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Television and SHORT-WAVE WORLD

APRIL 1939 1/-
No. 134 Vol. XII.

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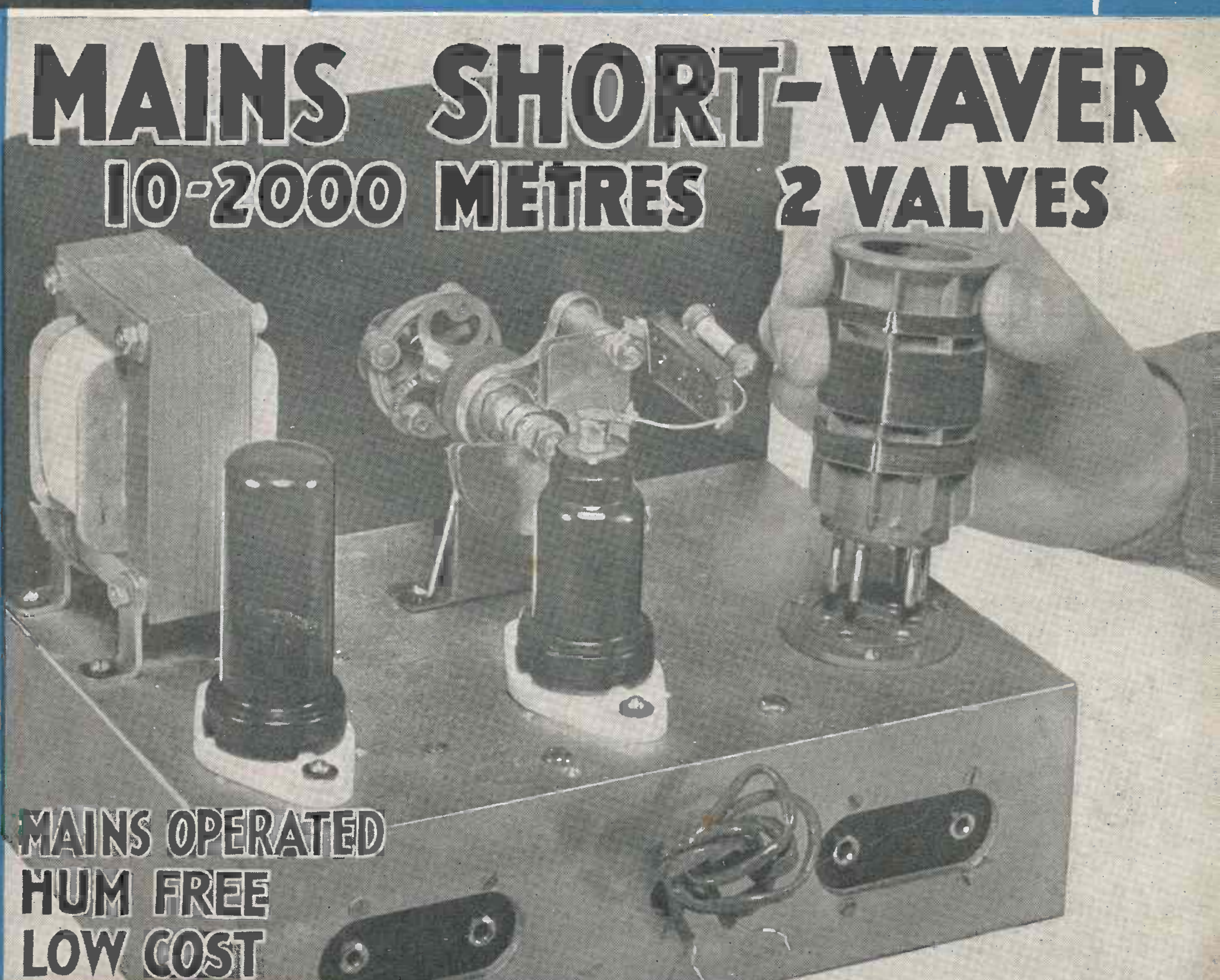

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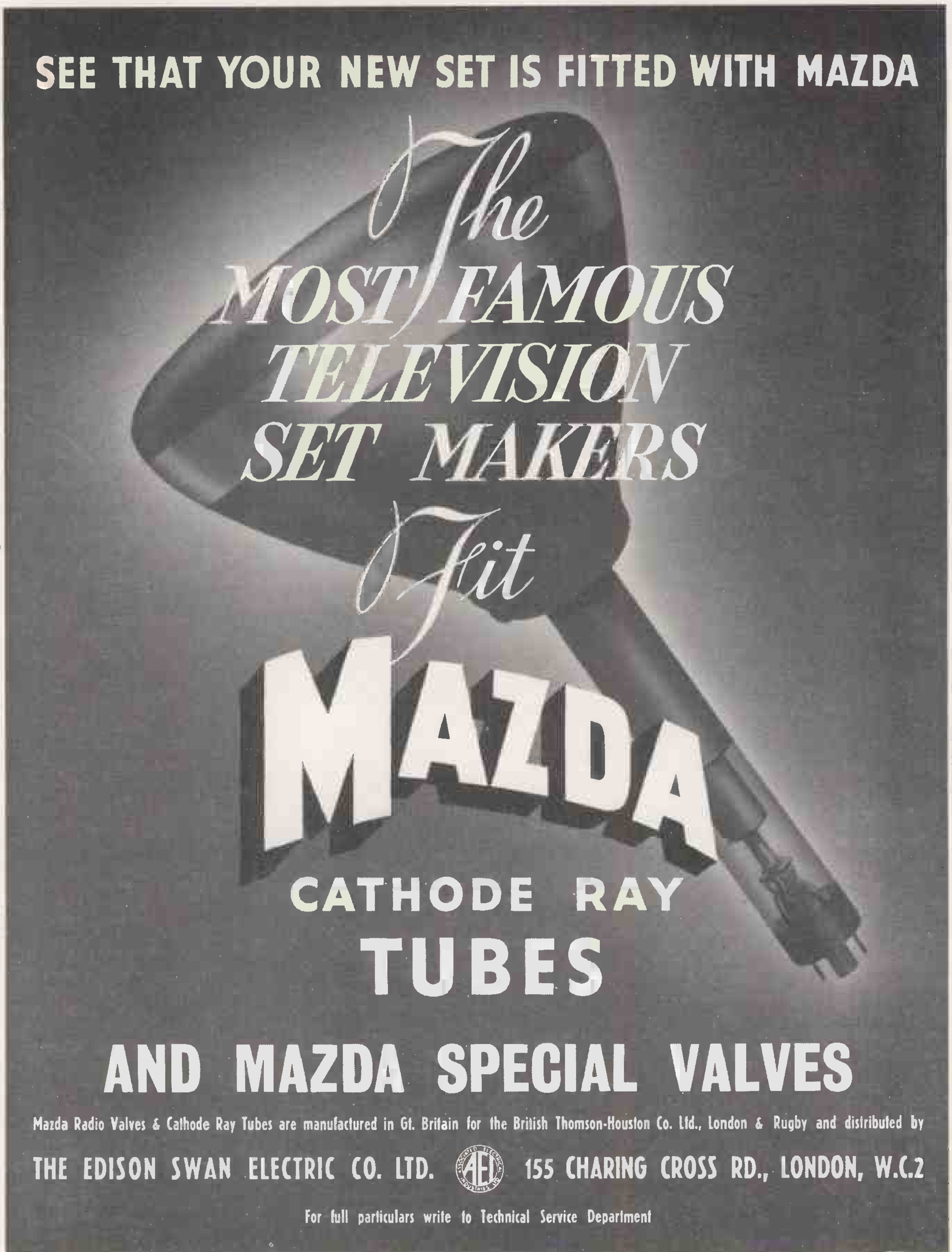
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COMMENT OF THE MONTH

Rediffusion

A GREAT deal of the uncertainty regarding the position of cinemas and television, and indeed any paying audience, has been cleared up by a statement of the B.B.C., which, it says, is given to make its own position clear. This statement should give a real fillip to the installations of receivers in public places, because it clearly indicates that the B.B.C. is agreeable to public showing of televised events in which there is no copyright. The statement says:—

> "Much misleading publicity has followed the theatrical reproduction of the B.B.C. television transmission of the Boon-Danahar contest on February 23. The B.B.C., therefore, wishes to makes its own position clear.
>
> "Large screen projection of television programmes is still regarded as experimental, and permission to use B.B.C. transmissions in this way will be subject to certain necessary restrictions. Experience of the results will afford guidance as to future policy, which is still under consideration by the Television Advisory Committee.
>
> "The B.B.C., although primarily concerned with the provision of a home service, does not oppose experiments in large screen rediffusion of its programmes before paying audiences, when the programmes concerned are either of events of national importance and interest, independent of commercial promotion; or when the subject is a sports event, the rights in which are held by a promoter.
>
> "For the present, therefore, the B.B.C. will raise no objection to rediffusion of events in the latter category if agreement as to terms is reached between the rediffuser and the promoter, subject to certain conditions. The conditions include an undertaking that no exclusive rights shall be given to any one group or system, and that all applicants shall be granted rights on equal terms, based approximately on the relative seating capacity of the theatres concerned. Should the promoter object, the B.B.C. will act accordingly and withhold permission to reproduce."

It is obvious that the whole problem of public showing of television programmes is exceedingly complex on account of proprietary rights which exist in a very large number of instances and it would appear almost impossible to obtain any ruling which would cover them all. This gesture on the part of the B.B.C., however, opens up possibilities and will certainly serve to encourage the further development of large screen apparatus. The possibilities are enormous and it is only right that this relatively new branch of television should at the outset be as free from hampering difficulties as possible.

FRENCH PROGRESS IN TELEVISION

AN EXCLUSIVE ACCOUNT OF THE WORK OF THE MONTROUGE EXPERIMENTAL TELEVISION STATION

BY THE DIRECTOR

R. Barthelemy, Ing.E.S.E.

Fig. 3. General view of the Centre Experimental de Television de Montrouge (1937)

THE first images which we presented in France in 1929 were constituted of 10,000 elements per second with the mechanical scanners and receivers, the essentials of which are shown by the photographs Figs. 1 and 2. To-day, 6,000,000 elements per second must be transmitted in the same time in order to achieve a 450-line picture. Electronic processes have been substituted for mechanical processes, and an entirely new technique had to be developed.

Fig. 1. Mirror-drum scanner (Montrouge 1929)

This was the reason for the creation of the Television Experimental Station of Montrouge, founded by the *Compagnie des Compteurs,* and comprising more than 4,000 square metres of laboratories. This included a transmission station, employing 20 specialist engineers, as many assistants and draughtsmen, and an executive staff of double that number. (Fig. 3).

The main object of this project was to secure autonomous and, therefore, complete production. Agreements had already been reached which, by the simple method of an exchange of patents, procured for us the benefit of foreign technical progres in this sphere. The field of research and the application of known principles was, therefore, no longer limited by industrial restrictions and the initiative and the resources of the research engineers was thus allowed full scope.

As these investigations have clearly defined industrial aims, we have been concerned not only with equipping the laboratories with highly specialised apparatus — particularly for electronic work—but also with testing the models constructed, whether for transmission or reception, under practical conditions.

This has led to the construction of a complete transmitting station with a power of several kilowatts, and also a spacious reception hall equipped for screen projection.

Studio Lighting

The studio is equipped for lighting, sound and signalling, and with movable scenery, and is in every way capable of being put to regular use. The lighting, in particular, reaches an ideal standard and is obtained by a series of racks entirely composed of small lamps of 100 watts, capable of regulation, forming a luminous ceiling of uniform brightness which avoids dazzling. The direct heat radiation of the lamps is reduced by 80 per cent. for wavelengths below 8,000 angstroms by a filter of special glass, which obviates the necessity for any other cooling means, the heat being naturally dissipated into the upper part of the hall which is 7 metres in height. (Fig. 4).

An experimental study of reverberation conditions by oscillographic recording led to the use of acoustic-deadening materials covering the ceiling and a small part of the walls. The periods of reverberation were thus reduced approximately in the ratio of 10:1.

Ten rolling bridges controlled from the side galleries support the lamp racks and the accessories in such a manner that the floor is absolutely

Fig. 2. An early disc receiver

free and can be devoted entirely to the artistic side.

The sound operator's box overlooks the studio, and it is from there that the signals are given to direct the transmissions. The technical arrangement and equipment of this room is, however, equally well suited for studio microphone transmission, for sound accompanying film transmissions, for exterior retransmissions, for the use of records, etc., with the further possibilities of new combinations.

The studio electronic camera is mounted on wheels (Fig. 5), and is movable in any direction; it can be taken also to an adjoining garden and used for the taking of exterior views. The latter are possible even in dull weather; with an illumination of less than 200 lux.

The electronic camera requires a cable with 32 conductors—of which several are coaxial—for its connection with the amplifier units situated in an adjoining room.

A film scanner is another essential part of the transmitting gear (Fig. 6). Here again the electronic method is used and the film to be transmitted is projected directly on to the mosaic screen of the Iconoscope. Special apparatus makes it possible to make use of the integrating quality of the Iconoscope with an ordinary film projector. Scanning is effected at the rate of 50 demi-images per second and permits the transmission of 450 interlaced lines according to our method, kwown as *à déphasage interne,* to which we shall have occasion to return.

Fig. 4. View of the studio showing lighting arrangements

A synchronising signal generator, presenting a strong mechanical inertia, ensures the production of an exact series of impulses.

Development and research have led to the construction of an apparatus known as a mixer, the function of which it is to transmit to the various controls and to the transmitter one or other of the chosen scenes (direct pick-up or film transmissions) or gradual superposition of the two. In this manner some very interesting transitions can be obtained.

Distribution

The distribution lines, 10 in number, at the output of the mixer, are coaxial cables with an impedance of 150 ohms. One of these goes to the transmitter which is at a distance of about 80 metres (Fig. 7). A special line is reserved for the D.C. component.

Starting at a level of 3 volts, the modulation is amplified while retaining, without appreciable distortion, its amplitude and *phase,* over a frequency band, from 25 to 3,000,000 cycles/second; the amplified signal modulates a push-pull H.F. stage, comprising two water-cooled valves of 3 kW, is working on a quartz-controlled 8-metre wave.

The D.C. high tension (8,000 V.) is furnished by a mercury arc rectifier, and the auxiliary supplies by several groups of rotary generators. The total power consumption reaches 40 kWs, while the maximum power furnished to the feeder is from 6 to 8 kWs. This low efficiency is due to

Fig. 5. (Left) Iconoscope camera for studio use.

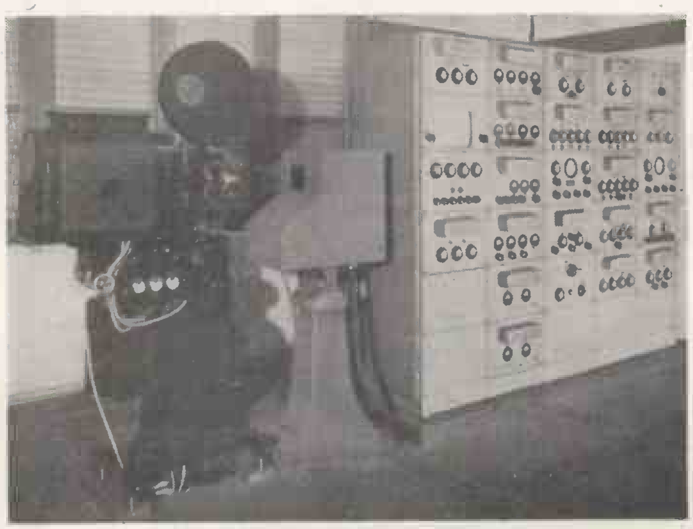


Fig 6. (Right) Film scanner and amplifier

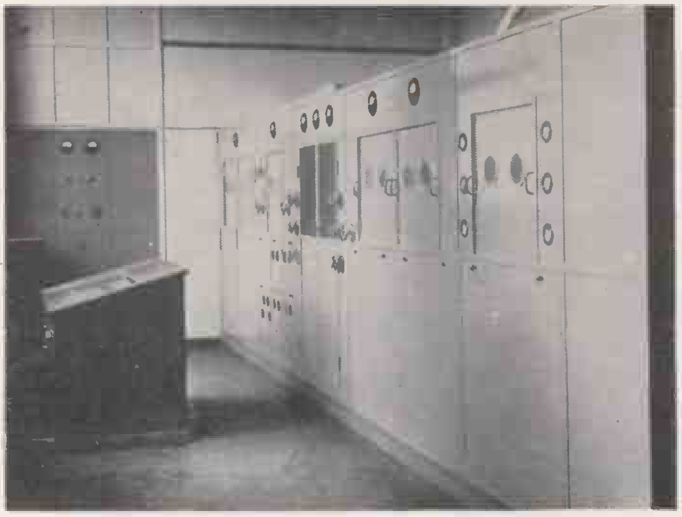
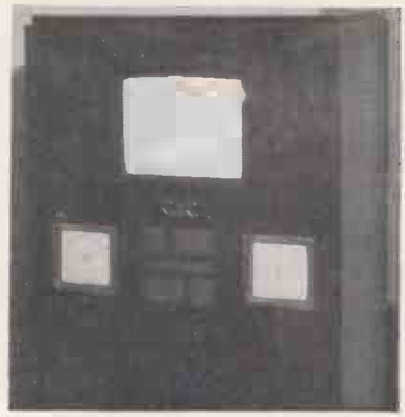


Fig. 7. (left) The 6-kilowatt transmitter.

Fig. 9. Experimental receiver with 360 mm. tube.



the size of the frequency band to be transmitted.

The aerial, which is at a height of 50 metres, is fed by a coaxial cable and has a form required for the transmission of such a wide band.

The field strength of this transmitter is sufficient for the satisfactory reception of the Experimental Station at a distance of 20 kilometres, which is quite sufficient for the experiments we have in view.

Parallel with the studio, there is a large reception hall furnished and equipped like a cinema. It is provided with a high-voltage cathode-ray tube (at present 40,000 V. and in the near future 60,000). The image, relatively small (100 by 80 mm.) formed on the flat bottom of this tube, is projected by a large objective (aperture $\frac{1}{1.4}$) on a ground glass screen.

I am only repeating the words of the majority of the spectators when I say that the results obtained are up to the standard of a good amateur cinema projection, both as regards light and definition. The quality of transmission and reception together has been recorded by photographs, of which Fig. 8, which has not been retouched, is an example.

Research Laboratories

The research laboratories, which are set out on two floors, comprise on the first the scanning technique department, the reception research department, the optics laboratory and the recording department. In the latter apparatus is prepared, which is not specifically destined for television but for associated technique, for instance, the first portable recording oscillographs to be constructed in France, and which are now in general use, were developed here.

Fig. 8. Untouched photograph of 450-line picture.

Oscillographs sensitive enough to allow recording with writing speeds higher than 100 Km/second have also been devised in very simplified forms. Signal generators producing all kinds of wave forms (rectangular, saw-toothed) and of all frequencies have been developed and are in constant use in the two adjoining reception and scanning laboratories.

There are already three distinct types in the range of receivers: a small model with a tube of 180 mm.; a medium-sized standard model, with a tube of 360 mm. (Fig. 9), and a receiver with screen projection.

Our present aim constitutes research into possible simplifications with a view to reaching a reasonable low price. There is, therefore, no longer pure research but industrial study.

The cathode-ray tube department occupies the whole of the second floor, with its testing rooms, pump and drying rooms, glass blowing workship and chemical laboratory. The first task was the making of recording tubes with electrostatic deflection and focusing; following that the television tube of 36 cm. diameter and only 45 cm. in total length, was taken to its highest pitch. This gives a very brilliant image (80 lux in the white parts) with a voltage of 6,000. It has electromagnetic deflection and focusing.

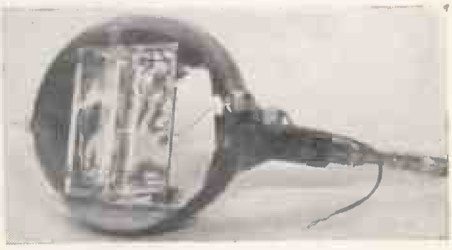
Tubes for projection (Fig. 10) with flat bottoms, operating at from 20,000 to 60,000 volts, were recently constructed and experimented with.

The study of photo-electric cells and secondary emission cells and finally the Iconoscope (Fig. 11) required special apparatus. The making of photo-sensitive mosaics has been brought to a high degree of perfection; in fact, the coefficient of

(*Continued at foot of next page*)

Fig. 10. (left) Three experimental projection tubes (20,000 v. 40,000 v. and 60,000 v.)

Fig. 11. (right) Camera pick-up tube.



BAIRD CINEMA EQUIPMENT

GREAT PROGRESS: 15ft. x 12ft.: 400 M/A BEAM CURRENT

FOR a considerable time Baird Television, Limited, have been active in the development of big screen television equipment, and during the course of the past twelve months have given many demonstrations at the Tatler Cinema, Charing Cross Road, where television pictures were projected on to a screen 8 ft. by 6 ft. 6 in. It has always been realised, however, that for very large audiences it would be necessary to increase both the size of the screen and the brightness of the picture. The material step forward in this connection has now taken place.

The latest form of apparatus gives a picture size of 15 ft. by 12 ft., and the picture brilliancy in the high lights is comparable to that obtained by ordinary cinema film projection. This equipment has been installed in the Marble Arch Pavilion and was used for showing the Boon-Danahar boxing match on February 23. This is the *first time in the world* that a public paying audience has seen an outside television broadcast of this nature in a cinema on a screen of these dimensions.

At the same time the Tatler cinema, Charing Cross Road, featured the same event using similar apparatus with a screen size of 12 ft. 6 in. by 10 ft. 0 in.

Intensive research into all the problems associated with projection-type cathode-ray tubes has enabled the Baird Company to manufacture this new form of equipment. The projection cathode-ray tubes have a diameter of approximately 16 in., but the intensely bright picture is built up on a fluorescent screen 5.5 in. by 4.4 in.

The new projection type tubes have a screen which is mounted inside in such a manner that its front face is scanned obliquely by the electron beam. Keystone distortion is corrected electrically and the resultant intensely bright picture is front-projected on to a silver surfaced screen that rises into position through a trap door on the stage. At the Marble Arch Pavilion the lens employed is a 14 in. f/1.8 type and at the Tatler a 10 in. f/1.6 type. The projector is accommodated in the centre of the stalls several feet away from the screen, the metal housing containing all the controls and meters to enable the operator to make any adjustments that may be required during the course of the actual transmission.

Each projector unit is of the twin type, that is to say it has two cathode-ray tubes which are kept running continuously. One of these projects the picture on to the screen while the second acts as a standby so that it can be brought into action immediately, should the necessity arise.

400 Micro. amps. Beam Current

Apart from the E.H.T. power supply all the essential apparatus is accommodated in this single container to which an aerial feeder connection is made so that the signals received from the standard television aerial on the roof of the cinema can be fed direct into the vision chassis. Normally, the cathode-ray tubes are operated at a voltage between 40,000 and 45,000 volts while the actual beam current is of the order of 300/400 microamperes. The source of high voltage fed into the projection tubes is derived from a special high-tension rectifier unit which is accommodated in another section of the theatre.

This unit comprises a voltage-doubling circuit employing two valves and is capable of giving a total output of 60 kilovolts at 10 mA. Separate transformers are arranged to heat each of the valve filaments and these transformers together with the main E.H.T. transformer and smoothing chokes, etc., are immersed in a tank filled with insulating oil. A ballast resistance joined across the output supply of the E.H.T. transformer protects the winding against any damage should a short circuit occur.

The whole of the equipment has been designed to meet all L.C.C. requirements for public use and the E.H.T. unit for this purpose is used in a safety cage so that when the door of the cage is open the supply is switched off automatically and the positive E.H.T. terminal earthed. Similarly, of course, it is impossible to restart the equipment unless the door is correctly shut. The total consumption of the whole equipment is only about 2 kilowatts and has been designed to operate from 50-cycle A.C. mains 200/250 volts. The sound installation has an overall frequency response from the aerial to the loud speaker speech coil of plus and minus 4 decibels from between 30 cycles to 20,000 cycles per second.

FRENCH PROGRESS IN TELEVISION

(*Continued from preceding page*)

usable surface has been raised from 25 per cent. at the outset to 66 per cent. with proportionate increased sensitivity.

The establishment of what is now called The Experimental Station of Montrouge has thus brought about, within the national framework, the solution of numerous problems and this courageous effort constitutes the first step in an industry in which is concerned the whole study and technique of electronics.

In my opinion if these studies and investigations continue there should be no reason of a technical nature to justify the delay in the exploitation of television in France. There remain only questions of administration and finance and unfortunately it is not in our power to find solutions in this sphere. . . . From this point of view we warmly congratulate our English colleagues upon their brilliant organisation of the industrial launching of television.

Dipole Measurements

There is considerable variation in the accepted dimensions of commercial dipole aerials, a fact which might lead to the supposition that there is no definite formula. The reason is that as both sound and vision are received upon the same aerial it is necessary to tune it either to one or the other, or alternatively, effect a compromise.

Some makers prefer to tune to sound and others to vision. Formulae for calculation of dimensions that have been generally accepted as correct are as follows:—

$$\text{Aerial in feet} = \frac{477}{\text{Frequency in megacycles}}$$

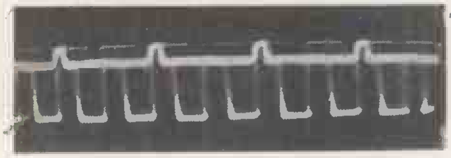
$$\text{Reflector in feet} = \frac{492}{\text{Frequency in megacycles}}$$

$$\text{Director in feet} = \frac{548}{\text{Frequency in megacycles}}$$

A PRACTICAL GUIDE TO TELEVISION RECEIVER SERVICING

PART II.

By W. A. L. Plews



Input. Showing complete line signal on black cross. Signal phase reversed.

Tube Faults

Electrostatic Tubes.—Where all the contacts are brought out to the base, damp and dust will often cause leakage between high and low potential points. On the screen this may show as bright flashes.

Careful handling of these tubes is very essential as it is quite easy to displace the internal electrode structure with rough usage to such an extent that the picture shift controls cannot bring the picture into its correct position in the mask aperture.

Magnetic Tubes.—With magnetic tubes the electrode structure is much simpler, consisting of a cathode, grid and anode, and in consequence the same danger does not exist. As a general rule all tubes should be most carefully handled and unsplinterable goggles always worn whenever the tube is exposed.

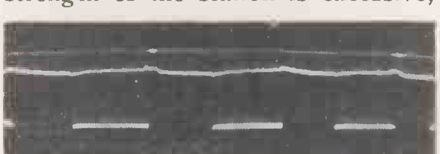
Apart from elementary defects such as disconnections or faulty contact in the tube base, the chief faults which develop are gradual loss of cathode emission, formation of ion spots and loss of fluorescence of the screen material.

The first and last give rise to dim pictures and the second to brown patches on the screen. It is, of course, a manufacturing defect and the tube should be returned to the makers.

Occasionally, a tube is found which has gone soft. This fault is characterised by loss of vision, a blue glow in the tube neck and eventually the smoothing resistance in the E.H.T. supply will burn out owing to the excessive beam current the tube is passing.

Interference

Apart from ignition and electrical apparatus interference may arise from other sources. Where the field strength of the station is excessive, intermodulation of the sound and vision signals may take place in the receiver causing a pattern of vertical lines on the screen. Rotation of the tuning control will cause them to change in direction leaning first one way and then the other as the control is altered about the correct tuning point. The remedy is to reduce the input to the aerial terminal by a properly constructed attenuator network.



Oscillogram of black cross signal using 50-cycle time base; taken at anode of video stage. A similar trace can be obtained at the detector.

Frame Time base inoperative.

To calculate value of r^1 and r^2

$$\frac{R-1}{R+1} \times 80 \text{ where } R = \text{ratio of attenuation required.}$$

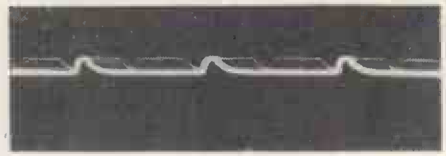
To calculate value of r^3

$$\frac{2R}{R^2-1} \times 80 \text{ where } R = \text{ratio of attenuation required.}$$

The formula given may be used for calculating the values of the resistance for any ratio of attenuation required. It assumes an input impedance of 80 ohms.

A continuous rain of white specks continuing with the aerial disconnected denotes arcing in the set. The trouble usually makes itself evident on examination though it may be helpful to work in a darkened room.

A heterodyne pattern which breaks the picture up into a diamond check formation may be caused from outside interference or generated by instability in some portion of the vision receiver. In the latter case all earthing points in the high-frequency end of this portion should receive attention.



Output from filter showing removal of vision portion of transmitted waveform.

Use of Instruments

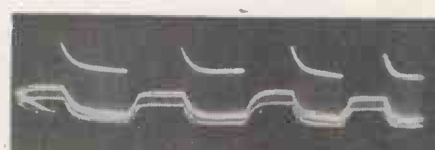
For complete checking purposes the following instruments are required:—

1. Multi range meter—1,000 ohms per volt.
2. Electrostatic or other high impedance voltmeter. 20,000 ohms per volt.
3. All wave oscillator with large output (1-2 volts R.F.).
4. High voltage ohmmeter or megger.
5. Service oscilloscope.

The oscillator is necessary both for stage-by-stage testing in the vision and sound receivers and for receiver alignment. Where the vision chassis is deemed at fault and a quick voltage check has shown the presence of all normal voltages a signal should be injected from the oscillator into the video end of the chain. The A.F. note of the oscillator, if available, should be used and the full output will be required. Injection should be on the grid of the video amplifying valve though, of course, if such a stage is not incorporated a start can be made from the detector at R.F. or I.F. according to whether the receiver is of the straight or superhet type.

The C.R. tube may be used as an indicator and a pattern of horizontal bars should be obtained. If the oscillator has only a low output, however, it will be necessary to use the oscilloscope, with amplifier, as an indicator. Each stage of the vision receiver can be tested by injecting an appropriate signal working from output to aerial terminal.

The oscillator is also of use in checking up the linearity of either time base. The frame time base can be tested by injecting a modulated signal into the aerial terminal. If the



Oscillogram taken at grid of C.R. tube of the same 50-cycle signal. This illustrates a faulty D.C. restoration circuit. If this section is functioning correctly the trace should appear as on the left.

modulation is 400 cps., then eight horizontal bars should occur on the screen. The actual number is unimportant, but the spacing between bars will show whether or not the vertical scan is linear. The line time base requires a pattern of vertical bars, and this can be formed by feeding a signal of approximately 120 kc. into the grid of the video stage or the C.R. tube. A large output from the oscillator is necessary. The spacing between the vertical bars produced on the screen can be used as a check on the linearity of the line scan. The internal modulation of the oscillation must be switched out. An electrostatic or high-resistance voltmeter is necessary to test the 5,000 volt line.

Its use comes not in finding out complete breakdowns in these circuits, when the cause is usually apparent, but in checking the actual voltage in cases where partial failure is suspected.

The high voltage ohmmeter or insulation tester is extremely valuable in testing continuity in high impedance circuits, testing condensers, and locating leaks in insulation. The applied voltage should be of the order of 1,000 v.

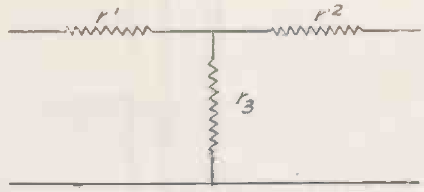
The service oscilloscope is an essential item if time is a consideration. Properly handled it can save hours of testing and frequently the only other method available is the laborious one of substitution. The new Mullard oscilloscope type GM3155 designed especially for radio and television servicing will be found admirably suited to this work. The most obvious uses to which it can be put in television service work are the following:

1. Location of loss of vision at any point after the video detector.
2. Checking waveform at input and output of synchronising filter.
3. Locating faults in time bases.
4. Locating ripple in H.T. supplies.

The correct functioning of filter circuits can only be satisfactorily determined by visual examination with the oscilloscope.

A few typical oscillograms are shown, and the points in the circuit where they have been taken are indicated.

In conclusion, it may be taken that television servicing is no more difficult than radio servicing, it merely being a matter of getting used to visual rather than aural indications. Since the eye is a far more reliable and accurate indicator than the ear, this fact should present little difficulty. It should be remembered, however, that due to this fact a customer will be more critical of his television receiver than his sound receiver and will be apt to complain of faults which he might not notice in a parallel case in a sound set.



Circuit of alternator network for reduction of input.

The Mullard type G.M. 3155 portable cathode-ray oscillograph employing a three-inch high-vacuum tube.

"The Assured Future of Television"

"THE future of the home television service is now assured," said Sir Stephen Tallents, B.B.C. Controller of Public Relations, at a luncheon of the Radio Manufacturers' Association last month.

"The pace of its establishment alone remains in doubt," continued Sir Stephen Tallents. Beyond that, possibilities of great interest are being explored—the possibility in particular of the adoption of television in cinemas. Here the future is not yet clear. A great variety of legitimate interests are involved—the manufacturers of television equipment for places of public entertainment, the promoters of outstanding events, the film producers and distributors, the owners of cinemas, the artists and authors and performers among them.

"The B.B.C. believes that it is taking the wise and public-spirited course in concentrating on the development of that now certain success—home television—and at the same time co-operating, as real and promising opportunities occur, in experiments which may shed light on what is bound for some time yet to be a complex problem.

"At the back of this industry's development are such forces as the Television Advisory Committee, the Post Office and the Government itself. One has heard in these last few weeks of television sets being bought by doctors and dentists, by porters and bus drivers, by mannequins and even agricultural labourers. Everyone in the range of Alexandra Palace who buys a set this year may know that he is procuring a source of great entertainment for himself and his household. He is doing his patriotic bit in the establishment of a new British industry, and the winning for it of a world-wide lead."

B.B.C. Handbook for 1939

THE B.B.C. Handbook for 1939 is a crown octavo volume of 176 pages copiously illustrated with photographs of various broadcasting activities and with several helpful explanatory maps. It contains a diverse mass of comprehensive information.

