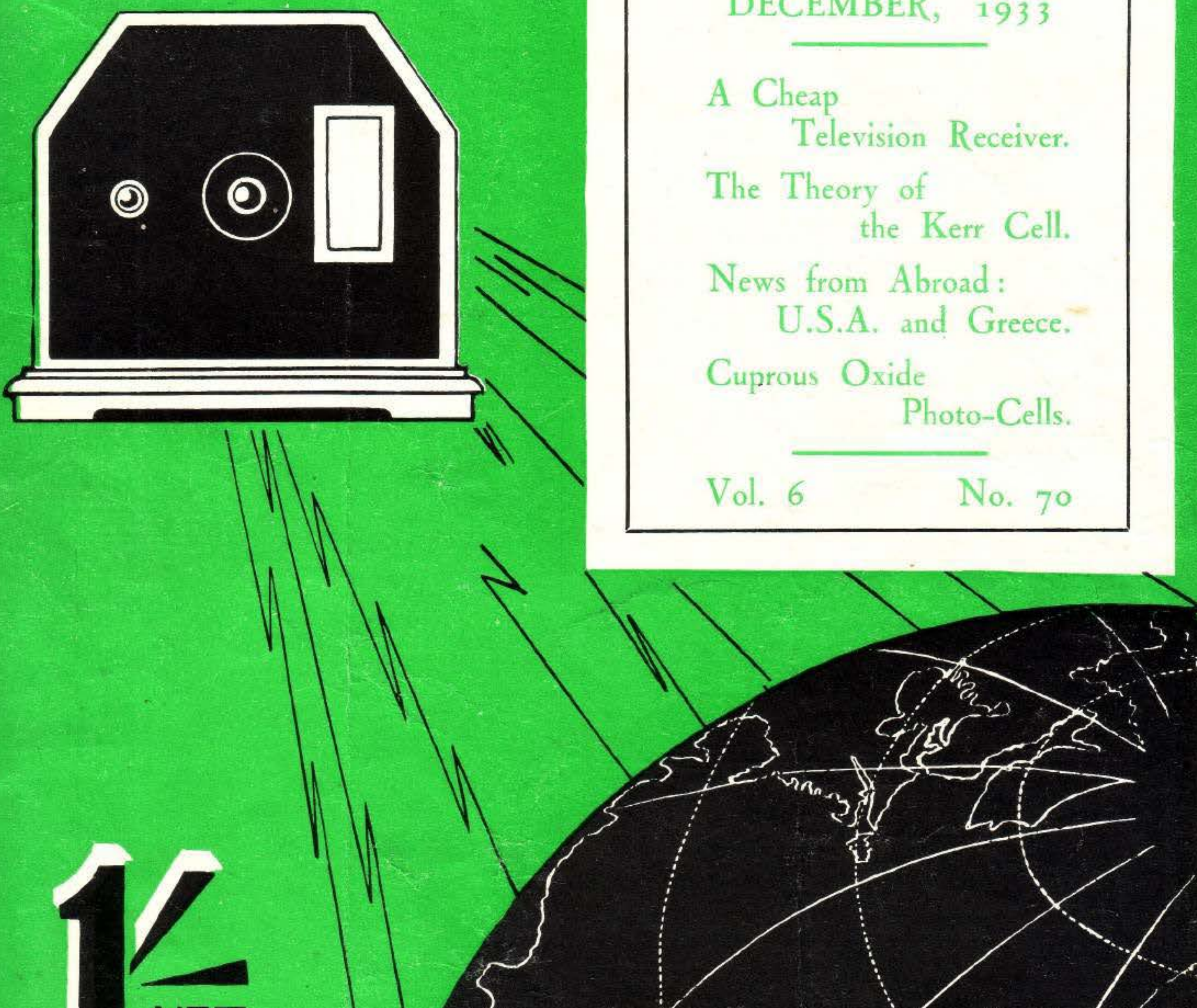
A REMARKABLE NEW AMPLIFIER

TELEVISION

DECEMBER, 1933

Vol. 6 No. 70



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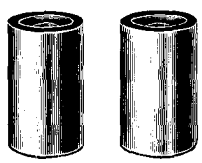

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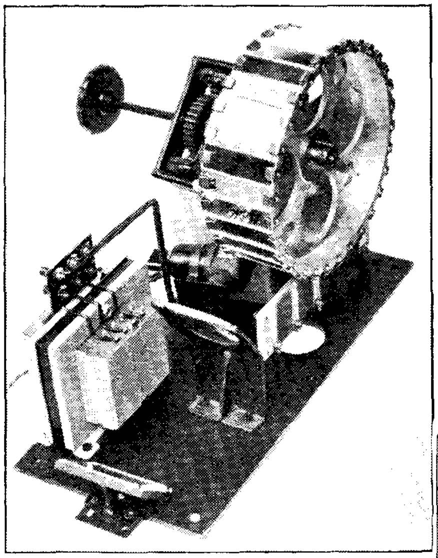

Whether it is an individual component or a complete kit of parts, television demands the best. See that you get it by always using individually tested Baird Equipment.

It must be emphasised that no guarantee of performance can be given with the Baird Projector Kit unless every specified part is used. Substitutes definitely give inferior results, and this applies particularly to the mirror drum.

Baird Grid Cell-Unit Prices.

	£	s.	d.
Grid Cell alone ... each	2	0	0
Square ended polarising prisms—			
6 mm. aperture... each		17	6
7 mm. aperture... "	1	2	6
8 mm. aperture "	1	7	6
Projection Lamp (12-volt 100-watt) ... each		12	0
Grid Cell unit complete with prisms, lens, mount and projector lamp each	5	0	0

Projector Kit Prices.

	£	s.	d.
Motor and synchronising gear, complete with stand and lamp housing	6	0	0
or			
Motor and synchronising gear only	5	0	0
Mirror Drum with flexible coupling	5	10	0
Grid Cell unit complete with projector lamp	5	0	0
Drilled Baseplate with Swivel Mirror and lens mount ...	1	0	0
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Screen television is now made possible for all with the advent of the Baird Grid Cell unit. Home made light modulating devices give poor and indistinct images. Every drawback is swept away with the Grid Cell unit, which, complete, comprises a special holder housing two light polarising prisms, a *hermetically sealed* cell, condenser lens and projector lamp. Send for fully illustrated brochure giving full details, post free on request.

If you want to build up the complete Baird Projector Kit, we can help you. Full instructions have been prepared showing the work step by step. Write for a copy : it costs you nothing.

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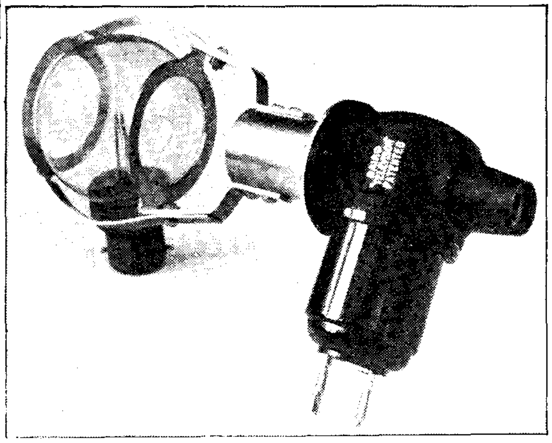

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TELEVISION

The First Television Journal in the World

Publishers: BENN BROTHERS, LTD. *Technical Editor:* H. J. BARTON CHAPPLE, WH.SCH., B.Sc

Offices: BOUVERIE HOUSE, FLEET STREET, LONDON, E.C.4

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Notes of the Month

THE past year has been one of consistent progress in television, both in this country and abroad. Looking back over the year it is difficult to single out any one development which is more outstanding than another, for there have been many notable refinements in technique which have all added to the value of television as an entertainment. The inauguration of ultra-short wave transmissions stands out as the "big event" of 1933. There are many difficulties in the way of a satisfactory public service, but there is little doubt that the future of television will depend on ultra-short waves.

* * *

1933 has been a year of steady progress in the television studio at Broadcasting House. We have seen several successful revues, of which "Looking at London" was, perhaps, the best; we have been entertained by stars of the stage and opera; we have looked-in to a boa-constrictor and a macaw from the Zoo; while the first birthday programme was celebrated by the televising of a boxing contest. We again congratulate Mr. Eustace Robb on an eminently successful year.

* * *

Television has found still another application—it is to be used in giving visual instructions to signalmen on the East Anglian main line of the L.N.E.R. It is explained that, between Romford and Shenfield are four running lines. Normally two tracks are reserved for fast trains, and the others for slow trains. At rush hours, however, trains are run on either track. Every train has its appointed route, and instructions will be sent to each signalman by the new apparatus. The principle on which the train descriptions are sent is similar to that of an automatic telephone exchange. The signalman at the transmitting end dials, for instance, "Express Passenger Train, Colchester line." Instead of ringing a bell at the other signal boxes, the description is shown on an indicator board. No audible message is passed on. The system is claimed to ensure extremely rapid working.

* * *

Readers will be interested to note that TELEVISION will appear next month under new auspices, and will become the property of Bernard Jones Publications Limited, the publishers of *Amateur Wireless* and *Wireless Magazine*. It will thus become part of a well-known group of radio publications and will have all the advantages of their resources and experience in this field of publishing. The new proprietors announce that the journal will be enlarged and will include new features of special interest, so our readers may look forward to excellent value for their shilling, as the price will not be increased.

IMPORTANT NOTICE

Beginning with the next issue (January) TELEVISION will be published by Bernard Jones Publications Limited, 58/61, Fetter Lane, London, E.C.4., to whom all enquiries relating to the journal should now be addressed. The new publishers announce that TELEVISION will appear in future with a new cover, the number of pages will be increased, and attractive new features introduced. The price will remain unchanged at 1/- monthly, and orders for the January issue should be placed immediately.

A Straight Line Amplifier

By C. P. Hall, B.Sc.

AN amplifier for television work has to satisfy requirements far more exacting than are intended only for acoustic purposes; indeed it quickly becomes obvious that faults the human ear cannot even detect become far too serious to be tolerated when the test is visual and not acoustic. Hitherto almost all the transmissions in this country have, of course, been made with a scanning of 30 lines on the medium broadcast waveband, but it is now proposed to put into operation 120 line transmissions on the ultra-short waveband.

Using an amplifier with a good response curve from 25 cycles to 10,000 cycles we obtain good pictures from the 30 line transmissions, whereas to take advantage of 120 line pictures it will be necessary for us to raise the high frequency response considerably. When it is remembered that we must have a straight line response curve from 25 cycles to at least 5,000 cycles and that we aim at a curve above this point which will tail off at least so gradually that at 300,000 cycles the response is appreciable, it is apparent that the designer is set a problem of some magnitude. It is proposed first to crawl and then to walk, and in this issue the amplifier given will be found to have a good characteristic. Using most of the components an improved amplifier will be described next month.

The amplifier has been designed with a view to achieving at a reasonable cost (1) a characteristic curve which is linear between 100 cycles and 4,000 cycles; (2) an appreciable response at 25 cycles and 100,000 cycles; (3) an undistorted output of 5 watts a.c.; (4) ease of construction with components which are readily obtainable; (5) to take advantage of the present 30 line experimental transmissions on the ultra-short waveband being broadcast from the Crystal Palace by Baird Television, Ltd.

The amplifier of which Fig. 1 gives a schematic circuit is four stages, resistance-coupled throughout. A further stage is incorporated for synchronising purposes, and this includes a tuned transformer suitable for the 30-line picture frequency at $12\frac{1}{2}$ pictures per second. It will be necessary to substitute this when the 120 line transmissions are regularly broadcast.

The intending constructor is warned that it is essential that non-inductive condensers should be used in positions *B*, *C*, *H*, *J*, *E*, *F* and that non-inductive resistances should be used throughout. A baseboard and panel of dry wood well seasoned has been used in preference to a metal chassis lay-out owing to the serious high note loss occasioned by the latter in close proximity to the wiring. The gain per stage has been deliberately kept low in order to preserve the top register.

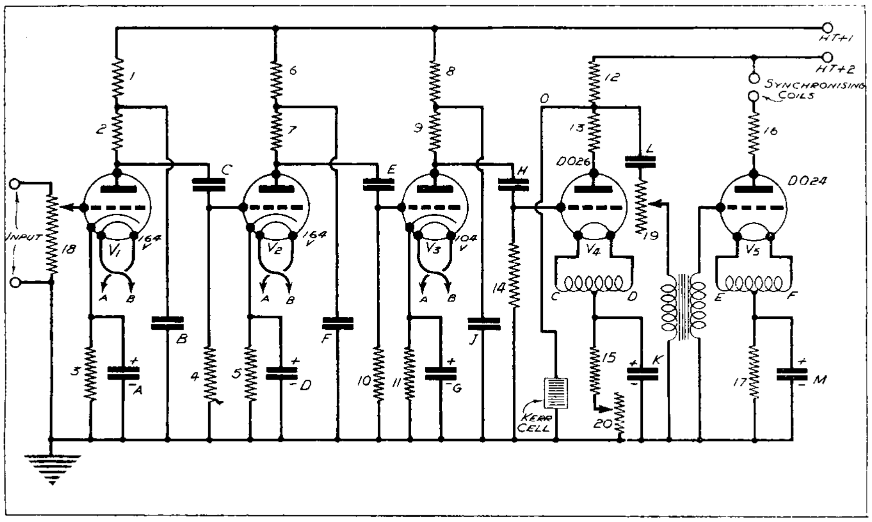


Fig. 1. Schematic circuit of the straight-line amplifier.

Fig. 2 gives the circuit of the H.T. eliminator using valve rectification. The mains transformer used has the following windings:

Primary suitable for 200-220-240 mains:—

1st secondary 600—centre tap—600 at 120 mas.

2nd secondary 4 volts 2 amps centre tapped.

3rd secondary 4 volts 2 amps centre tapped.

4th secondary 4 volts 3 amps centre tapped.

5th secondary 4 volts 2 amps centre tapped.

