AERIALS: PRINCIPLES AND PRACTICE

PRACTICAL TELEVISION

1/-

EDITOR F. J. CAMM

& "TELEVISION TIMES"

Vol. 2 No. 15 AUGUST 1951

A NEWNES PUBLICATION

IN THIS ISSUE

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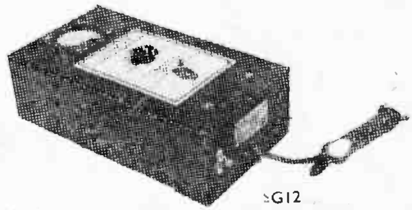

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Televiews

Eliminating Interference

A QUESTION of some importance to owners of television receivers is: who is responsible in law if a television receiver causes interference? Is the viewer or the manufacturer responsible? We have had a number of letters on these points. At present it is not an offence to cause interference by means of a television receiver, nor, for that matter, with a radio receiver. Neighbours may complain to the post office, and the owner of the receiver causing the nuisance will be visited by an official from the G.P.O. who will tactfully suggest ways and means of abating the nuisance. He cannot, however, threaten proceedings if his instructions are not carried out, although other branches of the law could be, although they have not yet been, invoked. It is, of course, a neighbourly action when complaints are received to take steps to remove the cause of the trouble. The owner of a television receiver cannot hold the manufacturer of the receiver responsible if the interference is caused by some defect in design, unless in his advertisement and literature he specifically states that the receiver does not re-radiate. In such a case he would be guilty of a breach of implied warranty but it is unlikely that any reputable manufacturer would refuse to rectify the matter.

At present there are no laws governing the construction and use of radio and television receivers as there are concerning radio transmitters, and whether this state of affairs will continue depends to a great extent upon whether manufacturers and users adopt the suggestions frequently made to avoid interference. This applies also to the manufacturers of electrical apparatus which causes interference with reception, and particularly the makers of motor-cars, many of whom are already fitting interference suppressors as a matter of course. But not all have taken this step.

In the early days of the motor-car an analogous position existed, but very soon laws were made controlling the construction and use of motor vehicles, and to-day over 2,000 regulations govern them. If the radio and electrical industry wishes to avoid a similar state of affairs, they should take immediate steps to redesign their equipment. Legislation against nuisances is only made when they reach the dimensions of a national scandal.

At present the cheapest method of avoiding interference is to fit suppressors to electrical apparatus. Interference caused by television receivers is a question of design, and no doubt steps are being taken to remedy such defects in design as have been revealed by users during the past five years. If laws are introduced it will be the user who will be made responsible.

Mr. Chuter Ede was recently asked in Parliament whether he proposed to introduce legislation to prevent the possibility of fatal accidents with television receivers. He replied:

"I have no power to make regulations to guard against this risk which, I am advised, is no greater in television sets than in many other electrical appliances used in the home. The recent distressing accident was due to an unusual combination of circumstances, and it is the only case on record in recent years of death occurring through a person touching the outside of a television or wireless set."

PURCHASE TAX ON PRE-BUDGET ORDERS

WHEN our June issue went to press it was not clear whether the Budget proposals relating to the increase in purchase tax on television receivers would apply to orders placed before those proposals were made. Our inquiries led us to believe that they would, although the position had not been finally clarified. The Commissioners of Customs and Excise have, by their notice number 78R, made it clear that the alterations apply only to goods which were delivered on sale or appropriated to retail trade or similar purposes by a registered manufacturer or wholesaler *on or after* April 11th, 1951. Goods delivered before April 11th, 1951, by a registered person under a taxable sale (e.g., to a retailer) and goods appropriated by a registered person before that date to retail trade or other taxable purposes are not affected by the tax alterations. Retailers are thus free to dispose of their existing stocks at a price to cover the tax which the goods previously bore.