A section is devoted to the television activities of the B.B.C. in which is explained how throughout 1938 intensive work was put into the improvement of programmes from the Alexandra Palace studios, and better studio equipment, better cameras, improved control systems have been adopted. A brief review of the high lights of the 1938 television programmes is included together with several photographic illustrations.

The B.B.C. Handbook can be obtained on application to the B.B.C. Publications Department, 35 Marylebone High Street, London, W.1, or to any Regional Office. Its price is two shillings, or 2s. 4d. by post.

TELEVISION TERMS IN FOUR LANGUAGES

A USEFUL REFERENCE

English.	French.	German.	Italian.
Scanning	Analyse, exploration, balayage	Bildzerlegung, Bildfeldzelregung, Abtastung, Bildabtastung	Analisi
Electronic scanning	Analyse, exploration balayage, électronique	Bildfeldzerlegung mit Kathodenstrahlröhren, Kathodenstrahl-Abtastung	Analisi Elettronica
Mechanical scanning	Analyse, mécanique	mechanische bildfeldzerlegung-Abtastung	Analisi Meccanica
Interlaced	Analyse, à lignes entrelacées	Zeilensprungverfahren	Analisi a Linee alternate
Scanning, interlaced	Exploration interlignée		
Scanner, picture analyser	Analyseur	Bildfeldzerleger, Bildzerleger, Bildabtaster	Analizzatore
Lens drum scanner	Analyseur, à couronne de lentilles	Linsenkranzabtaster	Analizzatore a Corona di Lenti
Mobile television van	Installation mobile de Télévision	Ferseh-aufnahmewagen	Autocarro televisivo
Electron camera	Caméra électronique (de prises de vues)	(Aufnahme) Elektronenkamera, Bildfängerröhre	Camera elettronica (di presa)
Coaxial cable, Cable for television work	Câble coaxial, pour télévision, à haute fréquence	Breitbandkabel, Fernsehkabel	Cavo, coassiale
Supersonic cell	Cellule ultra-sonore	Ultraschallzelle	Cella ad ultrasuoni
Kinescope	Kinescope	Kineskop	Cinescopio
Definition	Définition	Auflösung	Definizione (di un'immagine)
Saw-tooth	Dents de scie	Sägezahn	Denti di sega
Nipkow Disc	Disque de Nipkow	Nipkowscheibe; Spiralloch-scheibe	Disco di Nipkow
Lens Disc	Disque à lentilles	Linsenscheibe	Disco di lenti
Farnsworth's Dissector Multiplier	Analyseur Farnsworth	Farnsworth-Röhre	Dissettore
Control Electrode	Electrode-de contrôle	Steuerelektrode	Elettrodo di controllo
Secondary emission	Emission secondaire	Sekundäremission	Emissione secondaria
Cathode beam, electron beam	Faisceau cathodique, électronique	Kathodenstrahl, Elektronenstrahl	Fascio catodico
Photo cathode	Photocathode-cathode photoélectrique	Fotokathode	Fotocatodo
Photocell, photo-electric cell (vacuum cell, photo-conducting cell)	Photocelle, Cellule Photo-électrique (A vide poussé, á effet interne, à couche d'arrêt)	Fotozelle, Lichtelektrische zelle (Hochvakuum Fotozelle; Sperrschicht-fotozelle)	Fotocella
Photo-electrons	Photoélectrons	Fotoelektronen	Fotoelettroni
Photo-telegraphy, Picture transmission	Photoélégraphie, Transmission des images	Bildtelegraphie	Fototelegrafia
Frame frequency		Rasterfrequenz	Frequenza di Campo
Picture frequency	Fréquence d'image	Bildfrequenz - Bildwechselzahl	Frequenza D'immagine
Line frequency	Fréquence de ligne	Zeilenfrequenz	Frequenza di linea
Flicker frequency	Fréquence de scintillement —papillotement	Flimmernfrequenz	Frequenza di Scintillio

Synchronising Signal Generator	Générateur de synchronisme	Gleichlauferzeuger	Generatore di sincronismo
Iconoscope	Iconoscope	Ikonoskop	Iconoscopio
Electron Lens	Lentille électronique	Elektronenlins	Lente Elettronica
Light spot—Fluorescent Spot	Spot fluorescent	Fluoreszenzfleck, Leuchtfleck	Macchia fluorescente
Electron Microscope	Microscope électronique	Elektronen-Mikroskop	Microscopio Elettronico
Electron Multiplier	Multiplicateur d'électrons; électronique	Elektronenvervielfacher	Moltiplicatore elettronico
Electron Optics	Optique électronique	Elektronenoptik	Ottica elettronica
Persistence of Vision	Persistance de la vision	Trägheit (Nachwirkung) der Netzhautreaktion	Persistenza della visione
Resolving Power	Pouvoir séparateur	Auflösungsgrenze	Potere Risolutivo
Direct Pickup, Image Pickup	Prise de vues directe	Direktes Fernsehen	Presa Diretta
Electron Gun, Electron Jet	Canon électronique	Strahlerzeugungs-System	Proiettore Elettronica
Cathode Ray	Rayon cathodique	Kathodenstrahl	Raggio Catodico
Phonic Wheel	Roue phonique	Zahnradmotor, La Courches Rad	Ruota Fonica
Fluorescent Screen	Ecran fluorescent	Fluoreszenzschirm, Leuchtschirm	Schermo Fluorescente
Flicker	Scintillement, Papillotement	Flimmern	Sfarfallio
Synchronism	Synchronisme	Gleichlauf	Sincronismo
Synchronising	Synchronisation	Synchronisierung	Sincronizzazione
Intermediate Film System	Système à film intermédiaire	Zwischenfilmverfahren	Sistema (di televisione) a film intermediario
Mirrorscrew	Vis à miroirs	Spiegelschraube	Specchio elicoidale
Lens Drum	Tambour à lentilles	Linsentrommel	Tamburo di lenti
Mirror Drum	Tambour a miroirs	Weillersche Trommel, Spiegelrad	Tamburo do specchi
Television	Télévision	Fernsehen	Televisione
Colour Television	Télévision en couleurs	Farbenfernsehen	Televisione a colori
Stereoscopic Television	Télévision stéréoscopique	Plastisches Fernsehen	Televisione Stereoscopica
Television Transmitter	Emetteur de télévision	Fernsehsender	Trasmettitore Televisivo
Television Broadcasting	Emission visuelle, Radiodiffusion visuelle	Fernsehsendung, Fernsehrundfunk	Trasmissione Televisiva
Television-Telephony	Visiotéléphonie	Gegensehen - Fernsehsprechverkehr	Visiotelefonia

Theory and Applications of Electron Tubes. By H. J. Reich (McGraw-Hill Co., London. 30s. net.) 631 pp. and appendix 494 figs. in text.

Dr. Reich, who is Professor of Electrical Engineering at the University of Illinois, is already known to radio workers through his articles in the technical press of America. This book, which has just been issued by McGraw-Hill, embodies the notes which have been used in his lecture course to students during the past five years and covers the whole field of electron tube theory and application in a remarkably thorough and clear style.

Dealing first with the physical concepts underlying the electron and the emission phenomena, two chapters are then devoted to thermionic valves and their theory. The applications include modulation, detection, and the various types of amplification. A long chapter on the analysis of voltage and current amplifiers is followed by a section dealing with gas triodes, glow and arc-discharge tubes and finally photo-electric devices.

The greater portion of the book is devoted to amplifier theory and the student could not wish for a better or more complete covering of the subject. Each chapter is followed by a bibliography giving the more important references to the subject matter, and it is pleasant to note that due prominence is given to British writers.

The illustrations in the text are lavish—nearly one per page, and each page is accompanied by footnotes of further references. Altogether this is a first-class textbook, of which it would be difficult to speak too highly, and in conjunction with Terman's "Radio Engineering" provides the student and research worker with a complete radio library! We understand that the text book is obtainable on deferred payment terms through the Phoenix Book Co. of Chandos Street.

METAL RECTIFIERS FOR TELEVISION

This article explains recent developments in the use of metal rectifiers for television purposes.

IT is perhaps not generally appreciated that the metal rectifier can be used in quite a number of applications in the television receiver, and that in a number of cases it offers certain advantages over the valve type.

These applications may be for the provision of H.T. supply for individual units comprising the entire receiver, or a complete single unit power pack adequate to supply all the high-tension voltages necessary and which will result in a saving of cost.

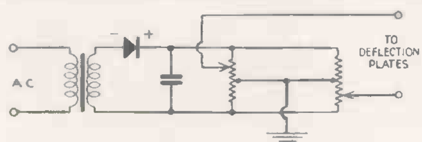
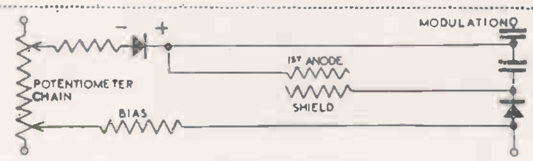


Fig. 1 (left). Half-wave rectifier for picture shift circuit.

Fig. 2 (right). Circuit showing use of rectifiers for restoration of D.C. component.



Vision Receiver H.T. Supply

Receiver design tendencies of late have been to combine both sound and vision receivers into a single-chassis unit, in which the earlier stages do duty for both sound and vision and the requisite H.T. current supply is usually a little lower than is the case wherein two separate receivers are each provided with an independent source; H.T. voltages have, however, a tendency to be slightly higher in order to enable the larger output valves to be operated at full efficiency.

The average vision receiver of to-day usually requires a full-wave supply of 70-80 mA at 230-240 volts. A suitable rectifier for this output is Westinghouse type H.T.17, used in voltage-doubler with an input of 150 volts 250 mA. The voltage-doubler reservoir capacities should be of 8 mfd. each, and should be capable of withstanding 250 volts peak.

H.T. Supply to Sound Receiver

Sound receiver requirements are of the order of 50 mA at 250 volts, for which type H.T. 16 may be used in voltage doubler with an input of 200 volts 170 mA. The voltage-doubler condensers should be of 4 mfd each, and should be capable of withstanding 230 volts peak. High-tension supply of this order will be adequate as too great a volume of sound may appear incompatible with the size of picture and be liable to become irritating and distracting from the screen.

C.R. Tube H.T. Supply

The requirements of the cathode-ray tube vary from 3,000 volts at (including current dissipated by the potentiometer chain) 0.75 mA to 4,000 volts at approximately the same current.

For a 3,000-volt output, two type J.176 rectifiers worked in a voltage-doubler circuit will be suitable. The metal rectifier in this case provides the advantage that should a component in the associated circuit break down, causing a short-circuit to the high-tension, the short-circuit current will be limited to the extremely small current-carrying capacity of the two voltage-doubler condensers in series, and the possibility of the damage spreading is remote. For larger outputs other types are available.

H.T. Supply to Time Base

It is now rarely necessary to provide more than 10 mA for the thyratron tube time base. Voltages, however, are high, as it is necessary to include high resistances in the thyratron anode circuits to provide a linear scan. In addition, when electrostatic deflection is employed, high values of anode resistance and high tension voltage are also required for the scanning amplifier valves, in order that the required output may be obtained without distortion of the generated saw-tooth wave-form. A full-wave supply of 10 mA at 1,000 volts may be obtained from two rectifiers type H.150, used in voltage-doubler with an input of 600 volts 30mA. The voltage-doubler reservoir capacities should be of 0.4 to 0.5 mfd. each, and should be capable of withstanding at least 850 volts peak.

When using the Westinghouse system for the above output, the transformer secondary winding is far less liable to breakdown, owing to the comparatively low voltage employed. With a full-wave valve rectifier the requisite secondary voltage would be 1,000-0-1,000, totalling 2,000, or over three times that required when using the metal rectifier. In addition, the lower potential between transformer secondary windings, and between such windings and frame, permits the use of a cheaper, smaller and more reliable transformer.

For outputs above 10mA it will be necessary to employ an additional pair of H.150 rectifiers wired in parallel with above; or to employ, alternatively, one of the larger output rectifiers as used for H.T. supply to receivers. If, upon grounds of economy in space, the extra pair of H types in parallel is preferred, the transformer should be designed to carry at least 50 per cent. extra current; the capacity of the voltage-doubler condensers should be doubled, and care taken to make all paralleling connections perfectly sound in order to avoil unbalanced resistance joints, as such joints would cause unequal distribution of the load.

An output of 250 to 300 volts 4 to 5 mA is usually required for the picture shift circuit, and a suitable rectifier is the H.75, which may be used in the half-wave circuit shown by Fig. 1.

Restoration of D.C. Component

Fig. 2 shows how the metal rectifier can be used for restoration of the

COMPLETE POWER PACK

D.C. component, an application which effects a saving in space, and in cases in which the C.R. tube anode is earthed, also an increase in safety. Valve rectifiers in the positions shown require highly insulated heater windings. This circuit, it will be seen, provides double modulation to the tube (modulating both shield and first anode) and restores the D.C. component of the picture signal which normally is lost between the output of the video-frequency valve, and the shield of the C.R. tube.

A complete power-pack employing metal rectifiers is shown by Fig. 3. The outputs of the rectifier arrangements are connected in series, in order that each circuit voltage commencing from the lowest is additive to that of the next, thus reducing the voltage requirements progressively. Provided a good transformer is used and a correct choice of rectifiers and associated components made, the electrical life of such a unit should be indefinite. The insulation between transformer windings and between windings and frame should be capable of withstanding 6,000 volts peak, and the spacing between terminals should be generous, in order to minimise brush-discharge.

The first consideration in the design of such a unit should be the total amount of current required. It should be noted that from the last anode of the C.R. tube, down to the lowest of the sound-vision receiver, all the rectifiers add their quota; and that therefore the rectifier arrangement at the negative end of the system must be capable of carrying the total current for the whole.

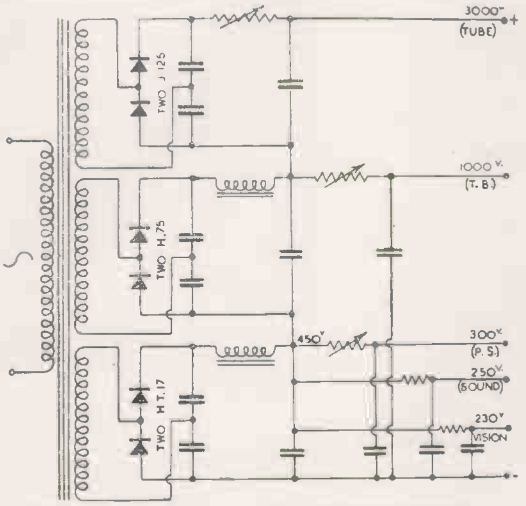


Fig. 3 (left). Complete high-tension power pack for combined vision-sound receiver, time base, cathode-ray tube and picture-shift.

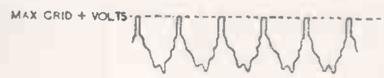


Fig. 5

Fig. 6

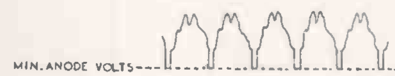


Fig. 7

Fig. 8

Fig. 5. Wave-form of the voltages delivered to the grid of the video-frequency output valve, from the demodulator.
Fig. 6. The anode current variation, which is proportional, and follows a similar wave-form.
Fig. 7. Represents the anode voltage variation; it is similar in wave-form, but is 180 degrees out of phase with the grid voltage.
Fig. 8. Shows the proportions of synchronising to vision signals, wherein: A represents minimum modulation of transmitter (zero carrier). B represents 30 per cent. modulation of transmitter C represents 100 per cent. modulation of transmitter (peak carrier).

Assuming the combined sound-vision receiver to require 130 mA; the time base 10 mA; the picture shift, or raster-centring circuit 5 mA, and the C.R. tube circuit 2 mA, the total would be 147 mA. A rectifier arrangement, therefore, capable of delivering 150 mA will be suitable.

First requirements, then, will be met by two type H.T. 17 rectifiers connected in voltage-doubler; which, after delivering the 135 mA load to the section under consideration, will leave approximately 450 volts available at the positive terminal to carry forward.

Next in order to be considered is the time base supply which requires 10 mA at 1,000 volts; but as there is already a potential of 450 volts available, the remaining 550 may be obtained from two rectifiers type H.75 connected in voltage-doubler. 145 mA at 1,000 volts is now provided for sound, vision, picture-shift and time base; and there is a potential of 1,000 volts available at the positive terminal to carry forward once more.

The C.R. tube requires 2mA at 3,000 volts. 1,000 volts are already in hand, so that it is only necessary to supply an additional 2,000. This final potential may be obtained by the use of two type J.125 rectifiers connected in voltage-doubler as shown. By utilising this scheme it will be seen that expense has been saved upon rectifiers to the voltage-values of picture-shift, 250; time base, 450; and C.R. tube, 1,000.

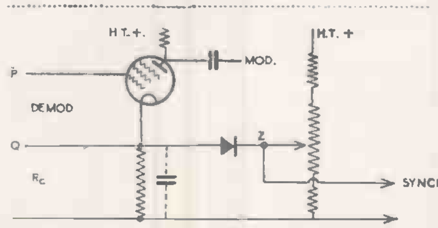


Fig. 4. Typical synchronising filter circuit in which it is necessary to insulate both sides of the input from earth.

The arrangement shown is not suitable for cases in which it is desired to earth the C.R. tube H.T. positive, but this practice is now practically obsolete.

Sync. Signal Separation

A successful method of separating the sync. signals is shown by Fig. 4. Fig. 5 represents the wave-form of the voltages delivered to the grid of the video-frequency output valve, from the demodulator. Fig. 6 represents the anode current variation, which is proportional, and follows a similar wave-form. Fig. 7 represents the anode voltage variation; which is similar in wave-form, but is 180 degrees out of phase with the grid voltage; since, when the grid is most negative, the anode current is at a minimum, and the anode potential with respect to earth is at its maximum positive value.

Fig. 8 shows the proportions of synchronising to vision signals, wherein:—

A represents minimum modulation of transmitter (zero carrier).

B represents 30 per cent. modulation of transmitter.

C represents 100 per cent. modulation of transmitter (peak carrier).

All signals between zero and 30 per cent. are synchronising signals.

Referring to Fig. 3 as the voltage across Rc varies in direct proportion to the anode current, if follows a wave-form as in Fig. 5, which is in phase with the grid signals, and out of phase with the anode signals.

The maximum synchronising signal appearing at Rc is represented by level B in Fig. 7. The positive end of the rectifier is biased at Z by means of a potentiometer P to a potential equal to B. When the potential across Rc drops lower than B, to any point between B and C, it will be lower also than the potential at Z; the current will tend to flow from Z to Rc but is prevented from so doing by the reverse resistance of the rectifier. Thus any signal from B to C is reduced to a negligible minimum at point Z.

When the potential rises higher than B to any point between B and A, it will be higher also than the potential at point Z; and current will flow through the rectifier, developing a proportional signal across the potentiometer lower half.

This signal may be fed direct to the grid of the frame thyratron; as it is of correct polarity, and D.C. connection is preferable. Care must be taken to counteract the constant positive D.C. bias always at Z, and which will appear at the thyratron grid unless the latter circuit is provided with extra negative bias.

Alternatively, if necessary the signals may be phase-reversed, amplified or dealt with in any other suitable manner before injection to the thyratron. It should be noted that in order to avoid feed-back of an inverse nature it will be necessary to isolate both sides of the input circuit (P and Q, Fig. 31) from Earth.

60,000-Volt High Tension for Cathode-ray Projection

Projection tubes provide a small, intensely brilliant fluorescent screen, and in order to include the whole of the 405 scanning-lines in the space available the beam-spot must be of infinitesimally small dimensions. This condition is obtained by the employment of extremely high voltages to the gun assembly.

It is possible to obtain these voltages with the conventional Westinghouse voltage-doubler, built with banks of H type units, air-cooled and insulated. The smoothed output of the standard apparatus is 10 mA. at 60,000 volts, continuous rating, and the residual ripple voltage does not exceed plus and minus 2 per cent. of the 60 kV. D.C. output.

Oil-immersed transformers are used, with output bushings to withstand 100 kV. peak continuously. The insulation of the secondary windings are graded to withstand the same peaks to core and primary. The negative end of the rectifier is earthed, whilst the centre point and the output are insulated for 100 kV. peak. Each half of the rectifier withstands a reverse voltage of 100 kV. peak.

The voltage-doubler condensers are of 0.0075 mfd. capacity, and are designed to withstand a peak working voltage of 50,000; whilst the smoothing condenser of 0.012 mfd. capacity is designed to withstand 100 kV. peak working. The smoothing resistance is of high wattage, 180,000 ohms; the voltage drop across this being 1,800. With such apparatus, of course, adequate safety precautions must be taken, and clearances of at least 12 inches, preferably 18 inches, allowed between any 100 kV. peak and earth.

10,000 Witness NBC-RCA Tests

MORE than 10,000 persons in Washington, U.S.A., witnessed television for the first time during a seven-day series of demonstrations by the Radio Corporation of America and the National Broadcasting Company. It was the first showing of high-definition pictures ever given in Washington.

Scores of leading figures in the nation's political life and hundreds of outstanding members of the press, learned societies, the diplomatic, colony and the military crowded into the viewing room at the National Press Club during the 90-odd programmes, each ten minutes long.

In one demonstration a machine gun platoon of cavalry and a platoon of the famous "White Horse" battery of Fort Myer manoeuvred before the Iconoscope camera for the benefit of military and civilian viewers at the Press Club. Another "stunt" programme, arranged in co-operation with the District Employment Service, was the world's first television appeal for a job. Michael Hudoba, an unemployed statistician, detailed his qualifications and made a bid for steady work to prospective employers at the viewing point.

The demonstrations gave the NBC television staff and the equipment a severe test, for weather conditions were very adverse. Light seldom remained stable for more than a few minutes at a time. The bitterly cold wind of the first two days was succeeded by downpours that continued practically from that time through the last day of demonstration. Engineers were forced to don rubber boots and heavy raincoats. The camera was put under an oiled silk hood and the microphone was shielded in a cellophane envelope. A platform had to be built to raise operators out of the mud and huge, vari-coloured umbrellas were hurriedly bought to give shelter to announcers, programme directors and persons interviewed before the camera.

Judged by audience reaction, the demonstration was an amazing success. Most of those who saw the images at the Press Club and thereafter spoke over the television system expressed great surprise that the pictures appeared so clear and bright.

Indexes and Binding Cases for 1938 are now available.

Increased Power and Increased Range

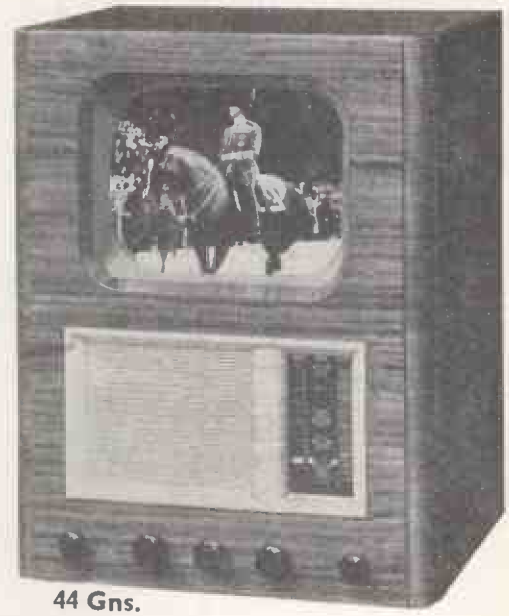
MANY viewers, especially those located on the fringe of the present service area of Alexandra Palace, appear to think that if the power was increased, the range would increase accordingly, and many of their existing difficulties disappear.

This is only true in part—for, generally speaking, to double the voltage picked up at a receiving point it would be necessary to quadruple the power, and at the most the effective range of the transmitter would only be increased by about ten miles.

A four-fold increase of the present power is out of the question and it will, in fact, be a difficult matter to increase it by even a few kilowatts because of the extremely high frequencies employed. Even a slight increase will result in some improvement to the received picture, of course, but this will not be noticeably apparent, and with whatever increase possible it would not go far towards solving the problem of greater coverage to any worth while extent. It is well known, of course, that the range of picture reception is very much in excess of the original estimate of 25 miles.

35 Gns.

Two selections from our wide range



44 Gns.

Always Remember

BAIRD RECEIVERS SET A PERFORMANCE STANDARD BY WHICH OTHERS ARE JUDGED

In support of this study these selected features common to all the company's sets.

SIMPLE OPERATION : The sets once installed require little or no attention. Minor adjustments can be made confidently by the owner without technical knowledge.

EXCELLENCE OF PICTURE DETAIL : This includes clear facial expression in " close-ups," the ability to recognise small objects as easily as though they were before viewers—identification of gestures, pattern of material, etc.

ADEQUATE PICTURE BRIGHTNESS : The picture is sufficiently brilliant to provide effortless viewing, yet never so bright as to be tiring to the eyes.

FREEDOM FROM OPTICAL OR ELECTRICAL DISTORTION : Achieved by use of BAIRD " Cathovisor " cathode ray tubes designed to counteract any chance of optical distortion and special precautions with regard to amplifying equipment in the case of electrical distortion.

WIDE VIEWING ANGLE : The ability to view the picture clearly and at a comfortable distance—and not necessarily from directly in front ; thus enabling a larger number of persons to view simultaneously.

ROCK STEADY PICTURE : A complete absence of any tendency for the picture to jerk or get out of synchronisation.

BLACK AND WHITE PICTURE WITH GOOD HALF-TONE GRADATION : Black and white always provides the best definition—the half-tones prevent any crude contrast to the eye for shades between dead black and white—in other words, natural tone values.

VERY LOW POWER CONSUMPTION : A matter of great importance to set owners. The modern Television receiver employs a greater number of valves and chassis than a Radio receiver—yet the BAIRD Television home receivers have very moderate current consumptions.

SIMPLIFIED DESIGN : In order to arrive at the simplest possible operation, intricate mechanism has been eliminated as far as possible. The lowest number of valves are used compatible with the required performance, and in order to achieve the greatest economy in current consumption.

HIGH FIDELITY SOUND : The quality of sound is really of equal importance with clarity of vision, whether it is to synchronise with the picture, or be heard in the reception of Radio Broadcast. The closest attention has thus been given to the design of the sound " side " of BAIRD Television receivers.

FIRST-CLASS WORKMANSHIP AND GREAT RELIABILITY.

GUARANTEE : All BAIRD Television Receivers are guaranteed for TWELVE MONTHS from date of purchase.

Send for full descriptive literature. Post Free.

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Osram valves

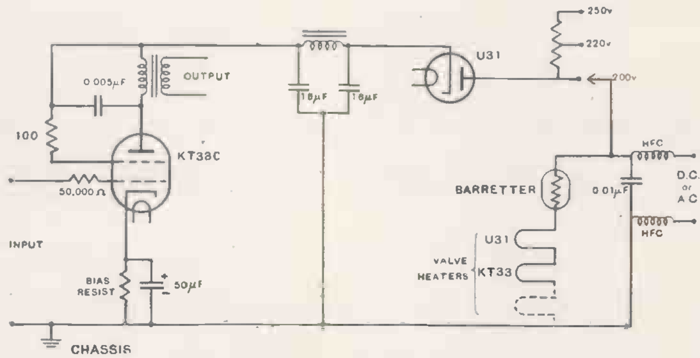
MADE IN ENGLAND

More about the Octal Base range

OSRAM (Octal Base) valves with heaters rated at 6.3 volt 0.3 amp. are equally applicable to A.C. (with parallel heaters) or D.C. (with series heaters) supply.

In order to ensure adequate emission for large undistorted power, special output valves are available to meet the parallel and series operating conditions respectively.

An outstanding example of a D.C. (or D.C./A.C.) output valve is the OSRAM KT33C.



Typical circuit for KT33C in output stage of DC/AC receiver or amplifier, showing heater connections.

TYPE KT33C

Heater* voltage ...	26	or 13
Heater current ...	0.3	0.6
Anode voltage ...	200	
Screen voltage ...	200	

	Single Valve Class 'A'	Push Pull Class AB1
Anode current (mA)	60	113 (total)
Screen current (mA) ...	10	18 (total)
Grid voltage	-13.3	-19.1
Auto-bias resistance (ohms)	190	240 (per valve)
Load resistance (ohms) ...	3000	4000 (anode to anode)
Peak input voltage	12.3	44 (for max. output)
Power output (watts) ...	5	15.5 (max).

**Centre tapped heater.*

By utilising the heater centre tap, type KT33C also becomes suitable for operation from a 12/13 volt Low Tension Supply, such as a car battery.

LIST PRICE 12/-

Other Osram "Octal Base" types for series heater operation (at 0.3 amps.) :—

Frequency changers ...	X63 (heptode) X65 (triode hexode)
HF Tetrode variable 'mu'	KTW63
HF Tetrode straight 'mu' ...	KTZ63
Triode high 'm'	H63
Triode medium 'm' ...	L63
Double diode triode (high 'm')	DH63
Double diode triode (medium 'm')	DL63
Double diode (separate cathodes)	D63
Beam power tetrode for 100-135 volt H.T. supply	KT32
Cathode ray tuning indicator	Y64
Rectifier (half wave) ...	U31

Write for descriptive leaflets with characteristic curves and full operating data.

Scannings and Reflections

TELEVISION IN JAPAN

JOAK will start broadcasting television from its laboratory at Kamatacho, Setagaya-ku, Tokyo, in April. The programmes will be received at many of the department stores and other places of prominence in the capital city. The receiving sets which are now being manufactured have a viewing screen 23 centimetres square. Twenty-five pictures per second will be transmitted. A 100-metre high steel tower for the aerial is being erected at the Kamatacho laboratory compound.

The Radio Broadcasting Corporation of Japan will also operate four mobile vans for outdoor programmes. Both the transmitting and receiving systems were evolved by Kenjiro Takayanagi, formerly Professor in the Hanamatsu Technical College.

Test broadcasts were made in February between the temporary studio and a point nearby. Broadcasts for general subscribers are not expected to begin for some considerable time. If the result of the test in April is satisfactory experiments will be made in addition at Osaka and Nagoya.

CHARLIE CHAPLIN " CLASSICS " TO BE TELEVISED

Television will pay tribute to Charlie Chaplin on April 16, the film star's fiftieth birthday. A selection of early " Charlie " classics, including " The Champion " and " The Bank " will be presented with a commentary, and to build up the atmosphere of the pre-war " biograph " theatre, a pianoforte will be played " emotionally " to suit the situations on the screen. Besides Charlie Chaplin, these early films show the pioneer efforts of such stars as Marie Dressler, and Norma Talmadge.

An important feature in this transmission will be the projection of the films at their normal speed of sixteen pictures a second. In modern cinema " revivals " of early films, the action is usually speeded up, with unfair results, because the cinema projector of to-day runs films at the rate of twenty-four pictures a second.

BRITISH FILM TELEVISION

Another British film, the third, has been booked by the B.B.C. for television, and will be broadcast on the afternoon of April 1st. This is " The Edge of the World." Previous British films broadcast from Alexandra Palace were " Aunt Sally " and " Jack Ahoy," during Radiolympia.

TELEVISION QUESTIONNAIRE

The demand for questionnaire forms has considerably exceeded 4,000 up to the present and more are coming in each day. It is too early as yet to state the result of this plebiscite, but outside broadcasts are the subject of most requests. There is also a demand for a children's hour.

THE BOAT RACE

For the first time in the history of the University Boat Race many thousands of people will—on April 1—see both the start and the finish. Two television mobile units are to be in operation. Cameras on a balcony on the Surrey side at Putney will show the crews paddling to the starting point just before 10.30 a.m., and it is hoped, by means of powerful telephoto lenses, to follow the crews till they round the bend at Craven Steps. John Snagge's running commentary on the National wavelengths will keep viewers in touch with the race till the boats reach Barnes Bridge, where they will be picked up by television cameras on the roof of Mortlake Brewery and " held " till the finish, three or four minutes later.

The finish of the University Boat Race was televised for the first time last year, and the occasion was memorable in that the transmission was nearly wrecked by a workman who accidentally cut a telephone cable with his pick. For a time, it will be remembered, the transmitter at Alexandra Palace was cut off from all telephone communication with the television staff at Mortlake, and recourse was had to hand signals and scribbled messages held up before the television camera.

BIGGER AND BETTER RADIOLYMPIA THIS YEAR

Big plans for Radiolympia, 1939, were revealed at the monthly luncheon of the Radio Manufacturers' Association in London on March 9, at which Sir Stephen Tallents, the B.B.C.'s Controller of Public Relations was the guest of honour and the principal speaker.

Emphasising the ambitious nature of the plans for this year's show, which will open on August 23, Sir Stephen said that the B.B.C. was already hard at work, in collaboration with the organisers—the R.M.A.—devising new attractions.

Speaking of the R.M.A.'s plans, Colonel Ozanne (Chairman of the R.M.A. Exhibitions Committee) stressed the diversity of the attractions which would be found at this year's Show. As well as being the focal point of radio interest throughout the country, Radiolympia would have something to interest everybody.

DEPUTY TELEVISION ANNOUNCERS

During the absence on annual leave of two regular announcers, Miss Jasmine Bligh and Miss Elizabeth Cowell, Miss Olga Edwardes and Miss Eileen Bennett have been booked as deputy television announcers. Miss Edwardes, deputising for Miss Cowell, has been booked for dates between March 30 and April 17, and Miss Bennett, deputising for Miss Bligh, from March 24 till April 4.

Miss Edwardes is twenty-two years of age, a brunette and is already well known to viewers as an actress; Miss Bennett, nineteen years of age, is a blonde.

THE G.E.C. (SCHENECTADY) AERIAL

A new type antenna, cubical in shape and radical in design, has been developed by General Electric's radio engineers for use in the company's new 10-kilowatt television station nearing completion in the Helderberg Hills, 12 miles outside of Albany. This consists of eight hollow copper bars, each four inches in diameter and about seven feet, or one-half wave, in length, arranged so as to form a perfect cube. The antenna is designed to radiate a horizontal polarised wave, carrying both picture and voice on the 4½-metre band.

The station has been licensed under the call letters of W2XB, with W2XH assigned to the low-powered 1.9-metre transmitter which will relay the programmes to the main transmitter, a distance of 12 miles.

REAL PUBLICITY

The Boon-Danahar fight undoubtedly did more to publicise television than any previous outside broadcast event, not excluding the Coronation. Amazing scenes took place both inside and outside the three theatres where the televised fight was shown. In Oxford Street the police had to deal with hundreds of people beseiging the box offices. Prices ranging from 2s. 6d. to a guinea were paid and hundreds stood at the back and in the aisles.