As it has already been pointed out, if the constructor has a transformer with a secondary winding of 550—0—550 or 600—0—600 this may be used and the heater supply obtained from a separate transformer which will only have a dissipation of 29 watts approximately according to its efficiency. Provided that the working voltage of any condensers which the constructor may have available is above or equal to the working voltage specified these may be used in the H.T. supply

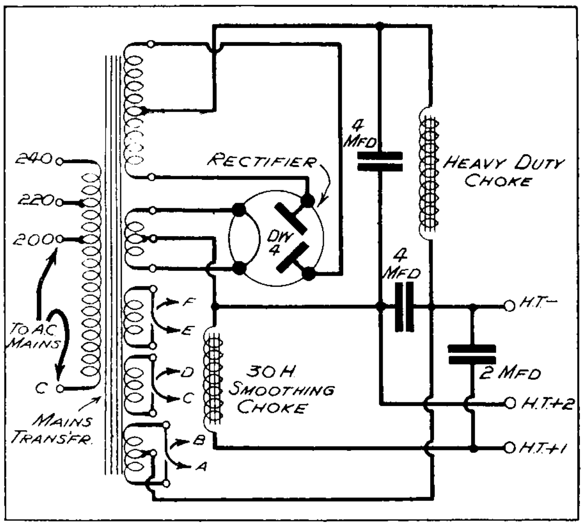


Fig. 2. Circuit of the H.T. eliminator.

unit. The wood baseboard should be cut from a piece of dry beech and should be stained. The panel may be cut from six or seven millimetre plywood which can then be stained and polished or they may be obtained already cut and stained as indicated in the list.

Two wood rails are then fitted to the baseboard. The three half-microfarad non-inductive condensers C—E—H should now be fixed flat against the underneath side of the baseboard and may be held in position by a strip of meccano metal utilising the perforations as screwholes. Five valveholders are now screwed to the baseboard in the positions indicated in Figure 3, taking care to place the five pin type in the correct positions for the three stages of resistance coupling and the four pin type in the positions for the output and synchronising valves.

The 25 microfarad condensers A—D—G are screwed in place between the valveholders with the plus sign towards the panel.

It is now advisable to wire the heater circuits of the first three stages, using tinned wire 18 s.w.g. covered with systoflex, or sleeving. The pair of wires should be twisted, as ordinary lighting flex is done, in order to restrict the a.c. field around them. This reduces the possibility of introducing hum into the surrounding circuits. The heater wiring should be run along the side of the baseboard nearest the panel.

The cathode bias resistances 3—5—11 are connected across the terminals of the 25 microfarad electrolytic condensers which have already been fitted in position. The plus sign terminal of the condenser A should be connected to the cathode terminal of the first stage valveholder. The plus sign terminal of condenser D to cathode of the second stage valveholder and the plus sign of condenser G to the cathode of the third stage valveholder.

The negative sign terminals of these condensers A—D—G are connected together by one length of wire less sleeving to enable other connections to be made to it later.

The anode terminal of the first stage valveholder should be connected to condenser C located under the baseboard. The lead should pass through a hole in the baseboard. The other terminal or solder tag of the condenser C is now connected through the baseboard to the grid terminal of the second stage valveholder.

In the same way the condenser E is connected to the anode of the second stage valveholder and grid of the third stage valveholder. Condenser H is connected to the anode of the third stage valveholder and the grid of the output valve.

Grid leaks 4—10—14 are now connected to the grid terminals of second stage, third stage and output valveholders respectively, the other ends of the grid leaks being grounded on the common earth lead coupling the negative terminals of the electrolytic condensers A—D—G.

The anode resistances 2—7—9 are connected to the anode terminals of the first stage, second stage and third stage valveholders respectively. About two inches of connecting wire should be used in each anode circuit between anode and resistance. Condensers B—F—J are then screwed in position. The free ends of the anode resistances 2—7—9 are connected to the condensers B—F—J, one resistance to each condenser.

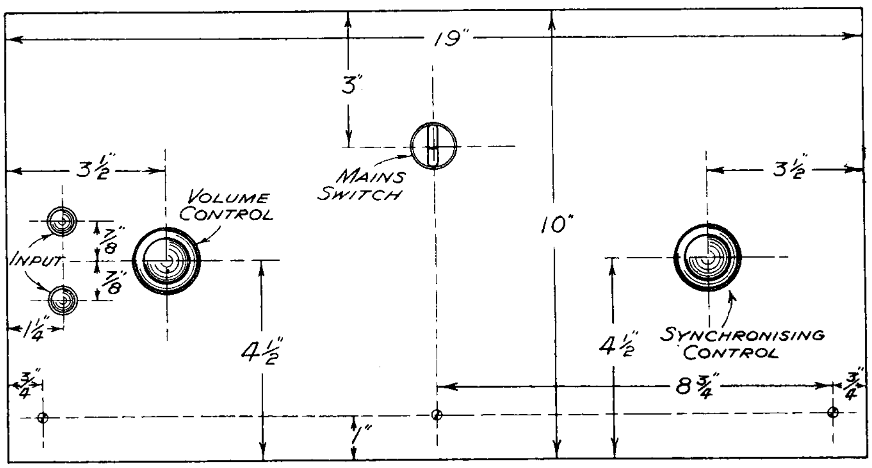
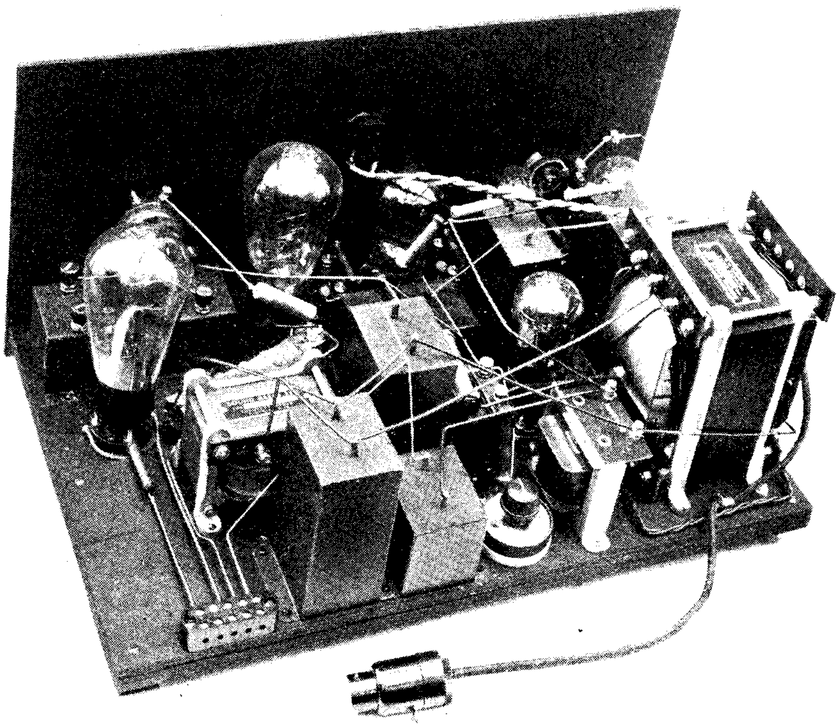


Diagram of the panel of the straight-line amplifier.

The output valve anode resistance 13 should now be fixed in position. The synchronising transformer is then screwed to the baseboard.



A view of the amplifier which clearly shows the components.

Potentiometers 18 and 19 are fitted to the panel, together with a mains switch, which should be mounted in the mid position and the panel can then be screwed to the baseboard.

A lead is taken from the grid terminal of the first stage valveholder to the centre terminal of the potentiometer 18. This lead should be as short as possible. The lower terminal of the potentiometer is connected to the lower of the two input terminals on the panel.

The top terminal of the potentiometer is connected to the remaining terminals of the condensers B—F—J and also to the common earth lead connecting condensers A—D—G.

The above wiring is explained in detail because it is important that it should be carried out in the way described. The remainder of the wiring is not so critical but should be carried out in a neat and tidy manner using sleeving on all leads except those at earth potential.

The remaining components should now be fitted and the wiring completed, as shown in the circuits. When the connections have been checked two Mullard 164v valves are placed in the first and second stage valveholders respectively. A Mullard 104v is fitted to the third stage and the DO26 in the output stage. A DO24 valve is placed in the synchronising valveholder and a Mullard DW4 may be used in the mains unit.

When the constructor has ascertained his amplifier is working satisfactorily it may be connected to the television equipment and a modulation test obtained from some local station.

List of Components

One baseboard 19 in. by 12 in. and panel 19 in. by 10 in.

Three 5-pin valveholders, base mounting type. (Whiteley Radio 10d. type.)

Two 4-pin valveholders (ditto.)

One synchronising transformer (Mervyn Sound & Vision.)

Two 100 ohm 1 watt resistances. (Erie Radio Resistance Co.)

Two 1,000 ohm 1 watt resistances. (Erie Radio Resistance Co.)

One 1,250 ohm 4 watt resistance. (Erie Radio Resistance Co.)

One 1,500 ohm 1 watt resistance. (Erie Radio Resistance Co.)

One 5,000 ohm 2 watt resistance. (Erie Radio Resistance Co.)

One 4,000 ohm wire wound non-inductive resistance to carry 60 milliamps. (Zenith Electrical or Mervyn Sound and Vision.)

Two 10,000 ohm 1 watt resistances. (Erie Radio Resistance Co.)

One 12,500 ohm 1 watt resistance. (Erie Radio Resistance Co.)

Two 35,000 ohm 3 watt resistances. (Erie Radio Resistance Co.)

One 35,000 ohm 4 watt resistance. (Erie Radio Resistance Co.)

Three 250,000 ohm 1 watt resistance. (Erie Radio Resistance Co.)

One 400 ohm preset resistance. (Igranic.)

One 250,000 ohm potentiometer. (British Radiophone.)

One 50,000 ohm potentiometer. (British Radiophone.)

Three 25 m.f.d. electrolytic condensers, 25 v. working.

Two 8 m.f.d. non-inductive 350 volt working condensers, type 84. (T.C.C.)

One 6 m.f.d non-inductive 350 volt working condenser, type 84. (T.C.C.)

Three 0.5 m.f.d. non-inductive condensers. (T.C.C.)

One 0.1 m.f.d. tubular condenser. (T.C.C.)

Two 8 m.f.d. electrotytic 120 volt working condensers. (T.C.C.)

One 5-way connector. (Wilburn Co.)

Two Mullard 164 v. valves, clear glass.

One Mullard 104 v. valve, clear glass.

One Mullard Do26 valve.

One Mullard Do24 valve.

MAINS UNIT VALVE RECTIFIER.

One mains transformer with the following specification:—

H.T. secondary 600—0—600 at 120 m.a.s.

L.T. secondary 1. 2v—0—2v at 3 amps.

L.T. secondary 2. 2v—0—2v at 2 amps.

L.T. secondary 3. 2v—0—2v at 2 amps.

L.T. secondary 4. 2v—0—2v at 2 amps.
(Sound Sales, P.600.)

One 30 h. 20 m.a.s. smoothing choke. (Sound Sales, W.W.C.1.)

One Heavy duty choke. (Sound Sales, P.40F.F.)

Two 4 m.f.d. 750 volt working condensers, (T.C.C.)

One 2 m.f.d. 750 volt working condenser. (T.C.C.)

One Mullard D.W.4 rectifying valve.

Key to Figure 3.

1.	35,000	Ohms.	3 watt.
2.	12,500	,,	1 watt.
3.	1,000	,,	1 watt.
4.	250,000	,,	1 watt.
5.	1,5 0	,,	1 watt.
6.	35,000	,,	3 watt.
7.	10,000	,,	1 watt.
8.	35,000	,,	4 watt.
9.	10,000	,,	1 watt.
10.	250,000	,,	1 watt.
11.	1,000	,,	1 watt.
12.	4,000	,,	15 watt.
13.	100	,,	1 watt.
14.	250,000	,,	1 watt.
15.	1,250	,,	4 watt.
16.	100	,,	1 watt.
17.	5,000	,,	4 watt.
18.	250,000	,,	Potentiometer.
19.	50,000	,,	Potentiometer.
20.	400	,,	Preset. Resist.
A.	25 mfd. Electrolyte.		
B.	8 mfd. N.I. Condenser.		
C.	0.5 mfd. N.I. Condenser.		
D.	25 mfd. Electrolytic.		
E.	0 5 mfd. N.I.		
F.	8 mfd. N.I.		
G.	25 mfd. Electrolytic.		
H.	0.5 mfd. N.I.		
J.	6 mfd. N I.		
K.	8 mfd. Electrolytic.		
L.	0.1 mfd. Condenser.		

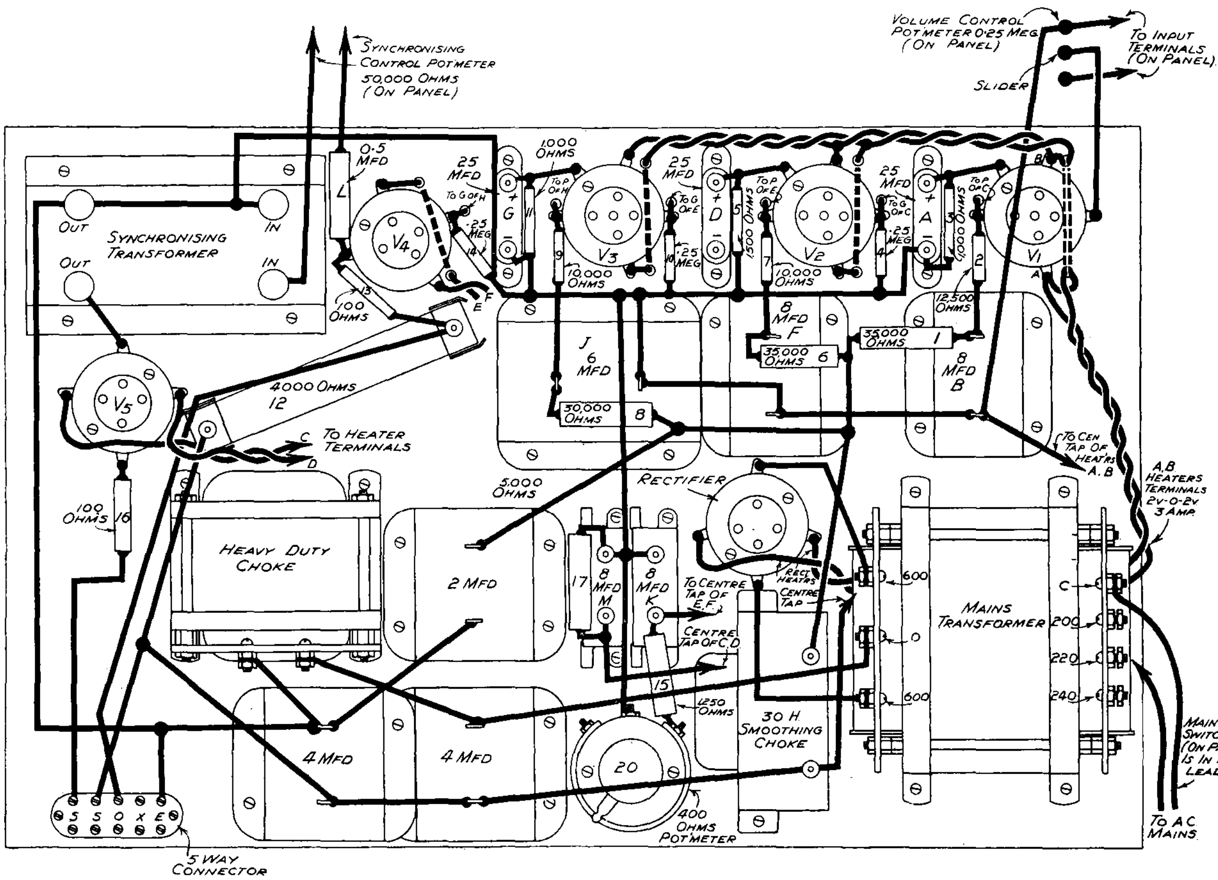


Fig. 3. The wiring diagram which is explained in detail in the text.