F. J. C.

A Combined Television-broadcast Receiver—2

A 21-valve Circuit with Single Power Pack

By S. A. KNIGHT

THE receiver is constructed in two sections; the main receiver is housed on an aluminium chassis measuring 19in. x 16in. x 3in., and this is connected by a five-way cable and plug to a socket on the power unit chassis which measures 12in. x 10in. x 2in., and which is similarly constructed of aluminium. For this latter chassis a heavier material, such as stout tinplate or brass, may be used in place of aluminium in the interests of mechanical strength, but for the main receiver chassis no alternative, apart from copper or brass, is recommended. The metal gauge is 16 S.W.G. Both are made in the normal manner, having four sides, and the corners are welded or mechanically stiffened in some way to give added strength.

The underchassis layout of the main receiver is shown in Fig. 1 with a dimensioned and keyed equivalent in Fig. 2. The broadcast receiver, which, of course, includes in the present design the common I.F. and audio stages, occupies the front section of the chassis as indicated, with the television R.F., mixer and I.F. stages placed approximately centrally across the chassis. The television first sound I.F. stage V_3 links across from the television mixer V_2 to the broadcast I.F. stage, the appropriate switching being carried out on the rear switch wafer, S_3A. The video-amplifier, sync separator and the time-base circuits occupy the rear half of the chassis, with their appropriate pre-set controls conveniently available on the back edge.

In describing a form of construction for a receiver of this nature where many connections have to be made, it is obviously impossible in a short space to deal with every point of assembly and wiring. Much in what follows is therefore left to the discretion of the builder; suffice to say here that attention to neat wiring and soldering is as important as to the exact disposition of components. Consequently, only the most general dimensions are shown in the layout figure, together with the positions of those components whose placings are considered fairly critical. This does not mean that all other parts can be spread about anywhere; commonsense must be used in transferring the theoretical circuit diagram of the first part of this article into the practical layout of Fig. 2. Using this figure and the under-chassis photograph in conjunction with one another should provide most of the information for a satisfactory job of assembly and wiring.

Assembly

The chassis should be drilled and punched for valveholders to the diameters given in Fig. 2. The holes for the front controls, the rear pre-sets, fixing tag and core-adjustment holes for the television screened coils should be drilled. The front controls are spaced 2½in. apart, but a small change may be made to suit particular components; the main difficulty may arise over the drive system to the main broadcast tuning scale above chassis. In the original models a cord drive is used, driven by a spindle and bush from below chassis; this spindle can be seen just below the main twin padding condenser unit in the photograph. A printed glass or