The performance at the Marble Arch Pavilion was watched by many influential people including members of the Television Advisory Committee, Mr. F. W. Olgilvie, Director-General of the B.B.C., high officials of the G.P.O., and representatives of film interests.

CINEMA TELEVISION

The Wireless Retail Traders' Association has petitioned the B.B.C. to veto television in cinemas. The association is of the opinion that if this is not done the future of television, both as a new industry and as a home entertainment, will be seriously jeopardised.

TOM WALLS IN TELEVISION

Tom Walls—ex-policeman, theatrical impresario, trainer of a Derby winner, actor, and stage and film director—makes his television début in the evening programme on April 5. Incidentally, "April the Fifth" was the name of his Derby winner. He will appear in Cosmo Gordon Lennox's one-act comedy, "The Van Dyck," with Campbell Gullan and Donald Findlay. The play will be repeated in the afternoon programme on April 15.

TELEVISION COLOURS

In order to improve transmission conditions on the occasion of the Len Harvey and Larry Gains fight a special colour scheme in the ring was adopted. Butter-cup yellow coloured canvas on the floor and a blue-roped ring were used.

O.B. RELAY STATION

The television relay station at Swain's Lane, Highgate, for the reception of O.B. relays from the mobile transmitter is now completed. It is situated 400 ft. above sea level and signals from the mobile transmitters in any part of greater London will be picked up at Swain's Lane and relayed to Alexandra Palace. Transmission from Swain's Lane to Alexandra Palace is by the television cable which extends from Alexandra Palace through the West End.

INTERFERENCE

Sir W. Womersley, Assistant Postmaster-General, replying to a question by Mr. Rostron Duckworth on the subject of interference to radio reception, said inquiries regarding the possible scope and operation of a new Wireless Telegraphy Bill to deal, *inter alia*, with the question of electrical interference with wireless reception were being actively pursued. The problem was, however, one of great complexity, involving consultation with many commercial and other interests which would be affected; he could not give any assurance that it would be possible to introduce a Bill during the current session.

TELEVISION COMMITTEE MEETING

The Television Advisory Committee met on March 14 for the first time under the chairmanship of Lord Cadman. It is understood that provincial and cinema television were discussed by the committee. No official statement regarding the results of the meeting was issued.

MR. BAIRD ON CINEMA TELEVISION

Replying to a toast Mr. Baird at the annual dinner of the London and Home Counties Branch of the Wireless Retailers' Association, in the course of his speech referring to cinema television, said: "The latest development was one which at first sight might not appear to affect the wireless retailer. I am not sure that that might not in its final effect be of great importance to the wireless trade. I am sure if the entertainment industry does take part there will be a tremendous improvement in the programmes," he declared, adding that people who were used to devising programmes in that sphere might, with all respect to the B.B.C., be expected to turn out something much superior to the B.B.C. There was the possibility that such programmes might be sent out on a wavelength which could be received in the home.

SCOPHONY BIG-SCREEN TELEVISION

It is understood that negotiations are now in progress in connection with the installation of Scophony television equipment in the cinemas of Odeon Theatres. It is possible that Odeon Theatres will take a financial interest in Scophony.

CINEMA EXHIBITORS

The Cinema Exhibitors' Association Committee on Television held its first meeting on March 16 to survey the television-cinema situation generally. No important decisions were reached.

NATIONAL BOXING ASSOCIATION AND TELEVISION

The Executive Committee of the National Boxing Association is to oppose any attempt to restrict the televising of professional boxing contests. The view is expressed that television of big fights will create a vast new boxing public which will eventually find its way to the boxing arenas, and it is the intention of the Association that the boxers shall share the profits of this source of revenue.

. . . . . AND MORE REFLECTIONS

TELEVISION SERVICES

In response to a question in the House of Commons, Sir W. Womersley stated that with regard to the extension of the television service to areas outside the range of the Alexandra Palace transmitter, the question involved serious problems, both technical and financial. Research is being undertaken to find out whether it is possible to relay programmes from London to other centres via ultra-high frequency transmitters, but this would involve a considerable period before definite results could be obtained.

CINEMA INSTALLATION IN GLASGOW

Plans have been passed by the Glasgow Dean of Guild Court for a cinema to be erected and equipped for the reception of television. It is the first theatre to be so equipped in Scotland, but how the equipment will be used has not yet been stated.

This cinema is to serve a new housing scheme of over 1,600 houses at a point near Robroyston.

MAKE-UP AND COLOURS

Great progress has been made in make-up since the early days, when blue and yellow make-up gave artists a sickly look. A healthy sun-tan complexion is all that is needed now to enable the cameras to transmit a clear—even flattering—picture of any face. Bald pates, by the way, are apt to be a problem, especially if they have a gleam that reflects the light; the discreet application of a darkish tint of powder solves that little difficulty, however.

To overcome the effect of halation caused by glistening instruments in the television orchestra; they are very rarely polished and, though they are certainly not the smartest instruments in London, they make a nice clean picture on the television screen.

So far as costume is concerned, the cameras have a definite dislike for anything black and a pronounced liking for pastel shades and non-absorbent material. Consequently, evening dress does not televise perfectly, and men who wear it in productions are sometimes provided with yellow collars and shirts and ties, so as to improve the contrast of light and shade—a flash-back to the early days of film production. An attribute of the cameras include their strange ability to see through fog in a way that makes it merely give a particularly beautiful texture to the picture.

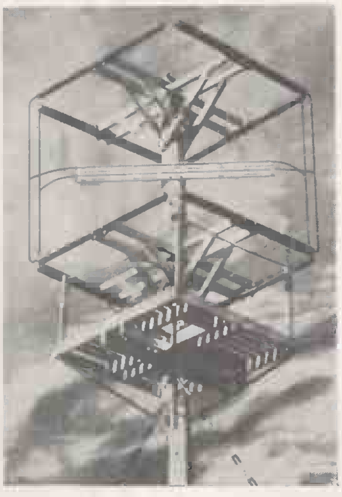
At rehearsals the make-up girl sits before the screen of a "monitor" set which shows her what sort of a picture would be going out to viewers if the show were being televised. She can, in fact, see both the real people and their images as television re-creates them and, scribbling pad and pencil in hand, she notes flaws in make-up, to be corrected or modified before transmission time.

B.B.C. TELEVISION OFFICIAL FOR U.S.A.

Mr. D. H. Munro, Television Productions Manager at Alexandra Palace, is to be released temporarily to the Columbia Broadcasting System of America for work in connection with the opening of the C.B.S. television service. He will sail for the United States of America on May 4 and expects to be away from London for at least six weeks.

Mr. Munro joined the B.B.C. in 1926 as an announcer at the Aberdeen station, came to London in 1929 as Production Assistant at Savoy Hill, and was intimately concerned with developments in multi-studio presentation involving the use of the then new dramatic control panel. As the operator of an advanced type of control panel, Mr. Munro was responsible for co-ordinating the "Round the Empire" broadcast of 1932 in which King George V gave the first of his memorable series of Christmas messages to the world.

When Mr. Gerald Cock was appointed Director of Television, in 1935, he chose Mr. Munro as Productions Manager. The appointment brought with it an entirely new set of problems, as no precedent existed for the organisation of a high-definition television service. Since the start of the service in the Autumn of 1936, Mr. Munro has been responsible for studio organisation and general routine.



The cubical aerial of the G.E.C (Schenectady, U.S.A.) television transmitter. A note regarding this appears on the preceding page.

TELEVISION IN THE NORTH OF ENGLAND

An energetic campaign is being sponsored by Allied Newspapers in Manchester in order to push forward the installation of a television transmitter to cover a good part of the North of England.

It is claimed that a television transmitter in Manchester would cover an area in which there are already 2,000,000 receiving licences.

THE A.R.R.L. CONTEST

During March the annual C.W. and telephony contest between American amateurs and amateurs in other parts of the world was held. If anything this year, there appeared to be more than the usual number of stations participating.

It does seem that amateurs are taking a lot more trouble with their installations, particularly from the aerial end, for a considerable number of British stations were using narrow angle rotatable beams, and in this way, despite their very low power were able to put up a good show, as compared with the Americans who can use up to 1 kilowatt input.

Unfortunately, most of the central European stations were absent so that the number of countries it was possible to work was still further reduced.

TELEVISION RECEIVER SALES

It is becoming rather difficult to purchase a television receiver without there being some delay, for manufacturers are now working to capacity. One particular maker is over 350 receivers behind delivery, despite the fact that the manufacturing quota is 30 per day. In this way, the sales in the service area will very shortly reach a high figure, particularly should there be some more interesting broadcasts, such as the Boon-Danahar fight.

Figs. 3 and 4. These photographs depict similar effects to that of Fig. 2.

TELEVISION PICTURE FAULTS AND THEIR REMEDIES—V

By S. West

This is the fifth article in a series that has treated the various faults likely to be encountered in vision receiving apparatus, both from the theoretical and practical viewpoints. Photographs illustrating these faults have accompanied the text and the complete series comprises a concise and lucid treatment on vision unit design and faults location.

LAST month the vision frequency output amplifying stage was treated from the point of view of its low-frequency response requirements. It is necessary now to consider the question of the high-frequency response, from which is assumed the response to frequencies from some 10,000 cycles to 2 or 2.5 mcs. Although there are various circuits for achieving this end, by far the simplest way to ensure linear gain at such high frequencies is to include a correcting inductance in series with the anode coupling resistance of the V.F. valve.

Actually linear response can be secured with a drastic reduction in value of the load resistance, indeed, with certain types of resistance, e.g., wirewound types having some inherent inductance, with a sufficiently low value of load resistance the response can well be linear to 5 mcs. The gain secured from the stage, however, is very low as is apparent from the fact that the gain from such a stage, wherein a pentode valve is employed, is given accurately by the relation: Gain = mutual conductance (mA. per volt) × coupling resistance (ohms).

The usual procedure is to employ an inductance having such a value that in conjunction with the associated valve and circuit capacities a resonant circuit is secured, the frequency of resonance being somewhat higher than the highest frequency the stage is to handle.

It is not proposed to deal with the question of phase shift for it is considered that no difficulties will be encountered in this respect as, in general, if the response is linear up to the highest frequency desired then the phase shift will be of such degree that it can be ignored. There are, however, two pitfalls likely to be encountered whilst striving for this stringent frequency response requirement. First, the ratio of in-

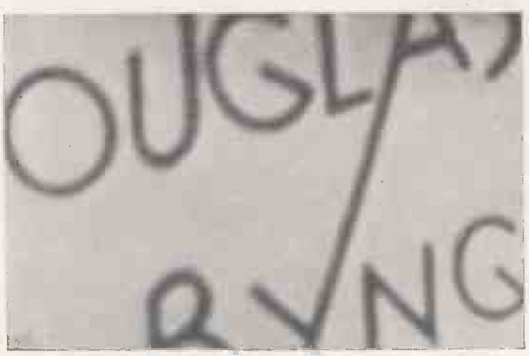


Fig. 1. The effect of incorrect damping in the V.F. stage is clearly revealed in the above photograph.

Fig. 2. The curious effect resulting when the oscillator is incorrectly tuned, coupled with an inadequate frequency response in the I.F. circuits.

TRANSITION EFFECTS

ductance to resistance must be low, for the circuit damping is critical if transient distortion is to be avoided. If the resistance is too high in value the abrupt transitions are lost due to the roundings of the corners of the transient wave, if too low there is a possibility of ringing occurring in the circuit; this will distort the wave shape giving rise to effects similar to those depicted in the photograph Fig. 1.

It is seen in this photograph that the transition from

Fig. 5. With poor overall frequency response considerable loss of definition will result as is apparent from the above photograph.

the black edge of the lettering to the uniform background is not correctly rendered, the effect being as though a white border follows the lettering. With a white letter the reverse effect would, of course, be obtained. This effect is due to the fact that the wave shape rises abruptly from the black edge of the letter then oscillates momentarily; it is a damped oscillation, before assuming the correct illumination level.

Secondly, the question of determining what value the stray capacity has is not without difficulties. So much will depend upon the form of sync. filter employed and also, largely, upon the length of the modulating lead to the grid of the C.R. tube. Also, if the C.R. tube E.H.T. potential has its positive earthed the capacity to earth of the grid blocking condenser (which will necessarily be a large high-voltage affair) will be appreciable.

Fig. 6. The uneven background illumination in the above photograph is due to the loss of or inaccurate restoration of the D.C. component.

There is a method for accurately assessing this total capacitance, including that due to the input capacity of the C.R. tube and valves, but this method implies a certain accuracy in calibration of the apparatus employed and is therefore not easily applicable.

It is probably reasonably safe to assume that this output capacity, including that due to the valve, is in the region of 35-40 uuFds., with an indirect tube connection, and approximately 25-30 uuFds. when a direct connection is employed.

Suitable values for both the inductance and the resistance to ensure a correct L/R ratio and to permit the response to be maintained to over 2 mcs. can then be obtained from the curves given on p. 662 of the November, 1938, issue of this journal. Alternatively, it will be found that a load resistance of 3,500 ohms and an inductance consisting of 89 turns of 38 D.S.C. instrument wire close wound on a $\frac{5}{8}$ in. diameter coil form will satisfy most requirements.

Some slight experimental adjustment of the turns number may be required, but it will be preferable to endeavour to reduce the capacity due to the C.R. tube feed arrangements before resorting to this measure. If it proves necessary to remove a substantial number of turns then the load resistance should also be reduced in value. It is a simple matter to check that the gain

Fig. 7. The above photograph shows the good definition and uniform illumination rendered by a correctly adjusted receiver.

is substantially maintained to the upper high-frequency limits by applying the output of a signal generator to the grid of the V.F. valve.

The procedure is as follows: With the generator connected as above, it is set to produce a signal at about 1.5 mcs. (200 metres) the output being adjusted so that the C.R. tube screen is reasonably illuminated. With careful adjustment of the sync. controls this frequency will produce a large number of vertical white lines. The frequency is then slowly increased to a little over 2 mcs., the individual lines, now increased in number, should still be plainly rendered at an approximately equal illumination level, although even if there is an appreciable change in the illumination level it can be disregarded; it is the ability of the system to render this large number of lines plainly that is the real test. Close examination of the screen will be required for there will be approximately 200 lines, though it is not suggested this figure be checked. If this large number of lines is secured with good definition it can be safely assumed that the high-frequency

GHOST IMAGES

response of the V.F. stage and associated circuits is excellent.

Transient Distortion

It is not such a simple matter to determine the amount of transient distortion present unless a square wave generator is employed. This entails construction of such an instrument, however, as it is an item not usually available. It is simpler to determine the performance by examining closely suitable scenes.

Now it is an unfortunate fact that similar transient distortions can occur in the intermediate frequency stages of a super-heterodyne vision receiver and, moreover, if both effects are present at the same time or if an attempt to make good a response deficiency, due to the I.F. amplifier, by overcorrecting the V.F. stage is made, very unpleasant picture distortions will result. (See Fig. 2.) This photograph gives some idea of what to expect, but actually the effect is manifest by a

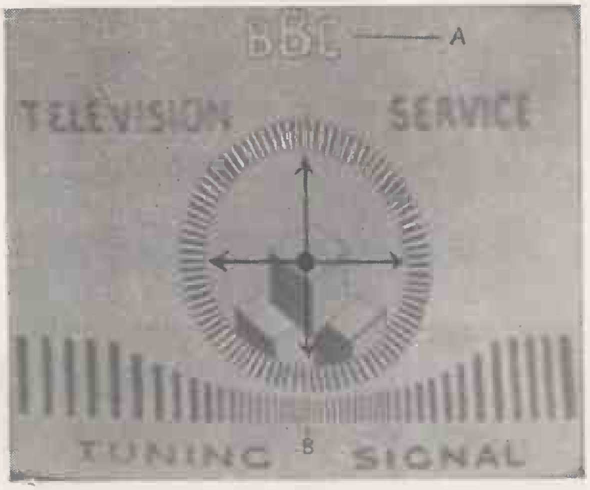


Fig. 8. The caption photographed above furnishes an excellent indication of the correct picture proportions and frequency response to aim at. The small serrations at A should be plainly visible and the centre pattern should be a true circle.

large variety of such distortions. In general, it can be assumed that where it is possible to eradicate this fault by tuning the oscillator for maximum sensitivity, then it is likely, though not necessarily so, that the I.F. pass band is inadequate or non-linear.

Figs. 3 and 4 depict similar effects. In each case where pictures such as these are secured, either the I.F.'s pass band characteristic, or the setting of the oscillator tuning, should be suspect. Fig. 3 actually is taken from a receiver whose I.F. amplifier had a very marked tendency to "ring." Such a condition is mainly engendered by a non-linear response within the I.F.'s pass band and suitable re-adjustment or an increase in the circuit damping will invariably effect a cure.

Ghost Images

Two somewhat similar effects, not illustrated here, are worthy of mention. The first is a picture in which the subject matter appears as though in relief; such a fault is invariably due to incorrect oscillator tuning and is caused by an over accentuation of the higher modulation frequencies in relation to the low. It is conceivable that such an effect could occur due to a coupling condenser in the V.F. stage becoming open circuited and it is perhaps as well to check such components.

The second effect is very similar to that depicted in Fig. 3, but, in this case, the subject matter is broken up into a number of such ghost images as are shown in this photograph. Generally speaking, this trouble is more usually experienced in single sideband amplifiers where the requirements in regard to phase shift and linearity are very much more stringent than are those for a double sideband amplifier.

Whilst referring to Fig. 3 it can be added that a precisely similar effect as is depicted obtains when the aerial termination is not correctly matched either at the receiver or to the aerial. The severity of this effect is largely determined by the length of the aerial feeder, for the fault is due to reflections occurring in this; that is to say, due to the mismatch, reflections occur in the feeder and thereby give rise to secondary images delayed according to the distance they have travelled, this will result in the production on the screen of ghost images rendered later than the true image.

Inadequate Frequency Response

To give an idea of the effect in the received picture due to an inadequate overall frequency response characteristic, the photograph Fig. 5 is reproduced, though it is hardly necessary to show what constitutes a poor picture. However, the lack of definition can be noted, due in large measure to the fact that unless the high-frequency response is adequate, sudden transitions cannot be truly rendered and rapidly repetitive transients not at all.

The photograph Fig. 6 shows the big improvement in definition resulting when the response at high frequencies is reasonably good, although this photograph is mainly included as it depicts a fault which is quite common. Examination will reveal that the background illumination is very uneven, the white lettering being followed by dark areas. This effect is common in receivers where the D.C. component is lost as far as the tube modulation is concerned, but it can occur, though not so readily, in receivers employing a direct tube connection.

Upon a cursory examination of a circuit wherein the tube is connected directly to the V.F. valve's anode, which is in turn D.C. coupled to the demodulating diode, one is tempted to think that the D.C. component is accurately preserved, but it is necessary to take into account the time constant as a whole or in part of the H.T. supply circuit which can influence the D.C. level. The effect of these circuits can be largely removed, but there exist a number of reasons why a direct tube connection, to a V.F. stage, should not be employed, and in the writer's view it is preferable and simpler to employ some form of D.C. restorer, especially as such a device is invariably necessary for most types of sync. pulse separators.

Even where a D.C. restorer is employed, however, care in the choice of the circuit constants is necessary for, unless the time constant of the restorer is high, it will be unable to maintain the D.C. level throughout

(*Continued on page* 220.)

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

Specially Compiled for this Journal

F. Fischer and M. Lattmann :: *B. M. Crowther* :: *Marconi's Wireless Telegraph Co., Ltd.* :: *The General Electric Co., Ltd., and F. R. Jones* :: *V. Zeitlinn, A. Zeitlinn and V. Kliatchko* :: *H. G. Lubszynski* :: *G. S. P. Freeman*

Incandescent Screens

(Patent No. 496,662.)

WHEN a televised picture is to be reproduced by incandescent, as distinct from fluorescent light, it is necessary that each elemental point on the screen should cool off rapidly, i.e., it must change from white heat to dark heat in one-twentieth of a second, in order to avoid blurring due to "after glow." For this reason the screen is best made as a mosaic of cells, each cell being covered with a layer of the incandescing material. At the same time it is necessary to prevent the heat from spreading laterally from cell to cell.

With these objects in view, a very thin layer of tungsten is deposited on the upper surface of a cellular material, the side-walls of each cell then being covered with a deposit of carbon to prevent them from radiating heat sideways.

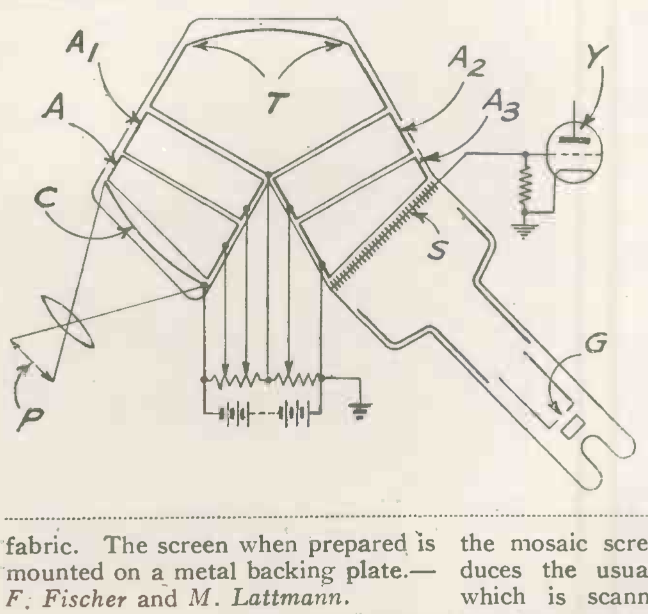
The cellular material is prepared by chemically treating an organic tissue, such as the pith of the elder tree, or by carbonising a velvet-like fabric. The screen when prepared is mounted on a metal backing plate.—*F. Fischer* and *M. Lattmann.*

Electron Multipliers

(Patent No. 497,406.)

An electron multiplier is combined with a cathode-ray television-transmitter in order to strengthen the primary stream of electrons by secondary emission. The difficulty is, however, to avoid distortion. If, for instance, the original stream is projected on to an ordinary "target" electrode, where the secondary emission takes place, all the picture points will not be in the same focus unless the surface of the electrode is suitably curved.

The drawing shows a cathode-ray tube designed to overcome this defect. The picture P to be televised is first projected on to a sensitive cathode C, which is made slightly concave, as shown. The liberated electrons are then drawn through a series of "ring" anodes A, A1 until they strike against the "target" T, which is also made concave. The reflected stream now intensified by secondary electrons passes on through a second set of ring anodes A2, A3 until it reaches the mosaic screen S. Here it produces the usual "charge image" which is scanned by the electron stream from the gun G of the tube, the resulting signals being fed to an amplifier V.—*B. M. Crowther.*



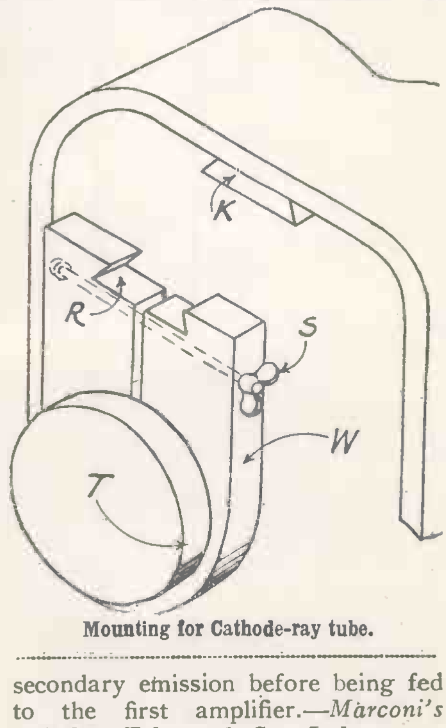
Electron multiplier transmitter tube. Patent No. 497,406.

Television Transmitters

(Patent No. 497,551.)

In order to increase the signal-to-noise ratio of the signals produced in a tube of the Iconoscope type, the scanning-beam current is first of all cut down in order to reduce the "shot" effect. At the same time, the capacity of the cells on the mosaic screen is made as small as possible by mounting the sensitised caesium on a thick backing-plate of insulating material. This helps to increase the sensitivity of the device.

The emission current, produced by the impact of the scanning-stream upon the mosaic electrode, is then passed through two electron-multipliers, which are mounted symmetrically about the screen. The picture signals are thus strengthened by secondary emission before being fed to the first amplifier.—*Marconi's Wireless Telegraph Co., Ltd.*



Mounting for Cathode-ray tube.

C.R. Tube Mounting

(Patent No. 497,626.)

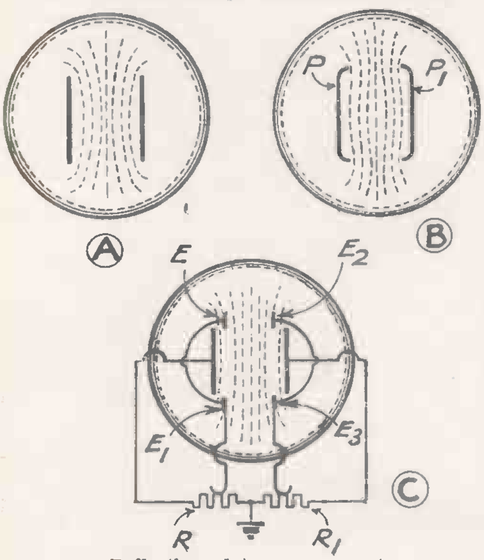
The cathode ray tube of a television receiver must always be mounted so that the screen on which the picture is projected occupies a definite position in the cabinet. On the other hand, all cathode-ray tubes are not exactly of the same length, owing to unavoidable variations in the process of manufacture. It is convenient therefore to provide an adjustable mounting for the tube.

The figure shows how this is done. The stem end of the tube (not shown) fits into a canister T which is held in a wooden collar W. The collar is formed with a wedge-shaped recess R which slides to and fro over an interlocking ridge K running along one wall of the cabinet. Once the proper position has been found, the collar is fixed firmly in place by tightening-up the screw S.—*The General Electric Co., Ltd.,* and *F. R. Jones.*

Deflecting-Plates

(Patent No. 497,631.)

There is a tendency for the lines of force set up between the scanning-plates of a cathode-ray tube to diverge outwards beyond the edges towards the metallised lining S of the tube, as shown in Fig. A. This "spreading" or curvature of the lines causes the outer parts of each "sweep" of the scanning-stream to have a slightly different focal length from the stream forming the inner or central parts of the sweep, and so gives rise to a lack of definition at the marginal parts of the picture.



Deflecting plate arrangement.

The difficulty is overcome, according to the invention, by bending the ends of the deflecting-plates P, P_1 slightly inwards, as shown in Fig. B. Or small auxiliary electrodes E, E_1 and E_2, E_3 may be arranged as shown in Fig. C, slightly inside the edges of the plates, for the same purpose. Each pair of auxiliary electrodes is connected together, and the two pairs are fed separately with biasing voltage from potentiometers R, R_1.—*V. Zeitlinn; A. Zeitlinn;* and *V. Kliatchko.*

Electron-Optics

(Patent No. 497,645.)

In an image-dissector, the picture to be televised is first projected on to a photo-electric cathode where it liberates a "composite" stream of electrons, which varies in intensity from point to point of its cross-section according to the light-and-shade values of the original picture. The composite stream is next focused electron-optically on to a mosaic-cell screen, where it produces an "electric image" out of the charges built up on each cell. The screen is then scanned by an electron beam, which liberates each "charge" in succession and so produces the signalling current.

In such a system it is desirable, for the sake of clear definition, to use as large a cathode and mosaic screen as possible. On the other hand this increases the difficulty of focusing the composite "picture" stream by electron-optical methods, since the latter produce less distortion when the cross-section of the stream is kept small.

According to the invention, a compromise is effected by using a converging pair of coils to reduce the cross-section of the stream coming from the cathode, before it enters the electron focusing field, after which it is enlarged again before it reaches the mosaic screen.—

H. G. Lubszynski.

"Mosaic" Screens

(Patent No. 498,134.)

The mosaic-cell electrodes used in pick-up tubes are generally made by spreading a thin layer of silver over a suitable base-plate, say of mica, and then heating the plate to a temperature at which the silver breaks up into small globules, which may then be made photo-sensitive by treatment with caesium.

It has now been found that if the layer of silver is made sufficiently thin, the metal breaks up, more or less automatically, into a "mosaic" of small globules, sufficiently insulated from each other for the purpose in view. This avoids the necessity for any subsequent heat-treatment. The critical thickness at which the layer breaks up is determined, in practice, by measuring the effect it has on the transparency of the mica base-plate. When the transparency falls to approximately 75 per cent. of its original value, the correct amount of silver has been deposited.—*G. S. P. Freeman.*

Summary of Other Television Patents

(Patent No. 497,116.)

Separating synchronising impulses from picture signals, in a system where synchronising is effected by interrupting the carrier-wave.—*N. V. Philips Gloeilampenfabrieken.*

(Patent No. 497,206.)

Means for coupling a television receiver to a dipole aerial in such a way as to increase its sensitivity.—*N. V. Philips Gloeilampenfabrieken.*

(Patent No. 497,217.)

Transformer coupling giving a wide-band response and suitable for the intermediate-frequency stages of a television receiver.—*Radio-Akt. D. S. Loewe.*

(Patent No. 497,371.)

Circuit for filtering-out the synchronising-impulses produced by suppressing the carrier wave in a television system.—*E. P. Rudkin.*

(Patent No. 497,404.)

Television system in which the separate elements of a viewing screen are made to diffuse light to an extent which depends upon the strength of the transmitted signals.—*P. M. G. Toulon.*

(Patent No. 497,566.)

Method of producing photo-electric screens of the mosaic-cell type for use in television.—*H. Rupp.*

(Patent No. 497,605.)

Generating and radiating synchronising-impulses made up of two separately-modulated carrier-waves. —*Farnsworth Television Inc.*

(Patent No. 497,808.)

Screening the control or deflecting electrodes of a cathode-ray tube in order to prevent distortion.—*C. Lorenz Akt.* and *W. Rogowski.*

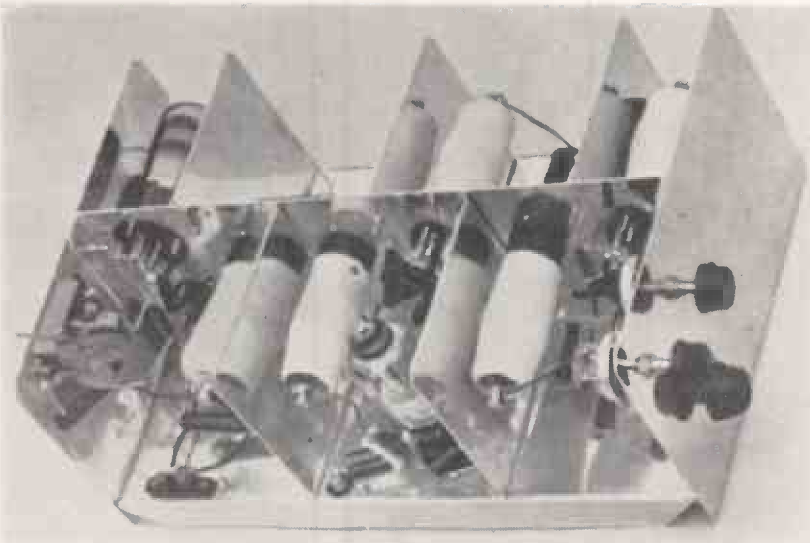
(Patent No. 498,146.)

Light-cell utilising supersonic "pressure" waves for variable-width recording on a cinema-film.—*Scophony, Ltd.,* and *G. Wikkenhauser.*

A RECEIVER FOR MECHANICAL TELEVISION

By J. H Jeffree

In preceding issues details of a simple mechanical-optical system for home construction have been given. This article describes the radio receiver for use in connection with this system. Full constructional details will be given next month.



A photograph of the combined sound and vision receiver for mechanical television.

THE fact that the steel ball scanning system recently described works at somewhat reduced definition makes it permissible to use with it a vision receiver with lower vision frequency response than is customary. Since frequency response and magnification are inversely related to each other, this reduction in the former makes possible a proportionate gain either in the latter or in some equivalent respect such as reduced cost or addition of refinements.

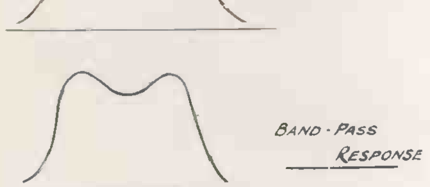


Fig. 1.—Response curves.

After a good many experiments, starting with attempts to cut the cost, above all things, to a minimum, it seemed in the end more profitable to include the sound, in a simple receiver of relatively low cost and high gain, rather than to provide vision only in the cheapest possible one. Sound is necessary, and its cost, if a separate receiver is built, has to be included in the total. We therefore present here a simple and somewhat unorthodox receiver with modulated 10 mc. vision output suitable for operating a supersonic light cell and giving also a small output of the television sound intended to be fed into the pick-up terminals of an ordinary broadcast receiver, or into any sound amplifier, but sufficient also to operate headphones, which is a convenience when experimenting.

The design considerations start with the requirements of the supersonic relay. This, in the simple form used in the mechanical set, needs something like 100 volts of modulated 10 mc oscillation, the required modulation being negative, so that the sync. signals are peaks of oscillation. This suggests at once the use of some form of grid modulation, so as to restore the D.C. picture component by rectification at the modulator grid, without a separate valve. One could, for instance, use a small 10 mc oscillator driving a suppressor grid pentode with the vision signals applied to the control grid.

To obtain good definition with the simple light relay, however, some sort of correction of its frequency response curve is desirable, and the best arrangement is probably a band-pass input circuit to it, the peaks of the band pass being arranged on either side of the crystal peak. (Fig. 1.) This involves two 10 mc tuned circuits, and if a third, for the driver valve, is added, the adjustment is somewhat tricky. If it is wrong, the advantage of the band pass is lost. In this receiver, therefore, we are grid modulating a self oscillating pentode to save the extra tuned circuit adjustment..

