stability, and power efficiency, whilst the amplitude of the generated frequency is not affected by changes in the constants of the external circuits, of the main anodes such as occurs through the action of the blackout beam. Picture signals are applied to the intensity controlling electrode E_1 of the main scanning beam.

Blackout is secured by suitably modulating the intensity of the auxiliary beam by the externally applied frequency, and this is effected by connecting the electrode E_2 to the auxiliary grid S_1 of the generator V. In addition negative frame synchronising voltages are applied to this electrode at S′ to produce blackout of the auxiliary beam during the frame fly-back.

The operation of the system is such that incidence of the blackout beam on any one of the surfaces S_1, S_2, S_3, S_4, produces neutralisation of the ultra-high frequency voltage existing thereon, without affecting the voltage on the other sections. The result is that the sustained secondary emission process previously occurring between this section and the screen surface, before the incidence of the blackout beam, is caused to cease instantaneously.

In order for this effect to operate correctly, the phase of the modulation of the blackout beam is arranged to be identical with the phase of the high frequency voltages developed on the sections S_1, S_2, S_3, S_4, so that the ultra-high frequency voltage developed by the blackout beam when incident on one of these sections is in reverse phase to that already existing thereon.

The operation of the system is such that the main scanning beam forms an electron picture on the first secondary emitting surface, which is reproduced as a retained light picture on the second surface or fluorescent screen, through the action of the sustained secondary emission process operating between these surfaces. The retained picture of the preceding frame is blacked out, section by section, immediately in the path of the new frame, by means of the blackout beam, which is scanned in the direction of the frame deflection, immediately in front of the main beam.

It should be noted that in Fig. 3 the arrangement is such that the frame scan takes place in the upward direction and the frame fly-back in the downward direction, so that although the blackout beam is shown above the scanning beam in the figure, it works in advance thereof. The application of negative frame sync. pulses to the control electrode E_2 of the blackout beam, prevents blackout of the retained picture of the preceding frame during the frame fly-back.

Further Possible Arrangement for Securing Sectional Black-out

A further arrangement for securing sectional blackout consists in employing four separate high frequency generators connected respectively across each of the four sections into which the first secondary emitting surface is divided, and a separate blackout deflection tube arranged to produce progressive quenching of the generators during the frame scan.

The Det 12—Output Figures

A number of our readers have been disappointed with the radio-frequency output obtained from some of the modern low-capacity high-efficiency triode valves. The troubles have been due mainly to bad circuit design, but in order to prove and to indicate just what sort of R.F. output should be obtainable with a good 50-watt triode valve we have chosen the Det12 for this purpose.

This valve, marketed by the General Electric Co. Ltd., is one of the best examples of good design for ultra-high frequency use. It has a standard British 4-pin base of which the grid and anode pins are left blank, these connections being made to pins at the top of the bulb. In this way the grid and anode connections are extremely short, while losses between them are kept to a minimum.

Providing the circuit constants for use with this valve are of an optimum value a very high degree of efficiency can be obtained. When building the power amplifier stage it is most important that the tuning condenser be on a level with the anode pin, having the tuning coil bolted directly to the condenser, and with the neutralising condenser also connected by the shortest possible leads.

The Det 12 valve has an overall length from pin to top connection of 165 mm. The maximum diameter is 65 mm.

Then, should the correct condenser value be used with a high anode inductance the efficiency goes up very rapidly. Readers who have failed to obtain the required output, not necessarily with the Det12, but with any type of low-capacity valve, should bear this point in mind. Construction and correct tank circuit capacity are of vital importance if maximum efficiency is to be obtained.

When used in push-pull in an ultra-short wave circuit the following interesting data has been obtained:

Filament Volts, 7.5.
Filament Current, 3.15 amp.
Anode Volts, 1,250.
Minimum useful Wavelength, 0.9 metre.
Output at 2.1 metres (2 valves), 85 watts.
Efficiency at 2.1 metres, 44 per cent.
Output at 2.5 metres (2 valves), 98 watts.
Efficiency at 2.5 metres, 49 per cent.