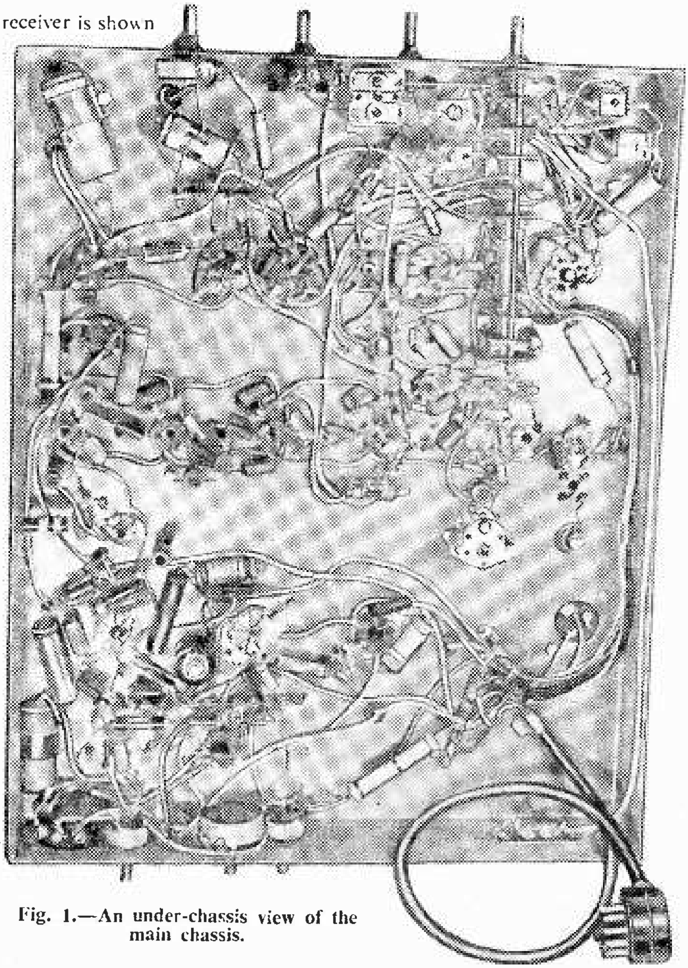


Fig. 1.—An under-chassis view of the main chassis.

Perspex dial is mounted above chassis, and some drive cord, a small pulley and the drive drum which is fitted directly to the main tuning condenser enable a suitable slow-motion control to be effected. Fig. 3 shows roughly the original layout, using parts obtained from Premiers, who can also supply a suitable scale. The scale length must, of course, be suited to the diameter of the drive drum. Alternatively, a ready-assembled dial and drive such as the J.B. may be used above chassis; the three remaining underchassis controls may then be suitably spaced to balance up.

The mounting and other holes for the television screened coils should be drilled in accordance with the dimensions given of the coil former base in Fig. 4, due regard being paid to the number of holes required for the coil ends themselves. Former and can fixing holes are 6 B.A. clearance, core-adjusting holes $\frac{5}{16}$in. diameter and coil-end spill holes $\frac{1}{8}$in. diameter. Valve-