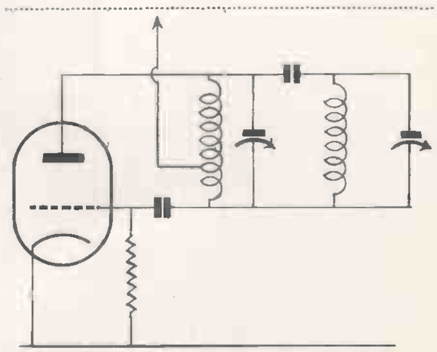


Fig. 2.—Band pass Oscillation Circuit.

An oscillator in a band-pass circuit such as Fig. 2 automaticaly oscillates, if the two circuits are about in tune, at the centre of their band-pass response; it will therefore only be necessary to adjust them, alternately, till the maximum crystal response is secured, to have the whole thing correct. (This would only not be the case, if the crystal coupling drew so much energy, at resonance, as to damp the oscillation markedly.)

Now grid modulation of an oscillator is not always possible. In such a circuit as Fig. 3 it is possible only so long as the oscillation is gentle enough not to swing the grid into grid current; if it is too strong, and this occurs, the grid current, and not

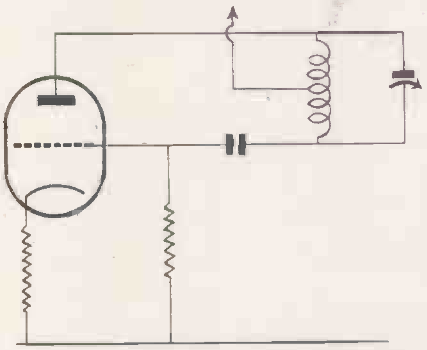


Fig. 3.—Grid modulation oscillator circuit.

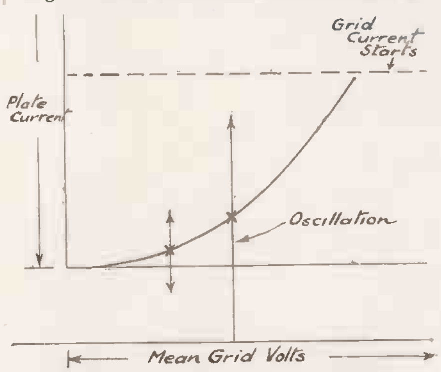


Fig. 3a.—Grid modulation of oscillator.

the modulation, regulates the oscillation. The desired condition only obtains when the effective feedback amplification ratio (grid back to itself) lies between 1 and 2, and as it approaches 2 the sensitivity to modulation goes up rapidly. Now since the effective value of this magnification factor depends on the momentary mean grid voltage which is following the modulation, distortion is probable and the arrangement is somewhat critical anyhow. It is, however, very sensitive to modulation.

If a resonant circuit be connected as in Fig. 4, Hartley fashion, between plate and *screen* of a pentode, and the valve oscillates, it will be possible to modulate it to some extent, as the conditions are different from the former case. The oscillation is likely, however, to be weak and easily stopped by negative modulation. If, however, the control grid be blocked to the oscillation by a choke (dotted) it will receive enough excitation from the screen, by inter-electrode capacity, to assist markedly in maintaining oscillation, and modulation can still be applied.

Moreover, the increasing effective feedback with positive modulation can be partly offset by the increasing screen damping with stronger oscillation, so that the adjustment of the circuit is not critical. It can, however still be stopped oscillating by strong negative modulation, an occurrence which shows as blank areas in the picture following the highlights; so a small unmodulated triode can be added in parallel to maintain a weak oscillation at such times. Fig. 5 shows schematically the resultant circuit. In practice, a 20 mmfd. condenser from screen to grid to supplement the inter-electrode capacity, improves the performance, without making it too difficult to preserve the higher modulation frequencies.

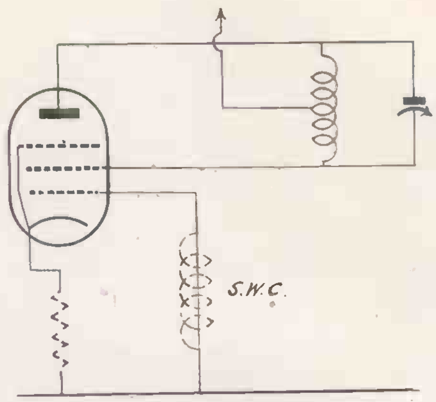


Fig. 4.—Hartley resonant circuit.

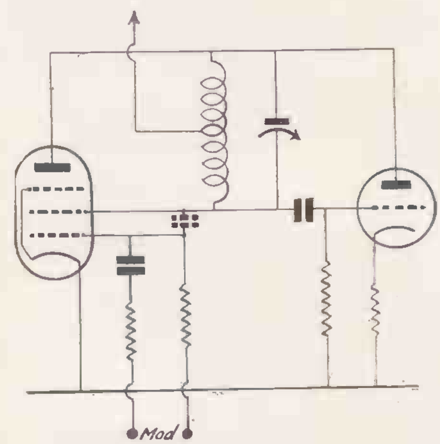
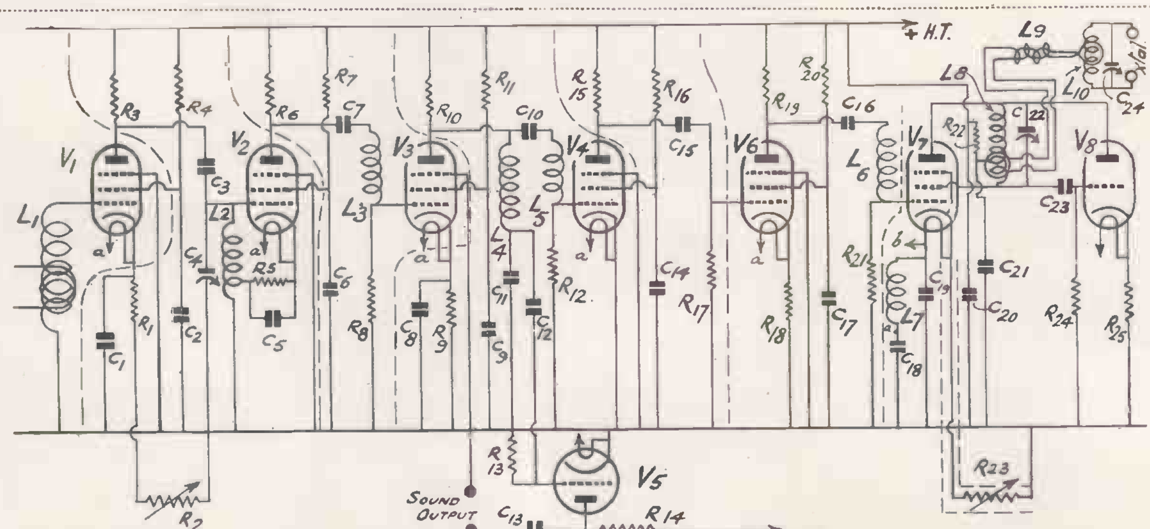


Fig. 5.—Modulated oscillator with sustaining valve.



The complete circuit of the radio receiver for mechanical television.

By including a grid leak and condenser system of a suitable time constant the D.C. component is restored without more ado.

This arrangement requires about 10 volts (swing) of picture signal (negative). This can be provided economically by a leaky grid detector followed by one V.F. stage, and the gain of the two can be about 500 times without making the detector operate at too low a level. At our reduced frequency response a greater gain could easily be attained, but certain decoupling considerations also come in in this connection.

Using a single power pack, low-frequency stability is less easy to secure in a receiver for mechanical reception as in others, as large variations in modulator plate current have to be catered for. The arrangement above outlined would almost certainly "motor boat" if no further precautions were taken. Accordingly, since we have something in hand as regards efficiency, the detector has been arranged as in Fig. 6 (schematic); the high plate resistor and low following grid resistor reducing the feedback impulses from the H.T. till they are about equal and opposite in effect to those entering through the V.F. stage plate circuit. The detector then operates, of course, at a low plate current, but not low enough to overload on the signals it has to handle. Not only feedback, but also H.T. ripple effects, are greatly reduced by this circuit, so that no exceptional smoothing of the supply will be called for.

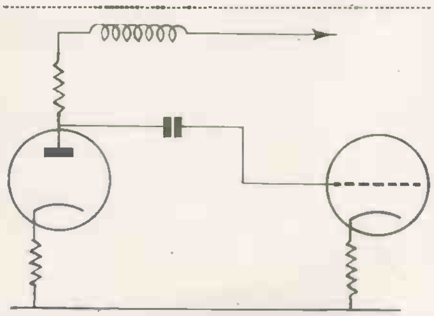


Fig. 7.—Conventional correcting inductance.

Referring back to the modulator, the choke in its grid circuit not only blocks the 10 mc. oscillation but acts also as a correcting inductance for the V.F. response. A correcting inductance is more usually connected, as in Fig. 7, in series with the plate load and in *parallel* with the valve capacities whose effect it corrects; at the frequency at which these shunt capacities have an impedance equal to the plate (plus grid) load, the inductance can have half this impedance and will then correct smoothly up to about this frequency without attenuation.

Another possible connection, however, is that of Fig. 8, where the inductance is *between* the two parts of the shunt capacity contributed by the plate and grid. If, as is usually the case, these are fairly equal, the inductance may have four times the value of the previous cases and the plate load twice; the gain is then doubled, and the level frequency response is no less than before, rather greater, actually, but the phase error is rather worse. The arrangement will well serve for our present purpose, however, and fortunately a short-wave choke of the correct inductance is available. The response could be pretty flat up to a megacycle, if a 7,000 ohm resistor were used for R.19, but 5,000 ohms has been specified to peak a little at 700 kc. Since no suitable choke for the detector plate circuit seems to be obtainable it has been left uncorrected; the loss thus occasioned is not great up to a megacycle, and is corrected as above up to 700 kc., which applies for the mechanical set.

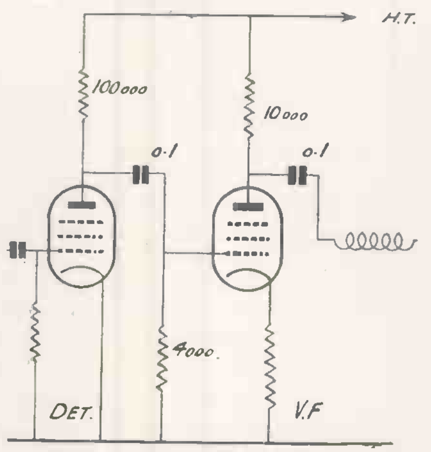


Fig. 6.—Minimising L.F. feedback.

There is no reason why the above arrangements, from the detector onwards, should not be used in a straight set, and where a really strong signal is available the addition of one R.F. stage, and reaction to the detector by a cathode tap to the grid coil, would make a very simple vision receiver for a mechanical set. Probably, however, two R.F. stages would more usually be required.

The set to be described, however, converts the sound and vision simultaneously, from 41.5 mc. and 45 mc. to 3.25 and 3.75 mc. respectively, by a simple frequency changer oscillating on 41.25 mc. (It can equally well operate on 41.75 mc. on the other side of the sound carrier, when the vision I.F. will be 3.25 mc.)

Most of us have used, in earlier ages, a simple oscillator as converter to bring in S.W. signals on the domestic set. In the present case, since two rather widely separated signals are to be received together, it seemed hardly necessary to use anything more complex than this The input circuit cannot (without band pass arrangements) be in tune to both at once, and further it must not be too sharply tuned to the vision, or it will cut the sidebands; in fact its parallel impedance to the vision signals should not be very much more than 1,000 ohms, for this reason. If the oscillator circuit of a convertor be tuned to 41.25 mc. it will have round about 500 ohms impedance to the vision signals, so that the difference is not very great.

An R.F. stage is clearly desirable to avoid radiation on 41.25 mc., and its aerial circuit can be adjusted to favour the vision rather than the sound, to balance the bias the other way of the frequency changer. In practice it suffices to have an aerial coil which resonates approximately at 45 mc. with the by-pass capacities, and this has been provided. Its impedance, owing to the degree of coupling of the balanced feeder, is under 1,000 ohms, and no perceptible gain is got by closer tuning.

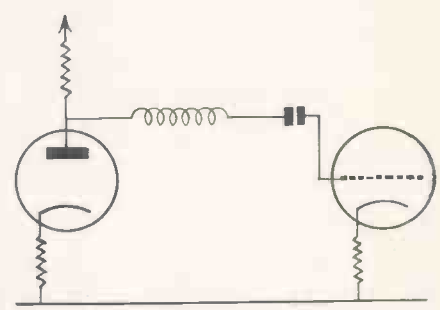


Fig. 8.—Series correcting inductance.

The I.F. circuits also need no tuning. They have to pass a band from about 3.25 to 5 mc., and are actually V.F. type couplings with the correcting inductance between the plate and grid, as in the stages previously discussed. The values, of course, are different, and since we have not found a suitable commercially available choke of the desired 140 micro-henries inductance they will have to be home constructed.

These two I.F. couplings together peak slightly between 3 and 5 mc., and have a response curve suitable for amplifying the vision carrier on 3.25 or 3.75 mc. and at least plus or minus 1 mc. of sidebands, without serious losses. The gain is about 20 per stage.

Separation of the sound and vision is facilitated by the wide difference of their I.F. frequencies. A S.W. choke L4 of 1,350 microhenries (similar to that used for the V.F. correction) in series with a 0.0003 condenser C11 to earth constitutes an acceptor circuit for 3.25 mc. effectively withdrawing it from the vision circuit, while the choke at the same time keeps the vision out of the sound. The vision coupling, through a small (30 mmfd.) condenser C.10 to the detector grid which, with the 8,000 ohm grid leak, has an input impedance of about 4,000 ohms, constitutes a high-pass filter which helps to keep the sound out, even if it is not converted exactly to 0.25 mc.; in particular if its frequency is lower; as a result there is not much intrusion if the convertor oscillates anywhere between 41.25 and 41.75 mc.

Tuning consists merely in first bringing in the sound and then adjusting till it no longer intrudes on the picture; it is not at all critical. At other positions of the tuning the sound will not be heard, but the vision can be received, in places more strongly than at the correct setting; it will, however, then be more or less lacking in definition and mixed with sound patterns.

It may be noticed that this detector coupling will necessarily cut the vision signals sharply at a frequency, determined by the small coupling condenser C10, at which this, with the choke, forms an acceptor circuit. The values given provide for the full definition of the mechanical set; if, however, it were reduced to 20 mmfd. the response would go on to 1 mc., and the sensitivity not be much diminished.

One further point of importance concerns the precautions taken to reduce interference from harmonics of the light relay oscillator. These tend to enter mainly by conduction along the H.T., and heater supply leads, and are reduced in effect by the condensers C18, 19, 20, 21 and R22 and L7. The last is merely a few turns in the heater wiring. One side of the heaters is earthed to the chassis, so there are only two supply leads, H.T. and one heater, the chassis forming the returns.

The wiring is consequently very simple. It is nearly all carried on the central partition on which the valves are mounted, and should be done as far as possible before assembling the rest of the chassis. The supply leads go from side to side of this partition through the holes under the valve-holders, and start from the terminal saddle in compartment 6.

The only wire under the base is the screened connection of the oscillator cathode to the variable resistor R23, which is mounted in front in compartment 2. This has been put under the base only for convenience, so there is no reason why a foil-covered wooden base should not be used if preferred, and this wire run elsewhere. The construction shown is easy, however, and can be in 18 gauge aluminium sheet.

Full constructional details next month.

BAIRD RECEIVERS

In our Buyer's Guide to Television Receivers, published in last month's issue, an error occurred in the title of the Baird Table model, which was described as the T20. Actually, the model number of this is T18. A misprint also appeared in the statement that Mr. Baird gave his first public demonstration at Selfridge's in 1935. This, of course, should have been 1925.

Electron Optics. By the Research Staff of E.M.I., Ltd. (Cambridge University Press, 6s. net.) 103 pp. 45 figs.

This monograph is one of the series of Cambridge Physical Tracts, of which three have already appeared, and is edited by Dr. Klemperer. The treatment of the subject is on conventional lines and deals with the fundamental principles leading to electrostatic and magnetic lens systems. The theoretical discussion is followed by a chapter on the practical applications of electron optics including the electron microscope and electrostatic picture transformer, Zworykin's device for projecting an image comparable in size with the original electron emitting object.

A short bibliography, containing references to the more important E.M.I. patents among other things, is included.

In a monograph of this type the subject naturally cannot be treated at great length, but it is a useful book of reference for those who wish to understand the main principles of the subject without going too deeply into the innumerable applications.

"Picture Faults and their Remedies"

(*Continued from page 214*).

the changes in a line's modulation; particularly is this the case when the load resistance of the D.C. restorer has its effective value reduced during white modulation. This can happen, for example, due to the lowered input resistance of a sync. separator valve during modulation, or for other reasons. The point is that a high time constant is required for the D.C. restorer throughout the picture modulation cycle, and if this is not ensured the effect in the picture will be, for example, an apparent black band backing up a row of white letters, and similar effects, some of which are revealed by Fig. 6. A time constant equal to approximately half the picture area's scanning time appears to be satisfactory, but considerable latitude is permissible providing it is not less than a few lines.

Long Distances on 5 metres

The Java station PK2WL who is heard so regularly on 10 metres, has now decided to operate on 5 metres and hopes ultimately to be heard and to make contact with European amateurs. He is using an input of 250 watts and proposes to contact European stations on 10 metres and then to transfer to 5 metres to see whether or not the signals will cover the distance.

It would be rather interesting to hear from any readers who may pick up PK2WL and reports would be very welcome.

THE TELEVISION ENGINEER

THE ANALYSIS AND DESIGN OF VIDEO AMPLIFIERS

By S. W. SEELEY and C. N. KIMBALL *

License Laboratory, Radio Corporation of America

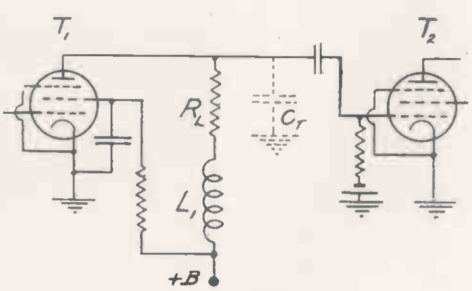
THE ideal video amplifier should have flat frequency response and constant time delay over the band of frequencies required for adequate reproduction of the transmitted picture.

The importance of maintaining the characteristics of individual video stages as close to the ideal values as possible is accentuated in cases where numerous stages are connected in cascade. This is true because the overall gain is equal to the product of the individual stage gains, while the net time delay is equal to the sum of the time delays of the individual stages.

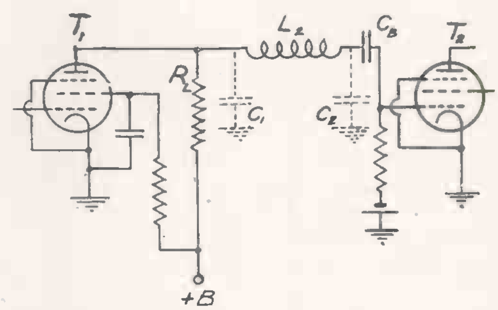
It may be said, in general, that it is quite difficult to maintain both time delay and gain constant over a wide band. Generally a compromise is made, with neither the gain or delay exactly constant, but with both satisfactorily close to optimum values.

All the video-amplifier circuits which have appeared to date consist essentially of resistance - coupled stages, each provided with some form of high-frequency gain and phase correction. The decrease in amplification and introduction of phase distortion at the higher frequencies in an uncompensated amplifier is a direct result of the existence of unavoidable shunt capacities, which are found in any circuit containing valves and associated components. The reactance of these shunt capacities appears as part of the plate-circuit load, and causes its impedance to decrease as the frequency is increased, resulting in a decrease in gain at the higher frequencies. The loss in gain is accompanied by a phase delay.

There are several ways to reduce the effect of the load-circuit capacitance. One method involves the use of a very small load resistor, whose resistance is so low compared to the reactance of the shunt capacitance at the highest video frequency that the reactance has no effect on the gain or phase characteristics. This arrangement would possess no practical advantages, because of the great loss in gain per stage entailed by the use of a small plate resistor. (The gain in a video-amplifier stage may be taken generally as the product of the valves mutual conductance and the plate-load impedance.



Figs. 1 and 2



High-frequency Considerations

A more practical way to obtain adequate high-frequency performance is to employ a circuit containing inductance to offset the loss in gain due to shunt capacitance. In this way essentially constant gain may be obtained, without resorting to abnormal reductions in the value of plate-load resistor.

The expedients employed to extend the frequency band in which constant gain obtains are described variously as correction circuits or peaking circuits. These may take any of several forms, depending upon whether the wide-band characteristics are obtained by inserting a peaking coil in the load circuit, to maintain the load impedance at a constant value, or whether the desired effect is obtained by the use of a coupling circuit, such as a low-pass filter, between successive stages of the amplifier.

Four types of high-frequency video load circuits will be discussed here: (1) Uncompensated load circuit. (2) compensated circuit containing a peaking coil in series with the load resistor—known as shunt peaking. (3) Compensated load circuit in which a π-type low-pass filter is employed as the coupling element—known as series peaking. (4) Combination of shunt and series peaking.

The analysis of these various types of load circuits and the evaluation of their relative merits is somewhat simplified and made more readily adaptable to direct comparison by the use of the following list of symbols and definitions.

V_1 and V_2 = Two successive valves of a video amplifier circuit.

R_L

circuit of V_1.

C_T = Total capacitance shunting the load circuit. This includes tube and wiring capacitances.

C_1 = Total output capacitance of V_1.

C_2 = Total input capacitance of V_2.

$C_2/C_1 = m$.

L_1 = Inductance of peaking coil in series with plate-

* R.C.A. Review, January 1939

load resistor of T_1 (shunt peaking).

L_2 = Inductance of peaking coil connected between plate of V_1 and grid of V_2 (series peaking).

f_0 = Top frequency in the video band.

f = Any frequency in video band above 1 kc.

Φ = Phase delay in radians (caused by reactance in plate-load circuit).

$T = \frac{\Phi}{\omega}$ = Time delay in seconds (due to reactance in plate-load circuit).

Δ_T = Departure from constant time delay (seconds).

It should be noted at this point that, in general, maintenance of a flat frequency-response characteristic (at high frequencies) in a video amplifier stage usually will result in sufficiently uniform high-frequency time delay so that correction expedients which might be applied to produce an entirely uniform delay (and which might alter the response somewhat) are not usually necessary or desirable.

In this connection it is important to observe that the high-frequency performance of the amplifier determines the quality of the picture along any horizontal line, i.e., the horizontal detail and resolution. If both gain and delay characteristics are flat the picture is reproduced exactly. If the gain is constant in the video band and the time delay varies with frequency all the higher frequency components are reproduced precisely in their proper relative amplitudes, but the location of the various picture elements is not correct, because of the different amounts of time taken for passage of the different frequencies. This results in inferior reproduction of horizontal detail.

The magnitude of the time-delay variations, Δ_T (departure from the desired constant value) in an amplifier stage may be written in a number of ways. One method of expressing Δ_T, which will be used in this article, evaluates the departure from constant time of transmission as a fractional part of a period at the top video frequency, i.e., $\Delta_T = K/f_0 = KT_0$.

Circuit 1—Resistance-Coupled Video Amplifier Utilising No High-Frequency Peaking Expedients.

The plate load Z_L comprises the load resistor R_L in parallel with the total shunt capacitance, C_T. The gain, which is equal to $Gm\ Z_L$, falls off as the frequency is increased according to

$$\text{gain} = GmZ_L = \frac{Gm\ R_L}{\sqrt{1+(2\pi f C_T R_L)^2}}$$

C_T at the top frequency, f_0, we have

If we let R_L equal the reactance of

$$R_L = \frac{1}{2\pi f_0 C_T}$$

and

$$\text{gain} = \frac{Gm\ R_L}{\sqrt{1+(f/f_0)^2}}$$

At this frequency where $R_L = \frac{1}{2\pi f_0\ C_T}$, the gain is 70.7 per cent. of the gain at low frequencies (f=10 kc, for instance). The departure from constant time delay at f_0 is

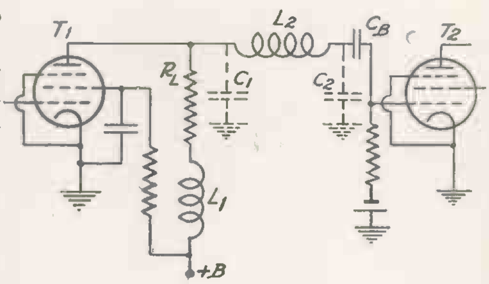


Fig. 3

$0.034/f_0$, i.e., 3.4 per cent. of the period T_0 at the top frequency, f_0. With f_0=3 Mc, Δ_T is 0.011 microseconds. This is the difference in time delay caused by the presence of shunt capacitance in the plate-load circuit.

It should be evident that the gain of this type of load circuit is not sufficiently constant to permit its use in a video amplifier, unless the load resistor is made small compared to the total shunt-load reactance at the top video frequency.

While this analysis is included primarily to demonstrate the behaviour of an uncompensated circuit, and as a basis of comparison for other compensated circuits to follow, it can be put to use as a means for measuring the total load-circuit capacitance of a video stage. The method makes use of the fact that the gain of an uncompensated stage falls to 70.7 per cent. of its low (10 kc.) frequency value at a frequency for which the reactance of the capacitance in question is equal to the plate-load resistance. The measurement of the point of 0.707 response may be determined by noting the frequency at which the input to the stage under test must be increased to $\sqrt{2}$ times its low-frequency value, to maintain constant stage output.

The indicating device may include the following valve in the chain, which should have a low (100-ohm) resistor connected in its plate circuit to provide a voltage drop which can be read on a valve voltmeter. The bias of this second tube should be maintained at its operating value, to preclude any error due to input capacitance variation with bias. A variation of this connection applies the valve voltmeter across the load resistor R_L (with the following tube in circuit) and measures the output across R_L. The capacitance contributed by the valve voltmeter must be known and taken into account in this measurement.

Circuit 2—Video Stage Compensated by a Coil in Series with the Load Resistor (Shunt Peaking).

This type of video stage may be compensated (the plate load-circuit impedance made essentially constant over the required frequency band) by inserting a properly proportioned inductance in series with the load resistor. The peaking-coil inductance is determined by the values of R_L, C_T, and the top video frequency, f_0.

R_L is chosen to equal the reactance of C_T at the top frequency, f_0, (C_T is measured with L_1 not in circuit, by either of the methods previously described). Therefore,

$$R_L = \frac{1}{2\pi f_0 C_T}$$

The value of L_1 is determined from $2\pi f_0 L_1 = \frac{R_L}{2}$ at the top frequency, f_0. Hence,

$$L_1 = \frac{R_L}{4\pi f_0}$$

The resonant frequency of L_1 and C_T is seen to be $\sqrt{2}$ times the top video frequency, f_0.

The gain is essentially constant, up to the frequency f_0, and is equal to GmR_L.

The values selected for compensating the circuit

$$R_L = \frac{1}{2\pi f_0 C_T} \text{ and } L_1 = \frac{R_L}{4\ f_0}$$

are not necessarily productive of the best phase and amplitude response. Other authors have shown that more nearly constant time delay and amplitude response may be obtained by using slightly different values of R_L and L_1.

If we designate the ratio of load resistance, R_L to capacitive reactance X_C at the top frequency by p, and the ratio of inductive to capacitive reactance at f_0 by s, we ave

$$p=\frac{R}{X_C}=2\pi f_0 C_T R_L$$

$$s=\frac{X_L}{X_C}=(2\pi f_0)^2 L_1 C_T$$

The values chosen in the preceding case are $p=1.0$ and $s=0.5$. If, instead, we use $p=0.85$ and $s=0.3$, the time-delay curve is almost flat, and the gain variation over the frequency band is slightly less than in the case previously described. However, this latter arrangement entails the use of a lower value of load resistor, so that the gain is decreased 15 per cent. at all frequencies.

As a typical case, consider a video amplifier employing Type 1851 valves. The total load-circuit capacitance (C_{in} plus C_{out} plus wiring and strays) is about 25 uuf. Let the top video frequency be 3 Mc. in whicht case Xc =2120 ohms. If p=1 the load resistor would also be 2120 ohms, and the coil inductance (for s=0.5) would be

$$\frac{2120}{2\times 2 \text{ uf.}}=56 \text{ uh.}$$

The results would be satisfactory on a basis of constant gain and time delay, with the actual gain equal to 19 per stage, for a tube having a mutual conductance of 9.0 mfd. per volt.

Use of $p=0.85$ and $s=0.3$ would require a resistor of 1800 ohms and a coil inductance of 33.5 microhenries, with a gain of about 16 per stage. In general, in practical cases, the value of L_1 may vary somewhat from the prescribed values, as may also the value of R_L.

Circuit 3—π-Type Low-Pass Filter Employed as Coupling Element Between Plate of T_1 and Grid of T_2 (Series Peaking)

This type of circuit possesses certain advantages over the shunt-peaking arrangement because it effectively separates C_2 from C_1 by means of L^2. (They would normally be in parallel in the shunt peaking circuit, appearing across R_L and L_1.) It affords a greater gain per stage with a smaller departure from constant time delay. The action of the circuit in preserving the high-frequency response of the amplifier may be described briefly as follows: A voltage $eg\ GmR$ is considered to exist across R (with C_1, L_2 and C_2 removed). C_1 is next considered to exist across R, which causes attenuation of the higher frequencies and produces a voltage

$$\frac{eg\ GmR_L}{\sqrt{1+(2\pi f C_1 R_L)^2}}$$

across R and C_1, in parallel. This voltage is applied to the voltage divider consisting of L_2 and C_2 in series, and the resultant drop across C_2 is maintained constant by resonant rise effects in L_2C_2, which counteract the attenuation produced by C_1.

The performance of the circuit depends upon a number of factors. One of these is the ratio of the two capacitances, C_1 and C_2, which appear at the terminals of the low-pass filter. Let this ratio of C_2/C_1 be m. C_1 includes the output and stray wiring capacitances associated with valve No. 1. C_2 includes the input and wiring capacitances of valve No. 2, as well as the stray capacitance between the blocking condenser, C_B, and ground. Note, from Figure 2, that the blocking condenser may be connected at either end of L_2 to assist in adjustment of the value of m.

The value of total capacitance (C_1+C_2) may be determined experimentally by the methods described for use with the shunt-peaking circuit (L_2 is shorted in this measurement). To measure C_1 open L_2 and find the frequency at which the gain of T_1 is 70.7 per cent. of its low-frequency value. A valve voltmeter of known input capacitance may be used across R_L as an indicating device, and its contribution to C_1 must be taken into account.

The procedure for compensating a stage may be itemised as follows: (1) Measure C_1 and C_2 and, if necessary, adjust C_2/C_1 to be at least 2; (2) make the terminating resistor R_L equal to one and one-half times the reactance of (C_1+C_2) at the top video frequency, f_0 and connect the resistor across the plate end of the filter network; (3) obtain a coil which resonates with C_1 at $\sqrt{2}$ times the top video frequency, or use the relation $L_2=\frac{2}{3}(C_1+C_2)R_L^2$. The resistance of coil L_2 is immaterial as long as the coil Q is greater than 20.

Under some conditions it might be necessary to work out of a high plate-circuit capacitance into a low grid capacitance. In such a case the value of C_2/C_1 may be more nearly $\frac{1}{2}$ instead of 2. In that event, the values of L_2 and R_L are the same as those calculated for $m=2$, but the load resistor is connected across the output terminals of the network, i.e., across the smaller terminating capacitance. A reciprocal action permits interchanging the point of resistor termination in this special case, and results in operating characteristics which are the same as for the more likely case discussed previously. The coupling network may be turned end for end without affecting its operation.

The basic design equations, to be used for any value of m, with the top video frequency chosen to be 0.707 times the resonant frequency of L_2 and C_1, are

$$R_L=\frac{1}{\sqrt{2m}\ \omega_0 C_1}$$

$$L_2=\frac{1}{2\omega_0^{\ 2} C_1}$$

where $\omega_0=2\pi$ times the top video frequency. If the values suggested above $\left(R_L=\frac{3}{2}\ \frac{1}{(C_1+C_2)\omega_0}\right.$ and $L_2=\frac{2}{3}(C_1+C_2)R_L^2$ are used in the video stage, the gain and time-delay characteristics are essentially flat out to f_0. The absolute value of gain is 50 per cent. greater than the gain experienced in a shunt-peaking circuit having the same total load-circuit capacitance and the same value of f_0 The departure from constant time delay is $0.0113/f_0$ seconds.

The series-peaking circuit merits serious consideration on the basis of these results. It may be expected to exceed the shunt-peaking circuit in performance in cases where the capacitance distribution is favourable, or when the ratio of capacitances can be adjusted to the desired value without causing a decrease in gain below the value experienced with shunt peaking. Note that operation with values of m less than 2 will cause the gain characteristic to peak at the high end. While this effect is not desirable generally, it may find some utility for peaking purposes in amplifiers in which the high-frequency gain in other stages of the chain is deficient.

Circuit 4—Combination of Circuit 2 and Circuit 3.

This circuit provides certain advantages over either No. 2 or No. 3 used singly. As described by E. W.

(Continued on page 225.)

Telegossip

A Causerie of Fact, Comment and Criticism

By L. Marsland Gander

THERE are signs that the question of a provincial television transmitter has become an exceedingly live issue again. The television group among the radio manufacturers is growing restless at the delay in deciding between the relative merits of ultra short wave radio and cable links. I heard Mr. C. O. Stanley publicly indicate his views in the presence of Sir Stephen Tallents, Public Relations Controller of the B.B.C.

Incidentally, Mr. Stanley also made a sly allusion to the " hen houses " which the B.B.C. are using as studios at Alexandra Palace. The implicit inquiry was: Why no progress with the theatre conversion at Alexandra Palace?

Provincial Television

This question of a provincial transmitter, together with other current problems, was thrashed out at a meeting of the Television Advisory Committee—the first presided over by Lord Cadman. Three members of the committee were absent, namely, Sir Frank Smith, who is in Iran, and Sir Noel Ashbridge and Col. Angwin, of the Post Office, who are at the wavelength conference in Montreux. The B.B.C. was represented by Mr. H. Bishop, the assistant chief engineer, and the Post Office by Mr. A. J. Gill.