News from Abroad

From our Own Correspondents

United States

Two new developments have recently been announced from the New York laboratories of Mr. William Hoyt Peck, an independent television experimenter. The first of these is a method of employing an ordinary automobile headlight bulb as a light source in television receivers, and the other is a synchronous motor that operates at a constant speed of 1,440 r.p.m.

A Cheap Light Source

In the headlight bulb light source, a reflector is placed behind the bulb, and what might be termed a combination reflector and lens is placed in front. This combination is made in one unit from a heavy globe of glass with suitable silvered surfaces. Light from the base of the bulb is collected and focused towards the front. This light, together with that from the front, is gathered and concentrated into a small spot so that it may be directed and utilized as desired. With such a light source, it is, of course, necessary to use some such modulating device as a Kerr cell. In any event, high efficiency from a dependable and low-priced source is claimed, Mr. Peck stating that with this system a television image may be obtained which is 385 times as bright as that obtainable with the best crater lamp.

In order to use standard talkie film for television, it is necessary that a shaft speed of 1,440 r.p.m. be obtained. Ordinarily this is done with a train of gears which are bulky, noisy, inefficient, and give rise to vibration. Hitherto it has been considered impossible to operate a synchronous motor at any speed that is not a multiple of the frequency of the current, and ordinarily 60-cycle current is used. Just how Mr. Peck has managed to gain this desirable end has not been revealed because of the patent situation, but the writer witnessed a demonstration of the motor and it fully justified the claims made for it. With a stroboscope, the speed of the motor was checked and re-checked. In every case it reached exactly 1,440 r.p.m. and " locked " at that speed regardless of load applied within the limits of the power rating. Speed counters also revealed the same condition. Synchronisation was always perfect and unaffected by changing conditions. The applications of such a motor are not limited to television, for there is a need for it in motion picture photography and projection.

Drastic action was recently taken by the Federal Radio Commission in the case of Short Wave and Television Corporation of Boston. According to reliable reports, this organisation was painting beautiful word pictures of its future activities as a basis on which to sell stock in its newly formed parent company called the General Electronics Corporation. Because of this activity, the Commission refused to grant an experimental licence for station W1XG and the renewal of the licence for W1WAU. Thus the television operations of this company have been suspended, at least for the time being.

This is the first time that the Commission has taken such action against a television organisation. In the past they have acted quietly to stop questionable stock selling activities, but in this case more forceful action was necessary. Nearly a year ago this same company was the subject of an inquiry by the Commission, when charges were made that it was promoting stock sales on the basis of mere experimental wave grants. It is noted that the point at issue in refusing the wavelength grants was not the merits of Short Wave and Television Corporation's researches, but that its claims to the public were at fault.

Studying the Future

A committee consisting of Messrs. E. T. Cunningham (chairman), Powel Crosley, W. Roy Canne and James M. Skinner has been appointed by the Radio Manufacturers' Association to make a special study of the future of television. The R.M.A. is an organisation devoted to the interests of radio for the purpose of fair play in manufacturing for the protection of the public.

On January 1, 1934, three of the five intermediate wave bands assigned to television in the United States will be dropped. This, according to the Federal Radio Commission, is being done for two reasons: first, it is in line with the Mexico City agreement as to short waves, and secondly, it is a logical development of the trend towards the ultra-short waves. The Mexico City agreement provides for the abandonment of the 1,600, 2,100 and 2,200 kilocycle bands and the operation in the intermediate waves of only the 2,000 and 2,750 kilocycle bands. The ultra-short waves allotted to television remain unaltered at frequencies of 43,000, 48,500 and 60,000 kilocycles.

Already the frequency of W6XS has been changed from 2,150 to 2,800 kilocycles, with the sanction of the Commission. Commenting on the change, Mr. Harry R. Lubcke, director of television for the Don Lee System, owners of W6XS, said: "We appreciate the opportunity of furthering the television art by placing our transmitter on a higher frequency. The new frequency will afford lookers better reception, in that their receivers will now pass the wide television band with less sideband cutting." At the conclusion of each broadcast from W6XS a simple line image of constant intensity is transmitted in order to afford lookers an opportunity to check signal strength, fading, image appearance, and ghosts without the variable conditions which are present when moving images of lights and varied shades are being received.

Greece

M. Anthony Doumas, a reader of TELEVISION in Athens, claims to be the first and only possessor of a television receiver in Greece. He has been actively interested in television for the past year. M. Doumas uses a 30-hole scanning disc and a plate neon tube (Philips 3500), modulated by a final power valve (Philips E406). "My radio set," he writes, "is a simple superheterodyne fitted with a bi-grid and two screen grid valves, feeding a triode grid-detector coupled to the power valve by an L.F.1/3 transformer. A simple choke coil is used for the connection of the power valve to the neon tube. Synchronising is manual, using two rheostats and employing pressure upon the disc spindle. I do not intend yet to get a second receiver for the sound.

"In spite of all these imperfections, and particularly the great distance from the transmitter and the interference from the Stuttgart station, I manage to catch for some minutes the images from London. At certain moments the reception is surprisingly clear and detailed, although for the greater part of these thrilling half-hours I can see little, the reception being too weak. I am wondering now if I must strengthen the H.F. stages of my receiver, or add a second L.F. valve. I intend also to construct a special mirror-drum which I have just invented. All the mirrors may be adjusted at once automatically.

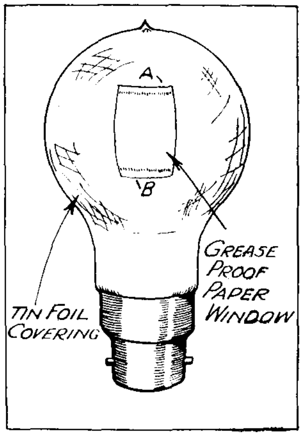
"Recently I became a reader of TELEVISION, and I must confess my surprise to learn that there are even in England people who declare themselves to be opposed to the television transmissions of the B.B.C."

A Cheap Neon Lamp

By G. O. Rowston

The writer has found the following to be a very simple and effective method for preparing an ordinary Osglim 5-Watt neon lamp for use in a television set. The lamp is first coated all over with glue, with the exception of a small square opening as shown in the diagram. This opening should be slightly larger than the picture formed by the scanning-disc to be used. When the glue has become tacky, the bulb is covered completely with silver paper or tin-foil, leaving the glass exposed only at the small aperture mentioned above.

A square of white, semi-transparent grease-proof paper should now be cut out, slightly larger in size than the opening in the tin-foil, and this should be secured in place over the aperture by a little glue applied at the top and bottom of the paper (A and B) only. If the glue is placed on all four edges it will be found difficult to make the paper lie over the bulb without creasing. Ordinary grease-proof paper of the type used for containing picnic sandwiches is quite satisfactory.



The finished lamp.

The whole of the outside of the bulb, with the exception of the small paper covered window, should now be given a further coating of glue (over the top of the tin-foil). This will make the latter absolutely secure and prevent any possibility of peeling. The general finished appearance can be seen from the diagram.

The writer has found a neon lamp prepared in this way to give really excellent results, as the light produced is very much increased by reflection from the tin-foil, and also a perfectly even source of illumination is obtained by the diffusion of the light through the grease-proof paper.

Webb's Radio Service have removed from 164 Charing Cross Road to 14 Soho Street, Oxford Street, London, W.1.

A demonstration of screen television was given by Mr. H. M. Dowsett, research manager of the Marconi Co., to the Cambridge University Wireless Society, on November 13.

Cuprous Oxide Photo-Cells

By H. Wolfson, B.Sc., F.T.S.

DURING the last twelve months considerable advances have been made by those engaged in research into the photo-electric properties of cuprous oxide and allied substances. Considering first the case of the liquid cells, it will be realised that there is considerable room for improvement in this type. These cells usually consisted of either two similar cuprous oxide electrodes in a solution of a copper salt, or a cuprous oxide and a metallic electrode (such as cadmium, lead, carbon, etc.), in a dilute acid solution, or in certain examples, in a dielectric liquid such as glycerine or alcohol.

In these cells with dissimilar electrodes, one always obtains, as might be expected, an E.M.F. even when the cell is in the dark, due to electro-chemical action. This current, ever present when the cell is connected in a circuit, results in the final destruction of the cuprous oxide layer, which is dissolved in order to provide this E.M.F. or dark current.

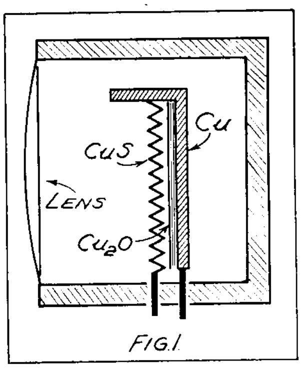
Solving a Difficulty

It is now possible to overcome these difficulties by special preparation of the cuprous oxide electrode, and by using a more suitable counter-electrode in the form of a disc of copper sulphide gauze. The copper electrode to be oxidised is heated to 1,000°C. in an atmosphere of oxygen, till a fused and dense layer of cuprous oxide is formed. It is then cooled slowly and immersed in hydrochloric acid. This will reduce the possible outer layer of cupric oxide together with some of the cuprous oxide. The reduction products so formed can be removed by cleaning the electrode in concentrated nitric acid for a few moments. The surface of the electrode now appears ruby red and glass-like. It must be etched to show a crystalline structure, as it is considerably more sensitive in this condition. The etching may be conveniently carried out by means of hydrochloric acid, or 5 per cent. sulphuric acid or even a 10 per cent. solution of ammonium chloride in water can be used.

It is important to make sure that no part of the electrode, other than the front oxidised surface, is exposed to the cell liquid, and for this reason all exposed metal surfaces in the cell should be covered with an asphalt base varnish, such as Brunswick black.

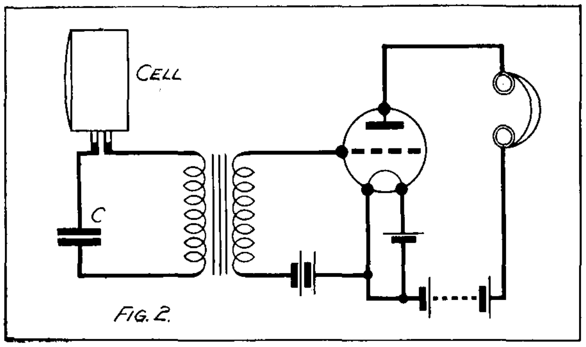
The counter-electrode is made by heating a copper gauze disc for 10 minutes in an atmosphere of sulphuric vapour at 500°C. This gives a coating of cupric sulphide about 5 mils thick. The cell, the construction of which is shown in Fig. 1, is filled with glycerine, ethyl, alcohol or ethyl glycol, to which has been added ½ per cent. of some organic acid, such as citric, butric, etc. The cell is connected to an L.F. amplifier through a condenser fed transformer, as shown in Fig. 2. This arrangement will give signals in the telephones or loudspeaker if the cell is illuminated with a modulated light beam, and a number of interesting experiments can be performed with its aid.

Turning now to a consideration of the dry cuprous oxide cell, one finds that a number of interesting and logical steps have been taken to improve the sensitivity and performance of this class of cell. It has been found that an annealing process may be applied to the oxide, which reduces its resistance considerably; in fact, under the most favourable conditions this reduces the resistance to 1/40th of its initial value before annealing. The process is quite simple, and consists in heating the cuprous oxide, prepared by oxidising at 1,000°C, to between 400°C. and 650°C. The optimum temperature has been fixed at 535°C. and the time of treatment from five to ten minutes. The complete process of oxidation, annealing and final etching may be accomplished in one continuous operation if desired. In this case the copper plate is placed in a furnace at 1,000°C. and the oxidation carried out to the required degree. The plate is then allowed to cool to 535°C. and maintained at this temperature for say ten minutes. It is then quenched in warm water, and etched in a suitable liquid, such as 5 per cent. sulphuric acid or 10 per cent. ammonium chloride, at 20°C.



Construction of the cell.

In a previous article I drew attention to the apparent relationship existing between the rectifying action and the photo-electric effect in this class of cell. Extensive research has shown that these two effects are, in fact, co-existing in all



Connecting the cell to an L.F. amplifier through a condenser feed transformer.

rectifier type photo-cells and that they exist in opposition. This means, of course, that where one has a photo-electric layer of cuprous oxide which exhibits at the same time a strong rectifying action, one can obtain only a very feeble photo-current. Those cells which exhibit the strongest photo-effect are the ones in which the rectifying action is the least. Let us consider this statement in greater detail. When light falls on the cell and penetrates the contact surface between the oxide and the copper, and thus releases photo-electrons so that an E.M.F. is produced, it is often the case that on the counter-electrode there is produced a high contact resistance, which increases the internal resistance of the cell, without adding to the photo-electric output.