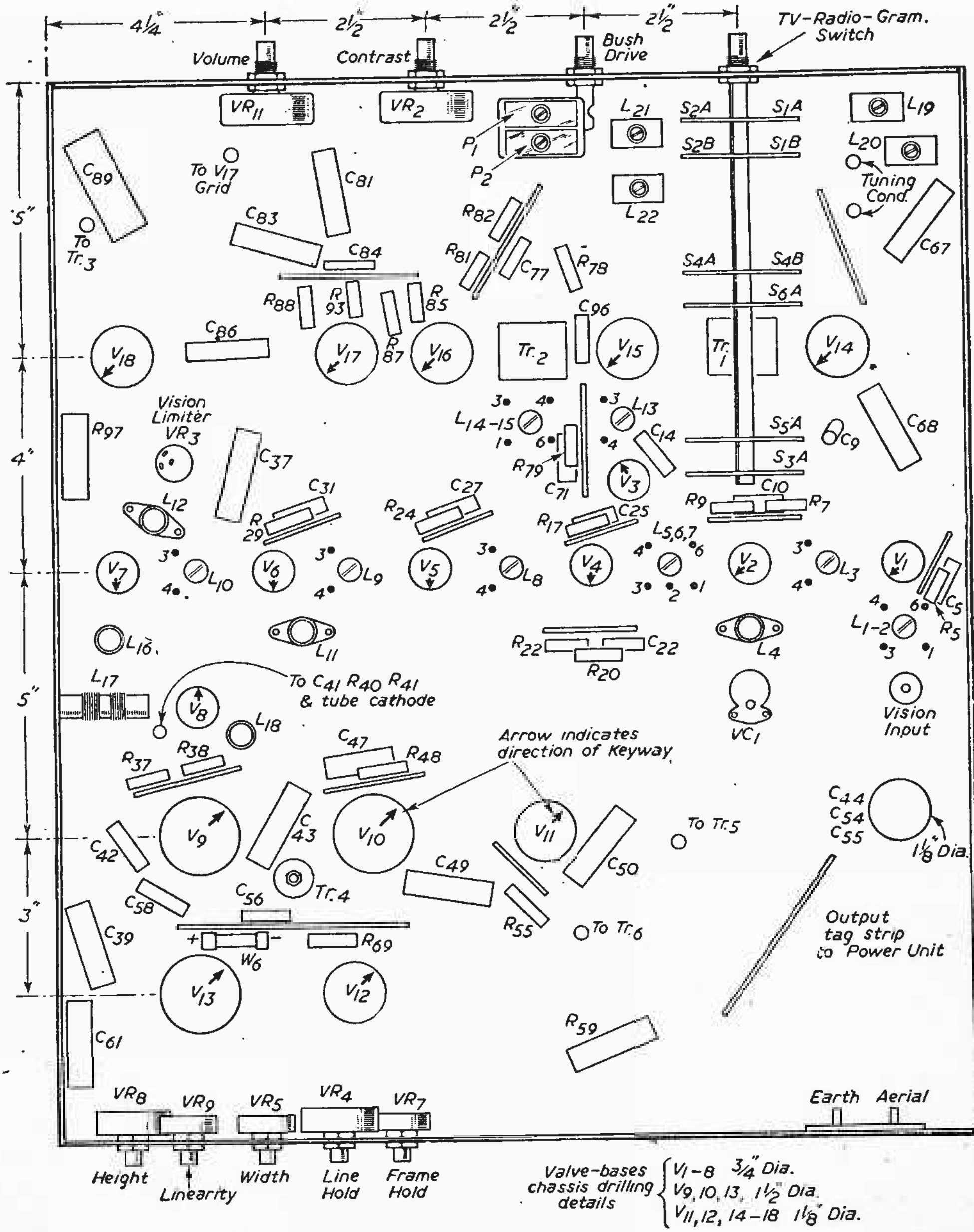


Fig. 2.—Details of chassis measurements, component positions, etc.

holders (noting the positions of the keyways from Fig. 2) may now be mounted, together with all larger components, such as I.F. transformers (broadcast), transformers, tuning condensers and scale, front and rear controls.

The wavechange switch is an Oak type made up of six wafers as shown in Fig. 5. Two supporting brackets are placed as shown to prevent twisting in operation, the assembly being rather long. The dimensions of these brackets are made to suit the actual switch, and are threaded on to the assembly when the wafers and spacers are being fitted. It is advisable to solder wires to the undermost tags before the switch is mounted in the chassis as it is difficult to get to them when other components are fitted round about. This particularly applies to the front wafers associated with the aerial and oscillator switching of the broadcast receiver.

Trimmers are mounted directly across the grid winding tags of the Wearite " P " coils before they are mounted on the chassis for similar reasons ; the trimmer " moving " plate is earthy.

The television coils are wound to the details given in Table 1 and Fig. 6. The actual assembly of the coils is fairly self evident from an inspection of the parts supplied ; the bakelite top plate is pushed over the top of the former to receive the ends of the stiff wires, the other ends of these wires passing down through the eyelets at the base of the coil former. The wires are soldered into these eyelets with *small* amounts of solder to prevent shorting to the can when this is finally placed over the completed coil. With these coils it is necessary to make the windings *before* the side wires are fitted, the coil

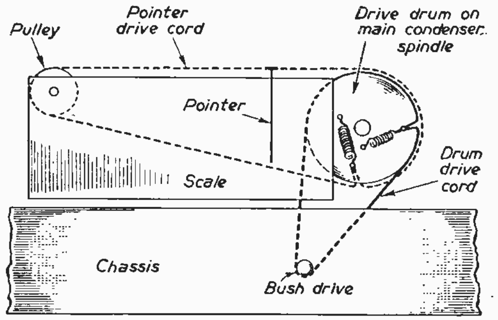


Fig. 3.—Suggested dial and condenser drive arrangement.

ends being fixed with a little wax until the side wires are ready to receive them. Fig. 6 shows a completed coil with its tuning condenser wired in circuit. The side-wire ends protrude for about ⅜in. below the former base, so that when mounted on the chassis a short length of sleeving can be slipped over them to prevent shorting

LIST OF COMPONENTS

This list gives the types, etc., of those components actually used in the original models. Other suitable types may be substituted at the constructor's discretion, but physical sizes are important and this aspect should not be overlooked in the choice of alternatives.