Mr. Gerald Cock, B.B.C. Television Director (" Dee Tel ") attended and explained his point of view at length, not only on the question of a provincial transmitter, but also on that of big screen television in cinemas which is, at the moment equally urgent. As usual the meeting was held *in camera* and no statement was issued.

I deduce from this silence that while the Post Office have been instructed to push on as rapidly as possible with their radio link experiments nothing definite has yet been decided. And " as quickly as possible " means when they have the necessary equipment. The last definite information I had was that the apparatus had not been delivered, since when, for a matter of weeks, the whole subject has been shrouded in mystery.

The Big Screen

The B.B.C. views on big screen television are fairly well known. They wish to develop television primarily as a home entertainment, and regard big screen television at the present stage as far from perfect and an indifferent advertisement for their programmes. At the same time the Corporation is willing to co-operate with the cinemas in connection with certain types of programmes, such as boxing matches, which they will allow to be exhibited to paying audiences if the interests of all parties are properly safeguarded. I expect that the Advisory Committee will support this point of view, for the time being.

But in the meantime Mr. Isidore Ostrer, of the Gaumont British Corporation, is equipping eight cinemas of the group in London with big screen apparatus, namely, the Dominion, the Tivoli, the New Victoria, the New Gallery, the Gaumont, Chelsea, and three suburban theatres. The size of the screen may be increased, for the bigger cinemas to 20 feet by 15.

Mr. Ostrer is still firmly of opinion that the time may come when the cinemas have a transmitting station independent of the B.B.C. One thing is certain, that in fairness neither the B.B.C. nor the Government can obstruct progress with cinema television. By the way, I hear that in the bigger cinemas, Gaumont propose to reduce the audience to 1,500 for television shows.

Before the televising of the Harvey-Gains fight, the B.B.C. issued a warning against unauthorised reproduction in public. I understand that this was done because some restaurants and public houses have made special charges for "television dinners." There are said to be 300 restaurants or public houses in London equipped with receivers, hence the need for clarification of the position.

FIRST PHOTOGRAPHS OF TRANSATLANTIC HIGH-DEFINITION TELEVISION

These remarkable photographs, printed from a frame of motion picture film, show a blurred television image broadcast from London and received at the R.C.A. Communications, Inc., station at Riverhead, Long Island, N.Y. Some detail is lost through the use of motion picture equipment.

It appears that the B.B.C. do not object to the reproducton of programmes to non-paying audiences, but as soon as the element of profit is introduced, then a proper arrangement must be negotiated. In the case of a fight, this means payment to the promoters. The B.B.C. has also stipulated that the promoter must not grant exclusive rights to any one cinema or group of cinemas.

Transatlantic Results

I have received from New York some remarkably interesting photographs taken of the screen of the television receiver which picked up pictures from Alexandra Palace at Riverhead, Long Island. It is true that they look rather like "spirit" photographs, or some of the results produced in the Baird 30-line days, but I fancy I can recognise Elizabeth Cowell, and Jasmine Bligh.

While the theorists are busily finding explanations, imagination leaps ahead to the time when transatlantic television is a commonplace. Yet I heard the other day that for over a year the Pye research engineers at Cambridge have been trying to pick up transmissions from New York and have received nothing. This may be due to the fact that the aerial on the Empire State building is designed to give its maximum field strength in a westerly direction. It will be interesting to see if the new aerial array, recently completed, makes any difference.

By the way, I have heard the explanation that the waves from Alexandra Palace are deflected from the ionosphere down to a point in mid-Atlantic and from there reach New York in another great bound. It is stated that transatlantic reception is particularly good when there is daylight on both sides, and conditions were notably favourable last autumn.

"The Design of Video Amplifiers"

(*Continued from page* 223)

Herold[3] it has the following characteristics: for a given total load-circuit capacitance C_T and prescribed top video frequency f_0, the load resistor which may be used (maintaining constant gain up to f_0) is approximately 80 per cent. greater than in the case of simple shunt peaking. This means, of course, 80 per cent. higher gain per stage, for the gain is $Gm\ R_L$, when the circuit is properly compensated. The departure from constant time delay is roughly equal to that experienced in a simple series-peaking circuit. The disposition of circuit components required to produce the 80 per cent. increase in over-all gain are as follows:

$$m = C_2/C_1 = 2$$

$$L_1 = 0.12\,(C_1+C_2)\,R_L^2$$

$$R_{L0} = \frac{1.8}{\omega_0\,(C_1+C_2)}$$

$$L_2 = 0.52\,(C_1+C_2)\,R_L^2$$

To design a stage similar to that shown in Figure 3 the procedure is as follows: (1) Select the top frequency f_0 to be passed with uniform gain; (2) make $m = C_2/C_1$ equal to 2; (3) determine the total load-circuit capacitative reactance at the top frequency; (4) choose a load resistor equal to 1.8 times this total load-circuit reactance at f; (5) calculate L_1 and L_2 from the formulas given above.

A LIGHT AND SIMPLE DIPOLE

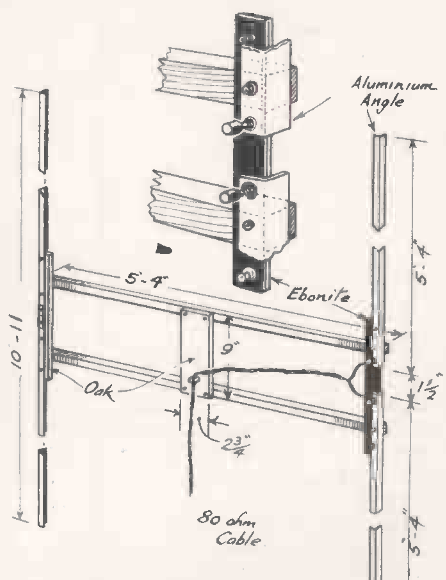
BECAUSE of certain difficulties in the fixing and support of a television aerial of any considerable weight, the prime objective in the construction of the aerial to be described was lightness and minimum resistance to the wind. It was decided, therefore, to use aluminium angle metal supported on a skeleton framework—and the actual weight of the complete aerial is approximately 2 lb. with an almost negligible wind resistance.

The wooden framework consists of two horizontal members each 5 ft. 4 in. of 1-in. square deal separated by a strip of $\frac{1}{4}$-in. oak $2\frac{3}{4}$ in. wide and 9 in. long, secured by screws in the centre. Across one end of the frame are two 1-in. 3/16th in. thick strips of ebonite, placed one over the other and screwed to the ends of each horizontal member. These strips of ebonite act as spacers and provide an insulated support for the attachment of the two arms of the dipole which are secured by four 3/16 in. bolts and nuts. The ebonite strips overlap the frame at top and bottom by $1\frac{1}{2}$ in. in each case.

At the other end of the frame is screwed a strip of $\frac{1}{4}$ in. by 1 in. oak which also acts as a spacer and is for attachment of the reflector. The entire assembly is thus very light and rigid.

The actual aerial and reflector members are $\frac{3}{4}$-in. aluminium angle, which any ironmonger can order if not in stock, or it can be obtained from J. Smith and Sons (Clerkenwell) Ltd., 50 St. John's Square, E.C.1. Each member of the dipole is cut to a length of 5 ft. 4 in. and mounted spaced $1\frac{1}{2}$ in. apart on top of the ebonite strips secured, as previously mentioned, by 3/16 in. bolts and nuts; two of the bolts also provide for attachment of the 80-ohm cable lead-in.

For convenience in handling, the reflector is in two parts butted one up against the other and secured by screws to the oak distance piece at the opposite end of the frame. A small bridging piece is placed over the joint and held firmly in position by screws. The total length of the reflector is 10 ft. 11 in. Provided all the screws are tight it will be found that the complete assembly is extraordinarily light.



Dimensioned diagram of novel dipole.

In order to preserve the aerial from the effects of the weather, both the wood and metal parts were given a couple of coats of good varnish after attachment of the lead-in; this in fact will be essential if an aerial of this type is used near the coast, otherwise, the aluminium will corrode and soon fracture.

A Two-valve A.C. Short-waver

This receiver has been designed by KENNETH JOWERS for those amateurs who wish to use a sensitive two-valve receiver operated from the mains. It covers all wavelengths from 10 metres upwards.

FOR headphone use a receiver which is particularly suitable for amateurs is the straightforward two-valver if the reaction circuit is particularly efficient. Amongst amateurs in this country there are still in service a very high percentage of battery operated two-valvers which have given a very good account of themselves for many years.

This view of the chassis indicates just how the major components are laid out and shows the sockets for H.T. supply and aerial and earth in addition to the two leads for the heaters.

These sets generally are of the conventional type with capacity controlled reaction and transformer coupled to a small output triode or pentode. The only disadvantage of this type of set is the use of an accumulator and high-tension battery and the difficulty in obtaining smooth reaction, particularly under 20 metres.

By using a suitable circuit the two valver can be made in which these difficulties are eliminated and with modern steep slope mains valves world-wide coverage obtained. For C.W. operation it can hold its own even against many multi-valve receivers.

This particular set was constructed for use on ham bands and mainly for C.W. reception, but with a complete set of coils covering all wavelengths, it has turned out to be a most useful receiver for general short-wave reception right down to 10 metres.

Hum Free

It is extremely difficult to produce a receiver of this type running from A.C. mains and to make it perfectly hum free with capacity controlled reaction and the ordinary triode valve. Generally when the receiver is on the verge of oscillation, modulation hum is increased until it sometimes drowns the received signal. While this can be removed, it is not a good plan to publish a circuit with difficulties which may call for a fair amount of experimental work on the constructor's side before the set really does do its work.

The Reaction Circuit

However, by changing over to a detector circuit in which oscillation is controlled by varying the screen voltage, most of the difficulties are removed and it is quite safe to assume that if ten receivers, for example, are built to specification, all will give equally good results. This is a qualification which makes for a successful home-built receiver.

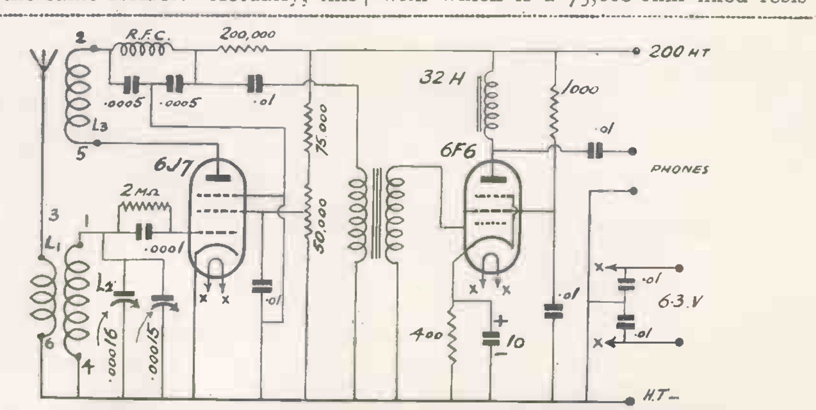
The circuit finally chosen is shown on this page. Coils L1, L2 and L3 are all on the same former. Actually, this plug-in coil is a standard Eddystone component with a 6-pin base. Coils are available to cover from 9 to 2,000 metres without a break for this receiver, but for the special type of reaction employed, the winding L3 has to be modified, otherwise the receiver will not oscillate.

Wavelength Coverage

In addition, the minimum wavelength which is officially covered by the coils is slightly higher than that claimed by the manufacturers owing to the fact that the parallel tuning capacity is 15 mmfd. higher than it should be, caused by the inclusion of a band-spreading condenser. Consequently, the minimum wavelength on the BB coil is approximately 10 metres, so that to cover the 10-metre amateur band the detector circuit has to be carefully wired. It may also be advisable, should the minimum wavelength be too high, to take off half a turn from the BB coil.

The following modifications have to be made to the reaction windings and merely consist of increasing the number of turns. On coil 1, increase from 3 to 5 turns, on coil 2 increase from 3 to 6 turns, on coil 3 increase from slightly over 4 turns to slightly over 7 turns. On coil 4 the existing 9 turns should be increased to 12 turns. The 80-metre coil which at present has 12 turns has to be increased to 20, but the 160-metre coil oscillates quite freely without alteration.

The grid condenser and leak are wired in parallel between the grid of the valve and L2. Actually, connections are made shorter by using one side of the band-spreading condenser as a terminal point instead of using the coil. Voltage to the screen is adjustable by means of a 50,000-ohm potentiometer in series with which is a 75,000-ohm fixed resis-



The coils have been numbered in order that constructors will connect them the correct way round in order to obtain maximum gain and reaction.

10 Metres Upwards

tor, the whole being across 200 volts. It will be noticed that the reaction winding, L_3, is in series with the H.T. supply to the 6J7 detector. The anode resistance has a value of 200,000 ohms, which provides quite a good compromise between stage gain and voltage drop.

It is impossible to obtain satisfactory gain with transformer coupling as the impedance of the primary would be far too low as compared with the impedance of the 6J7. On the other hand, the gain from a straightforward R.C. coupled stage is not too good, so in order to overcome this difficulty a combination of resistance capacity and transformer coupling is used. The anode impedance is the high value of resistance necessary while the transformer which is parallel fed provides a step up of about one to three. Consequently, the 6J7 quite easily loads the 6F6 output valve so that a loudspeaker can be operated on quite a fair percentage of signals received.

Bias to the output valve is obtained in the usual way with a cathode resistor of 400 ohms, shunted by a condenser having a capacity of 10 mfd. The 6F6 valve normally operates with the same voltage on the anode as on the screen but there is a considerable saving in anode current if the screen voltage is slightly lower than the anode voltage. This is the reason for the 1,000-ohm resistor in series with the screen.

Headphone Reception

As previously mentioned, the receiver is intended for headphone reception so that it is essential to have a filter circuit in order to prevent D.C. current passing through the headphone winding. The normal choke and condenser is included as a transformer would have to be of the correct ratio for headphones which would not match the average loudspeaker. Even if the ratio of the transformer were one to one, it is not a good plan to put the secondary of one transformer in parallel with the primary of another.

The receiver has been built on a small aluminium chassis in which the three holes for the valve and coil are already partially drilled. The chassis is also supplied with the hole for the jack, the reaction control and band-set condenser already drilled. On the chassis the band-spread condenser is mounted in the centre as close to the detector valve as possible. In this way the grid of the 6J7 can be connected to the condenser by means of the grid leak and fixed grid condenser.

The left-hand control is the band-set condenser, and the right-hand control a 50,000-ohm potentiometer in the reaction circuit.

Grid Connections

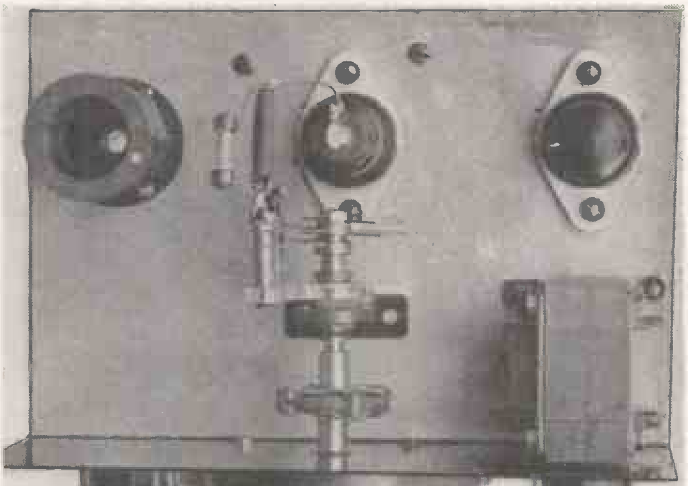
If the band-spread condenser is mounted on the side, one side of the fixed plates go to the grid condenser and the other side of the fixed plates is connected to the fixed plates of the band-set condenser. Again make sure of a short lead which is most important on lower wavelengths.

On the right-hand corner of the chassis is mounted the L.F. choke in the anode of the output valve and the two leads to this are taken through the chassis, carefully insulated and joined to H.T. positive and one side of the headphone jack. On the rear lip of the chassis are fitted two two-socket strips, one being used for aerial and earth connections and the other for H.T. voltage supply. L.T. is connected to flexible wires which come through the centre hole.

Component Lay-out

Next refer to the sub-chassis photograph. The coil holder is arranged so that the aerial and grid leads are as short as possible. Also the anode bypass condensers are connected one directly from the coil holder and the other from the H.T. side of the R.F. choke. All earth returns are made to a common point on the coil holder. It will also be noticed that the earthy side of the band-set condenser and of the jack and potentiometer, are all joined together, so that automatic earths are not used.

The inter-valve transformer is a midget Bulgin mounted as closely as possible to the grid terminal of the output pentode. Just behind this transformer can be seen a special insulator which is used as an H.T. terminal. As there are three or four connections to be made to H.T. positive, it was thought inadvisable to leave these floating so they were anchored to one insulated point.



The grid condenser and leak are connected between the grid of the 6J7 and the band-spread condenser.

The Power Unit

Care should be taken in connecting the six--pin coil. It will be found that the coil holder is actually numbered at the side of the pins. Connect terminal one to grid, terminals four and six to earth, terminal three to aerial, terminal two to the R.F. choke and terminal five to anode.

Power Unit

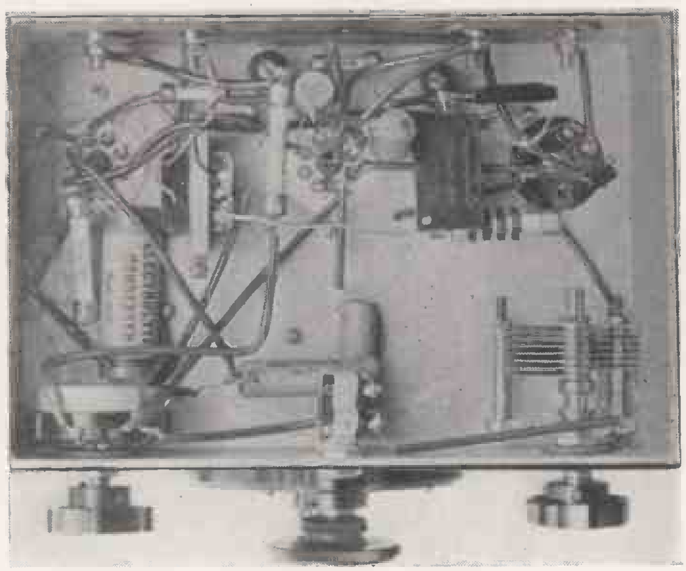
Next comes the power unit which is quite separate, for when the receiver is running with the reaction well advanced, it is extremely difficult to eliminate hum when the power pack is part of the receiver, so for this reason the power pack is on its own chassis and connected by means of quite lengthy cables to the receiver. Even so, there are still traces of hum pick-up unless the power pack is rotated until zero point is found.

The power unit uses a type HT15 metal rectifier which provides 200 volts at 30 mA. with an A.C. input of 140 volts at 120 mA. There are also two 4 mfd. paper type condensers in the voltage doubler circuit and one 8 mfd. smoothing condenser.

Off load the voltage can surge to quite a high value so for this reason it is not a wise plan to economise in the condensers in the voltage doubler or smoothing circuit. This is the reason for 400 volt condensers being used even though the output is only 200 volts. If constructors could make perfectly sure that the power pack is never run off load, then it might be possible to use lower voltage condensers. This plan, however, is not to be advised.

Also from the mains transformer is a separate supply of 6.3 volts at 1 ampere to supply the heaters to the two valves in the receiver. The wire used for the heater leads should be at least 16 gauge and twisted for their entire length.

In operation should there be any traces of hum after all due precautions have been taken, it can be caused by the two condensers in the circuit being unequal in capacity, and a cure can generally be effected by connecting a further condenser of 2 mfd. capacity across both these condensers.



Most of the small components are connected under the chassis as shown in this illustration. Notice the midget inter-valve transformer.

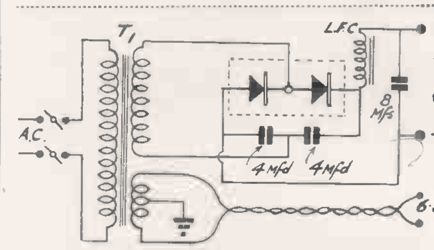
Oscillation will be found to be very smooth indeed but in order to obtain maximum output the receiver should always be used close to the oscillating point.

As individual valves vary as regards characteristics, it is sometimes necessary, in order to be sure of smooth reaction, to increase the value of the bypass condenser immediately following L3 from the present capacity of .0005 mfd. up to as high as .003 mfd. This was the only component that need be varied as regards value, and experimenters are advised to remember this point.

If the aerial is too lengthy, despite the fact that it is coupled to the grid winding by means of a primary coil, it still may cause blind spots or even complete lack of oscillation. A preset condenser will effect a cure while occasionally it may be necessary to reduce the number of turns on L1.

Modulation Hum

Modulation hum will be most noticeable on strong broadcast stations such as Zeesen, unless the condensers across



A metal rectifier is used in the power unit and here is the circuit.

the heater circuit are included. It may also be found that the receiver oscillates more freely without an earth connection, but this is merely an indication that the aerial is too long, or the coupling between aerial and coil too tight. This can easily be remedied as previously explained.

Glass or metal valves can be used as required, although there did appear to be a tendency when testing for the receiver to be more docile and less prone to hum pick up with metal valves.

Components for A TWO VALVE A.C. SHORT-WAVER

CHASSIS AND PANEL.
1—Chassis type 1117 (Eddystone).
1—Panel type 1118 (Eddystone).

COILS.
1—Set 6-pin 9-170 metres type 959 (Eddystone).

CONDENSERS, FIXED.
1—.0001 mfd. type 690W (Dubilier).
2—.0005 mfd. type 690W (Dubilier).
6—.01 mfd. type 691W (Dubilier).
1—10-mfd. 50-volt type 3016 (Dubilier).
2—4 mfd. type LEG 400 volt (Dubilier).
1—8 mfd. type 402 (Dubilier).

CONDENSERS, VARIABLE.
1—.00016 mfd. type TRO160 (Premier).
1—.000015 mfd. type TRO15 (Premier).

CHOKES, L.F.
2—Type 40 mA. 30H (Premier).

CHOKE, R.F.
1—Type CHM (Raymart).

DIAL.
1—Type Indigraph (Peto-Scott).

HEADPHONES.
1—Pair type Supersensitive (Ericsson).

HOLDERS, VALVE AND COIL.
1—Type 964 (Eddystone).
2—Type ceramic octal (Clix).

JACK.
1—Open circuit type with plug (Bulgin).

RESISTANCES, FIXED.
1—2 megohm ½ watt (Bulgin).
1—200,000 ohm 1 watt (Bulgin).
1—75,000 ohm 1 watt (Bulgin).
1—400 ohm 1 watt (Bulgin).
1—1,000 ohm 1 watt (Bulgin).

RESISTANCES, VARIABLE.
1—50,000 ohm type potentiometer (Reliance).

RECTIFIER.
1—Metal type H.T.15 (Westinghouse).

TRANSFORMERS.
1—Inter-valve type LF58 (Bulgin).
1—HT type 140 volt 120 mA. (Premier).

VALVES.
1—6J7 (Webbs Radio).
1—6F6 (Webbs Radio).

Crystal-oscillator Circuits for Experimenters

This interesting article which is in two parts deals very thoroughly with all types of crystal-oscillator circuits suitable for amateur use.

CRYSTAL controlled oscillators have their origin in some basic self-excited oscillator arrangement. Frequency control is brought about by connecting a quartz crystal into the circuit in such a manner that the crystal becomes a frequency determining element. The conventional triode or pentode crystal oscillator is merely the well-known tuned-anode tuned-grid circuit with a quartz crystal substituted for the grid tank. For purposes of discussion, such circuits are sometimes called tuned-anode crystal-grid oscillators.

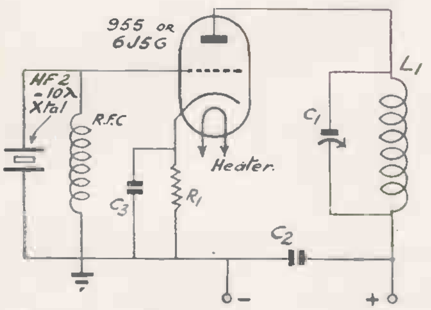


Fig. 1. Triode crystal oscillator, primarily intended for 28 mega-cycles.

Oscillator circuits are remarkably self-regulating; the circuit values can be varied over wide ranges and the oscillator will continue to function. With any set of component values which do not prohibit oscillation entirely, the various currents and generated voltages will distribute themselves for the best performance under those conditions. Of course, there are circuit values which will give optimum performance and efficiency, but for practical applications, these require no great consideration. Representative components are generally chosen and then, by cut-and-try methods, the most satisfactory values determined.

The crystal controlled oscillator is equally self-regulating and for that particular reason it requires more care in design and operation. A quartz crystal, as previously explained, has mechanical limitations in that an excessive vibration amplitude will cause a crystal controlled oscillator to be shattered. It is necessary to design a crystal controlled oscillator such that, in attempting to correct for varying operating conditions, it will not cause the crystal excitation to become excessive. This consideration necessitates a reasonably careful choice of circuit values and, in addition, limits crystal control to comparatively low powered oscillators.

Crystal excitation in the usual type of oscillator circuit depends on the amplification factor of the valve, grid bias, D.C. operating potentials, circuit feedback and the activity of the crystal.

For a given power output, the valve with the highest amplification factor will generally require the least excitation (lowest crystal current). This is immediately apparent in the performance of pentode crystal oscillators as compared to triode oscillators. Screen-grid valves, having the highest amplification factor, require much less crystal excitation for a given power output. Beam-power valves are excellent crystal oscillators due to the small amount of excitation required for full output. In the conventional tetrode crystal oscillator circuit, good output and performance are easily obtained. Where the valve performs as a combination crystal oscillator and frequency multiplier, however, beam-power valves such as the 6L6 have a strong tendency toward the development of parasitics, especially at higher frequencies. This is due to the power sensitivity and the fact that the screen grid in such valves is not fully effective at R.F.

Crystal excitation in a particular oscillator set up is determined by the R.F. voltage across the oscillator tank.

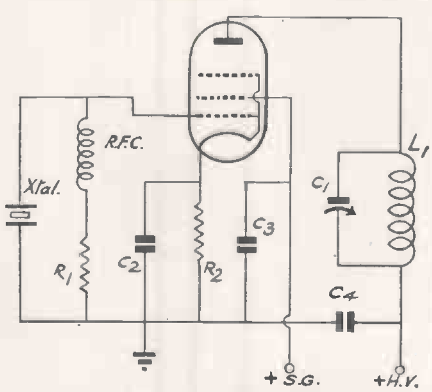


Fig. 2. Standard pentode crystal oscillator.

As this voltage is applied to the crystal circuit, the excitation will naturally increase as the R.F. tank voltage is increased. The L/C ratio of the oscillator tank determines its impedance and, as the ratio is increased, the R.F. voltage will also increase. A reasonably high L/C ratio is desirable with

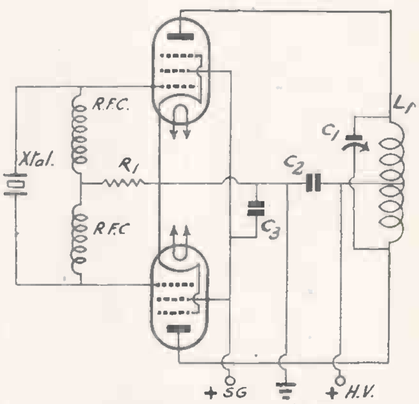


Fig. 3. Push-pull pentode oscillator.

conventional pentode or tetrode oscillators, while a lower ratio is better with triode valves. The greater internal anode-to-grid capacity and the low amplification factor of most triodes, requires that the tank voltages be limited so that the crystal excitation will not become excessive. This applies also to the cathode tank of the tritet circuit, for the oscillating portion is a triode.

The feedback in conventional tuned-anode crystal-grid oscillators is brought about by the internal anode-to-grid capacity of the valve. The excitation requirements of active quartz crystals are so small that even with screen-grid valves, this internal capacity is usually sufficient to bring about ample excitation of all but low-frequency crystals. At frequencies much below 1,000 kc., the reactance of the internal feedback capacity becomes too large to maintain oscillation. Some valves, such as the 802 and RK23, have very low internal capacities and a small amount of external feedback capacity is recommended. Most active crystals above 1,500 kc. will oscillate without the addition of the external capacity, and every effort should be made to operate the circuit without the added capacity before any attempt is made to increase the feedback. Excessive feedback, whether through the intentional use of a condenser or through the presence of stray circuit capacities, will bring about high excitation and endanger the crystal.

28 Mc Oscillator

With screen-grid valves proper by-passing of the screen-grid is essential, for if the by-passing is inadequate, the grid will assume an R.F. potential, greatly increasing the feedback to the crystal.

Bias to the valve is an important consideration. In general, the higher the bias the greater will be the crystal current and the power output. Beyond certain limits, however, an increase in bias will cause a considerable increase in crystal current with only a small gain in power output. Too much bias can bring about excessive excitation.

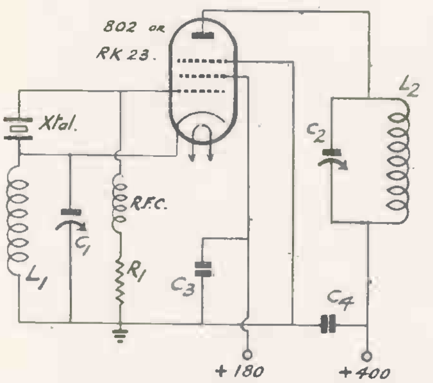


Fig. 4. Tri-tet oscillator-doubler for 5-metre output.

Bias is most generally obtained by the use of a grid-leak resistor, a cathode resistor, or a combination of both. With grid-leak bias an increase of resistance will be accompanied by an increase in the crystal current.. Within certain limits, lowering the value of the grid resistor will increase the output with a reduction in the crystal current. When grid-leak bias is employed, the crystal starts oscillating under conditions of zero bias with a continually increasing bias as the crystal excitation becomes greater. This means that the crystal current will be greatest when the oscillator is not loaded because the anode tank voltage and the bias will be highest under that condition. As a result of the zero bias in a non-oscillating condition, the crystal may be hard starting and may not key well, especially when a low value resistor is employed. By resorting to cathode bias, the crystal will start oscillating under more favouruable conditions. The initial bias has a tendency to increase the anode-to-grid feedback and also brings about a grid condition more conducive to the starting of oscillation. Too much bias of this type, however, will produce the opposite effect, the crystal, will be hard to start and the current high. The correct value of cathode resistor generally lies between 200 and 500 ohms, 350 ohms being a good all-round value.

With pentode or tetrode type valves, best performance is usually obtained by combining grid leak and cathode bias. In general, the grid-leak resistor should not be higher than 20,000 ohms while the cathode resistor will be between the values already given. The grid resistor increases crystal current and thus it will be necessary, when adding cathode bias to a given oscillator, to decrease the value of the grid resistor. Unless a good R.F. choke is used in series with the low value resistor, the crystal will be virtually shorted out to R.F. When using triode valves in the tuned-anode crystal-grid circuit, it is best to connect an R.F. choke directly across the crystal to provide a path to ground for the D.C. grid current, and then employ cathode bias exclusively. The addition of a grid resistor will greatly increase the crystal current without effecting a corresponding increase in power output.

The D.C. anode voltage on an oscillator will naturally influence the crystal excitation. As the potential is raised, the developed R.F. voltage will increase bringing about additional excitation. With pentode and tetrode type valves the screen-grid voltage becomes an important factor, the higher this voltage, the greater will be the crystal current and the power output.

Circuit losses must be properly considered in the design of a crystal oscillator. The circuit should be carefully arranged so that there will be a minimum of stray feedback capacities which may increase the crystal excitation. It is readily possible, with improper layout, to fracture a crystal because of additional feedback brought about by stray capacities. If any appreciable coupling exists between the oscillator and other stages of the transmitter working at the same frequency, crystal excitation may easily be increased to an excessive amount. Thorough inter-stage shielding in high power transmitters is imperative. At the higher frequencies, especially above 6,000 kc., the tank circuit should be well constructed and preferably made self-supporting. If coil forms are used, these should be of minimum loss and preferably made self-supporting. The copper wire in the tank inductance should be sufficiently large to carry the circulating tank current for if the wire is too small, the resultant losses will effect a considerable decrease in power output. When the cathode of the oscillator valve is operated at an R.F. potential, the heater leads should be by-passed to ground at the valve socket.

While it is often desirable to obtain relatively high power outputs from crystal oscillators, it should be remembered that a crystal oscillator is fundamentally a frequency controlling stage; the "heart" of a transmitter. It is much better to work the crystal easily by using a low-powered oscillator and adding an additional valve to obtain sufficient driving power for the following stages. This assures good frequency stability and removes the danger of crystal failure through excessive excitation in an attempt to obtain sufficient power output.

Triode Oscillators

The conventional triode crystal oscillator is shown in Fig. 1. It is a universal circuit because it performs well with crystals at all frequencies. Cathode bias, as indicated, is best for crystals above 1,500 kc., while grid-leak bias is preferable at lower frequencies. The proper cathode resistor varies with different type valves but will normally be between 200 and 500 ohms. Grid-leak bias, in addition to cathode bias, is recommended only for low frequencies.

A relatively low L/C ratio should be employed for best stability and reduced crystal current, while the D.C. anode potential directly influences the crystal current and the voltage, therefore, should not be too high. Some valves may be operated at potentials up to 350 volts, while with other, the potential must be limited to 250 volts or less. The maximum safe potential for any individual triode oscillator will depend on the amplification factor of the valve, the bias and the tank L/C ratio.

The dual-triode crystal-oscillator frequency-multiplier is a popular arrangement for frequency multiplying. Although the tank circuit values are given for 10- and 5-metre operation, the circuit can be adapted for any crystal frequency by choosing the correct tank constants. It is the usual practice in amateur applications to provide a switching arrangement so that the buffer stage can be coupled either to the output of the crystal oscillator for working at the crystal frequency, or to

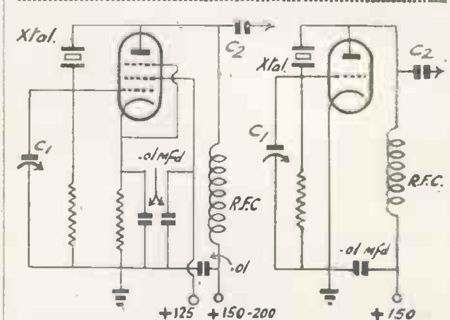


Fig 5. Pierce crystal-oscillators.