If, for example, the cell is made in such a way that a thin layer of oxide is produced on a small copper plate (counter-electrode) and a grid-shaped active electrode is fitted on this oxide layer, it may happen that the rectifying effect at the counter-electrode (which is, of course, normal in the case of ordinary rectifier plates) is so large that it is comparable with the rectifying effect between the oxide and the active electrode where the photo-electrons are generated, and since these two rectifying actions are in opposite directions, the cell has apparently a very high resistance. This rectifying action can be imagined as a contact resistance which is effective in one direction and ineffective in the other. This is the usual theory of the copper oxide rectifier, which has a forward and a reverse resistance. But in those cells which are produced by condensing metallic atoms on to the oxide by sputtering, to form the active electrode, a high contact resistance or rectifying effect may occur. This so increases the cell's internal resistance as to render it almost useless.

In the new cell the counter-electrode, fitted in addition to the active electrode upon a solid block of annealed and crystalline oxide is made so that the contact resistance, and therefore the rectifying action taking place at the counter-electrode is small compared with that taking place at the junction of the oxide and the active electrode, and is in fact small compared with the remaining total cell resistance. The rectifying action must in particular be small with all values of a biasing potential which may be used with the cell, for although we have seen that these cells can be used with no polarising battery potential, it is preferable, when connecting them to an amplifier, to join the cell in series with a battery and a resistance of 10,000 ohms, the current flowing being of the order of 5 m/a.

Graphite is particularly well suited for making a counter-electrode which fulfils the above conditions, as it gives good contact with the oxide and shows little or no rectifying action when so combined. In actual production the graphite may be applied to the oxide in the form of a colloidal solution or emulsion. The preparation known as "Aquadag," sold for lubricating and other purposes, is an excellent colloidal solution of graphite in water, and can be used successfully. The conductivity of the graphite layer may be subsequently increased by applying a layer of metal foil, or a metallic coating of silver or gold.

Another method of reducing the rectifying effect between the oxide and the counter-electrode is to submit the oxide surface to a process by which the most intimate contact can be secured between oxide and counter-electrode. This is most readily done by submitting one side of the cuprous oxide block to sand-blasting, and then condense metallic atoms on this surface by any suitable process, such as "Schoopising," galvanising, cathodic sputtering, etc. It is also possible to achieve a similar result by heating till vitreous and then polishing, but undoubtedly the best method of all is a combination of the sand-blasting and subsequent application of graphite, deposited from an emulsion. The side of the oxide upon which it is intended to form the active electrode is then etched, and the best solution in this case is 25 per cent. sulphuric acid, used hot. It is important that care be taken with the form of the active electrode, which must be clear and sharply defined. Any roughness or unevenness about the edges of the grid structure which forms this electrode will result in a considerable lowering in efficiency and output.

"Sputtering"

It is possible to achieve the desired form of electrode by sputtering or by electro-deposition, the undesirable parts being removed mechanically or chemically, or certain parts may be protected with varnish or wax, etc., from the deposition of metal. Many ways will suggest themselves to the reader, and it is not necessary to go further into this question, which is of the least importance of any.

An active electrode of extreme thinness may be produced which, though it covers the entire surface of the oxide, is pervious to light. This translucent film is formed by a reduction of the upper surface of the oxide layer. The oxide is heated to 600°C. (max.) and either treated with alcohol vapour, or quenched by throwing into a dilute aqueous solution of alcohol. Carefully carried out, this process yields very good results, and leaves a homogeneous layer of oxide under a translucent copper film only a few atoms in thickness. This process is employed in the manufacture of rectifier plates by several firms who are not licensed under Westinghouse patents.

According to Dr. B. Lange, a substantial improvement can be effected by paying particular attention to the form of the active or "take-off" electrode, which is superimposed on the cuprous oxide layer. In his opinion, if a network or grid-shaped active electrode is employed, difficulties are encountered, not only on account of imperfections in the accuracy of the electrode, but more particularly because the parts of the photo-electric surface which are covered by the electrode are shielded from the irradiating light, while even with a uniform translucent electrode such as has been described above, only part of the available light is utilised in releasing photo-electrons. Hitherto it has not appeared possible to do away with the take-off electrode completely, since one uses a metallic electrode dusted on to the oxide layer, the photo-current diminishes according to an exponential law, the further the irradiated surface is from the active electrode.

The results of numerous experiments and measurements have shown that this can be avoided, even when the surface of the oxide is exposed, if the take-off electrode is in the form of a ring, or closed annulus. Thus we find in the latest Lange cell that the oxide is provided with a conducting metallic annulus at the marginal region only. The take-off electrode is deposited, as before, by Schoopising, sputtering or electrolysis, and is but a few millimetres wide. With an exposed oxide surface of about 20mm. and a 2 mm. annulus surrounding this, the difference of sensitivity between the centre and the edge is of the order of 1 per cent., which is well-nigh negligible.

A Recent Improvement

One of the most startling, and the most recent improvement in this type of photo-cell has come about through investigations along slightly different lines. While many workers have continued to experiment along the above lines using cuprous oxide as the photo-active electrode, others have looked around for a related substance with a far greater sensitivity.

This has resulted in the successful production of a cell, similar in all other respects to the above, but employing not cuprous oxide, but *cuprous iodide* as the photo-electric substance. The iodide is brought into contact with the copper counter-electrode by fusing. As with the other similar cells, no polarising voltage is needed, and the cell is free from inertia or "lag." The direction of current flow in this case is in the opposite direction to the oxide cell.

The Television Society

In view of recent events, special interest attached to the discussion on ultra-short waves at the last meeting of the Television Society in London. Mr. T. M. C. Lance took the chair.

Mr. R. W. Corkling read a paper entitled "Ultra-Short Waves and their Application to Television." The paper discussed in some detail the frequency requirements of television as compared with those required for the transmission of sound. Mr. Corkling then explained some fundamental terms in connection with U.S.W. The paper then went on to consider briefly the nature of U.S.W. uses for television.

Mr. E. C. S. Megaw, B.Sc. (G.E.C. Research Laboratories), read an interesting paper on "Short Wave Oscillators." After introductory remarks on different valves in use for U.S.W. oscillation, he described the Magnetron oscillator. Special reference was made to the Lecher wire tuning system, where, apart from wavelength adjustment, the behaviour of the circuit can be easily controlled by a filament and field current rheostats. This fact has many advantages considering the very short wavelengths in use. Mr. Megaw then proceeded to demonstrate an actual U.S.W. oscillator, using the Magnetron valve.

Mr. E. L. Gardiner, B.Sc., gave some notes on the reception of U.S.W. television. Mr. Gardiner discussed different circuits for the reception of U.S.W. signals in connection with television, and pointed out the advantages and disadvantages of the various types.

A discussion was then opened by Mr. L. B. Friedman, who stated that in his opinion high definition television is technically solved. The only thing to be solved is the connecting link between the television transmitter and the television receiver, and, to his mind, after carefully examining available connecting links, the only one adaptable seems to be U.S.W. In this connection, the chief problems to be solved would be: the uniform amplifications of the wide frequency band involved; satisfactory transmission on U.S.W. using comparatively high power; the design of receivers which can be easily handled by the man-in-the-street; and the problem of chain transmitters.

Positive Synchronising

By K. S. Davies, B.Sc., and E. L. C. White, B.A.

THE use of the scanning-strip frequency component of the signal current standardised by Baird, continues to be the only practicable method of synchronising television receivers with the transmitter in cases where facilities do not exist for the transmission of a separate synchronising frequency. In the case of the Baird system, there are 30 strips per picture and 12½ pictures are transmitted per second. At the end of each scanning strip the picture current is interrupted and so a 375 cycle component is introduced into the signal wave. At the receiver, this signal is amplified and applied to a cogged wheel, direct coupled to the motor which drives the receiver disc. Provided that sufficient power is thus supplied to the cogged wheel to enable it at all times to overcome any tendency on the part of the main driving motor to change its speed consequent upon fluctuations in its supply voltage, or slight mechanical disturbances, the method proves satisfactory and synchronism is maintained.

Unfortunately, however, the required synchronising frequency component is far from constant in amplitude, varying considerably according to the tone distribution over the picture, and hence, unless large amplification is applied, the cogged wheel will not, at all times, receive sufficient power to enable it to perform its necessary function. Having regard to these considerations the writers decided to design a system for the reception of the Baird transmissions in which synchronism might at all times be held. Though rather more apparatus than usual is used, the method has many advantages which justify its complexity, particularly in cases where absolute synchronism is of paramount importance, as in demonstrations of reception, etc.

In place of amplifying up the received strip frequency the synchronising current is generated by a separate oscillator designed for 375 cycles, and the received signal is merely used to maintain this locally generated frequency constant. For this purpose, of course, a very small amount of power suffices. The oscillator output is amplified and supplied to the standard Baird cogged wheel synchroniser. This amplification might well be performed by an ordinary thermionic valve amplifier of either class A or class B but in the system under discussion a thyratron inverter has been employed, as providing a ready and convenient means of giving the requisite power output of several watts.

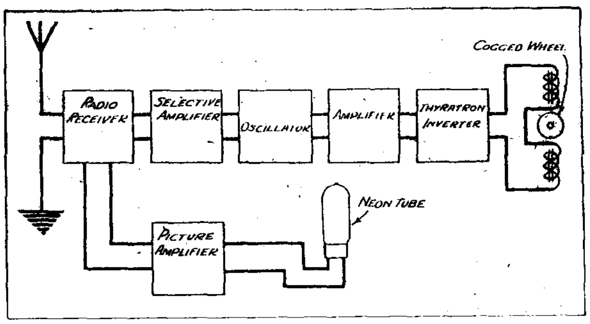


Fig. 1. The scheme of the complete receiving system.

The Scheme

Fig. 1 shows the scheme of the complete receiving system. The radio receiver is a standard H.F. and detector arrangement, and needs no further comment. Part of the detector output is passed to the picture amplifier, where it is amplified and applied to the neon lamp in the usual way. The remainder of the output goes to the synchronising circuit. Here the first stage is a selective amplifier designed to amplify selectively the 375 cycle component of the signal wave and hence to improve the wave-form of the synchronising current, which is then applied to the grid of the local 375 cycle oscillator, whose frequency is thus maintained at exactly the transmitted strip frequency. The oscillator output is amplified by a single stage amplifier and then used as the control voltage on the thyratron inverter which supplies the power to the cogged wheel. The input to the latter is thus at all times constant and is independent of the amount of signal current received. Providing that the amplitude of the 375 cycle component of the received signal is sufficient to stabilise the frequency of the synchronising oscillator which, in practice, is always the case, even under the worst conditions of fading, or change of type of picture, the receiver is held positively in step throughout the transmission. A further advantage lies in the fact that since the power input to the cogged wheel is constant, hunting, which normally produces an irritating oscillation of the image in a vertical direction, is largely diminished.

The circuit is shown in detail in Fig. 2. Following the detector of the radio receiver, the first stage in the synchronising circuit consists simply of a valve with its anode tuned to 375 cycles. For this purpose an air-cased slab coil having an inductance of one-tenth of a henry shunted by a 2 mfd. condenser is suitable. Unless the coil has very low resistance, very little gain will be obtained from this stage, but this is immaterial, since its main function is the improvement of the wave-form of the synchronising current. Of course, a band-pass filter passing a narrow band about 375 cycles might equally be employed for this purpose, but the valve stage is considerably more simple while providing sufficient selectivity. Fig. 3 shows the characteristic of such an amplifier, using an L.S.5 valve with a tuned circuit as above described.

A Simple Oscillator

The oscillator is of the simplest type with tuned anode circuit coupled to a grid coil. For the tuned circuit, a large air-cored coil with an inductance of about 10 henries was employed tuned roughly to 375 cycles by fixed condensers, with a variable condenser of .001 mfd. in parallel to provide for accurate adjustment of frequency. The output of the selective amplifier is applied to the grid of the oscillator through a condenser of .05 mfd. impurity, and the oscillator output taken from a third coil, coupled to the plate and grid coils, and then amplified by a small power valve.

The thyratron inverter makes use of the peculiar properties of the new gas-filled relays. These resemble thermionic valves in construction, having a cathode, an anode and a grid, but the bulb, in place of being evacuated, is filled with mercury vapour, whose presence causes the characteristics of the tube to differ fundamentally from those of ordinary thermionic valves. Suppose a positive potential is applied to the plate of the relay and a heavy negative potential given to the grid. Providing the negative grid voltage exceeds a certain critical value which depends upon the anode voltage, no current will pass. If, however, the grid voltage is reduced below the critical value, the full plate current flows, limited only by the load impedance and the emission, and the voltage across the tube drops to about 15 volts. The grid, once the discharge occurs, can exercise no further influence upon the anode current which can only be stopped by breaking the anode circuit or by lowering the anode voltage below the requisite 15 volts. The discharge having been stopped, providing the grid voltage is above the critical value, the anode current will be held at zero until the grid voltage is again reduced. Fig. 4 shows the relation between the critical grid voltage and the anode voltage for the Osram Type G.T.1 Relay.

The circuit of the inverter will be followed from Fig. 2. Two relays are used in a circuit which closely resembles that of a push-pull amplifier. It will be observed, however, that the anodes of the tubes are connected by a condenser whose function is essential to the operation of the circuit. The frequency to be amplified is applied to the grids of the tubes through a push-pull input transformer. Thus the grid of one tube will be swung positive when the other is swung negative. The grid bias is so adjusted that, in the case of the first tube, say V_1, the grid is reduced below the critical value and so the anode current flows and the voltage across the tube drops to 15 volts. During the next half-cycle the grid of V_2 is swung below its critical value and the voltage across V_2 also drops. Since, however, the plates are connected through the condenser, the anode voltage on the tube V_1 is reduced below the critical 15 volts, and the current in that tube ceases, and does not start again until, in the next half-cycle, its grid is made positive again. As a result of this action it will be seen that a current is obtained in the output circuit whose frequency is the same as that of the applied controlling voltage. Since the tubes are capable of carrying currents up to a third of an ampère, a very great power output can be obtained from such an arrangement. In the system under discussion, only a few watts are required, which is well within the capacity of the inverter. Since the current from the output transformer is alternating, and the cogged wheel requires a pulsating, unidirectional current, a steady current about equal to the peak value of the alternating current is superimposed upon it by means of the battery, B. (Fig. 2) of 50 to 70 volts.