FIXED CONDENSERS

.001, .002, .01, .05 μF. : All T.C.C. type 543, 500 v. working.
C7, C11, C12, C13, C15, C19, C35, C36, C45, C69, C75, C76, C77, C78, C82 : Erie 10 per cent. Ceramicons.
C3, C18, C24, C28, C32, C33, C46, C48, C53, C62, C70, C80, C84 : Dubilier, T.C.C., 350 volt wire-ended moulded mica.
C44, C54, C55 : T.C.C. electrolytic, 500 v. working. Grouped or single.
All other condensers : Any reliable types of adequate rating ; electrolytics used where indicated.

FIXED RESISTANCES

R22, R33, R34, R37, R38, R56, R69, R72, R76, R94 : Erie 1 watt.
R47, R98 : Dubilier H.S. 1 watt.
R58, R97* : Erie 3 watt wire-wound.
R59* : Erie 5 watt wire-wound.
R99* : Vitreous, 30 watt.
All other resistances : Ediswan Morganite ½ watt.

POTENTIOMETERS

VR8, VR9, VR7, VR10, VR11, Carbon track types* ; VR1, VR2, VR3, VR4, VR5, 3 watt wire-wound types* ; VR6, 5 watt wire-wound type*.
N.B.—All pre-set except VR2, VR11.

VARIABLE CONDENSERS

VC2, VC3 : 500+500 pF. twin gang, less trimmers. N.B.—A suitable scale is required and this should be of the long type for preference with horizontally moving pointer. See layout in the photograph for ideas.
VC1 : 10+10 pF. split stator*.
T1, T2, T3, T4 : 70 pF. postage-stamp trimmers.
P1, P2 : Twin padder, 150+750 pF. Hunts type TP8.

COILS AND FORMERS

TV Screened coils L2, L3, L5-6-7, L8, L9, L10, L13, L14-15 : Formers, cans, cores, screws and nuts, side wires and fixing plates. Seven with four base eyelets, one with six base eyelets. Haynes Radio, type G1, or Bel Sound Products.
L4, L11, L12 : Polystyrene ⅜in. diam. formers with cores. Aladdin.
L19, L20, L21, L22 : Wearite " P " coils, types PA1, PA2, PO1 and PO2 respectively.

TRANSFORMERS

TR1, TR2 : 465 kc/s I.F.T.s. Wearite type 500, 501.
TR3 : Suitable output transformer.
TR4 : Line oscillator transformer, Premier Radio.
TR5 : Line output, Plessey type 72000.
TR6 : Frame output, Plessey type 72001.
TR7 : Mains transformer, type TV4, Premier Radio.

SCANNING COILS.—Plessey type 72003.

SWITCH.—S1AB, S2AB, S3A, S4AB, S5A, S6A : Required : Six wafers, each two pole, four way, Oak type. 7in. four position locator unit for above.

VALVEHOLDERS.—7 of B8A (EF41, EF42)* ; 1 of B7G (ECC91) ; 3 of B9G (EF50) ; 7 of Int. Octal ; 2 of Brit. 4-pin (1W/4/500).

SMOOTHING CHOKES.—5 Henries, 250 mA.* 10 Henries, 150 mA.