A 5-metre Arrangement

the output of the second section of the tube for working at harmonics of the oscillator frequency. If it is desired to use the second section as a buffer at the crystal frequency, neuturalisation must be incorporated. This is necessary to prevent feedback into the oscillator. The maximum oscillator anode voltage

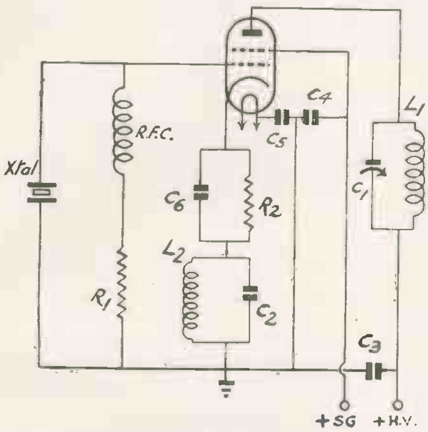


Fig. 6. Pierce oscillator-multiplier circuit.

for valves such as the 6E6 and RK34, is 325 volts, while valves such as the 53 and 6A6 may be operated with a maximum of 350 volts. It is best practice, however, to limit the anode voltage of the oscillator section of all dual-triode circuits to 300 volts. The multiplier section can be operated at a higher voltage if greater harmonic output is desired.

As the excitation requirements of most triode valves are quite high, their power output as crystal oscillators is relatively low under conditions of safe crystal current. Power outputs of up to 5 watts are normal with the usual type of triode valve at frequencies above 500 kc. In the dual-triode circuit the power output, when frequency doubling, is in the neighbourhood of 3½ watts.

Pentode and Tetrode Oscillators

The conventional pentode or tetrode crystal oscillator is the most practical and commonly employed circuit. A representative pentode oscillator is shown in Fig. 2. The general characteristics of pentode and tetrode oscillators are identical inasmuch as the essential difference between the valves lies in the method of suppressing secondary emission from the anode. This is accomplished in the pentode by means of a special grid (suppressor) and in the tetrode by the beam-power design.

A combination of grid-leak and cathode bias gives the most satisfactory results with all crystals above 1,500 kc. The correct value for the grid resistor will usually be between 5,000 and 20,000 ohms, while the cathode resistor will be from 200 to 500 ohms. A representative combination for most pentode and tetrode valves is a 20,000-ohm grid resistor and a 350-ohm cathode resistor. At the low frequencies, best performance is generally obtained with simple grid-leak bias.

The screen-grid voltage has a considerably greater influence on the crystal current than the anode voltage. A potential of 250 volts is generally maximum for normal anode potentials while a lower voltage is preferable when the anode potential is greater than 400 volts. Proper by-passing of the screen-grid is important, especially so with beam-power valves. The by-pass condenser, preferably of the mica type, should be placed directly at the valve socket. With pentode valves, where the suppressor grid is connected to one of the base terminals, an increase in power output can be accomplished by operating the suppressor grid at a low positive voltage.

Pentode and tetrode valves, having a high amplification factor, will provide a greater power output for a given crystal current. Furthermore, the frequency stability with such valves is

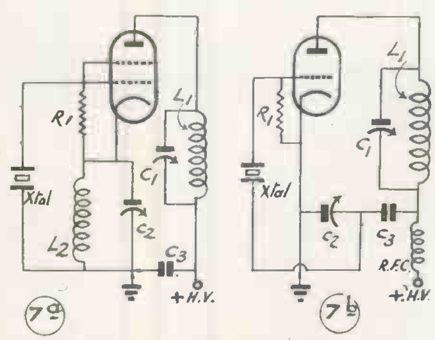


Fig. 7. Modified Pierce oscillators.

much better than obtainable in the conventional triode oscillator due to the action of the screen-grid. This grid reduces the internal anode-to-grid feedback and also has a compensating action on the valve impedance under conditions of changing power supply voltages. With valves such as the RK23, 802 and 807, which are designed specifically for use at radio frequencies, power outputs of 10 to 15 watts can be obtained at frequencies above 500 kc., with a reasonably low crystal current.

Push-pull Oscillators

A push-pull pentode crystal oscillator is shown in Fig. 3. Oscillators of this type are only advantageous in that the output circuit is balanced and even harmonics are cancelled out. They are not in general use because there is little gain in power output over a single valve of the same type and because a balanced output is seldom an essential consideration.

Only with valves which require a very low grid drive is it possible to obtain a substantial increase in power output with the push-pull arrangement. The two valves will require approximately twice as much driving power as a single valve of the same type and it follows, therefore, that the crystal must vibrate more intensely to drive both valves to full output. It is necessary, with most valves, to reduce the operating voltages so that the crystal current will be within safe limits under all conditions of performance. The final result is only a small power increase over the use of a single valve oscillator.

Tri-tet Oscillators

Developed by James Lamb, the tri-tet is an excellent frequency multiplying arrangement. It is, as shown in Fig. 4, a combination triode crystal oscillator and pentode (or tetrode) frequency multiplier. The oscillating portion is a triode with the screen-grid serving as the anode. By inserting the tuning tank in series with the cathode, the grid-grid is grounded to R.F. At the same time, regeneration results at harmonic frequencies by reason of the fact that the common tank circuit carries currents at both the crystal and the harmonic frequency.

Since the oscillating portion of the tri-tet is a triode, the usual consideration of employing a low L/C ratio applies to the cathode tank. For lowest crystal current and highest output at harmonics, the tank should be tuned to a frequency considerably higher than that of the crystal. As a matter of fact, the circuit should never be operated with the cathode tuned closed to the crystal frequeuncy for the result will be high crystal current and decreased output. The cathode tank should be tuned for greatest power output on the particular harmonic without serious regard to the relation between tuning and

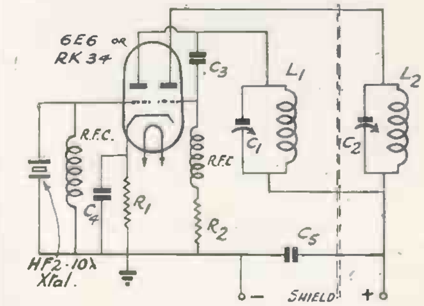


Fig. 8. Double-triode, oscillator-doubler for 5-metre output.

A Simple Circuit

D.C. anode current. For each particular type of valve there will be an optimum L/C ratio.

It will be noted that, as far as R.F. is concerned, the cathode and anode tanks are in series. For this reason, when the anode tank is tuned to the crystal frequency, the crystal current will be lowest at no load and will increase with loading. The crystal current, when frequency multiplying, remains substantially constant with loading because the oscillator portion then functions nearly independently of the remainder of the circuit.

A condition of decreased power output on the second harmonic can exist if the cathode tank should happen to be tuned to that frequency. This condition is obviously corrected by slightly retuning the cathode tank.

Since the screen-grid serves as the anode of the crystal oscillator the screen-grid D.C. potential will influence the crystal current to a large extent. A potential of 250 volts is considered an average maximum, while lower values are preferable. The proper bias conditions are somewhat different than for a simple triode oscillator, due to the fact that the bias also influences the power output on harmonics. A combination of grid-leak and cathode bias generally gives best performance. The bias recommendations given for the pentode and tetrode crystal oscillators should be followed with the tri-tet.

The effectiveness of the screen-grid in valves employed as tri-tet oscillators requires consideration. If shielding is poor at radio frequencies, the circuit should be used only for frequency multiplying—this is most important with crystal frequencies much above 3,000 kc. Where poor internal shielding exists, the crystal excitation can become excessive as a result of additional feedback when the anode tank is tuned to crystal frequency. Valves such as the 802 and RK23 have excellent radio-frequency characteristics while others, such as the 6L6, 6F6, 2A5, 42, 59 and 89 are poorly shielded since they were designed primarily for use at audio frequencies. When operating at the crystal frequency, especially with poorly shielded valves, it is best to convert the circuit to a conventional pentode or tetrode oscillator by shorting-out the cathode tank.

The tri-tet has excellent frequency stability, inasmuch as the coupling between the oscillator and the output circuit is brought about electronically within the valve. The power output, when operating straight-through with a suitable valve such as the 802 or RK23 and at a crystal frequency above 500 kc. is in the neighbourhood of 12 watts. When frequency doubling, it is about 8 watts.

This article was furnished by The Bliley Electric Co., of America, to the British Authorised Distributors, G5NI (Birmingham), Ltd., 44 Holloway Head, Birmingham, 1, who have stocks of all Bliley crystals. They also are able to supply an interesting manual on frequency control which should be of particular interest to amateurs. It is the *Bliley Engineering Bulletin* E-5, which can be obtained from the above address for sixpence, post free. We also advise readers to refer to advertisements in this issue dealing with crystal units.

The article will be completed in the May issue and will deal with Pierce multiplier circuits, modified Pierce oscillators and very comprehensively with 30-megacycle crystal oscillators and 5-metre transmitters.

Circuits for 2·5 Metres

ALTHOUGH on 5 metres it is now advisable to adhere to crystal control, the $2\frac{1}{2}$ and $1\frac{1}{4}$ metre bands are still suitable for experimental work with simple self-excited oscillators, for with low input, interesting results can be obtained.

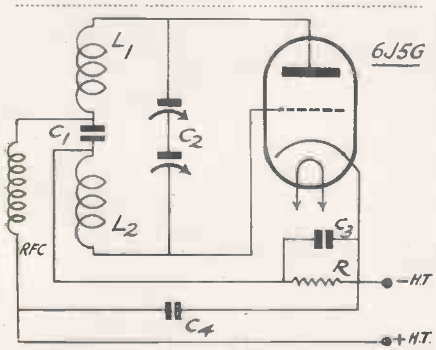


Fig. 1.—A straightforward single valve circuit using the new low capacity triode.

In Fig. 1 there is a well tried circuit using the latest type of triode, the 6J5G. The input to this type of valve is small, rarely exceeding 3 watts, and it can be used for reception with only very slight modifications. However, for transmission the values are as follows: C1, a fixed mica condenser of 100 mmfd., C2 a split stator condenser of the Eddystone type, but having only one rotor plate and two stator plates, C3 is approximately .002 mfd. but the value is not critical. Coils, however, should be built up of one turn $\frac{3}{8}$ in. diameter of about 12 or 14 gauge wire which is usually ample for 112 megacycle work.

A more suitable circuit which will even operate down to 224 megacycles is shown in Fig. 2. This uses a valve such as the new Mullard TV03-10, or an RK-34, which has similar characteristics. It can be run with an input of 10 watts and provides excellent stability with long lines in the anode circuit.

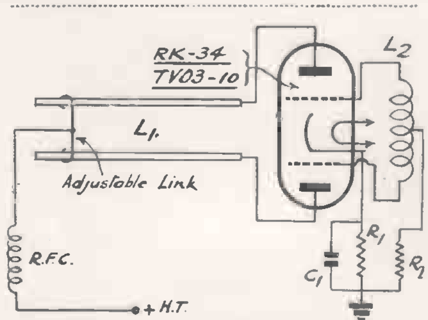


Fig. 2.—This arrangement gives quite good frequency stability.

Resistance values are R1 100 ohms, R2 3,000 ohms. Coil L1 should be 12 in. long and spaced the width of the anode connections to the valve. The exact length has to be determined by moving the adjustable link until resonance is obtained. L2 is made up of 5 turns $\frac{1}{2}$ in. diameter and 14 gauge, and this should be expanded or compressed until resonance is reached. Finally, condenser C1, which should be between 50 mmfd. and 100 mmfd.

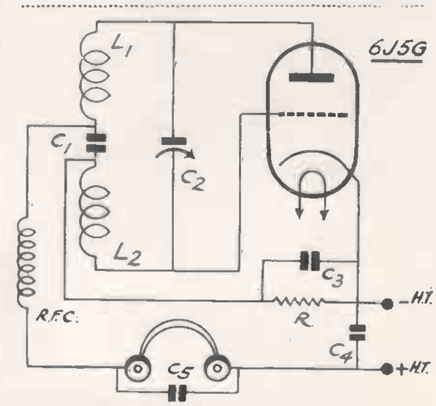


Fig. 3.—The receiver need be only made up of one valve in this way.

The 6J5 circuit shown in Fig. 1 can be adapted for reception, as shown in Fig. 3.

An Efficient Single-valve P.A.

This power amplifier will provide at least 60 watts of R.F. and be suitable for use on three wavebands. Plug-in coils are used in both grid and anode circuits. Valves of lower input, such as the TZ20, can be used without alteration to the circuit.

IN the March issue was described a two-stage exciter which could be used to drive a higher powered final stage, or on its own as a low-power transmitter.

This single valve power amplifier to be described has been built for amateurs who wish to use 50 watts or so and to make use of the exciter already published. On the other hand, any efficient tetrode tritet oscillator will quite comfortably drive the TZ40 which only needs approximately 35 mA. grid current for maximum output.

This illustration gives a very good idea as to the layout of the components. Notice how the tank condenser and coil are mounted well away from the chassis.

It is the easiest job in the world to build a power amplifier, merely two coils and a pair of condensers in a straightforward circuit and the job is done. Results will be reasonably good depending on the component values chosen. However, if the maximum output is to be obtained then very careful consideration has to be given to coil inductances and condenser capacities, otherwise, the R.F. output drops off very rapidly.

3-band Working

This particular exciter is suitable for operation on three wave-bands: 40, 20 and 10 metres. On 40 and 20 metres, it can be driven by the exciter described last month, so acting as a straightforward power amplifier, but on 10 metres, unless the input is considerably reduced, it must be operated as a power doubler.

Before considering the circuit of the amplifier, notice how the components have been arranged in order to obtain a symmetrical lay-out. The final tuning condenser is mounted on four feed-through insulators so that it is approximately the same height as the tank coil which is mounted on two Raymart ceramic pillars. The main reason for raising the coil off the chassis is to prevent losses and to increase efficiency. If the coil is mounted directly on the chassis, the mass of metal considerably increases the wavelength to which the coil will tune by virtue of the additional capacity. As it is essential that the coil have a high inductance, this loss had to be as far as possible eliminated, hence the ceramic mounting pieces.

It will also be noticed that the valve is mounted off the chassis but this is not for quite the same reason. A large hole could have been cut and the valve mounted flush with the chassis, but with a heavy gauge steel chassis many amateurs would have difficulty in cutting this hole. There is also the disadvantage that the grid lead to the coil and the neutralising condenser would have to come through the metal chassis, which is not advisable.

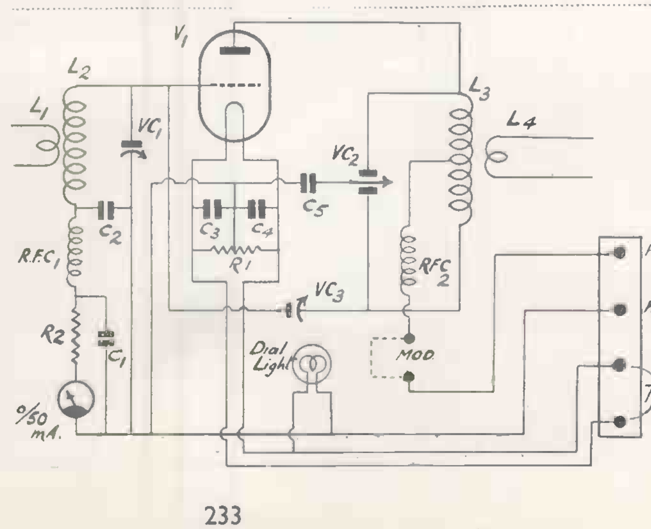
The grid tuning condenser is mounted on an adjustable bracket and the spindle levelled up with that of the tank condenser. Again, to save cutting a large hole, a baseboard type of valve holder is used as a coil mount. In this way the two leads to the fixed condenser are only an inch long, which is permissible.

Directly underneath the mid point of the tank coil is fixed the high-frequency choke. In this way the lead from the coil to the choke is extremely short, as it should be. The other end of the high frequency choke is taken to a small terminal saddle into which is injected modulation for telephony working, while it is short-circuited for C.W. operation.

A well insulated four-way connecting block takes H.T. positive, H.T. negative and the two heater wires. No additional bias is required for the TZ40, a valve of the high slope type, which can be biased quite safely by means of the grid resistor, which in this case has a value of 5,000 ohms with a 15-watt rating.

Incidentally at this point it is worth explaining why a TZ40 has been used instead of a T40. A TZ40 has a very much higher impedance and amplification factor. In practice, although not borne out in theory, the TZ40 requires considerably less drive than the T40, in addition, the TZ40 makes a fine power doubly in view of its high impedance.

The neutralising condenser has a capacity of 8 mmfd. and it will be



The circuit is a straightforward one but in order to obtain maximum R.F. output the components values should be strictly adhered to. Grid bias is obtained automatically.

Plug-in Coils

found that an actual capacity of 6 mmfd. is required to neutralise the valve. Of this capacity 4.5 mmfd. is pure inter-electrode capacity, the balance losses.

On the front panel is mounted a grid meter for the measurement of drive which reads up to 50 mA. It has been arranged so that the grid choke and resistor can be connected in series between the coil and meter without any additional fixing and with the minimum of lead. There is also the by-pass condenser C1, which has a capacity of .002 mfd. and the blocking condenser, C2 .006 mfd. Both these condensers have their earthy sides taken to a common point. Actually a bolt with several soldering tags fitted to it, is placed just underneath the grid meter and all earthy returns are taken to this one point by means of insulated wires.

Next for the circuit of the unit. The R.F. output from the exciter is connected across L1, which is a single turn coil mounted on the grid coil holder. It will be noticed that this coil, L1, is not fixed to a coil former and the coil can be plugged in and out leaving the link winding behind. Inductance, L2, is wound on a standard 1½ in. former and consists of 21 turns of number 16 gauge tinned copper wire spaced one diameter. On 20 metres, this should be reduced to 12 turns of similar wire and spacing, and on 10 metres, 5 to 6 turns of 14 gauge wire spaced one diameter.

Contructors may think these windings are rather on the long side but owing to the method of construction, the low loss and the extremely low inter-electrode valve capacities, the inductance is naturally much higher than normal.

The condenser tuning VC1 is a 60 mmfd. double spaced type which has a low minimum capacity necessary for 10-metre operation. The R.F. choke is of the receiving type but is capable of withstanding quite a high D.C. current.

A special Raymart coil form is used in the tank circuit and this is supplied with base, sub-base and all fittings, and has a diameter 1¾ in. grooved to take 32 turns. This is just enough for 40-operation with the split stator condenser specified, but unfortunately, 40 mmfd. capacity has to be used, which is a little on the high side for maximum efficiency. On 20 metres, use 19 turns of 14 gauge wire and on 10 metres 10 to 11 turns of 14 gauge wire.

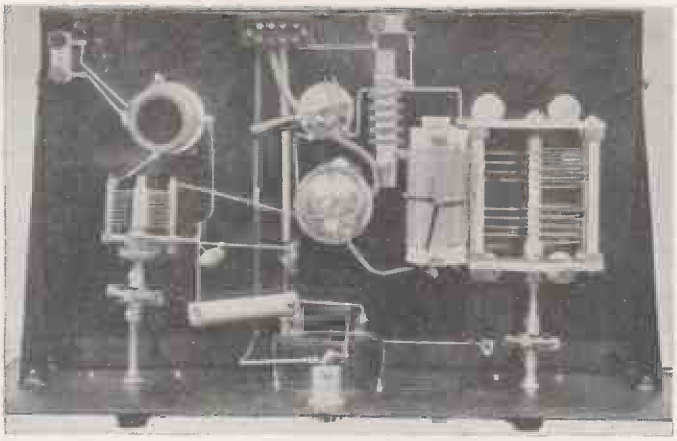
There is a slight increase in efficiency on 10 metres if 12 gauge wire is used, but it is rather difficult to wind this heavy gauge wire on a small former.

The tank coil is, in each case, accurately centre tapped and this tapping taken to the high-frequency choke by the shortest possible lead. Also around the centre of the coil is L4, a single turn link of 14 gauge wire insulated with high voltage sleeving and terminated in two fixing bolts on the ends of the coil form.

Directly across the valve heaters are C4, C5 and R1, with the mid points taken to the common earth. C5 is a blocking condenser in series with the rotor of the tank condenser, and this very effectively prevents arc-over with modulation peaks.

Next comes the question of a power unit. With 1,000 volts an input of up to 75 watts can be obtained quite comfortably but those who are interested mainly in low power operation can use a 500-volt supply of a standard type and then the input can be run up to 60 watts quite nicely. Actually, tests were made at one period with an input of

Left-hand control is for grid tuning and the right-hand for anode tuning. The meter, which reads up to 50 m/A., is for grid current checking.



This plan view shows how the components are arranged and particularly the short connecting leads through the tank condenser and tank coil.

Components for AN EFFICIENT SINGLE VALVE P.A.

CHASSIS, ETC.,
2—Chassis type 1109 (Eddystone).
2—Panels type 1112 No. 6. (Eddystone).
4—Brackets type 1110 (Eddystone).
1—Black type 1107 (Eddystone).

COIL FORMS.
1—Type BTX with base, sub-base and supporting pillars (Raymart).
1—Type CT4 (Raymart).

CONDENSERS, FIXED.
1—.002 mfd. type 690W (C1) (Dubilier).
1—.006 mfd. type 691W (C2) (Dubilier).
1—.002 mfd. type 690W (C3) (Dubilier).
1—.002 mfd. type 690W (C4) (Dubilier).
1—.002 mfd. type 680, 5,000 v. test (C5) (Dubilier).
1—4 mfd. jelly filled 1,000 volt working (C6) (T.C.C.).

CONDENSERS, VARIABLE.
1—60 mmfd. type 1093 (VC1) (Eddystone).
1—50 plus 50 mmfd. type 1081 (VC2) (Eddystone).
1—Type 1088 (VC3) (Eddystone).

CHOKES, R.F.
1—Type SW68 (RFC1) (Bulgin).
1—Type CXT (RFC2) (Raymart).

CHOKE, L.F.
1—Type 150 mA. 40H (Premier).

DIALS.
2—Type indigraph (Peto-Scott).

DIAL LIGHT
1—Type D9 (Bulgin).

HOLDERS, VALVE AND COIL.
1—4-pin type 949 (Eddystone).
1—4-pin type American (Webbs Radio—Amphrenol).
2—4-pin type SW21 (Bulgin).

METERS.
1—0-50 mA. (Ferranti).
1—0-250 mA. (Ferranti).

RESISTANCES, FIXED.
1—70 ohm humdinger (R1) (Premier).
1—5,000 ohm 15 watt (R2) (Premier).
1—100,000 ohm 8-watt (R3) (Premier).

SUNDRIES.
2—Terminal saddles type 1046 (Eddystone).
2—4-way terminal blocks (Andrew Bryce).
2—2-way terminal blocks (Andrew Bryce).
2—Insulating brackets type 1007 (Eddystone).
2—Insulating couplers type 1009 (Eddystone).
2—Insulating pillars type SP (Raymart).
2—Feed-through insulators type ST1 (Raymart).

SWITCHES.
2—Type S/L39 (Bulgin).

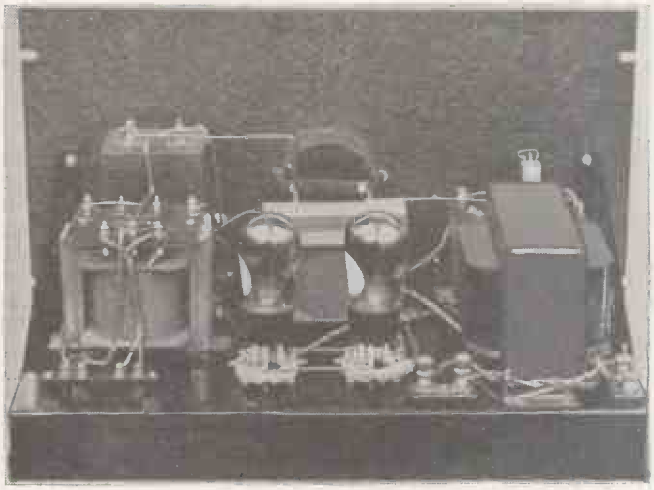
TRANSFORMERS.
1—1,000-0-1,000 volts 250 mA. type SP 1,000 (T1) (Premier).
1—5 volt 3A. CT (T2) (Premier).
1—7.5 volt 3A CT (T3) (Premier).

VALVES.
1—TZ40 (V1) (Webbs Radio).
2—GU1 (V2 and V3) (Osram).

1,000 Volts H.T.

only 25 watts and even at this low input the efficiency was extremely high.

Constructors must remember that the output stage and power units are mainly a matter of choice and TZ20's can be used in place of TZ40's with either 500 volts or 750 volts input. It is the design lay-out that should be followed rather than the valve types. However, in the suggested power unit there are three transformers. T1 providing 1,000 volts at 250 mA., T2 giving 5 volts at 3 amperes for the heaters of two half-wave rectifying valves, and T3 7.5 volts at 3 amperes for the TZ40. The primaries of T2 and T3 are connected in parallel so that the valve heaters can be switched on before the H.T. voltage is applied.



The power unit uses two GU1's and provides 1,000 volts D.C. For lower inputs a 500-volt transformer would be satisfactory with a type 83 full-wave rectifying valve.

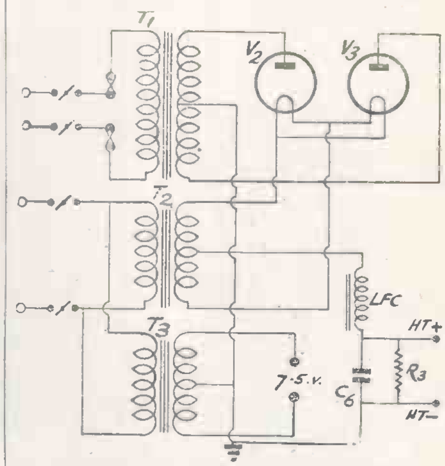
The smoothing circuit is simple consisting merely of one choke, smoothing condenser having a capacity of 4 mfd., and a bleeder resistor of 100,000 ohms.

Again, no large holes have to be cut in the chassis for the valves are mounted on baseboard type valve holders. These are fitted with small legs so that there is ample gap between the anode pin of the valve and the chassis. An optional meter is included, and this reads 250 mA., is in series with H.T. positive, and is merely for checking the anode current of the TZ40.

After the amplifier and power pack have been wired and carefully checked, they should be inter-connected and the valve heaters warmed up. Apply drive to L1, and adjust VC1 until the grid current reading is around 40 mA. Unscrew the neutralising condenser until it is at its minimum capacity and then adjust VC2 until there is a considerable change in grid current. The resonant point is juite noticeable, for as the condenser is tuned to resonance, the grid current reading rapidly changes.

Adjust VC2 through resonance and at the same time adjust VC3, the neutralising condenser, until a point is reached on VC3 where VC2 can be adjusted without causing any change in the grid current reading. The stage is then correctly neutralised.

With VC2 adjusted to resonance, or as near as possible, apply the full H.T. voltage. If VC2 is not at resonance, the total anode current may be anything up to 200 mA., but as VC2 is tuned, the current will drop down to a very low value. Actually, in the original model, it was considerably under 10 mA., showing that the stage was quite efficient.



The circuit of the 1,000-volt power unit.

A 60-watt bulb connected across L4 will light up to full brilliancy if the transmitter is working efficiently, and with an input of about 75 watts.

A suitable aerial is a half-wave dipole fed with 80-ohm cable which can be terminated directly in L4. However, it is a good scheme with an efficient output stage to use the best possible aerial such as a simple beam of the W8JK type.

A final point is the wires connecting the heater of the TZ40 to the filament transformer should be of heavy gauge so as to prevent voltage drop and the voltage applied should be checked actually at the terminals of the valve holder.

A New Eddystone Short-wave Manual

All radio dealers, booksellers, etc., can now supply the second edition of the well-known Eddystone Short-wave Manual. This manual, which is made up of 40 pages, is an extremely interesting one and of particular value to short-wave listeners and transmitting amateurs.

Amongst the information included is full constructional data on a good Ham Band Two covering 8.8 to 100 metres. The Everyman Short-wave Receiver, which is battery operated, is also fully described in its new improved form. This set has one R.F. and two A.F. stages and is particularly suitable for long-distance communication. Those who are interested or contemplate taking up amateur transmission will appreciate the article describing an amateur station which is suitable for an input of 10 or 20 watts on 40 metres and 20 metres.

For checking purposes there is also a description of an accurate absorption wavemeter which covers from 10 metres upwards, while there is also a very effective cathode-ray oscilloscope of a simple type using a 3 in. tube.

Amateurs who wish to listen in on the 5-metre amateur band or to pick up the television sound programmes at long distances will also find the U.H.F. receiver described in this manual quite simple to build. We suggest that readers obtain a copy from either Webbs Radio, 14 Soho Street, W.1, or 41 Carrs Lane, Birmingham, or direct from Stratton & Co., Ltd., Eddystone Works, Bromsgrove Street, Birmingham, 5, mentioning this journal.

Mullard Low Power Transmitting Valves

A particularly useful brochure has recently been introduced by the Mullard Wireless Service Co., Ltd., of 225 Tottenham Court Road, W.1. This brochure gives complete data on a large number of transmitting valves, cathoderay tubes and rectifiers. Illustrated are valves of the RK34, T20, 250TH, RK45, 807, RK39 and 866 types to quote but a few.

Several pages are devoted to valves suitable for audio use. In the cathode-ray section is also included a measuring bridge, small cathode-ray oscillograph, a calibrated audio frequency oscillator and a cathode-ray tube unit.

We certainly feel that amateurs should write to Mullards for this booklet, which is free, provided this journal is mentioned.

With the Amateurs

By G5ZJ

G5ZJ suggests that during the next year or so at least more attention should be paid to 160 metres for local working and to 10 metres for low power DX. Criticisms on these views will be appreciated.

AFTER an absence of nearly three years, I have begun to take more interest in 160 metres. At one time, I knew practically every call-sign on that band, and although little DX was possible, it was certainly most interesting for experimental work of all kinds.

A few days ago, after having built a new receiver, I gave it an extensive test on 160 metres and could not but help noticing just how the band had changed. It appeared to me to be more crowded than at any other time, which is not what I expected at all. I was given the impression by some of the old-stagers that most of the amateurs had migrated to lower frequencies. In addition, John Preston, in Muirkirk, is still listening as much as ever and supplying reports of everything he hears.

W9DXX, owned and operated by Alice G. Bourke, in Chicago, has undergone its almost annual rebuild. This is the latest picture, showing part of the operating room and the transmitters.

G4's

The noise level does not seem at all bad although the QRM from trawlers and commercial stations has certainly increased. Although the band is very full of G8's, G3's and even a G4, it still appears to be the most useful band for local working provided the modulation level is kept reasonably low. In view of the terrific QRM on 40 metres, I am surprised that even more amateurs have not considered going back to 160 metres.

G6CT tells me that he has heard quite a number of DX stations on this band, including FA8, who was calling a VE1. I am also told, quite reliably, that contacts with W are not uncommon, which says quite a lot for the radiating systems providing the 10-watt restriction has been adhered to.

There is no doubt that more genuine experimental work is carried out on 160 metres than on any other bands. I am not taking into consideration 80 metres, for this is rather restricted. The only competitor appears to be 5 metres, which will probably be one of the most popular bands in a year or so. It was quite a pleasure to have reasonably long contacts on 160 metres and to be able to discuss problems of common interest. After being on 20 metres for some years where card collecting seems to be the order of the day, the 160-metre contacts were a pleasant surprise.

Most amateurs feel that with the deterioration in conditions, not much can be done on 10 and 20 metres for the next year or so and, generally speaking, there appears to be a rather widespread feeling of depression and the view that unless higher power is used, only local contacts can be made.

It is my personal opinion that the so-called bad conditions are going to be rather useful for it will tend to make amateurs improve their rigs and certainly consider erecting small beam aerials. There is no question at the present time with the bands comparatively dead, that more stations than ever can be worked owing to the lack of QRM. It merely means operating at the correct time, and not necessarily with high power. The work of G8MX with his 20 odd watts rather proves this point, for he has now worked 30 zones on telephony and without very much difficulty.

Generally speaking, if a station can be heard, it can be worked, which is vastly different from conditions which existed three years ago. Then so many DX stations were coming over that it was practically impossible to maintain 100 per cent. QSO's with normal equipment.

It seems to me that as such a high percentage of British amateurs are limited to an input of 10 watts, more time should be devoted to 10 and 160-metre working. Those who can operate on 10 metres will find it well worth their while for the band is open from 12 hours to 20.00 or 21.00 hours at least. Local contacts can be maintained on 160 metres or even on 5 metres

W9DXX has invested in one of the new Hallicrafter HT1 transmitters, which gives 75 watts on telephony and over 100 watts on C.W.

New U.H.F. Stations

should there be any co-operation.

Some very useful work can be carried out when working with the Dutch stations by transmitting on 160 metres and receiving on 80 metres, remembering, of course, to check one's own transmitting frequency. It will usually be found that Dutchmen are particularly keen to co-operate with tests of all kinds. They usually have some extremely good ideas, and are very free with their suggestions.

A pair of 6L6's as a C.O. P.A. are all that is required on 160 metres and this is not likely to prove too excessive.

U.H.F. TRANSMITTERS

EIGHT high-frequency stations, located in widely separated sections of the United States are available for experimental use by the Columbia Broadcasting System following the inauguration of W6XDA on February 1. The short-wave and ultrashortwave stations owned, operated by or affiliated with C.B.S. are the International broadcasting stations W2XE, New York and W3XAU, Philadelphia; high frequency broadcasting stations W2XDV, New York; W9XHW, Minneapolis and W6XDA, Los Angeles; television station W2XAX, New York.