Preparing for Reception

About a quarter of an hour before the commencement of the transmission the requisite voltages are applied to all filament, grid and anode circuits, care being taken not to apply the anode voltage to the gas-filled relays until at least a minute after switching on their heaters. The motor is run up to speed, and the oscillator frequency adjusted as nearly as possible to 375 cycles. The motor speed may then be adjusted so that the cogged wheel locks in step with the oscillator. On commencement of the transmission, the received signal is applied to the neon lamp, and, if the oscillator is not immediately pulled into step, its frequency is altered slightly until synchronism is obtained and a stationary image appears in the frame. As usual, of course, the chances are 29 to 1 that the motor will be brought into synchronism with the picture divided into two parts, as illustrated in Fig. 5, by a vertical line, the two parts being transposed. This may be connected in the usual manner, viz., by allowing the receiver to go out of synchronism and permitting successive images to drift past in a vertical direction until the correctly framed picture is found, when synchronism is re-established. In the equipment under discussion this framing is very conveniently performed by means of the key marked " SYNC " in Fig. 2. It will be seen that depressing this key removes the controlling voltage from the grid of the oscillator, thus permitting it to oscillate uncontrolled, when its frequency will almost certainly differ slightly from the picture strip frequency. If therefore it is found that the image is not correctly framed, the key is depressed whereupon the image drifts slowly out of frame to be followed by others until the correct framing is obtained. The key is then released, the oscillator pulled into step with the received signal, and the receiver remains in synchronism at the correct adjustment.

Under normal conditions the gas-filled relays take about 140 milliamps at 200 volts. Then, with an output of one volt from the oscillator, it was found that the D.C. power supply to the main driving motor could be varied gradually from 345 milliamps at 47 volts down to 250 milliamps at 35 volts without causing the speed to change. With 41 volts applied to the D.C. motor it was found that rapid changes up to ± 5 volts could be made in the supply voltage without causing synchronism to be lost. It will be observed that nearly 4 watts of mechanical power are available for synchronising, amply sufficient to hold the receiver in step under the most difficult conditions.

As stated above, the tubes used in the thyratron inverter were two Osram G.T.1 gas-filled relays, obtainable at a price of 50s. each. They have a standard 5-pin base and an indirectly heated cathode taking 1.3 amperes at 4 volts. They can thus be run from a standard 4-volt heater winding on a transformer, or, of course, from a high-capacity 4-volt accumulator. We have found that, for best results, the heater voltage should be well up to the rated 4 volts (or even up to 4.2 volts) at the actual pins of the relay, and that it is best to allow a quarter of an hour or so for these tubes to warm up thoroughly (one minute is essential) before applying the anode voltage. When the relay is in operation a deep blue glow fills the bulb, and if this glow appears at all thin, or if for any reason it is suspected that the tube is not working properly, the potential should be measured, between the anode and cathode pins, with the oscillators switched off. For this purpose a

(*Continued on page 416.*)

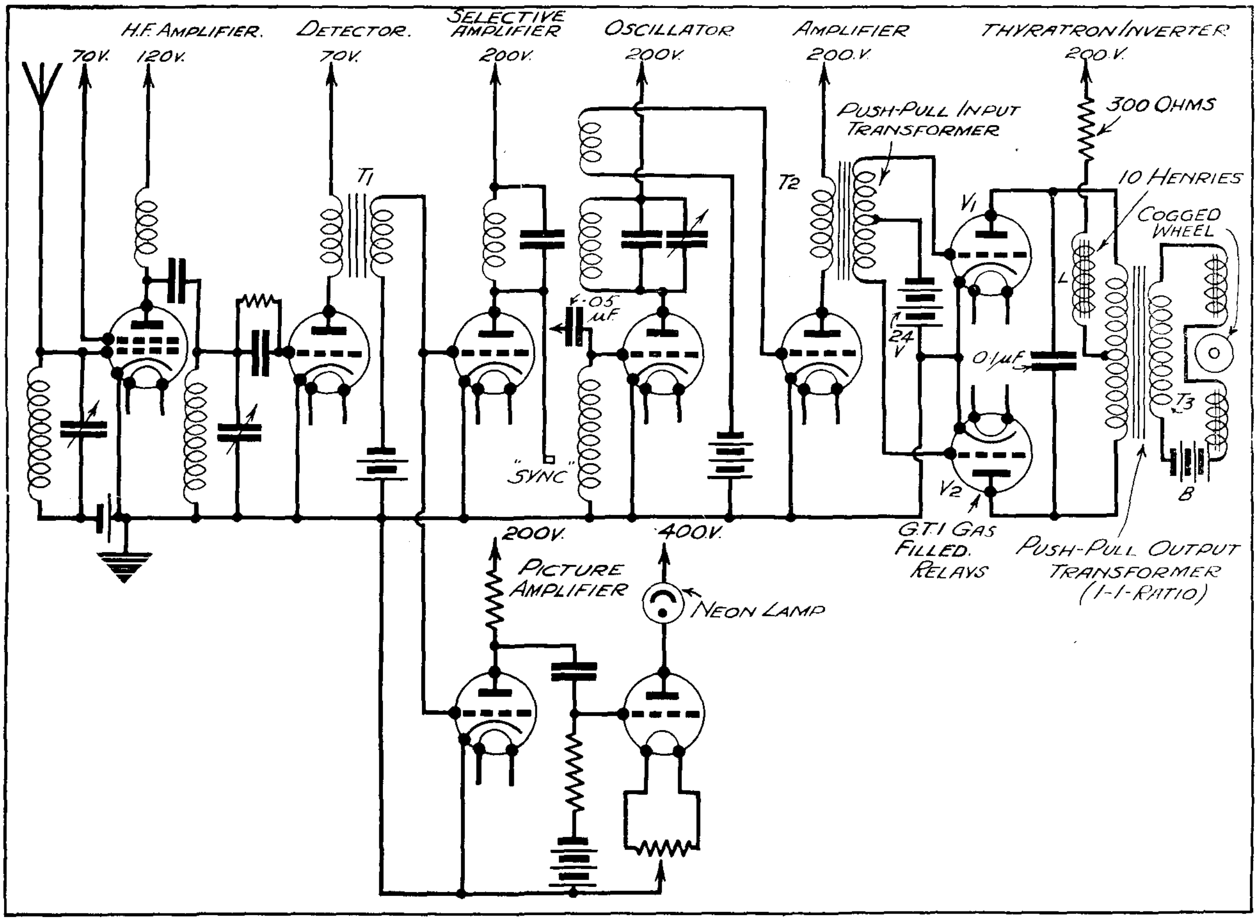


Fig. 2. The synchronising circuit described in the text.

Last Month's Programmes

By "Spectator."

GREATER precision in top "lighting" has produced slightly clearer pictures during the month, an improvement being noticeable in all three positions, close-up, semi-extended and distant. Several simple and ingenious gadgets have produced this result. Later they may be incorporated in a suitably decorative form in the permanent equipment of the studio, meanwhile, the engineers must forgive my reporting that Heath Robinson might be proud of their appearance. But they work, and the effect is good, as I have already recorded.

A bank of photo-electric cells is still strapped to the front of the balcony at the projection end of the studio; but the second cell, which was formerly suspended over the centre of the studio at the end of a pole projecting from the balcony, is now fixed to an overhead pulley and by means of a cord may be moved backwards and forwards so that the cell is always immediately above the artist's head wherever he is standing between the balcony and the backscreen. For better illumination of the artist in close-up, a cell which may be raised or lowered on a pulley has been hung immediately above his head. White American cloth has been pinned to the wall just above the projection window and three cells have spaced in a wooden bracket on the wall at head level for direct lighting and reflection from the American cloth. While for clearer definition of dancers' feet, a bank of cells has now been placed at floor level for use in extended shots.

All this experimentation helps to explain the success of the ballet, an outstanding feature of the month's work. The programme opened oddly, the microphone being brought into use too soon, and the caption was still being shown by the small transmitter as Eustace Robb and Massine were heard talking in French, in the excitable way that producers and artists have when their work is about to be exposed to the test of public performance. But the incident seemed to me to create atmosphere for the occasion. French is the language of the ballet and is taught with the steps to young English girls who seek fame in this field, a broken accent being just as important as a Russian name, though less easily acquired.

The dancing was superb. Baronova was my favourite. She is only sixteen and danced the spinning top on the points of her shoes, a dance which always got the biggest hand at the Alhambra. Danilova was lovely, too, in "The Traveller and the Child," which she danced with Shabalevsky, making the most awkward poses look graceful and easy. From watching the rehearsal, I learned that each member of the ballet practised all the steps and could dance any character at will. Lichine had sprained his foot and, though he turned up with others from the theatre to watch, Shabalevsky took his place in the programme. Massine is a master of choreography. Toumanova is only fourteen and the younger ones hang on his words. On the stage they talk while dancing and Massine found it disconcerting not to be allowed to encourage his partner as he usually does. The microphone was near and silence was the rule.

Shabalevsky and Danilova in "The Traveller and the Child"

Every costume had to be adapted for television and a needle-woman sat sewing from noon until the programme opened, so that each dress should be properly emphasised. Black sashes, bows, aprons, scarves and scallops were stitched on as the photographs show. Rightly thinking that his material this evening deserved the best treatment, the producer had spared no trouble to secure perfection in detail, and Lourié, who was responsible for the décor of the new Massine ballet, was engaged to paint the backcloth for the studio and seventeen cards which were used in the caption machine during the evening. Efrem Kurtz, musical director to the ballet, brought an instrumental quartet to provide the music. Flowers arrived during the performance and at the end bouquets were presented. A pretty touch.

Judged on its purely visual merit, I should say that the Petrouchka ballet made the most effective pictures, and it was in this sequence that I was delighted to see our old friend Algeranoff, a pioneer of dancing in the television studio. He has now joined the Ballets Russes de Monte Carlo Company and was seen as the Blackamoor. I have often wondered how records of ballets are preserved, for the manuscript of a play can be laid aside for use later on; but how can ballets be revived in anything approaching their original form, where no film has been made of their movements? Only, I gather, by memory and by information passed down from one generation to another. The spirit of ballet is so ethereal that the peculiar hieroglyphics which are used in the profession to describe poses are of very limited use where revival is being planned. Much more valuable is the memory of Woizikovsky, who remembers every detail of ballets of pre-war days. But a ballet is lifeless without the impress of the individual genius of the producer, and we were lucky to see the work of Massine, the artist behind the Alhambra season.

Baronova as Columbine from "Carnival."

I am always pleased when artists who have been regular performers in the television studio gain stardom, and in previous articles I have noted the success on the West-End stage of several pioneers whose talents have been developed before the projector. Sometimes the publicity which is inseparable from Broadcasting House has helped to draw attention to a capable player who has not happened to catch or retain the public eye. Iris Kirkwhite, already well-known when she came to the studio, made her last public appearance in this country before the "Televisor" and then sailed for Australia to take the lead in "Gay Divorce," a part which is played by Claire Luce in the London show. Iris made good pictures in her numbers from "The Gold Diggers of 1933," but her voice is no match for her dancing, which is grand. Billy Milton was sailing to play Fred Astaire's part in the same play and three days later on the eve of departure, he came to bid lookers farewell. We shall miss his gaiety, for he was often with us. Appropriately, he sang a medley of songs from his shows and, like Eby Namash in the same programme, was seen in close-up throughout. Both these artists have regular features, expressive faces and an intimate manner which ensure success close to the lens.

Because the play "Carnival" overran its time in the broadcasting programme, lookers were kept waiting until 11.15 for transmission when Leslie Sarony was the star. Delays are always awkward and the situation was not improved by the discovery that Leslie had forgotten to bring his music. Such a predicament is a test for all concerned and Sydney Jerome proved once again the value of a first-rate accompanist in the studio. Without a note of music he played every song in Leslie's programme, bar one, a new number which was to have been sung for the first time. Leslie Sarony writes and sings his own numbers. "I lift up My Finger and I Say Tweet, Tweet" is, I think, his best yet. He is an artist who needs to be seen for full appreciation of his art, as was demonstrated when his "hour" was broadcast recently. After his television appearance he told me that he would have been nervous if he had had to broadcast without music for his accompanist, but that, standing in the beam of the projector, keyed up as he would be on the stage, with the knowledge that he was being watched, he was able to get through his act confidently. And it certainly was a good show.

Television requires greater concentration than broadcasting, both of the artist and the audience, and for this reason I question whether lookers will demand a continuous programme as the radio audience does, even when results are much better than those obtained at present. No one can knit or read when looking; as in the cinema the screen claims full attention. Programmes must therefore be good and short and for years to come a sequence lasting from an hour and a quarter to an hour and a half, the duration of a featured film, is likely to satisfy the average need. In this matter, the cinema must be the criterion and, looking ahead, I believe that in time we shall be offered a series of separate, individual programmes at advertised hours. One avoids entering a cinema in the middle of the big picture and when we are all equipped we shall not often switch on the Televisor casually to see what's on. It will be important for us all to plan our looking as only discriminating people plan their listening to-day.

Nora Savage chose simple sentimental songs in contrast to the hot numbers that we hear so often. "I Hear You Calling me" would not be my own particular choice, but reminiscent numbers always get a hand from the old guard and the post next day brought appreciative letters, which are sweeter than any bouquet to an artist at Broadcasting House. Tap dancing on the points of ice skates was a novelty shown by Skater Gardner, who brought a small metal sheet which he spread on the squared linoleum of the studio floor. After a close-up of his feet, so that we could see there was no deception, he retreated to the backscreen for some tricky tapping and a change to roller skates, the distant shots being well illuminated by cells placed at floor level.