N.B.—Certain components may be bought from the surplus market and so cheapen construction, but in general it is a wise plan to restrict such items to those marked with an asterisk above. Even then, the parts should be unused.

and connections can be made to the under-chassis circuitry. Coils L_3, L_8, L_9, L_{10} and L_{13} require two side wires, coils L_{1-2} and L_{14-15} require four side wires and coil L_{5-6-7} requires five side wires. Note that coil L_{14-15} is left *unscreened.*

The oscillator coil and the two sound trap coils are wound on *polystyrene* Aladdin-type formers; *the bakelite types are not permissible* for these coils. The wire gauge is rather heavy and it is advisable *first* to coil the wire tightly around a spare former having a

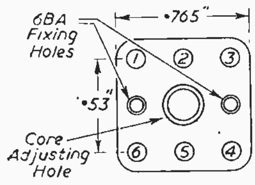


Fig. 4.—Details of coil base.

diameter *slightly less* than that of the actual formers to be used. The coil thus wound is then allowed to "spring," and it is then slipped on to the actual former and doped with polystyrene varnish or Durafix, being left until completely dry.

All coils have iron dust cores inserted in them, note being taken of the fact that coil L_{5-6-7} and coil L_{14-15} each have two cores, one at the top and the other at the bottom of the former.

The compensating coils L_{16}, L_{17} and L_{18} are pile wound on bakelite or paxolin formers and are not critical in construction. Flying wire ends are left for wiring into circuit.

Wiring

The order in which wiring is carried out is not particularly important, but a method is needed, and it is advisable to proceed with one "section" at a time. For example, the broadcast receiver may be wired

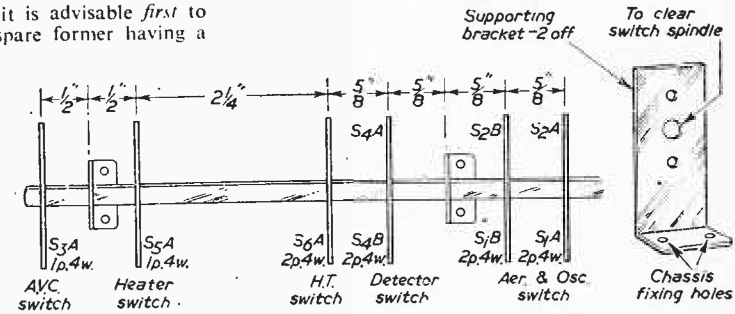


Fig. 5.—Ganged switch details.

completely (with the possible exception of the H.T. input and the 2nd I.F. transformer), then the vision and sound receiver, and finally the time-base section at the rear.

The wiring of the broadcast receiver needs little comment and Figs. 1 and 2 provide most of the necessary information. Tag strips are used to support the smaller components and anchor H.T. points, etc., and large condensers are clipped down to the chassis. 22 S.W.G. tinned copper wire and 1 or 1½ mm. sleeving is