In addition, W1XAL and W1XK, international broadcasting stations in Boston, co-operate with C.B.S. by transmitting a number of network programmes to Latin-America and Europe. Columbia stations W2XE and W3XAU are licensed for international experimental broadcasting. Both operate with 10 kilowatts input and employ directional antenna systems. Since the inauguration of W3XAU's directional antennas on January 10, it has been possible to broadcast Columbia programmes to Latin America and Europe simultaneously, if required. W2XE is now using the 21570, 15270, 11830, 9650 and 6170 kilocycle bands, while W3XAU employs the 9590 and 6060 kilocycle bands.

Station W2XE is on the air from 7.30 a.m. to 1 a.m. EST on week-days and from 8.0 a.m. to 1 a.m. Saturdays and Sundays, with the exception of several 30-minute intermissions to permit frequency and antenna changes. W3XAU broadcasts from 1 p.m. to 1 a.m. EST, daily.

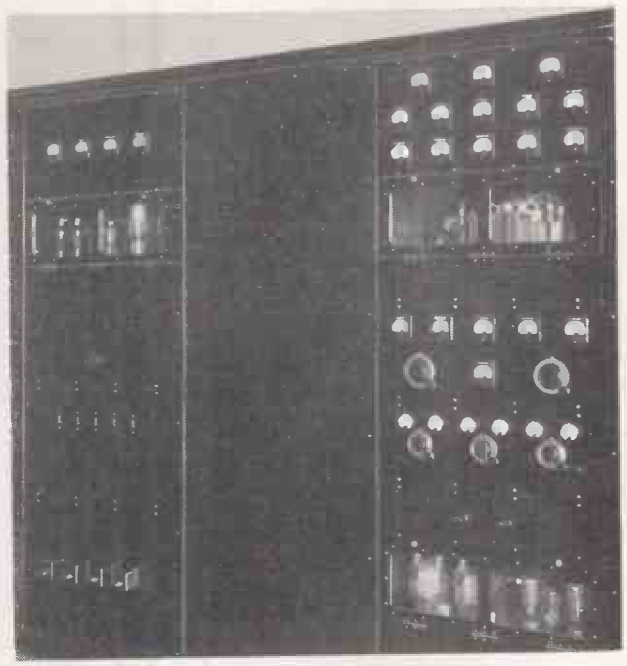
One of the many interesting things already observed by C.B.S. in their studies of these frequencies is the almost complete absence of static and the high fidelity with which musical programme can be transmitted. On the other hand, interference created by motor-car mobile and even airplane ignition systems is a problem.

In addition to being used for research, these stations are now employed for cueing purposes when the network carries programmes from planes above the cities in which the transmitters are located. With the advent of television, receivers will be put on the market capable of picking up high fidelity musical programmes from such sources.

W9XUP.—Most listeners on 10 metres have at one time or another heard the St. Paul's station, W9XUP, on 25.950 kc., which has been operating since May, 1938. The input is 1,000 watts and reports have been received from England, New Zealand, Alaska and South Africa just to mention a few countries. The frequency, however, has now been changed to 26.150 kc in order to be clear of interference of other programmes, and better reports are expected particularly from Europe. The transmitter was designed and built by the engineering staff of KSTP. The final amplifier consists of two type 833 valves in push-pull driven by two type 806's in push-pull which are, in turn, driven by one type 808 The driver stages consist of an 807 oscillator and two 807 buffer amplifiers.

In the audio equipment there are two 833's in class-B driven by two 845's in class-A preceded by two 271's in class-A. The aerial is mounted on top of a 175 ft. tower and consists of a 3 in. steel seamless tube three-quarter wavelength long, of which one half-wavelength is used as the actual radiator. It is mounted in a sleeve fastened to the steel tower so that the tube can be adjusted up to three-quarter wavelength.

Programmes from W9XUP are relayed from either KSTP or the N.B.C. network. The station is on the air from 7 a.m. to 12 midnight C.S.T. seven days a week and all short-wave listeners' cards are appreciated and acknowledged.



This is the transmitter at W9XUP which is now operating on 26.150 Kc. and relaying the N.B.C. red network programmes. The power input to the final is 1,000 watts.

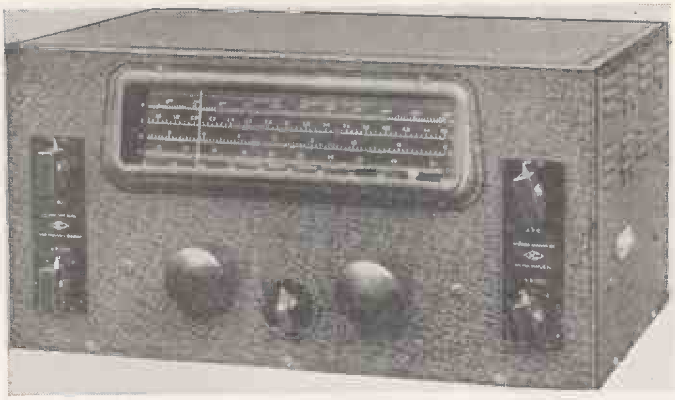
On 10 and 20 metres at the present time there are quite a number of stations which are using more or less a fixed frequency and which can be heard with great regularity. On 10 metres the following have been listed:—

	kc.		kc.
TI3AD	28,290	K4FKC	28,200
HI7G	28,310	K6LB	28,262
K4EZL	28,210	K4EJG	28,075

On 20 metres, there are quite a large number of African and Asiatic stations which can be heard in this country, including:—

	kc.		kc.
ZS1AX	14,080	VQ2HC	14,310
ZS1BL	14,360	FB8AB	14,375
ZS1CN	14,070	VS7GJ	14,080
ZS1B	14,060	VU2LL	14,100
ZS2AZ	14,120	VU2FU	14,280
ZS2AH	14,020	VU2DR	14,140
ZS2BB	14,050	XU8CN	14,310
ZS2N	14,030	XZ2EX	14,340
ZS4H	14,270	XZ2BY	14,100
ZS5AW	14,090	XZ2PB	14,040
ZS5AD	14,110	XZ2EZ	14,200
ZS5BZ	14,030	VS6AG	14,080
ZS5BH	14,400	VS3AF	14,350
ZS6BA	14,350	FI8AC	14,070
ZS6DJ	14,040	KA7EF	14,140
ZS6EF	14,370	K6OJI	14,170
ZS6FB	14,140	J5CC	14,405

By making a note of these frequencies and listening at the correct time amateurs will stand a much better chance of working good DX.



This external view of the NC-44 gives a good impression of the way the receiver has been built. It is very robust.

The Latest National Receiver NC—44

A RECEIVER which will undoubtedly prove popular amongst discriminating amateurs is the new 7-valve National type NC-44. It is a smaller edition of the well-known National NC-80 which appeared last year, but it has a simplified specification. Externally, the design and appearance of the NC-44 are extremely good and follow modern National lines. The receiver was designed in the first instance for operation on D.C. or A.C. mains on 105-140 volts and with this input draws approximately 40 watts. However, on higher voltage mains, a line cord is supplied so that there is no need to modify the receiver in any way.

Four-band switching is included so covering 540 kc. to 30 mc. The main tuning drive is of the dual type and provides general coverage and band-spread operation for amateur service. The main tuning condenser, a two-gang unit, is of the straight line frequency design and is coupled to the tuning dial which is accurately calibrated in megacycles. The slow motion reduction drive is approximately 30 : 1.

An electrical band-spreading system using a completely separate two-gang condenser, has its own scale and drive and is arranged so that on amateur bands there is quite a wide coverage. For example, the four most popular amateur bands are spread as follows:

3.5 to 4 megacycles 65 divisions
7.0 to 7.3 megacycles 50 divisions
14.0 to 14.4 megacycles 56 divisions
28.0 to 30.0 megacycles 40 divisions

With the band-spreading dial set at 90 degrees on the scale the main coverage condenser is then accurately calibrated according to the main dial. However, if the band-spread dial is in a position other than 90, the normal calibration will be inaccurate.

Separate audio and I.F. gain controls are provided each with its own integral switch. When the audio gain control is in the "off" position the H.T. supply to the receiver is broken, while the line switch is part of the I.F. gain control. Automatic volume control is also provided and this is switchable and is quite separate to the switch covering the beat-frequency oscillator.

As previously mentioned the circuit uses seven valves, in which the first is a combined detector and high-frequency oscillator using the new 6K8. This stage is transformer coupled to a 6L7 which is in turn coupled to a second I.F. stage. In both I.F. amplifiers the transformers are iron cored, permeability tuned and can be adjusted through the chassis.

It is rather unusual to find a pentode valve as a second detector, but in this particular instance the 6K7 used is very satisfactory and does provide ample A.V.C. control voltage. The second detector is then R.C. coupled to a D.C. type 6L6 in which the gain control is connected in the grid circuit.

A headphone jack is provided in the output of the 25L6G and arranged so that with the phones in circuit the loudspeaker is disconnected and visa versa. A small resistor is connected across the headphones in order slightly to reduce the total volume. A 6J7 pentode is used as a beat-frequency oscillator and again the grid-cathode coil is of the iron-cored type. It is permeability tuned but there is also a capacity of 100 mmfd.

No Hum

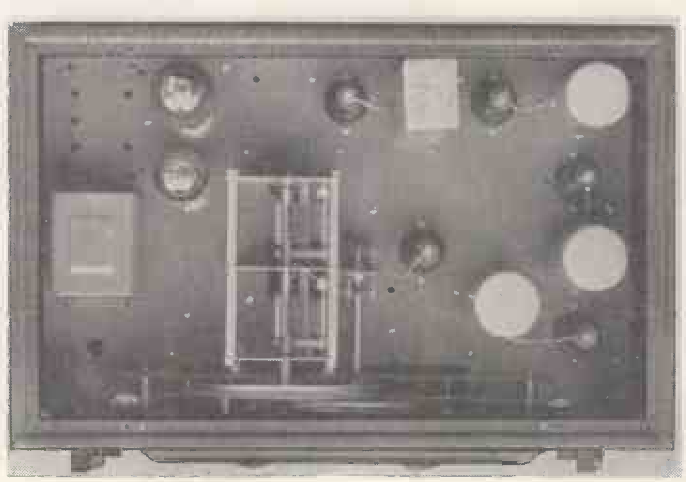
On A.C. mains a 25Z5 rectifier is in circuit but this is a passenger on D.C. mains. There is only one smoothing choke, but as the smoothing condensers have a capacity between them of 80 mfd. this no doubt accounts for the absolute freedom from hum even when using headphones.

British amateurs are still inclined to believe that a receiver without an R.F. stage is not satisfactory, but as with the NC-80, the NC-44 is exceptionally selective due to the design of the I.F. amplifier, and when used on 10 and 20 metres, results are so satisfactory that it is hard to believe the first valve is a detector oscillator.

During our tests which were made over a long period on all bands, we found that the receiver did actually have a complete world-wide coverage and that weak signals could be easily copied owing to the extremely low noise level, With the aerial removed from the receiver and all gain controls at maximum, there is no trace of noise of any kind.

With the beat-frequency oscillator in circuit there is just the slightest trace of noise introduced, but this is at such

(*Continued on page 255*)



Most of the small components are underneath the chassis so leaving the receiver clean in appearance Notice the small two gang band spreading condenser alongside the main unit.

The Short-wave Radio World

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

RADIO REMOTE CONTROL

MANUFACTURERS in this country are now developing remote control tuning of a broadcast receiver by means of a unit which is not line connected to the receiver in any way. The receiver can be tuned automatically to any one of a pre-determined number of stations, the volume level adjusted and the band switching altered all from a small unit, less than a foot square.

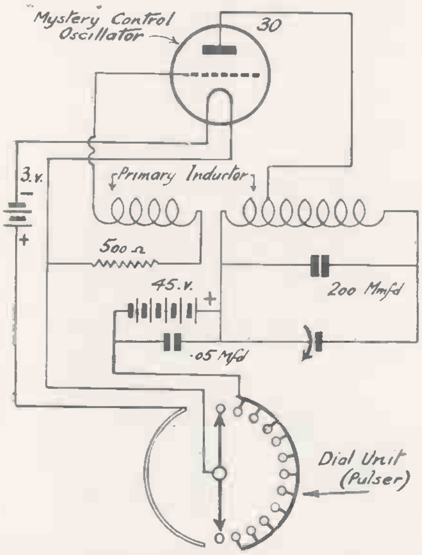


Fig. 1. The Philco remote control arrangement.

The Philco system first described in "Communications" last year is arranged for the remote tuning of eight stations. In order to tune in a station a telephone type dial is operated, and within 15 seconds the receiver will be tuned to the station dialed. Should the volume be excessive, or too low, this can be adjusted by using the soft or loud positions on the dial.

Actually, the controller is an oscillator complete with its own power supply built in. The dial, which has 10 positions, in the same way as an automatic telephone dial, is connected to a pulsing mechanism which times the return of the dial so that connection is made to different points at regular intervals. The dial also acts as an on-off switch for directly it is rotated L.T. supply is connected to the triode oscillator.

After the dial has been swung, it returns to normal but connects the oscillator grid intermittently to the filament. This sets up an oscillation in the primary inductor, for each contact on the pulser mechanism.

As the dial stops, it automatically disconnects the L.T. supply for by this time the station has been accurately tuned in. A large frame aerial has to be fitted to the bottom of the receiver cabinet and this frame is tuned to the frequency of the oscillator in the controller, so acting as a straightforward aerial.

In this way pulses from the controller are picked up and amplified by means of a 78 and a 6J7G. A 6ZY5G diode is used as an A.V.C. valve to maintain an even input to the 2A4G thyratron rectifier. The second diode is used as an attenuator to strong peaks which might cause the thyratron valve to continue operating over too long a period.

The output stage of the control amplifier is also an argon filled thyratron which is similar to a conventional gas-filled rectifier with a grid. A rectifier passes current during the entire portion of the A.C. cycle in which the anode is positive with respect to the cathode. A grid inserted between the anode and cathode permits current flow only during that portion of the cycle in which the grid has proper bias.

If both grid and anode voltages are taken from the same A.C. source, their phase difference can be arranged so that the grid will permit current flow during the half cycle in which the anode is positive with respect to the cathode, so that no anode current will flow between these limits.

The anode current of the 2A4G flows through and energises the holding relay and permits operation of the stepping relay. The stepper assembly houses a holding and a stepping relay. When the thyratron lights the holding relay closes and the stepping relay switches a ratchet as many times as the pulses sent out by the pulser in the control box. There is a primary and a secondary ratchet. The stepper relay operates the primary ratchet which is connected to the primary switch. This switch controls the volume control motor and shorts the speech coil to earth in the station-selecting positions. A switch which connects the anodes of the output valves together is closed during the station-selecting operation.

The set, of course, operates during changes in volume but is muted as the secondary ratchet returns to its home position and climbs to the station dialled. The oscillator used by Philco is shown in Fig. 1.

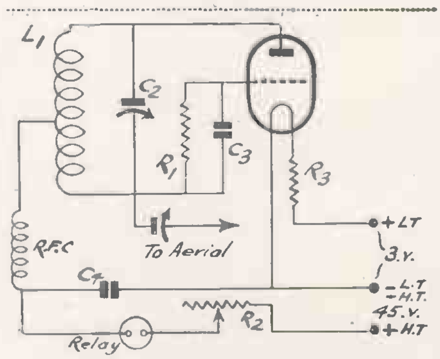


Fig. 3. Remote control circuit with gas-filled triode.

A LOW-POWER PHONE TRANSMITTER

A Tuning Indicator with Triode Detectors

Practically every design which includes a tuning indicator circuit is used in connection with a diode detector. There are, however, a lot of receivers which use cathode bias second detectors in order to obtain maximum signal level from weak stations.

With this type of receiver there is not, of course, the usual A.V.C. voltage which is required to operate a magic eye. However, W9HMS, in the March issue of *Radio*, applies a circuit shown in Fig. 2 of a 6C5 indicator for use with a triode second detector.

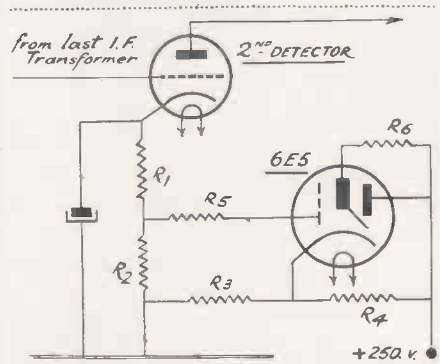


Fig. 2. The tuning indicator with triode detector.

The current flowing through resistors R3 and R4 provides a perfectly fixed bias to the 6C5. When a signal is received the second detector cathode current flowing through R1 and R2 increases which increases the voltage across R2. The increased voltage across R2 is applied to the 6C5 triode second grid, balances out the fixed bias and allows the eye to open.

This action is the reverse to that obtained when the eye is operated from the A.V.C. line, for the eye opens for signals and closes when no signal is received.

Resistance R1 is the normal cathode resistor since the addition of R2 will have comparatively little effect on the operation of the detector. On valves of 56, 6C5 or even 6F7 types the value of R2 is 7,500 ohms. R3 should be approximately 1,500 ohms, and R4, R5 and R6 the usual resistors recommended for 6C5 indicators.

MULLARD DOUBLE TRIODE TV03-10

Price 25/- Net

This valve is designed for use as an oscillator or amplifier on ultra short wavelengths. An output of 10-14 watts is obtainable and at 2 metres the full anode voltage may be applied.

TECHNICAL DATA		*CHARACTERISTICS, EACH SECTION*	
Cathodes, indirectly heated,	6.3 volts, 0.85 amps.	Amplification Factor	12.5
Anode Voltage	300 volts max.	Mutual Conductance	3.2 mA/V
Base	Standard British 5 pin	Anode Impedance	3,900 Ohms
		Anode Dissipation	5 watts max.

Address your enquiries to:

TRANSMITTING DIVISION

The Mullard Wireless Service Co. Ltd.

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No wonder the designer of this fine Receiver featured in this issue chose Ericsson Telephones as indispensable. They are simply perfect for the 100 per cent. functioning of this set.

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Telephones : 6396 HOLborn

30-watts input on 5 metres

Radio Control for Light Aircraft

The late Ross Hull published some interesting data on radio control of light aircraft, and one of the simplest circuits he designed is shown in Fig. 3, in which a gas-filled triode is employed. This circuit is quite normal being a super-regenerator with a slight difference that the by-pass condenser C4 has the high value of .25 mfd. Also, the variable resistor, R2, is necessary and this has a value of 10,000 ohms. The total anode current without signal input is 1.7 mA. which drops to approximately .5 mA. with an average signal. This gives a fair amount of anode current change, sufficient to operate a relay of the Sigma type quite reliably.

Incidentally, the Sigma relay has a resistance of 8,000 ohms and weighs only 2 oz., while the gas-filled triode valve is now available from Webbs Radio.

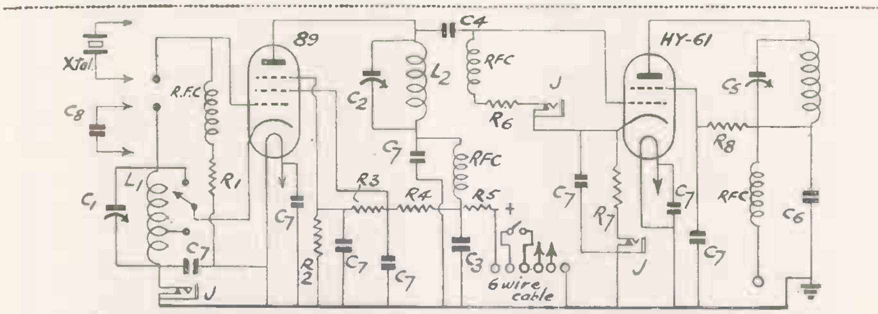


Fig. 4. The input to this transmitter can be increased to 30 watts at 5 metres.

A 15-watt 5-metre Transmitter

W2IDV has designed a 15-watt transmitter for 5-metre phone using an 89 crystal oscillator driving an HY-61 tetrode in the final. In America, of course, the new regulations are that all 5-metre transmitters should be frequency controlled which accounts for the complete lack of self-excited oscillators and the rise in popularity of 10-metre crystal elements.

This transmitter is in two units, the radio-frequency section and the combined audio and power supply. The R.F. unit gives sufficient output to drive a high power final of up to 200 watts input while in the audio section over 20 watts can be obtained which will also drive a high output class-B modulator.

The designer recommends that the power supply furnish 400 volts at 250 mA. plus two 3 ampere 6.3 volt heater windings.

First of all comes the R.F. side of the transmitter. The oscillator is an 89 pentode as a tri-tet, and although not this type of valve is not officially recommended by the crystal makers for 10-metre operation it has proved to be quite satisfactory, in fact, the excitation to the HY-61 is sufficient to drive this valve to about 30 watts input. In addition, the crystal is run with extremely low current so eliminating drift which is sometimes noticeable with high-frequency crystals. If necessary, the oscillator can be switched from crystal control to self-excited. The cathode lead to the oscillator is taken from the top end of the coil to a tap one or two turns from the earthy end, a grid condenser of the small mica type plugged in in place of the crystal. The coils are self-supporting of number 12 gauge wire and soldered directly across their respective condensers.

The cathode coil and tuning condenser are mounted on top of the chassis so that the connections to crystal and grid of the valve are short. The oscillator anode coil with its condenser are below the chassis so that there is complete screening between the two circuits. A common busbar of 12 gauge copper wire is run the full length of the chassis and it is stressed that all earthy returns be made to this busbar.

The 89 oscillator is capacity coupled to the output valve by means of a condenser having a capacity of 50 mmfd. Bias is obtained automatically by means of grid resistor R6 having a value of 10,000 and cathode resistor R7 having a value of 400 ohms. The values in this circuit are approximately as follows.

C1 75 mmfd.	R1 60,000 ohms.
C2 35 mmfd.	R2 10,000 ohms.
C3 4 mfd.	R3 25,000 ohms.
C4 50 mmfd.	R4 25,000 ohms.
C5 25 mmfd.	R5 3,500 ohms.
C6 .002 mfd.	R6 10,000 ohms.
C7 .01 mfd.	R7 400 ohms.
C8 50 mmfd.	R8 20,000 ohms.
	RFC 2.5 mh choke.
	F,W ST switch.

The modulator is quite straightforward, consisting of 6F5, 6C5, 6C5, and two 6L6's with values normal to this type of arrangement. The output transformer should, of course, be matched to suit the R.F. load.

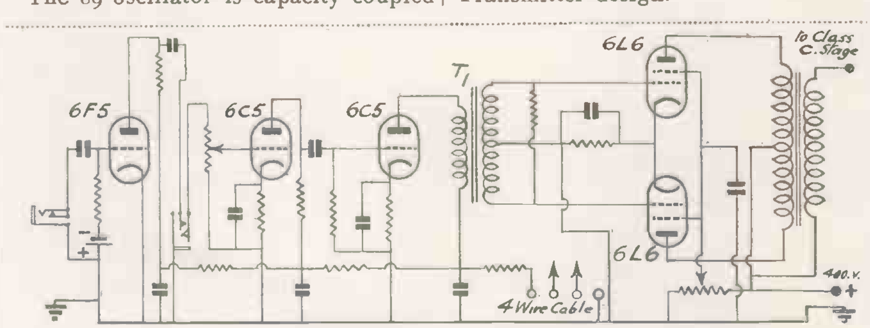


Fig. 5. Over 20 watts of audio are obtainable from this modulator.

Eastbourne and District Radio Society.—At a recent meeting of this society held at the Cavendish Senior School, Eastbourne, experiments with the Society's 5-metre transmitter were conducted. Tests were made to show how quickly it could be adapted for battery operation and in view of its efficiency, it was decided to instal a permanent ultra short-wave aerial. The honorary secretary, G. R. Dowsett, demonstrated a new McMichael superhet which is made up of a triode pentode detector-oscillator, H.T. pentode I.F. amplifier, double diode and pentode output valve. Further information regarding the activities of this society can be obtained from the honorary secretary at 48 Grove Road, Eastbourne, Sussex.

The Southend and District Radio and Scientific Society has held several meetings so far, all of which have proved successful. The outstanding events were a talk by Mr. R. M. Chamney, of the G.P.O., and Mr. E. J. Buchan on Transmitter design.

At the annual general meeting a report was read of the past year's activities of the society. During 1938 twenty-two meetings were held and many field days, while there was a record number of new members bringing the total membership of the society to just over 100.

A Twin-triode 2.5-metre Transmitter

This simple transmitter requires the minimum control and is quite suitable for experimental work on U.H.F.

DURING the summer months it is anticipated that there will be considerable activity on 56 megacycles not only for local distances but also by amateurs who, with crystal controlled transmitters and rotary beam aerials endeavour to break existing DX records.

Fortunately, for these serious experimenters, there is a general tendency for crystal control or stabilised transmitters to be used on 5 metres, while those who are only interested in covering short distances with the minimum amount of trouble will migrate to 112 megacycles. It is not generally realised that difficulties in constructing equipment for 112 megacycles are less than for 56 megacycles, and that very low power is quite satisfactory.

Generally speaking, the average amateur, for contact up to 10 miles on 56 megacycles, only needs an input of a few watts and equally good distances can be covered up to the 10-mile limit on 112 megacycles with perhaps the advantage that the power used is even lower.

Twin Valve

However, by using a twin-triode oscillator of reasonably low impedance, 10-15 watts of carrier power can be obtained on 112 megacycles with the simplest equipment, which generally appears to be the most efficient.

The Mullard Company have recently produced a valve, the TV03-10, which is a twin triode having a standard fitted 5-pin base and two anode connections through the glass envelope. The connections to the 5-pin base are normal and with one control grid going to the grid pin and the other control grid to the usual anode pin.

The characteristics of the TV03-10 are approximately as follows:—

This close-up of the valve and grid circuit shows the best way in which to fix the components.

Heater voltage, 6.3 volts.
Heater current, 0.8 amps.
Amplification factor, 13.
Maximum anode dissipation, 10 watts.
Maximum D.C. plate current, 80 mA.
Maximum D.C. grid current, 25 mA.

When used in a circuit having a resonant grid coil and long line anode inductances, the input can be raised to 25 watts with only 300 volts H.T. and if the transmitter is sensibly constructed a carrier power of 10 watts can be relied upon. This means that cost is low for the power unit, which is generally one of the most expensive items in a transmitter, is of a type that is used with many broadcast receivers.

The circuit for a 112 Mc. transmitter is shown on this page. It will be seen that across the two grids there is the coil, L1, which does not have any parallel tuning capacity. It is wound to resonate at approximately 112 megacycles and brought accurately into resonance by having the windings compressed. The cathode of the TV03-10 has in series with it a small resistor having a value of 200 ohms and an 8-watt rating. Additional bias is given by virtue of grid current flow across the grid resistor R1, an average value for which is 15,000 ohms.

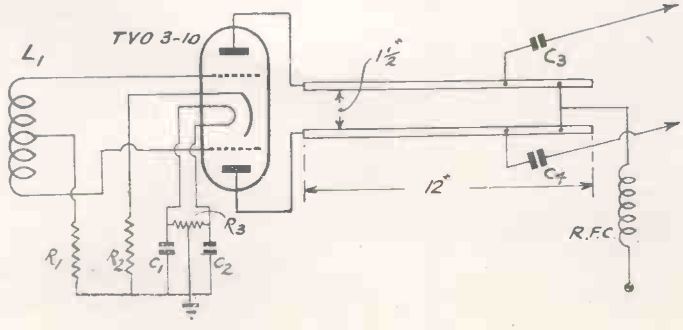
In neither case is it necessary for these circuits to be by-passed although it is essential that condensers C1 and C2 be included in the circuit. These condensers each have a value of 100 mmfd. Also across the heater circuit with the electrical centre taken to earth is a humdinger, and this should be connected actually across the heater pins at the valve holder.

It is suggested that the valve be mounted on its side. In this way the leads to the grid circuit are kept very short while the anode pins will approximately meet the two anode inductances. These inductances are 12 in. long made up of half-inch copper tube with approximately an 18 gauge wall. They are placed 1½ in. between centres and mounted in the manner shown. Four holes are drilled in the tubes so that they can be mounted on stand-off insulators.

In practice it will be found that the bolt supplied with the insulator is not long enough to go right through the tube so they have to be replaced with new bolts 4 BA and 2 in. long.

It is impossible to tell with any degree of accuracy the exact length required for the tubes, but this is immaterial as they are tuned by means of the semi-fixed shorting bar. To the centre of this bar is connected a high-frequency choke which in turn goes to H.T. positive or to the source of modulation as required.

In the original design a small by-pass condenser of 50 mmfd. was connected between the choke and common earth



Notice that no condensers are needed in the grid or cathode circuits It is suggested that the aerial be coupled directly to the tank inductance.

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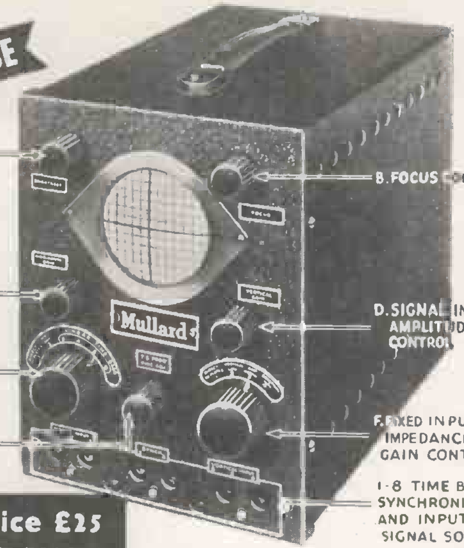

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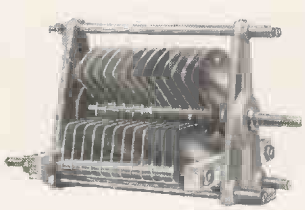

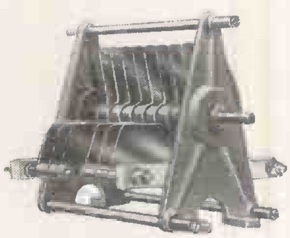

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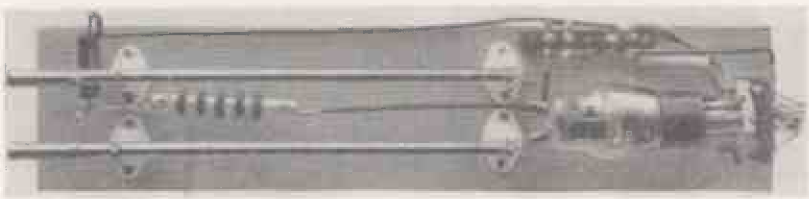
Twin-triode TX

point and this can be seen in the illustration. This condenser, however, is not essential and it should only be used if found to give more satisfactory results.

Construct the grid coil L1 very carefully. It should be wound with 16 gauge tinned copper wire consisting of



This plan view will give constructors all the information they require about the layout of components.

7 turns at half-inch diameter and spaced to cover a distance of $1\frac{1}{4}$ in. Long ends should be left from this coil then it will be found that it can be soldered directly across the two grid terminals on the valve holder. The mid point is tapped, with the resistance R1 joined at this point with the opposite end taken to H.T. negative.

The whole transmitter is mounted on a wooden plank 16 in. long and 3 in. wide. This provides just sufficient space to take the valve and the inductances in the manner shown and if wired with heavy gauge wire is extremely robust and can be screwed on to the wall. In this way the transmitter does not take up very much room and is more convenient than a small 6 in. by 6 in. chassis of conventional design.

The frequency stability, of course, is very much higher by using long line anode inductances, while little advantage will be gained by using a similar tuning system in the grid. In fact, it is rather a disadvantage having long line grid and anode tuning for the amount of space taken up is very considerable as the inductances have to be at right angles to one another.

One of the biggest difficulties in operating a 112 Mc. transmitter is locating the amateur bands. In our experiments was used an aerial cut to frequency and coupled in the first instances to the transmitter by means of a single horse-shoe loop. In the centre of the aerial is connected an R.F. milliammeter, although a low consumption bulb would be equally satisfactory.

The adjustable bar is moved up and down the two tubes until maximum amount of current is obtained in the aerial. Then the grid conductance is adjusted to see if possible the amount of aerial current can still further be increased. It can then be assumed that the transmitter is more or less on frequency, but the aerial link should be moved to see which is the best coupling position to give maximum R.F. into the aerial.

A more accurate way of checking frequency is the Lecher-wire system. Erect two parallel wires approximately 17 ft. long spaced 6 in. These should be very taut. Couple these two wires to the copper rods by means of an ordinary 600-ohm feeder terminated in a single turn link. Apply as much R.F. as possible to the feeder and then slide a low current lamp up and down the twin wires until two points are reached where maximum light is obtained.

Components for
A TWIN TRIODE 2.5 METRE TRANSMITTER

BASEBOARD.
1—Wooden 16 × 3 × 1 ins.

CONDENSERS, FIXED.
1—.001-mfd. type 690W (C1) (Dubilier).
1—.001-mfd. type 690W (C2) "
1—.0005-mfd. type 690W (C3) "
1—.0005-mfd. type 690W (C4) "

CHOKE R.F.
1—Type HF21 (Bulgin).

HOLDER VALVE.
1—5-pin type SW21 (Bulgin).

INSULATORS.
4—Type 1557 (Premier).

RESISTANCES, FIXED.
1—15,000 ohm type 4-watt (R1) (Premier).
1—200 ohm type 8-watt (R2) (Premier)
1—Humdinger (R3) (Premier).

SUNDRIES.
2—Terminal saddles type 1046 (Eddystone).
2—Copper tubes 12 ins. long, $\frac{1}{4}$ in. diameter.

VALVE.
1—TV03-10 (Mullard).

The distance between these two points should be measured by means of a ruler which will then give half the wavelength to which the transmitter is tuned.

Two short lengths of semi-flexible wire, with hooks on each end, can be soldered to the bulb and slid along the twin wires quite easily.

After the transmitter has been accurately set for frequency the aerial can be connected in the proper manner, that is, directly to anode inductances. In order to prevent D.C. voltage being applied to the aerial, in series with each feeder must be connected condensers having a value of 50 mmfd. They are adjusted up and down the rods until maximum draw or correct anode current is obtained. Constructors will find it is very easy to load twin triode valves in this circuit so care must be taken not to grossly exceed the rated input.