The Locarno Legions appeared in the same programme, which was altogether an unusual bill. The doves are accustomed to spotlights and the flickering beam had no terrors for these sweet little stoics. A most effective picture was obtained when the birds were placed in a row on their perches and their shadows on the backscreen were transmitted by swinging the projector from side to side. Though they had many clever tricks and appeared to enjoy their work, I preferred to see them resting on their perches. There is such dignity in their pose. Black ribbon was wound round the spokes of the wheel for greater definition, as it revolved when trodden by one of the birds.

In a Fashionable Bar

On November 8 we were discovered in a fashionable bar. The close-up of a champagne bottle promised sparkle, and the cabaret which followed was as snappy as many that are staged in places where that wine is chiefly drunk. Lee, the studio attendant, whose labours were immortalised in these pages last month, emerged from his obscurity to shake a cocktail and you saw his back as he stood at the bar. There was a slight snag; Peggy Cochrane had forgotten to bring her shaker. In a moment of inspiration the producer remembered a thermos of coffee waiting in the lounge for the refreshment of the late announcer. This was fetched and the crisis passed. I wonder how many lookers spotted the smoke as Peggy lit a cigarette at the bar? It was a distance shot, and the smoke may have been missed by some receivers. Unless my judgment is at fault, it was a test for the best apparatus. The cast was strong but familiar. Each contributing artist had been seen and heard before; yet the programme seemed fresh and at the end I was left with the conviction that the producer is wise to develop his lighter programmes on these lines. The "props" provide material for visual exercise and the items gain from being fitted into a scheme.

Another programme which scored for the same reason was the song scene of Cockney cameos, played to a background of the Eros statue in Piccadilly Circus. On this evening, as on others during the month, the small transmitter was used to good purpose for showing sketches that give colour to the production.

Positive Synchronising.

(*Continued from page* 413).

reasonably good voltmeter should be used, and the potential should lie between 13 and 17 volts. If it is greater than 20 volts the anode circuit should be broken immediately and the reason investigated. It may be insufficient resistance in series with the anode, or the tube may not be sufficiently warm. There should be at least 330 ohms resistance in the anode circuit with 200 volts supply, the G.T.1 tubes being rated at 0.6 ampère maximum (peak) anode current. A safety resistance of 300 ohms is shown in Fig. 2. The mean current when the circuit is functioning is about 140 milliamps so that there is not a great loss in this resistance, and ample power is, in any case, available. If, for any reason, more power is required the supply may be increased up to say 500 volts, and the safety resistance to 800 ohms. A $1\frac{1}{2}:1$ or a $2:1$ step-down output transformer would then be required with the standard Baird synchronising coils.

Some slight difficulty may, at first, be found in getting the inverter circuit to work properly. The 0.1 mfd. condenser usually connected across the synchronising coils of the cogged wheel should be removed (it can be employed to connect the anodes of the gas-filled relays, Fig. 2). It will generally be necessary to use a choke of about 10 henries in the combined anode feed.

The Theory of the Kerr Cell

By J. C. Wilson

(*Continued from page* 385)

WHAT are the practical possibilities of polarising light? It is well known that a pencil of light, when it encounters the surface between two transparent substances (such as air and water) obliquely, undergoes refraction. This bending disappears when the light-beam strikes the surface perpendicularly, and is in general accompanied by a certain loss in luminous intensity due to reflection. When the light-beam is travelling in a medium of greater optical density than that beyond a surface which it encounters, then, if the obliquity be great enough, no ray passes through but all the light is reflected. Everyone knows that the angle between the perpendicular to the surface and the incident ray is called the angle of incidence, i, and that the angle between perpendicular and refracted ray is called the angle of refraction, r, and that the sine of the angle of incidence is always equal to μ times the angle of refraction where μ is a constant called the refractive index for the pair of media considered.

When a fine pencil of light becomes incident on a plate or block of certain crystalline substances, of which examples are Iceland spar and tourmaline, two pencils emerge, one of which obeys the law of refraction while the other obeys a law of the same kind but with a lower value of μ. This ray is termed the extraordinary emergent ray, and crystals possessing the property of producing an extraordinary ray are birefringent. Tourmaline is unique in possessing the property of absorbing the extraordinary ray produced at the surface of incidence very rapidly as the ray passes onward through the crystal, and for this reason only one ray is usually emergent.

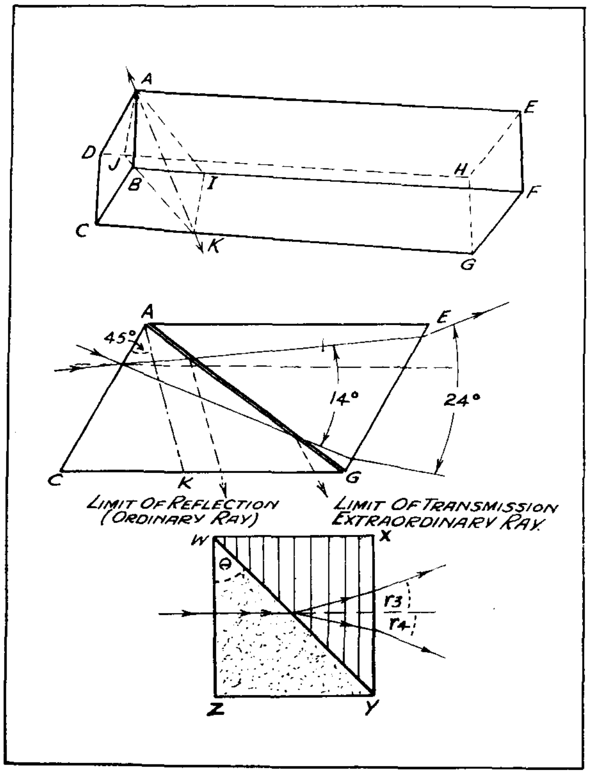


Fig. 1 (*Top*) *Effect given by a natural crystal of Iceland Spar. Fig.* 2 (*Centre*) *Nicol's scheme for cutting the crystal. Fig.* 3 (*Below*) *Woollaston's prism.*

Both ordinary and extraordinary rays produced by a birefringent substance are found to be plane polarised, and the planes of polarisation are at right-angles to each other. Half the incident light, when the incident beam is completely unpolarised, is contained in each emergent ray (less the reflection and absorption losses in the substance) and the angular separation of the two rays in the crystal is dependent upon their direction of propagation relative to the crystallographic axis of the crystal from which the block or plate was originally cut.

When the pencil of parallel rays of light becomes incident upon a reflecting surface, part of the reflected light is plane polarised; if the angle of incidence is the same as the polarising angle of the reflecting medium, the polarised content of the reflected beam is a maximum; and if the refractive index of the reflecting medium is about 1.46, the reflected beam is completely polarised. It will thus be seen that only a few substances are capable of completely polarising light by reflection; a kind of black glass, however, often used in polarisation experiments on account of its suppression of the transmitted ray, is obsidian.

Useful Devices

We can now understand the construction of some of the more useful devices for polarising light; for over a hundred years a great technique in the construction of polarisers has been developing. Of the forms now available we have here only space to consider one or two.

A natural crystal of Iceland spar presents, when split parallel to cleavage faces of the raw crystal, the appearance shown in Fig. 1. It should be noted that the end-faces A B C D and

E F G H are not at right-angles to the parallel edges AE, BF, CG and DH. A direction of great importance is indicated by the line AK which lies in the plane AIKJ at 45° to the face ABCD; this direction is called the optic axis of the crystal, and a ray of light passing along AK or KA or any direction in the crystal parallel to AK, is not resolved into two rays of unequal velocity corresponding to the two values of μ for the crystal.

A ray of light proceeding in any other direction, however, as previously explained, is accompanied by another ray, of equal intensity (provided that the incident light was unpolarised) but different velocity, polarised in a plane at right-angles to its own plane of polarisation.

If we study the values of refractive index corresponding to ordinary and extraordinary rays in calc spar at 18°C. together with values for quartz, another birefringent medium, it will be seen that while the refractive index for Iceland spar corresponding to the extraordinary ray is lower, that for quartz is higher than the value corresponding to the ordinary ray in the respective cases.

In order to limit the light emergent from a crystal of Iceland spar (when a beam is incident upon an end-face such as ABCD) to rays polarised in the plane DBFH (that is, vibrating in the plane AEGC), William Nicol devised the scheme of cutting the crystal in half along AG (Fig. 2) and cementing the two halves together again (after polishing) with Canada balsam, which has a refractive index lower than μ ordinary, but higher than μ extraordinary for the crystal.

The result of this is to cause the ordinary ray developed in the half AGC to be totally reflected from the film of balsam over almost all of the field, while the extraordinary ray, corresponding to a refractive index in the crystal of lower value than that of the film, passes readily through, up to a certain angle of incidence on the film at which, owing to the direction of propagation veering round towards the optic axis AK, the refractive index rises to a sufficiently high value for reflection to take place. The upper and lower angular limits for the passage of pure plane polarised light through the prism are shown in Fig. 1; in practice the section AG is made very nearly at right angles to the natural faces AC and EG, and the ratio of length of edge of the prism to the short end-face should be between 3 and 3.7 to one. The sides of the prism are usually blackened to absorb the ordinary ray reflected from the balsam film. Since the refractive index, and therefore the critical angle, varies with the wavelength of incident light, total reflection will not take place at the same part of the film for light of all colours and therefore the field passed is bluish on the side nearest CG.

A modification possessing the advantage that less light is lost and that the image of the source behind the prism is not displaced when the prism is rotated about its longitudinal axis comprises cutting the end-faces perpendicular to the long edges of the crystal. Ordinarily, the transmission of a nicol is 25 per cent. to 40 per cent. of the total incident light; reflection at the faces and absorption in the Canada balsam account for most of the rest.

Double-range Prisms

A prism of great practical importance using the birefringent properties of Iceland spar in a rather different way is the *double-image* prism, of which, perhaps, Wollaston's, though it possesses several disadvantages, is the best example.

Fig. 3 shows a typical example of Wollaston's prism; it consists of two right-angled triangular-section prisms of spar in which the directions of the optic axes are at right-angles, with their hypotenuses cemented together to form a rectangular parallelepiped. In the figure, the optical axis of the portion WYZ, as indicated by the stippling, is at right-angles to the plane of the paper while that of the portion WYX is parallel to the paper and to the face XY. The angle Θ may be varied over a wide range, according to the degree of divergence desired between the outgoing rays, but should not be greater than about 50°—55° unless a very limited field is immaterial.

To understand the functioning of the device, let us consider a ray progressing as shown by the arrow and incident perpendicularly upon the face WZ; this ray, since it is not bent at the surface and therefore lies in the crystal at right-angles to the optic axis, is split up into two rays progressing in the same direction but with different velocities, indicated in the figure by two arrow heads. At the interface WY, that ray which is polarised in a plane parallel to WZ (that is, the extraordinary ray for the half WYZ) since it cannot change its plane of polarisation perforce finds itself transmitted as the ordinary ray in the half WYX, and since the ordinary refractive index is higher than the extraordinary, it passes at the interface from a medium of lower effective optical density to one of higher density and is bent upwards in the diagram. The reverse, however, is the case for the ray which was the ordinary one in the half WYZ, since this now becomes the extraordinary ray in the half WYX, and on passing into a medium optically lighter than that in which it was travelling, is bent downwards in the diagram.

From My Notebook

By The Technical Editor

Radio Up-keep and Repairs

Everyone who uses a wireless receiver should be in a position to carry out repairs and maintain it at its full efficiency. Often this is not done because the owner is under the impression that an exhaustive technical knowledge is necessary. While this is an advantage it will not be essential if reference is made to a book entitled "Radio-Upkeep and Repairs for Amateurs," by A. T. Witts, and published by Sir Isaac Pitman & Sons, Ltd., at 5s. It is a straightforward book of simple instructions enabling the set owner to diagnose faults and, provided his capabilities are not very limited, rectify them.

The author refers to his work as a radio first aid and this very aptly describes the material contained in the 158 pages. It is well illustrated while the matter is broken up into easy paragraphs. Over a hundred diagrams and photographs supplement the explanatory text and leave little chance for the reader to go wrong. A handy little volume for amateurs which can be recommended.

The International Broadcasting Union

The International Broadcasting Union, which includes among its members nearly every European broadcasting organisation, held recently a series of meetings at Amsterdam under the presidency of Vice-Admiral Sir Charles Carpendale (Great Britain), with the assistance of the new vice-presidents, Baron van den Bosch (Belgium), Mr. (Chamberlain) Lerche (Denmark), and Dr. (Engineer) Marchesi (Italy).

One of the principal objects of the meetings was to study the conditions in which the Plan of Lucerne, relating to the allocation of wavelengths in the European region, could be put into force on January 15, 1934, taking into account that some Governments have not so far given their consent to the said plan. It appeared that the difficulties would be practically confined to the long-wave band, but that it would be possible to arrive at an acceptable *modus vivendi*, until certain stations provided for in the Lucerne Plan should be put into service.

The Union, in its capacity of adviser to the Governments in regard to technical questions concerning broadcasting, has taken various resolutions of a practical nature which will be communicated to these Governments in order to enable the possible necessary modifications to the Plan of Lucerne to be effected and to make the necessary wavelength changes in the European region on January 15 next, with the minimum of disturbance to listeners.

The Technical Committee has continued its investigations relating principally to the new methods tried in various countries which will make it possible to improve the operation of European broadcasting, particularly the stabilisation and synchronisation of transmissions, the reduction of indirect radiation, the improvement of modulation and, finally, transmission with single sideband. These investigations showed that very interesting results have already been achieved in various countries and that their wider adoption would enable the situation to be considerably improved.

That Output Stage

In the minds of a good many listeners a small power valve is associated with small volume, a super-power valve with larger volume and a Class "B" valve with very great volume. This is only a half-truth and the choice of a suitable last stage valve depends on more than the amount of sound required from the receiver.

As many listeners are aware the actual amount of programme strength radiated from a broadcasting station varies during the course of a transmission, being maximum at moments when, say, a band is playing a fortissimo passage, and considerably smaller during soft passages, talks and the like. The average programme power is something like one-fifth of the maximum or, as engineers would say, the average modulation of the carrier is only 20 per cent.