LIST OF CONDENSER AND RESISTOR VALUES

CONDENSERS			RESISTORS		
C1—.002 μF.	C33—500 pF.	C65—0.1 μF.	R1—2.2 kΩ	R34—50 kΩ.	R67—330 kΩ.
C2—.002 μF.	C34—.01 μF.	C66—0.1 μF.	R2—470 Ω.	R35—4.7 kΩ.	R68—91 kΩ.
C3—500 pF.	C35—100 pF.	C67—.05 μF.	R3—6.8 kΩ.	R36—6.8 kΩ.	R69—40 kΩ.
C4—.002 μF.	C36—15 pF.	C68—.02 μF.	R4—33 Ω.	R37—3.3 kΩ.	R70—680 Ω.
C5—.002 μF.	C37—0.1 μF.	C69—100 pF.	R5—120 Ω.	R38—3.9 kΩ.	R71—160 Ω.
C6—.01 μF.	C38—2 μF.	C70—500 pF.	R6—3.3 kΩ.	R39—270 Ω.	R72—33 kΩ.
C7—2 pF.	C39—8 μF.	C71—.02 μF.	R7—4.7 kΩ.	R40—68 kΩ.	R73—470 kΩ.
C8—.002 μF.	C40—.002 μF.	C72—.05 μF.	R8—4.7 kΩ.	R41—47 kΩ.	R74—270 Ω.
C9—.02 μF.	C41—2 μF.	C73—.02 μF.	R9—2.2 kΩ.	R42—6.8 kΩ.	R75—47 kΩ.
C10—.002 μF.	C42—.05 μF.	C74—100 pF.	R10—22 kΩ.	R43—1 mΩ.	R76—47 kΩ.
C11—47 pF.	C43—0.1 μF.	C75—100 pF.	R11—470 Ω.	R44—33 kΩ.	R77—330 kΩ.
C12—10 pF.	C44—16 μF.	C76—47 pF.	R12—100 kΩ.	R45—22 kΩ.	R78—100 kΩ.
C13—100 pF.	C45—100 pF.	C77—47 pF.	R13—2.2 kΩ.	R46—1 mΩ.	R79—3.3 kΩ.
C14—.01 μF.	C46—200 pF.	C78—10 pF.	R14—33 kΩ.	R47—100 kΩ.	R80—270 Ω.
C15—100 pF.	C47—.05 μF.	C79—.01 pF.	R15—270 Ω.	R48—22 kΩ.	R81—100 kΩ.
C16—.01 μF.	C48—500 pF.	C80—500 pF.	R16—22 kΩ.	R49—6.8 kΩ.	R82—470 kΩ.
C17—.01 μF.	C49—.01 μF.	C81—.002 μF.	R17—3.3 kΩ.	R50—200 kΩ.	R83—33 kΩ.
C18—500 pF.	C50—.02 μF.	C82—20 pF.	R18—4.7 kΩ.	R51—*	R84—1 mΩ.
C19—100 pF.	C51—.05 μF.	C83—2 μF.	R19—33 Ω.	R52—1 mΩ.	R85—2.2 mΩ.
C20—.01 μF.	C52—.001 μF.	C84—500 pF.	R20—150 Ω.	R53—2.2 Ω.	R86—1.2 mΩ.
C21—.01 μF.	C53—.005 μF.	C85—25 μF.	R21—6.8 kΩ.	R54—470 Ω.	R87—47 kΩ.
C22—.01 μF.	C54—16 μF.	C86—.02 μF.	R22—120 kΩ.	R55—1 mΩ.	R88—220 kΩ.
C23—.01 μF.	C55—32 μF.	C87—25 μF.	R23—22 kΩ.	R56—100 Ω 1 w.	R89—2.2 kΩ.
C24—500 pF.	C56—.001 μF.	C88—.01 μF.	R24—3.3 kΩ.	R57—2.2 kΩ. 2 w.	R90—1 mΩ.
C25—.01 μF.	C57—.001 μF.	C89—8 μF.	R25—4.7 kΩ.	R58—2.5 kΩ. 2 w.	R91—470 kΩ.
C26—.01 μF.	C58—.001 μF.	C90—.002 μF.	R26—3.3 kΩ.	R59—450 Ω 5 w.	R92—330 kΩ.
C27—.01 μF.	C59—.004 μF.	C91—.002 μF.	R27—150 Ω.	R60—22 kΩ.	R93—1 mΩ.
C28—500 pF.	C60—.01 μF.	C92—.01 μF.	R28—22 kΩ.	R61—100 kΩ.	R94—200 Ω.
C29—.01 μF.	C61—0.5 μF.	C93—.01 μF.	R29—3.3 kΩ.	R62—47 kΩ.	R95—47 Ω.
C30—.01 μF.	C62—.001 μF.	C94—.01 μF.	R30—4.7 kΩ.	R63—39 kΩ.	R96—4.7 kΩ.
C31—.01 μF.	C63—.02 μF.	C95—.01 μF.	R31—4.7 kΩ.	R64—1 mΩ.	R97—100 Ω 3 w.
C32—500 pF.	C64—2 μF.	C96—.02 μF.	R32—150 Ω.	R65—330 kΩ.	R98—150 kΩ.
			R33—27 kΩ.	R66—47 kΩ.	