For general coverage a half-wave vertical aerial will be satisfactory, but there will be quite a big rise in gain if a horizontal aerial is used for point-to-point communication.

If modulated, an audio output of approximately 4 to 5 watts would be required provided the modulator is accurately matched to the R.F. load.

Particular note should be taken that even with this simple equipment a post office licence must be obtained, details of which will be given by the Engineer-in-Chief, Radio Division, Armour House, Aldersgate, E.C.1.

An Inexpensive Universal Meter

We are accustomed to seeing data on multi-range American test meters, but there are few British instruments which are quite so comprehensive. We have just come across an instrument which is absolutely free from snags. It is inexpensive, covers everything that the average experimenter, radio engineer and serviceman is likely to require, and generally speaking is a very good investment.

This meter is available from Taylor Electrical Instruments Co., 77/77a Queen Victoria Street, E.C.4. It is built into a polished oak case, fitted with a leather strap handle and has built in a $4\frac{1}{2}$ in. moving coil meter. The model 80a which is priced at 10 gns., covers no less than 70 different measurements, some of which are the following:

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D.C. amps. 0.5 mA., 0-1 mA., 0-20 A.
A.C. volts 0-2.5, 0-5, 0-500, 0-2,000.
A.C. amps. 0.5 mA., 0.5 A., 0-5 A.
Ohms 0-500, 0-50 megohms.
Output 0-2.5 volts, 0-250 volts, 0-2,000 volts.
Capacity 0-.0002 mfd. to 0-100 mfd.
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By using a small external battery resistances up to 500 megorms can be read. Adaptors are also suitable for reading up to 10,000 volts A.C. or D.C. and up to 50 amperes.

Hoddesdon and District Radio Society.—Listeners on 160 metres will know quite well the call-sign of this society, G5HO. Intending members should write to 2FUU, Caxton House, High Street, Hoddesdon, Herts, while the headquarters are Blairgowrie, Station Road, Roxbourne, Herts.

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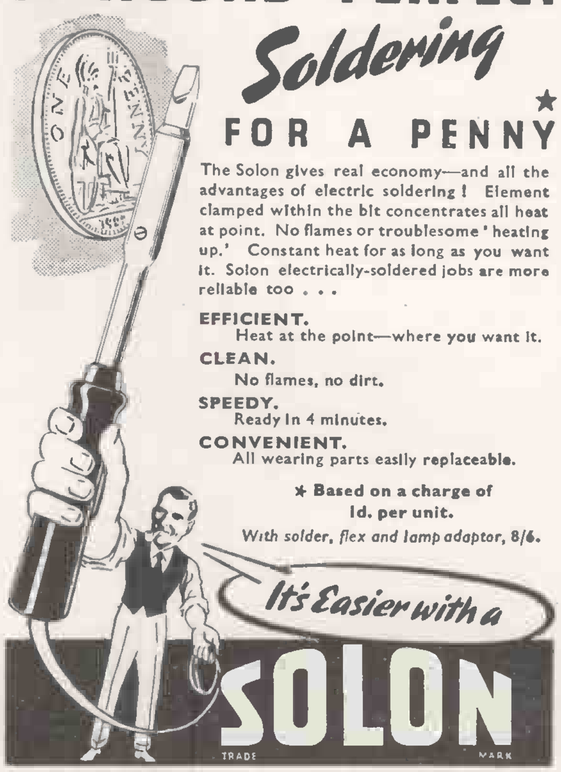

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Long Skip

G5KA would like reports from any amateur logging new DX Stations.

CONDITIONS over the period of the DX contest were not kind to the C.W. boys and many of our friends in the low power category dropped out after the first week-end. The 28 mc. band was not much help over this period, but livened up towards the end of the contest. We shall be greatly surprised if G6NF does not attain the diploma for this country, as he finished up with a total of 70,300 points. Radio G6NF had 636 contacts, and his district multiplier was 37, while G6WY finished a close second with a total of 60,445, the result of 578 contacts with 35 districts. "Ham" only operated for 68 hours out of the stipulated limit of 90 hours, so his score is all the more remarkable. G5KA was put out of the fracas after only two hours' operating when his rotary converter blew up. We still suspect sabotage. . . . If some of the "W's" want to know why a certain G3 did not come back to their calls on 7 mc. one Friday morning (very early), it was because the gentleman in question was listening on 14 mc. and transmitting on 7 mc. Quite accidental, but what a waste of 2½ hours!

We have to report another "suspect" from Turkey, namely, TA2BS, heard by G8PL on the H.F. end of the 14 mc. The note was T5, and the QRA given was Angora. "Phoneys" seem rather plentiful round G8PL's district as his neighbour, G8PP reports CS2V on approximately 14,360 kc. He gave his QRA as a trawler in the Atlantic. SWL Heys, of Macclesfield, is now back busily logging DX for us. He has been rebuilding his receiver, and now that this is finished lets us know about the following C.W. stations: ZL1LZ, H.F. end; ZL1GW, H.F.; ZL1LS, H.F.; FT4AN, H.F.; PK4FS, Sumatra, H.F.; ZC6RL, L.F.; K5AF, L.F.; and KA1LB, L.F. We thought you might be interested in the ZL1's as these are none too common.

We have to thank 2FLK for another puzzler, XX2JQ, heard up the L.F. end. Any suggestions? Toby also heard KA7ES, one of the rarer Phillipine districts, up the same end. Both these were on the key. SWL Kebbell sends along a list of U.S.A. 'phones heard on 28 mc. and asks us what the Hootsie Tootsie Network is all about. He heard W9AGO calling members of this club. We have to plead ignorance of this one and ask for enlightenment from any one who can help us.

Bob Jardine, G6QX, sends along a card telling us he could not make the contest owing to business QRM. During a brief spell of 55 minutes he had 10 "W" contacts on 7 mc., and over a period of 90 minutes on 28 mc. ran up another 16.

SWL Jacobs took advantage of the C.W. contest to gather some good DX, and tells us of LU5AN, approximately 14,355; LU9AX, 14,300; XU4XA, 14,375; VE5EF, 14,110; PY6AJ, 14,120; VS2AL, 14,370; ZL1MQ, 14,080; CT2BJ, 14,055; and VU7BR, Bahrein Island. We have had a few inquiries as to whether there are two Bahrein Islands as the Callbook prefix for Bahrein is VS8. The answer is no! VU7BR should rightly be signing with a VS8 call, and we are not aware at the moment why he choses VU7.

A very, very unusual one comes from GM8CH, who reports having worked FY8AA, in Cayenne. FY8AA was up the H.F. end of 14 mc. with a T6 note.

Frank Robb, GI6TK, who usually goes in for contests in a big way, gave the C.W. section of the A.R.R.L. one a miss. He puts this down to illness and to the fact that he is fed up with contests in general. During a session on 7 mc. he raised VP2AT, VO1I, YI2BA, all districts of "W" barring the 7th, VK and ZL. On 14 mc. he heard VP2LB, 14,380; VK6RU, 14,300; PK4FS, XU2AW, VS2AL, VS1AL, all between 14,300-14,380 kc. Mexico is a rather rare one, so thank 2FLK, for XE1D, heard up the H.F. end around 2,300 G.M.T.

From Dennis Tyler, Ilford, Essex, comes the following: W5FPD, Hot Springs, Arkansas; W5GZK, Oklahoma; W5FXD, Okla., and W5ZS, all 28 mc. 'phones. Some 20 metre 'phones are VP2GB, Grenada; VQ2PL, ZE1JO, YS1FM (Salvador), HC2JM, XZ2DY, CT2AB, HC2AT, and VS6AN, all on the H.F. side. PK5LO, FB8AH, ZB1E, FT1AI, CE3AT and VK4WS were all logged up the L.F. end. The American 'phone band brought in VP4TI, KA1JP, K4EJF, KA1BC, HC1FG, HI3N, VP9L, VS7RA and VP6FO.

We extend thanks to the anonymous person sending us a card bearing the crytic message: "CR4HT, Cape Verde, H.F. end 20 metres C.W." We would like to hear from you again OM, but next time please append your "handle."

G6ID spent three weeks in bed through illness, and had his RX at his bedside. He was unable to get his outside antenna into the room, so used the bed spring as an antenna! (We don't recommend this with a transmitter.) On this meagre antenna he heard the following 'phones: W6NYD, operating portable in Honolulu, approximately 14,226 kc.; VK5RN, 14,250; VP4TK, 14,200; CO2CR, 14,050; and VP6MY, 14,140. G6ID had plenty of time to study conditions during his enforced holiday, and wants an explanation of QRM "sounding like a circular saw which starts up at various intervals throughout the day on 14 mc. varying in pitch, and travelling up and down between about 14,080 and 14,120 kc."

Congratulations to G2MI who worked CO2WM in Havana, which gave him his 100th country for the DX Century Club.

This is WIBB, Mass., U.S.A., who has been an outstanding signal on the 1.75 Mc band.

Heterotone Reception

An apparent gain in signal strength can be obtained by modulating the screen of the I.F. amplifier as well as by using a normal beat-frequency oscillator in the second detector circuit. A suggested arrangement is shown on this page from which it can be seen a single valve oscillator is used in which the secondary of an output transformer is connected in series with the screen supply to the I.F. amplifier. It must be appreciated that the B.F.O. is also retained, but in the succeeding stage. The increase in signal strength is most noticeable which is only partially due to an actual greater output.

However, by modulating in the screen of the I.F. stage a pair of side bands are acquired in the normal way and with 100 per cent. modulation by a fixed frequency tone source, the sideband power increases the input to the second detector by 50 per cent.

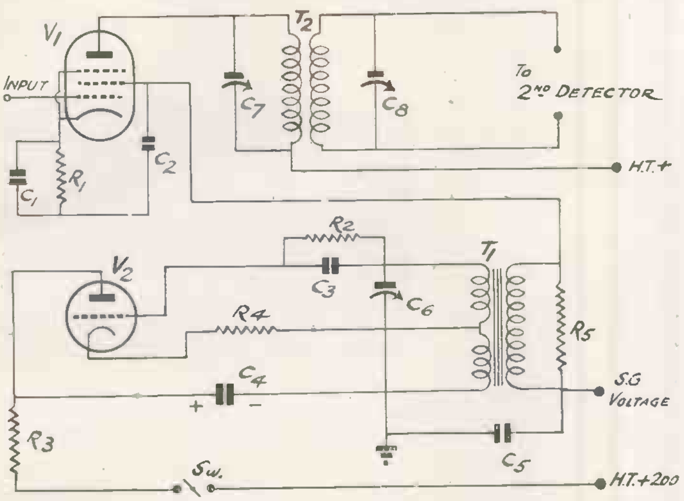
Generally this extra 50 per cent. is obtained in the final stage so causing the increase in gain on a given signal.

The circuit is a simple one in which V_2 is a triode valve of the 6J5 type. Components values are approximately as follows :—

R_1 100 ohms.	C_1 .01 mfd.
R_2 100,000 ohms.	C_2 .01 mfd.
R_3 100,000 ohms.	C_3 .002 mfd.
R_4 20,000 ohms.	C_4 1 mfd.
R_5 100,000 ohms.	C_5 1 mfd.
	C_6 .0005 mfd.

The condenser C_6 can either be a bank of fixed condensers or a straightforward variable condenser in order to adjust the tone injected into the screen of the I.F. amplifier. The switch is merely to break the H.T. supply to the oscillator when telephony is being received. The output transformer T_1 is a standard push-pull input type which can be of quite normal characteristics without any pretension as to frequency response.

The unit can be built up in a small metal can with the switch on the end and mounted through the panel. In this way space can be found in most amateur-built or commercial receivers.

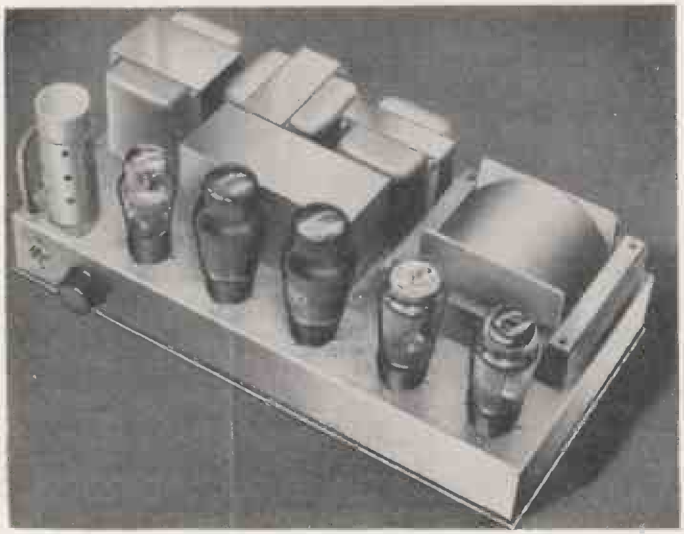


A circuit of an audio oscillator suitable for heterotone reception is quite simple. It must be appreciated that the beat-frequency oscillator must also be retained but the only modification to an existing set is to break the screen lead as shown.

Trade News of the Month

Of particular interest this month is the release of high-grade valves with American characteristics produced by British manufacturers.

TWO interesting high-quality amplifiers have recently been introduced by W. Bryan Savage, Limited, of Westmoreland Road, N.W.9. The first of these, type S315KT illustrated on this page, has an output of 16 watts and a frequency response which is practically level from 50 to 10,000 cycles. It is designed in the first instance for public address work being fitted with an output transformer with a secondary suitable for 10, 20, 40 and 80 ohm connection.



The new Savage high-fidelity amplifier has a gain of 96 DB and a noise level of —60 DB. A commendable feature is that the frequency response is within 2 DB from 50 to 10,000 cycles.

The amplifier is priced at £10 15s., but for an extra 10s. a special output transformer suitable for matching any R.F. load can be provided. The circuit consists of a high-frequency pentode R.C. coupled to a double-triode which is in turn coupled to two beam tetrodes in push-pull. The gain is approximately 96 db, noise level —60 db, and power consumption from the mains 120 watts.

A second amplifier S330KT is priced at £16 15s. with a normal output transformer or £17 5s. with a modulation output transformer. The amplifier has a gain of 94 db, noise level —60 db and an output of 30 watts with 4 per cent. harmonic distortion at 1 Kc. The circuit is made up of a high-frequency pentode, R.C. coupled to a double triode which is in turn coupled to two beam tetrodes in push-pull fed by two rectifying valves.

Amongst the new receivers introduced by the Gramophone Co., is the H.M.V. 1102. It is a 6 valver with a superhet circuit and priced at 15 gns. On short waves the coverage is 13.8 to 50 metres, on medium waves 195 to 580 metres and on long waves 725 to 2,000 metres. Included is a volume indicator, an accessory not usually found in a receiver of this kind, fluid light tuning indicator and an alphabetical short-wave station index. Another interesting feature which makes this set particularly suitable for short-wave listeners is an automatic-frequency control which prevents drift on the lower wavelengths.

Harvey transmitter type UHX-10 is well known amongst amateurs for it is ideal for low input working. However, for those who require higher power there is the new Harvey UHX-25. It is suitable for operation on frequencies between 1.5 to 60 megacycles with an input of 50 watts. On 60 megacycles a carrier power of 25 watts is obtainable which rises to 37 watts on 1.5 Mc. The valve line up is a 6L6 oscillator, 6L6 frequency multiplier with an 807 in the final stage. Modulation is by a pair of 6L6G's in Class B.

The power source is normally 230 volts at 50 cycles, but the whole equipment can be run from 12 volts D.C. with small rotary convertors if required. Complete with valves and coils for two bands but less crystal, microphone and

This new Harvey transmitter is suitable for operation between 1.5 and 60 megacycles for a maximum power output of 37 watts.

key, it is priced at £29. This transmitter is available from stock at Webb's Radio, who are also showing the new Hallicrafter model 23, in which 8 bands are employed, four giving general coverage from 10 to 540 metres, with the balance for spreading the 80, 40, 20 and 10-metre amateur bands. All amateur bands cover the major portion of a 330 degree tuning dial.

There is also an interesting valve line up being 6SK7 R.F., 6SA7 detector, 6SJ7 oscillator, two 6SK7's in the I.F stages, 6SQ7 second detector and first audio, 6B8 amplified A.V.C., 6F6G power output, 6SJ7 beat-frequency oscillator, 80 rectifier and 6N7 noise limiter. The price of this receiver is £33 10s. complete with 455 Kc. crystal.

(Continued on page 254)

The Gramophone Company has produced this new H.M.V. receiver model 1102. It is a six-valver and has an extremely good performance to 13.8 metres.

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"OSRAM" TUBULAR TALKIE LAMPS, 100 volts, 1,000 watts (new), **20/-** each.

ROTAX" G.P.O. ROTARY CONVERTERS 4 0 d.c. in cases, **17/6** each.

ELECTRIC DRILLS, D.C. 220 volts, approx. ⅜ capacity, **35/-** each.

MORTLEY SPRAGUE & CO., Generator. H.T. and L.T., nearly new **50/-** each.

"HIGGS" GENERATING SET. 440 volts A.C. 3-phase Input, 6/8 volts, 14 amps output, **£4 10 0.**

"M.L." ROTARY 250 D.C. input, 600 volts 160 m/A. output, **40/-**.

"CRYPTO" 240 A.C. ROTARY 1 phase, D.C. 100 volts 4.5 amps. secondary, **£5 10 0.**

ELECTRIC FIRES. New, solid metal base, 750 to 1,000 watts, **6/-** each.

ELECTRIC FIRES in various colours with imitation logs, **25/-** each.

ELECTRIC FANS 200/240 D.C. many types, **7/6** each.

"G.E.C." METER 0-1,000 and 0-30 amps., **15/-**.

A.C. & D.C. MOTORS. ½ and ¾ h.p., 5,000 and 6,000 revs., **30/-** each.

"G.E.C." GENERATING SET. 200/250 D.C. input, 720 D.C. 14 amps., output with controlling resistance, fixed midway, **£4 10 0.**

"HUMMEL" SCANNING LENSES, 4½ in., **3/6** each.

"G.E.C." AUTOMATIC CUT-OUTS, 6/- each.

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STOLL EXPERIMENTAL TALKIE MICROPHONES, 5/- each.

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"MACKIE" ROTARY CONVERTER for talkie Work, **50/-** each. 50 v. D.C. input.

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QUANTITY OF NEW GRAMOPHONE MOTORS as used in "H.M.V." and "Marconi" sets. Model No. 330, **7/6** each.

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"CRYPTO" ROTARY CONVERTER, 100 D.C. input 230 A.C. output 440 watts. Price **£6 10 0.**

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"MALLORY" RECTIFIERS 6 volts 2 amps., new, **17/6** each.

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"ELECTRAD" WIRE-WOUND RESISTANCES, 100,000 ohms 75 watts, 80,000 ohms 50 watts, and 150 ohms, flat type wound in mica, **2/6** each.

"FOSTER" POWER TRANSFORMERS (Double-wound), 100/230 volts S/P. 500 watts, **30/-** each ; 1,000 watts, **45/-** each ; 2,000 watts, **60/-** each ; 3,000 watts, **80/-** each ; 4,500 watts, **95/-** each ; 5,000 watts, **120/-** each.

"MULLARD" TRANSMITTING VALVES, type SW1/19, **50/-** each.

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"LOTUS" RADIO RECEIVER, 200/240 A.C., working order, **25/-**.

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"H.M.V." TABLE MODEL RADIOGRAM, 200/240 D.C., working order, **55/-**.

"MARCONI" RADIOGRAM, 200/240 D.C., working order, **70/-**.

"MIDGET" RECEIVER, universal voltage, working order, **30/-**.

"McMICHAEL" RADIOGRAM, Model 366, 200/240 A.C., working order, **£7 10s.**

"H.M.V." RADIOGRAM, 200/240 A.C., late model, working order, **£10 10s.**

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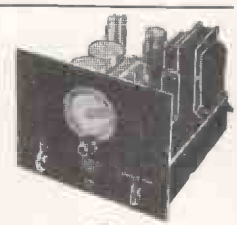

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City of Belfast Y.M.C.A. Radio Club.—The membership of this society is growing very rapidly and includes a number of fully licensed amateurs. Lectures have been given by GI5UR, GI6TK and 2DTM. The club library contains copies of the amateur call-book and other interesting magazines, while a Morse construction club is held on Friday night from 8 to 9 p.m. for juniors and 9 to 10 p.m. for seniors. The club station GI6UM is active on 7 and 14 mc. and hopes shortly to be on 28 mc. Applications for membership should be addressed to the Hon. Secretary, Mr. J. Gallaugher, 90 Somerton Road, Belfast, N.I. Meetings are held on the third Wednesday of each month at 8 p.m. and subscription is 5s. per year and 3s. 6d. for junior members.

Reception in U.S.A. on 40 Metres

An American listening station operated by Mr. N. W. Soplop, at 54 Chestnut Street, Allegany, New York, has been making a special point of logging European stations on the 40-metre band. A surprising number of British stations have been received mostly between 07.30 and 09.30 at strengths varying between R8 to 9, and R5. Reception is obtained with an R.M.E. 69 and DB-20 and signal strength readings taken by means of the meter.

The following are a few of the stations heard:—

G2BY	R7	G8AR	R8
G3ZF	R7/8	G3SJ	R8
G5BM	R7/8	G5TN	R6
G5LM	R5	G5QI	R6
EI8J	R7/8	CN8MT	R8
G3IT	R6	YR5IC	R7
G4BH	R7	ON4FOR	R5
G5BQ	R8/9	F3OD	R8
G3ZI	R5/6	F3DI	R7/8
G2IW	R5	F8ME	R8
G8GP	R8	F3KQ	R6
EI7M	R8/9	F3ER	R8
G6JB	R7/8	ON4AK	R6
G5PC	R7	F3MT	R7
G6PL	R6	F3WB	R7
G3BM	R7/8	F3PZ	R9
GW2UH	R7/8	F3QF	R8
GW32B	R7	YR5TB	R7

If any G station would like a report on 40-metre signals from New York the request can either be sent direct or via G3BG, at Breaston, Derby. Calls and frequencies should be given so that they can be published in the *Newark News Radio* Bulletin.

Mullard American Type Valves

No less than 14 valves have been added to the Mullard range of American type valves. The following are now available in the UX series and are interchangeable with American types having similar designations.

6A7 Heptode Frequency Changer,	11/6.
6C6 H.F. Pentode	10/6.
6D6 Vari-mu H.F. Pentode	10/6.
24A H.F. Tetrode	10/6.
25Z5 AC/DC Rectifier	9/-.
36 H.F. Tetrode	10/6.
39/44 H.F. Pentode	10/6.
42 Power Pentode	10/6.
43 AC/DC Power Pentode	10/6.
47 Power Pentode	10/6.
75 Double Diode Triode	9/6.
77 H.F. Pentode	10/6.
78 Vari-mu H.F. Pentode	10/6.
80 Rectifier	9/-.

These valves can be obtained from the Mullard Wireless Service Co., Ltd., 225 Tottenham Court Road, W.1, or from local Mullard stockists.

Trade News of the Month (*Continued from page 250*)

A clock in which Greenwich or local time can be ascertained immediately is now available. It is for A.C. operation and is fitted with coloured 24-hour dials marked for direct reading. A small

A new range of receivers released by the G.E.C. includes a five-valver in the 4050 series which is priced at 10 gns.

centre dial marked with world-wide locations rotates the hour hand, while the clock is also equipped with a second hand. It is self-starting, operates on 230 volts 60 cycle A.C. mains and can be made flush mounting. The price is 57s. 6d. and it can be obtained from Webb's Radio.

We are very interested to see that at last British manufacturers are producing inexpensive valves suitable for amateurs. Webb's Radio in collaboration with Messrs. Tungsram are offering 6L6G's with a ceramic octal base for 7s. 6d. It is extremely robust, compares very favourably with the best American valves of a similar type and will stand a considerable amount of R.F. at high frequencies. Incidentally the price of 7s. 6d. includes postage.

There are several other Tungsram valves which are now available such as a new OQ-15/600 which is similar to the well known O-15/400, but has been designed for ultra-shortwave working. It is fitted with a ceramic base and the lead out wires are arranged to allow for minimum capacity and possibility of arc over. All these valves are tested for 5-metre working, have a 4 volt 1 amp. filament and are priced at 12s. 6d.

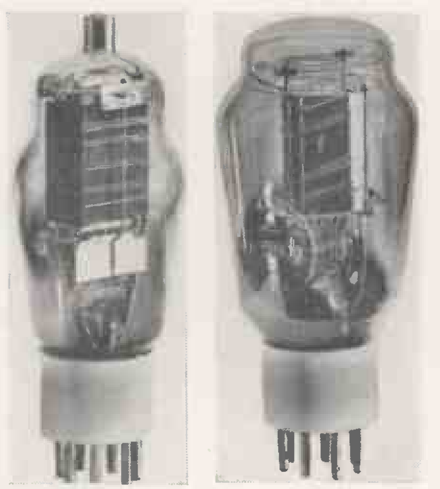
The OS-12/500 which is the British equivalent of the American 837 is an interesting pentode with a 6.3 volt 1.4 amp. heater. It is rated for 12 watts anode dissipation, has the suppressor grid brought out to a separate pin and is fitted with a ceramic base. There is no need to neutralise this valve, and it is extremely suitable for use as a power amplifier.

In order to be quite sure that the transmitter is always working at maximum efficiency it is necessary to keep a careful check on anode and grid current. Some of the cheap moving iron meters are not always satisfactory, and for this reason many amateurs are inclined to ignore the operation conditions of valves.

A new range of instruments is now available from Messrs. Premier Supply Stores at either their Clapton, Fleet Street or Clapham branches. The model 21 has a square bakelite case with an overall width and height of 3 in. It is available in five ranges, 0-1 mA., 0-10 mA., 0-50 mA., 0-100 mA., and 0-250 mA., in which all but the first are priced at 17s. 6d., the 0-1 mA. meter cost 1s. extra.

A very interesting meter is the 0-500 micro-amp., model number 1, the case of which is $4\frac{3}{8}$ in. by 4 in. It is priced at 37s. 6d. and is ideal for use in radiation meters, signal strength meters and monitors. There is also a 0-1 mA. meter of a similar type at 32s. 6d. which can be used in universal test sets. All these moving coil instruments are guaranteed to plus or minus 2 per cent., although they are actually calibrated to within finer limits.

The Premier 10 watt all-band transmitter is now in full production. Actually it can be loaded to 15 watts

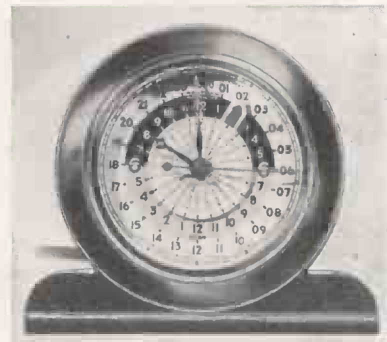


On the left is the Tungsram OS12/500 a valve similar to the 837. An interesting valve is shown on the right—the Tungsram 015/600 specially made for 5 metre operation.

and still with full modulation. It is priced at £10 10s., complete with built-in power pack, 7 megacycle crystal, coils, valves and microphone. The coils supplied cover 40 and 20 metres, and additional coils are priced at 3s. 6d. a pair. This recever is entirely self-contained, is completely chirp free and a crystal calibration is supplied with each transmitter.

This is the new 6L6G marketed by Webbs Radio which has a ceramic base and is particularly suitable for high-frequency working. For many amateurs it makes an ideal power amplifier for it can also be used as a doubler on 10 to 5 meters. It is priced at 7s. 6d.

In the G.E.C. 4050 range of receivers is the Model BC4050, an A.C.



The Gordon clock is fitted with 24-hour dials and standard or Greenwich time for any part of the world can be immediately obtained. It is A.C. operated.

receiver priced at 10 gns. which covers short waves in addition to medium and long wages. There are 12 press buttons, 8 for station selection and four for switching. The circuit is a five valve superhet, in which the output valve is a beam power tetrode. This receiver at the price is good value for money for it covers most of the channels likely to be required by the all-wave listener. Full information on this set can be had from the General Electric Company, Limited, Magnet House, Kingsway, and also regarding the battery and universal models.

A new pre-amplifier has just been introduced by Radiomart (G5NI) Birmingham, Ltd., and designated the SA56. This pre-amplifier is fitted to a $19\frac{1}{2}$ crackle finished panel and cadmium-plated chassis. It uses six all metal valves in a phase invertor circuit, and is designed to operate with a crystal microphone.

In the output circuit are two 6C5's in push-pull, while in addition to the built-in power pack supplying ample H.T. current there is a 300 volts D.C. 40 mA. supply, a surplus to be used with other equipment. It is priced at £3 17s. 6d. completely wired, while there is an additional charge of £1 10s. for six first grade valves.

Raymart have also stocks of the latest Howard receiver, type 438 which is priced at £15 10s. It is an 8-valve receiver covering 43 Mc. to 54 Kc. and has a stage of pre-selection on all bands. The high-frequency coils on ceramic formers are all separate, while there is separate electrical band-spread. The crystal filter is in an iron cored transformer circuit, while provision is made for an R meter. The receiver is complete with loudspeaker, but an additional £2 is charged for the crystal filter circuit.

The New National Receiver

(*Continued from page* 238)

a low level that it does not interfere with the reception of weak stations.

A full vision dial is easy to read and owing to the size is ideal for the logging of stations in the congested amateur bands. At 16 gns., the receiver is very good value for money and unlike many receivers in the cheaper market, it is well built up to the normal National standards.

We were able to test this receiver through the courtesy of Messrs. Webbs Radio, 14 Soho Street, W.1, who lent us the receiver for our laboratory test, but other importers are able to supply and details will be found in the advertisement columns of this issue.

Westinghouse Metal Rectifiers

Metal rectifiers have a multitude of uses which is borne out by the fact that the Westinghouse Brake and Signal Co., Ltd., of 82 York Way, King's Cross, N.1, have recently produced no less than six manuals dealing with metal rectifiers from all angles.

The most interesting one to our readers is the "1939 All Metal Way," which covers no less than 30 metal rectifiers. Details are given on how to make battery eliminators, charge accumulators, or make complete power units for television receivers. Westectors for A.V.C. or straightforward detection are fully discussed.

A second manual deals exclusively with battery chargers from A.C. mains and it is interesting for those in the trade who contemplate as a side line taking up large scale battery charging. Some of the equipment is ideal for garage use or for charging high capacity accumulators.

Projection engineers will find the booklet, type DP11G, of interest for it deals with metal rectifiers for projector arcs. It shows the special equipment required and also specifications of arcs up to 75 volts.

Electric trucks are particularly useful and these are covered in a booklet DP11E dealing with metal rectifiers for electric vehicle and truck batteries.

Descriptive pamphlet DP11 covers metal rectifiers including the construction, application, and its use in every conceivable way.

Full information on Westinghouse rectifiers and free manuals can be obtained from the manufactures at the address given above.

Dollis Hill Radio Communication Society.—During February talks were given on the cathode-ray oscilloscope by G8PO, and also on the theory of alternating currents by 2DLB. The secretary of this society is E. Eldridge, of 79 Oxgate Gardens, Cricklewood, N.W.2, from whom all information can be obtained.

An Interesting Low-power Contest

By J. Hum, G5UM

IN recent years low-power transmitting contests seem to have suffered a temporary eclipse, possibly due to the difficulty of battling against high-power QRM when using a small transmitter.

The idea received a new lease of life a few weeks ago, however, when a low-power contest was organised by amateurs in Hertfordshire, and proved to be a remarkable success. It was held during the last two weeks of January, a maximum operating time of 20 hours being permitted. One point was secured by contacts with English stations, two for Scotland, Ireland, Wales, France, Holland and Belgium, and three points for the rest of Europe. Four points went to anyone lucky enough to contact a station outside Europe.

Although no power restriction was laid down, every member was compelled to use one standard 120 volt H.T. battery to all stages of his transmitter. This led to many ingenious attempts to extract the maximum amount of power out of the long-suffering battery, while still persuading it to last the fortnight over which the contest was spread.

Most members chose to use the simplest possible type of transmitter in order to economise on milliamps. Actually, the winner followed a completely different course, and went the whole hog by obtaining nearly five watts from the battery! If all contestants had followed his example he might not have had such a walk-over as, in fact, he did secure.

This winning station was G6XN, owned by L. A. Noxon at Welwyn Garden City. He ran up the amazing score of 77 points, and did most of his work on the 7 Mc. band. His best contact was with Algeria, which gave him 4 points. He also worked the notorious TA1AA, who is supposed to be in Ankara, Asiastic Turkey. He claimed three instead of four points for this QSO, which, in view of the station's doubtful authenticity, was perhaps wise. G6XN was the only contestant to work outside Europe.

During the first week of the contest it seemed as if G8PM, also of Welwyn Garden City, would run into second place, but as the fortnight wore on he was overhauled by G2KQ, a third Welwyn Garden City station, who finished up with thirty-three points, obtained with a straight 6L6 crystal oscillator, working solely on 7 Mc., against the twenty-six points of G8PM, who used 7 Mc. and occasionally 1.75 Mc. with an A.C. 4 Pen crystal oscillator.

Each of these contestants receives a prize presented by G5ZJ—an 802 suppressor grid transmitting valve for G6XN—a National condenser for G2KQ and a 6L6G valve for G8PM.

Fourth place was taken by G5UM, of Welwyn Village, who organised the contest. As he does not work at all on 7 Mc. he obtained most of his twelve points on 1.75 Mc. and 3.5 Mc., though he managed to work one German station on 14 Mc. He used his ordinary transmitter with 6L6CO, FD and PA, running about 15 milliamps to the FD and PA.

Though handicapped by aerial difficulties, G2YN, of Welwyn Garden City, sensed fifth place with seven points, being followed by G8TK, St. Albans, and G8MH, Watford. G3JX, Harpenden, and G2CN, of Welwyn Garden City, purchased batteries but could not manage any contacts.

The transmitter employed by G6XN was of rather interesting design. As a matter of fact, he should have been handicapped, since he is a research engineer and more likely to score on points of design!

He used a Pen 220 battery pentode as the crystal oscillator. This was followed by a PD220 double triode, one section was used as a frequency doubler. The other section was used as a buffer amplifier when working on 40 metres, or as a doubler when working on 20. The final stage was two PD220 valves in push pull, drawing about five watts from the dry battery.