Now an output valve will only give a certain amount of output power reasonably free from distortion and it follows, therefore, that listeners who require good quality reproduction must choose an output valve which, while giving reasonable volume on low modulation periods, corresponding to the bulk of the programme time, will also handle without distortion the maximum modulation corresponding to loud passages of music.

Thus, when it is stated that a small power valve will give, say, 150 milliwatts of undistorted power while a super-power valve gives, say, 300 milliwatts, this can be interpreted in two ways. Either you can take twice the amount of power from the super-power valve than from the small power valve with the *same* percentage of distortion on loud signals, or you can take rather less than twice the power from the super-power valve with very much better quality.

Two other important points arise in this connection. First, that various types of output valve differ in their sensitivity, i.e., in the amount of grid input signal they require for a given output. Thus for the same output a pentode requires a smaller grid excitation than a triode.

The other point is, of course, that different types of output valve take greatly different amounts of power from the high tension supply.

Two Interesting Meetings

I have attended two very interesting meetings of quite different character within the last few days. The first was at Hampstead where I introduced to a large public audience the subject of "Music from the Air." The demonstration of the "Electronde" as the instrument is called seemed almost weird for the player, Martin Taubmann, was able to produce some music of excellent quality and timbre. Essentially the principle involved is that of "beat notes" provided by valve driven high frequency tuned circuits. In practice the instrument is used in conjunction with an ordinary radio receiver, the set being tuned to about 1,000 metres.

The pitch of the note is determined by the position of the hand relative to a short vertical metal rod. To raise the pitch, the playing hand is brought nearer to the rod and to lower the pitch the hand is brought further away. In the other hand a quick action switch is held, this cutting off the sound on releasing and enabling detached notes to be played. The volume of sound is controlled by a foot pedal, it being an easy matter to pass from pianissimo to double forte. To my mind this form of electronic music is capable of many forms of application and merits a very close study.

At the second meeting I gave a twenty minutes discourse of television to a very crowded audience that had assembled at Jones Bros., Holloway, to see a demonstration of television at 11 p.m. on two Baird mirror drum machines. The enthusiasm was made manifest by the fact that the doors had to be closed long before the show was due to start. The images which came through were extremely good and surprise was expressed on all sides at the quality which could be obtained even with thirty-line images.

A Monumental Book

Unless the student, engineer, experimenter or even the amateur is sure of his principles he can make but little headway in his work. This is particularly so in radio and television and from my early student days I found one of the best books on radio principles was that of H. Morecroft. A third edition has now made its appearance, being published by Chapman and Hall, Ltd., at 46s. 6d. When I say that there are over 1,000 pages and over 1,000 diagrams and photographic illustrations in the ten chapters the reader will readily appreciate that this is a work of no mean character.

Superfluous or obsolete material has been vigorously deleted, only the features of fundamental importance appearing in the book. Modern radio practice both in commercial and broadcast apparatus is discussed very fully. Mathematics has been carefully avoided except where absolutely necessary and in this way the reader will take a relish in studying its pages. The facts of radio are so clearly explained, and the treatment of the subject is so thorough that no one who handles a radio set intelligently or professes to have some knowledge of the subject can afford to be without this book.

An Excellent Valve Guide

I have just received a specimen of the new Mullard Master Valve Guide for the ensuing season, a most impressive book which every wireless enthusiast will find of great value. Of handy pocket size, measuring 5 in. by 7 in., the book comprises no fewer than 88 pages packed with really informative material. To each standard receiving valve in the 2-volt battery range, the A.C. mains range and the D.C. mains range, at least one full page is devoted, the operating data and characteristics being clearly set out with a really useful sized characteristic curve.

The application of each valve is simply explained and useful hints concerning such matters as grid bias voltage, operating notes and so forth are included for each type.

The Technical Appendix which occupies 34 pages includes a useful article with many diagrams on Automatic Grid Bias, an authoritative article on the operation of rectifier valves, an handy method of calculating the correct ratios for output transformers, a guide to the standard connections to the new seven-pin base and many other informative articles.

Equally useful is a full list of Mullard valves with their equivalents in other makes, and a table showing which Mullard valves are most suitable for the principal types of factory-made and magazine receivers, covering nearly a thousand sets.

In addition to these features the Guide is interspersed with readable articles on valve manufacture and there are two complete indexes, one enabling any subject to be readily turned up, and the other, on the last page, showing on what page of the book details of any particular valve type can be found.

Our Constructors' Circle

TWO members of the Constructors' Circle, Mr. A. A. Keen and Mr. L. Tunaley, of 44, Broad Street, Chesham, are receiving excellent results on a mirror-drum receiver built to the design described in TELEVISION by Mr. Ernest L. Gardiner. They write:

"We must congratulate Mr. Gardiner on his design for a complete mirror drum receiver. As soon as the articles appeared in your journal, we decided to build this, and commenced by making the cabinet. Then gradually the components came in from the various makers, and the receiver was completed with the exception of the sound receiver, which we have not yet troubled about. Our chief difficulty was in setting the mirrors on the drum; the makers sent no instructions for setting up, but we understand they now do so, and we spent many hours on this job. At first we very carefully set the mirrors, using a spot light torch bulb as a light source, so that the edges of the square spots exactly coincided—a very tedious job.

"On trying the mirror drum for actual reception, however, it was found that the horizontal black lines at the top and bottom of the picture were very jagged and the picture distorted. We reasoned this out and came to the conclusion that the commencement of scan of each spot was not on the same horizontal line, and on testing out the drum on the bench with the bulb, we found this was the case.

"Our mirror setting job had to be done all over again, but this time the mirrors had to be set correctly, both horizontally and vertically. Eventually, however, we finished the setting up to our satisfaction, and on trying out the receiver again were rewarded with splendid results. It is evident from our experience that the utmost care must be taken in setting up the drum, as the results depend on this. Should any members of the Constructors' Circle care to know the method we adopted for setting up the drum in detail we should be pleased to give it to him.

"Although we are now getting such good results, we are not able to hold the picture absolutely steady, but hope to do so before long, by experimenting with different values of resistance across the filter unit. We know, though, how difficult it is to get perfectly steady synchronising from our experiences with the old scanning disc apparatus, which we have had since television transmissions first commenced from Long Acre. It is very noticeable how the transmissions have improved since those early days, and the amount of detail that shows on the screen of the mirror drum receiver is amazing considering only 30 line scanning is still used.

"We have now turned our attention to the ultra-short wave transmissions, having built an Eddystone ultra-short wave converter, and tried it with different receivers, but have not yet succeeded in receiving signals. Probably we are situated too far from the transmitter, being about 25 miles, or perhaps we have not happened to listen when transmissions are taking place."

For twelve years Mr. H. J. Cheney, of 179 Highfield Road, Saltley, Birmingham, had held experimental licences for both transmission and reception of wireless telegraphy. "I recently reached the point," he writes, "when I wanted to see as well as hear, so, having gained a fairly good knowledge of the disc construction for television, I set about the task of assembling apparatus.

"My first problem was to procure a sheet of 22 gauge aluminium. I marked out the main circle twenty inches in diameter and then marked out another circle sixteen inches in diameter. Next I cut out four pieces to lighten the disc, then marked off three more circles each one millimetre apart, starting half-an-inch from the main outer circle. By means of a protractor I then divided the disc into thirty divisions each of twelve degrees, and then punched round holes one millimetre in diameter every twelve degrees, each time working one millimetre nearer to the centre in a spiral formation. I cut out the disc from the sheet of aluminium, all the cutting being done by hammer and chisel using a piece of solid steel as a cutting block.

"I purchased a 220-volt D.C. motor from a second-hand dealers, its power being 1/20 horse power. I bushed my disc to fit on to the motor spindle. Up to the present my expenses had only been nine shillings—very modest considering the items used. I now mounted the motor and disc complete on a table with a slot made to take the 20-inch disc. A spiral neon lamp was then fixed up behind the disc, which, of course, was quite a simple matter. Next I made a framing apparatus and magnifier. For this an Oxo tin was used. It was cleaned by boiling in soda water, then with a hammer and chisel a space 10 cm. × 6 cm. was cut out in the bottom of the tin; this made it possible to slide a mask up and down so as to frame the image. Next I cut out a larger space in the lid of the tin and made room to fix in a lens. The metal portion was then painted with black enamel and fixed to the table.

"Now came the time for a try-out, and I connected the motor to the mains through resistance 1 direct in the main lead and another in the field circuit. Everything was ready for my first test using H.F. Det. L.F. PENT using D.C. mains for H.T. Alas, my only reward was to see lines, snowstorms and spots, but nothing more. It occurred to me that perhaps the disc was wrong. So next day I made a new disc using very thin aluminium and square holes and tried again on the next transmissions. This I am pleased to say gave better results though only very slightly so.

"I then listened to the vision sound with my motor running and found the trouble—the motor was sparking badly. I managed to overcome this trouble and tried again. I just managed to see the blur of an image but it was upside down and I began to wonder again what had gone wrong. I had little to help me and had to find a kind friend to give me some assistance. I reversed my motor direction and things began to improve and I saw something worth while. Now I am laying myself open to improve things as I have books, greater technical knowledge and friends to work with. I am exploring the magnetic field and its relationship to light; who knows, perhaps a new idea for television?"

Mr. E. F. Senior, of 179 Kings Road, Harrogate, took up television about a year ago after having been given a copy of this journal. He writes:—

"I have been greatly struck by the fact that, while most of your correspondents have taken great pains to enlarge the size of the picture in the disc type of receiver, very few seem to have tried enlarging the light from the neon before it reaches the disc. In my few small experiments, I found that the picture received by the neon alone, especially with the necessary frosted glass in front, is extremely dark. I have overcome this difficulty to a great extent by the following methods.

A Magic Lantern Lens

"I obtained a condenser lens from an old magic lantern (of course two half convex lens together flat sides outward would act as a condenser). This is placed immediately behind the ground glass which is in turn glued to a piece of cardboard with an oblong hole the size of the resultant picture. This cardboard mask is placed as near as possible to the disc. Behind the condenser, and *touching it*, is the neon lamp. Then at the rear of the lamp and again in contact I placed a concave mirror reflector obtained from an old motor-cycle gas headlamp. This combination has increased the brilliancy of the picture tremendously. I can view pictures on the bare disc in full electric light. The use of a magnifying glass in front, in this case, is detrimental owing to reflection on the glass. Further experiments with this source of light will be carried out shortly."

More Members for the Circle

LONDON.

Aldam, J., 110 Charlemont Road, East Ham, E.6.
Bates, H. E., 178 Chigwell Road, South Woodford, E.18.
Davies, D. S. G., 1 Clovelly Avenue, Colindeep Lane, N.W.9.
Dench, A. D., 86 Countess Road, Walthamstow, E.17.
Dyer, H. V., 6 Lambolle Place, Hampstead, N.W.3.
Swift, F. G., 77 Brighton Road, Stoke Newington, N.16.

LIVERPOOL.

Cantrell, W. A., 503 East Prescot Road, Knotty Ash.
Cantrell, W. J., 179 Askers Hall Avenue, Knotty Ash.
Jones, C., 5 Cowper Road, Liverpool, 13.

BUCKINGHAMSHIRE.

Goodearl, R., 137 Desborough Avenue, High Wycombe.
Keen, A. A., 44/6 Broad Street, Chesham.

CHESHIRE.

Beswick, H., 76 Sumner Road, Birkenhead.

DERBYSHIRE.

Gelsthorp, F. S., 37 Arthur Street, Derby.
Hill, R., 39 Union Road, New Mills.

DEVONSHIRE.

Batten, A. T., 115 Clifton Street, Exeter.

Co. DURHAM.

Osborne, H. G., 122, Clifton Road, Darlington.

ESSEX.

Shearman, D. G., 17-19 Vandieman's Road, Chelmsford.
Swaine, C. H. C., "C" Flight, 56 (F) Squadron, R.A.F., North Weald.

KENT.

Richards, G., 19 Manor Road, West Wickham, Kent.
Wells, L., Linden Lodge, Broadway, Bexleyheath.

LANCASHIRE.

Gorman, J., 132 Manchester Road, Nelson.
Greaves, H., 64 Heap Street, off Greenacres Road, Oldham.
Holt, W., 72 Vavasour Street, Rochdale.
Tweedale, A., 131 Haslingden Old Road, Rawtenstall.

MIDDLESEX.

Green, R., 74 Nag's Head Road, Ponders End, Enfield.

NORTHUMBERLAND.

Wardlaugh, J. G., 6 Westfield Terrace, Hexham-on-Tyne.

STAFFORDSHIRE.

Dovey, H., 107 Merridale Street, Wolverhampton.
Guest, L. W., 7b Bull Street, Gornal Wood, near Dudley.
Jones, W. E., 19 Oakwood Street, West Bromwich.

SURREY.

Bennett, B., "Jesmond," Redstone Copse, Redhill.
Evershed, J. B., Norwood Road, Effingham.
Gilbert, F. W. M., 46 Broomfield Road, Surbiton.
Gotto, A. G., Robinites, Charterhouse, Godalming.
Herbert, R., The Nook, Smitham Downs Road, Purley.

SUSSEX.

Coster, E. J., 46 Tideswell Road, Eastbourne.
Martin, A. W., "Robin Hill," Middleton, Bognor Regis.

YORKSHIRE.

Farrar, A., 1 Park Grove, Stump Cross, Halifax.
Firth, R., 8 Rand Place, Bradford.
Hellawell, H., 2 Upperthong Lane, Holmfirth, near Huddersfield.
Kershaw, L. F., 1 Ramsden Street, Huddersfield.
Orrell, J. T., 3 Golden Cup Yard, Rotherham.
Shepherd, W., Londesboro, Rolston Road, Hornsea.

SCOTLAND.

Bowman, A. M., 46 Cowgate Street, Kirkintilloch.
Farquharson, W. S., 1799 Cumbernauld Road, Millerston, Glasgow.
Gouck, J., 42 Cairns Street, Kirkcaldy, Fife.

Reports on Apparatus Tested

Nilos Variable Condenser

Although many suggestions have been made for doing away with variable condensers for tuning purposes on radio receivers this component still holds the field. Naturally the condenser must be of high grade for the best work and we were particularly interested in the "Nilos" marketed by Graham Farish, Ltd. Steel end plates, treated to avoid corrosion, together with a three-point suspension of the frame, has ensured rigidity. The moving centre driving spindle is mounted between cone end-bearings, and two-point fixing to the centre spindle is provided. The shaft is independent of the condenser while large size terminals are fitted in an accessible position.