It will be observed that at the ultra-short wavelengths around 2.5 metres and as low as 2.1 metres the Det12 gives an exceedingly high output with a high degree of efficiency. The reason for this is easy to see, for the design, general construction and characteristics are ideal for operation below 5 metres.

200 Watts

Two valves used at 30 Mc. with maximum possible efficiency will provide a carrier of approximately 200 watts without exceeding the rated anode dissipation of 100 watts per pair of valves. In such conditions the anodes do not colour, neither is the life of the valve affected. Full information on the Det12 can be obtained from the Valve Dept., The General Electric Co., Ltd., Magnet House, Kingsway, W.C.2.

"A Push-Pull Transmitter for 5 and 10 metres."

(*Continued from Page* 118.)

the chassis. In this way there is no possibility of breakdown due to faulty insulation.

About 400-volts at approximately 150 mA. are required for the crystal oscillator and doubler, while for maximum input approximately 800 volts at 200 mA. are needed to feed the final two stages. The additional 50 volts are optional for they merely make quite sure that a full 750-volts are applied to the T20's after automatic bias has been deducted.

In the original circuit meters were not permanently mounted on the chassis, but as the unit has since been mounted in a relay rack we have included a set of meters to read anode and grid current as shown in the illustration.

We have made arrangements for Messrs. A.P.A., Ltd., to supply the chassis and panel already cut and drilled to constructors' requirements.

For 'phone use we suggest anode modulation while approximately 40 watts of audio are required.

We have obtained extremely satisfactory results on the 10 metre band with this arrangement, while the R.F. output on 5 metres indicates that quite long distances can be covered in suitable circumstances. If constructors have any queries on operation we shall be glad to answer these if a stamped addressed envelope is supplied.

"The Southend and District Radio Society."

The annual general meeting of the Southend and District Radio and Scientific Society was held at Westcliff-on-Sea on Friday, January 7.

The Hon. Treasurer, Mr. E. H. Bridges, reported that the financial position of the Society had improved during the year, a small deficit having been turned into a balance in hand.

The Hon. Charities Secretary, Mr. Fred Waller, reported by letter that the excellent work in connection with blind persons' sets was being maintained by Mr. Ward, and that various members were doing yeoman work in other connections.

The business part of the meeting having concluded, Mr. H. B. Dent gave a talk on "Recent Progress in Ultra-short Wave Communication," followed by a demonstration on 56 mc., when G2LC co-operated from his home station some two miles distant. Two-way communication was maintained. G2LC's signals are of excellent strength (R9+) and quality. Car interference was too bad to hear any weak signals.

On January 21, Mr. P. G. A. H. Voigt gave an excellent talk and demonstration entitled "Reproduction."

The Society invites all interested in its many activities to communicate with the hon. secretary, Mr. J. M. S. Watson, G6CT, of 23 Eastwood Boulevard, Westcliff-on-Sea, Essex, who will be pleased to furnish details of meetings and answer any inquiries.

"The Three Bears"

A children's ballet, "The Three Bears," is to be televised in the afternoon and evening programmes on February 7. The music is by Eric Coates. The choreography is by Joy Newton, who will bring her Vic-Wells company of Child Dancers to the studios at Alexandra Palace. The ballet tells the familiar story of Goldilocks and the Three Bears, which lends itself admirably to picturesque orchestral treatment. Running through the work is a kind of musical motto based on the bears' indignant exclamation: "Who's been sitting on *my* chair?"

Goldilocks will be represented by Julia Farron, and the Father, Mother and Baby Bears will be Leslie Edwards, Wenda Horsbrugh and Margaret Bolam, respectively. "The Three Bears" will be presented by Elizabeth Cowell, the television announcer.

OPPORTUNITIES SECTION

BUSINESS :: EQUIPMENT :: EMPLOYMENT :: MISCELLANEOUS

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