On test we found the capacity of the condenser within the accepted limits at its maximum position, while the electrical efficiency was of a high order. Priced at 5s. the "Nilos" condenser is definitely a component which we can recommend.

Solon Electric Soldering Iron

There is no doubt that the efficiency of a radio receiver can be very adversely affected if there are one or more defective joints where the leads make connection to components. An electrically efficient soldered joint is really essential and a sure aid to this is an electric soldering iron. The iron is then maintained at a proper heat and there is not the constant journey to the gas jet for heating purposes. One of the best we have tested is the "Solon" marketed by Henley's Telegraph Works, Ltd., at the remarkably cheap price of 7s. 6d.

Cossor Superheterodyne Receiver

This season has seen a marked revival in the popularity of the superheterodyne receiver and we have welcomed the opportunity of thoroughly testing out the Cosser model 635, a set which proved outstandingly good under rigid test conditions. It is an all-electric model but there is a battery counterpart—model 634—and briefly its technical specification is as follows:—

There are six valves, namely, MVS/PEN detector, MVS/PEN intermediate frequency amplifier, 41 MP oscillator, MSG/HA second detector (anode bend), MP/PEN pentode output and 442BU rectifier valve. There is a mains energised moving coil loudspeaker of the latest type included while other features are single dial tuning, combined volume control and on/off switch, tone control and mains aerial. The set is housed in a very handsome walnut-finished cabinet and is complete with pick-up plug and jack.

Not only does the set have a first-class appearance but this is backed up with a performance well above the average.

Two Good Loudspeakers

There is such a wide range of loudspeakers now on the market that the potential purchaser is apt to be confused in making a choice. He will not go wrong, however, if he pins his faith in two Celestion models which we have just been testing. The first was a model P.P.M. 49 a permanent magnet moving coil loudspeaker housed in an inlaid walnut cabinet with a highly glazed finish. A universal transformer is included allowing it to be matched with any valve in common use. The valve classes covered are battery pentodes, mains pentodes and small power valves, ordinary power and super power valves, large output valves, pentodes in push pull and triodes in push pull.

The price of this model complete is £4 10s. and on test revealed tonal qualities and a sensitivity that definitely places it in the forefront of "sound reproducers." The "attack" was good while there was a remarkably brilliant response, real bass being present without any boom. The power handling capacity was well above the average while the universal transformer with its six ratios allowed the output to be nicely matched. A speaker with a very fine external appearance having a performance that should satisfy any musical taste.

The next model tested was the P.P.M.9. This was a low priced chassis complete with transformer, the cost being only 35s. Naturally the results obtained with this speaker did not equal that of the P.P.M.49 but even so its sensitivity and power handling capacity were found to be more than adequate for all normal household requirements. It worked extremely well even on low inputs and had quite a rich tone which seemed far better than one would expect to associate with such a low cost. A speaker of good quality when used in conjunction with a suitable baffle that brings moving coil quality within the reach of those of very moderate means.

McMichael Twin Supervox

One of the oldest firms in the radio industry, McMichael Radio, Ltd., choose as their slogan, "It is worth a little more to be sure." Undoubtedly their products are not only reliable but have a sound mechanical and electrical design which stamps them as being in the highest radio class. The new Twin Supervox is no exception to this and, frankly, we were amazed at the performance of this "straight" four valve set. There are two screened grid high frequency stages, a detector and pentode output with a metal rectifier. Band-pass tuning is employed while the detector valve is followed by a carefully selected low frequency coupling to a corrected pentode. The set is non-oscillating, non-radiating and reactionless the controls being tuning, combined on/off switch and volume and "selective" wavechange switch. The cabinet is of finished and polished walnut mounted on rubber feet.

A *pair* of moving coil loudspeakers is incorporated, these being matched to the output. On test the value of this scheme soon made itself manifest. The whole gamut of frequencies in the broadcast sound was covered from deepest bass to highest treble while the reproduction was quite lifelike owing to the "stereoscopic" effect. It is a long time since we listened to a receiver whose reproduction seemed so outstandingly good.

On quite a small aerial the range of reception was very wide, every worth-while station being heard and in addition the selectivity was all that could be desired. A most noteworthy feature was the inclusion of a selector switch. It gave what the makers call controlled reproduction and was most effective in removing any high-pitched whistle caused by interference between stations.

Effective range, high tonal reproduction, good selectivity and simple control backed with a handsome appearance stamp the Twin Supervox as the set for the connoisseur.

Osram Valves

The Osram MSP4 is an H.F. screen pentode fitted with an indirectly heated cathode and the standard 4-volt 1 amp. heater having characteristics which make it particularly applicable for use as a detector. The advantages of a screen grid valve as a detector over a triode have long been appreciated owing to the very much lower anode-grid capacity of the former, and thus the lessened damping on the tuned circuit, giving added selectivity. A possible objection to the tetrode is the limited output available without distortion, due to the presence of negative anode currents. In a pentode valve the addition of the suppressor grid has a two-fold advantage, the first, by removing the negative anode current "kink" in the anode current-anode voltage curve the portion of working characteristic is considerably increased or, in other words, the load resistance in the anode circuit can be increased without causing distortion. This means that for a given input signal in grid volts the available output volts developed across the load is normally considerably greater than in a tetrode and hence the voltage amplification efficiency is higher.

The second point is that the addition of the suppressor grid avoids the possibility of negative screen currents which are liable to occur in tetrodes. Both these points facilitate the use of the screen pentode, type MSP4, as a detector where the use of a tetrode might be objected to on the grounds of restricted output without distortion. Type MSP4 can be employed equally successfully either as a leaky grid or anode bend detector.

An Important Feature

A particular feature of the MSP4 and VMP4 types is the provision of a 7-pin base which allows the suppressor grid to be brought out to a separate connection and also the metallised coating on the bulb to be brought out to a separate connection which may be earthed. This last is an extremely important point, particularly in the case of a detector oscillator valve, and avoids the necessity for a separate earthed screen can over the valve.

Characteristics	Osram MSP4	Osram VMP4.
Filament Volts	4.0 A.C.	4.0 A.C.
Filament Current	1.0 amp.max.	1.0 amp.max.
Anode Volts	200 max.	200 max.
Screen Grid Volts	100 max.	100 max.
Mutual Conductance	4.0 ma/volt	3.5 ma/volt
(measured at anode volts 200, screen volts 100, grid volts 0)		
Mutual Conductance	—	0.004 ma/volt
(measured at grid volts −30)		

Both these valves are supplied in metallised bulbs only.

At some time or another no doubt every listener and "looker" has experienced trouble from man-made static. Cracks and bangs disturb otherwise good quality reproduction or if using television apparatus disturbances produced by the motor not only can be heard in the speaker but may be seen as light splashes on the vision screen. A very effective cure in quite a high percentage of these cases is provided by installing one of the latest Belling Lee Disturbance Suppressors. The circuit is very familiar to readers of this journal, a pair of fixed condensers together with fuses and an earthed centre point neatly housed in a bakelite moulding, but it is where it is put and the technical details of the condensers that matter. This is given very thoroughly in a booklet prepared by Belling & Lee, Ltd., and our tests have substantiated the makers' claims. Write for a copy direct, mentioning TELEVISION, and you will then see how to apply the component for individual requirements.

MISCELLANEOUS ANNOUNCEMENTS.

SEND your orders and enquiries for all Television apparatus to us. We supply all "Mervyn" and "Baird" components, including motors and synchronisers, scanning discs, mirror drum kits, lenses, neons, resistances, phonic wheels, etc. Motors, universal type, $\frac{1}{4}$" double spindle, slow running, built for television £3/3/-. Cheaper motor suitable for drums or light disc, with ball bearings, price 31/- post. Optical unit can be seen and explained why projector assembly is easy. Complete with lenses, £2/17/6. Send for illustrated list. Handbook, "Easy Lessons in Television" 2/-, post free.—H. E. SANDERS & CO., 4, Grays Inn Road, London. Telephone—Chancery 8778.

CRATER Point Neons. We are able to supply a new lamp to carry 30 m.a. Price £2/10/-. "Unisphere" mirror drum kit for home construction with easy adjustments (improved type). This can now be seen and setting up details explained. Price £3/10/-. Synchronising transformer, price 12/6, post 6d. We have designed a new synchronising gear for use with most types of motors (constructed for experimenters' own winding), price 17/6, postage 9d. —H. E. SANDERS & CO., 4, Grays Inn Road, London, W.C.1. Telephone—Chancery 8778.

MIRROR Drum. New type all metal for home assembly, medium weight, well balanced for steady synchronisation. Consisting of base, 30 spherical mirror carriers, and 30 light spot tested mirrors. Price £2/2/-. Multi plate cell with electrodes in container, improved type, 27/6, post 6d. Motor interference suppresser, price, 10/6. Screen projector kit. We offer the following kit of components comprising Motor and Synchroniser, Mirror Drum (new type), Optical unit complete, Crater point lamp, and Screen. Price £10/7/-. Send for details. Lenses, $4\frac{1}{2}$", double convex, a few only, 4/-, post free. We have for disposal the "Original Mirror Drum Receiver" designed by E. L. Gardiner, B.Sc., and described in this journal. Complete with both vision and sound amplifiers, eliminator, etc., as exhibited at Radio Exhibition, enquiries invited. Apparatus can be sent C.O.D. Callers invited. Watch our announcement for further new apparatus. —H. E. SANDERS & CO., 4, Grays Inn Road, London, W.C.1. Telephone—Chancery 8778.

MAZDA valves for sale, almost new, AC/SGVM; AC/SG; AC/HLDD; DC2/SGVM; DC2/SG; UU60/380; 9/-. AC/Pen. OC2/Pen. 10/-. Class B input and output transformer PP220; valve and holder 27/6.—RADIO, 20, Lady Somerset Rd., N.W.5.

STUDY these prices: Aluminium Drums 7"×$1\frac{3}{4}$" bored $\frac{1}{4}$" with 2 set screws bored 30 holes each side of circumference, 10/-, other bores 1/6 extra. Ditto, complete with 36 mirrors, 30 fibre plates, nuts, bolts and washers, ready for assembling, 20/-; assembled ready for adjustment, 25/-. Mirrors $1\frac{1}{4}$"×$\frac{11}{16}$"×$\frac{1}{16}$", 1/6 per doz. Fibre plates $1\frac{7}{8}$"×$\frac{11}{16}$" holes bored $1\frac{5}{8}$" apart, 1/- per doz. Nicol prisms, new, 7mm. mounted in cork, 15/- each. Ditto, 6mm., 14/6 each. Plano convex lenses, 4/6 each. Condenser lenses, 6" focus, 2" dia., 10/-. Achromatic lenses, $\frac{3}{4}$" dia., 12" focus, 10/6; 1" dia., 12" focus, 12/6. Postage extra. Goods sent C.O.D. if required.—COOKS, 83, New Oxford Street, W.C.1.

FOR SALE—Slightly used "Baird" Television Motor, 5-guinea model, complete with Synchronising coils, 79/6 complete; as new. Also Scanning Discs, 12/6 each, all Mervyn and Baird components. Baird Grid Cells, etc., in stock.—A. S. J. SHEARMAN, Radio Engineer, 17/19, Vandiemans Road, Chelmsford.

A. MATHISEN, B.Sc., Patent Agent Specialist in obtaining patents for Television and Radio Inventions. Working drawings, circuit diagrams prepared for submission to manufacturers. Exploitation advice. Preliminary interview free.—First Avenue House, High Holborn, London, W.C.1. Holborn 8950.

A. DOSSETT, Commercial Artist and Draughtsman for all technical diagrams, illustrations and layouts.—High Holborn House, 52, High Holborn, W.C.1. Holborn 8638.

ORIGINAL Pressler Cathode Ray Tubes, Cells, Crater Lamps, as reviewed in the TELEVISION, are available from the sole British representative, EUGEN J. FORBAT, 28-29, Southampton Street, Strand, W.C.2. Temple Bar 8608.

JOB Figured Walnut Cabinet 31" wide, 18" deep, 3'4" high. First class piece, £5/10/0. Also fine writing table, exact copy of Chippendale, two pedestals, job, £12/0/0. 108, Beach Avenue, Leigh-on-Sea, Essex.

SYNCHRONISING outfit to fit motors with single ended spindles, 18/6. Square ended Nicol prisms 15/- each. "Kindrag Minloss" synchronising outfit 14/6. Mains smoothing chokes (100 m.a.) 6/6. "Hynductance" synchroniser coils 4/- pair. Speed indicator for A.C. or D.C. mains, 6d. Send list of your requirements with stamped addressed envelope for reply to—M. KINGSTONE & COMPANY, 372 Essex Road, London, N.1.

ALL components supplied: mirror wheels, Nicols, mirrors any size, lenses, etc. See lists. Electric motors, used, fully guaranteed, 18/9. A wide range of used or new motors in illustrated list. All motors fully guaranteed to reach 750 r.p.m. on television load, with ample reserve power. Scanning disc, 12/6. Beehive neon, 3/8. Synchroniser tooth wheels, 3/6, machine cut, 4/9. Synchroniser gear to fit any motor, 19/9. Disc receiver pamphlet, 1/3. Mirror receiver pamphlet, 1/6. Interesting pamphlet on television free. Illustrated catalogue free.—GOODMAN TELEVISION CO., 16, Highbury Terrace, N.5.

FOR SALE—Complete Projection Television Kit (Kerr Cell), including Synchroniser, £5. Two P.M.24's and two D.O.10's, £1 the lot. Ferranti OPM3C and AF7C, 25/- pair.—R. F. SCARISBRICK, Whitby, Wirral.

SLIGHTLY used—Baird Neon, 13/6; complete Baird lens system, 19/-; G.E.C. Universal Motor with Synchroniser, 27/6; Large Rheostat, 10/6; very accurate Thin Aluminium Disc, 8/6; Osram P.T.625, 10/-; Mazda Ac/sb, 9/6; AC/HL, 6/-.—Write BM/NLWV, London.

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