* See text

suggested for wiring purposes. The leads to and from the detector circuit to the switch bank S_4A and S_4B are screened (capacity not important) and covered with sleeving.

The television receiver proper is easily wired because of the absence of any screening below chassis, everything thus being very accessible. The heaters are best wired first, then all valve pins requiring earth connection should be tied down to tags under the fixing bolts. Since all the stages are very identical, an enlarged wiring plan of one of the I.F. stages and the mixer stage will be given in Fig. 7 next month. All leads are kept very short; this is made possible by the use of small components and the fact that the tuning coils are above chassis. The lead to the contrast control is screened and sleeved.

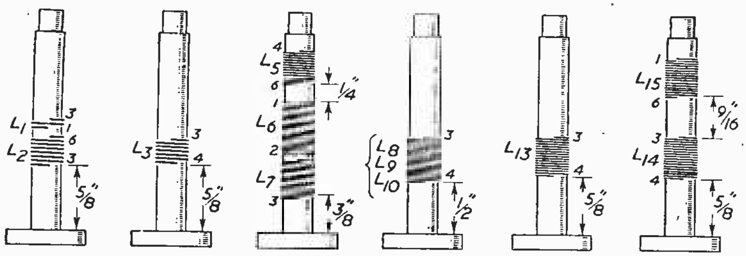
The time-base section, too, is straightforward and is not critical as regards actual wiring, although every attempt must be made to avoid the placing of wires and components so that interaction is possible between the line and frame circuits.

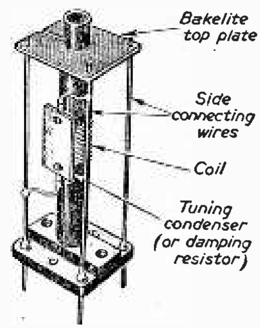
The supply leads are brought together on a tag strip, as shown in the photograph, and a 5-way cable is used to connect to the power unit. The wires leading to the switch banks S_5A and S_6A are led along the side of the chassis as shown, being formed into a combination cable. The heater leads here and in the 5-way cable are made up of heavy flex wire to avoid loss.

No diagram is given of the power unit as this is not critical in construction and can be made to suit the individual builder. Good ventilation is required, particularly for the valves and the heavy dropping resistances.

No mention has been made so far about the type and mounting of the tube. Any 9in., 10in. or 12in. tube may be used with the receiver; the only change required in the design is the choice of focusing magnet to suit the tube, that is, for a triode or tetrode type.

(*To be continued.*)





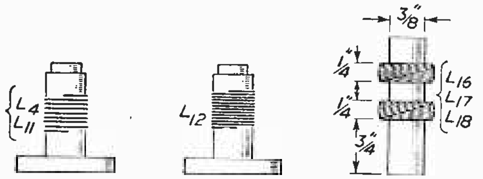


Fig. 6.—Individual coil data and a detailed sketch of a completed coil with its associated condenser.

TABLE 1.—COIL WINDING DETAILS

Coil	Wire	Turns		Frequency		Other Components in Coil Can	Remarks, etc
		London	B'ham.	London	B'ham.		
L_1 L_2	36 D.S.C. 36 D.S.C.	1½ 9½	1½ 6½	— 45 Mc/s	— 61.75 Mc/s	3.3 kΩ across L_2 for London only	Turns spaced diameter of wire with L_1 wound close against L_2.
L_3	36 D.S.C.	8	5½	43 Mc/s	60.25 Mc/s	R_6	Turns spaced diameter of wire.
L_4	20 enam.	11	7	31.5 Mc/s	48.25 Mc/s	—	Very slight turns spacing on ⅜in. polystyrene.
L_5 L_6 L_7	26 enam. 38 enam. 36 D.S.C.	19 52 30		10 Mc/s — 10.8 Mc/s.		C_{19}	All coils close wound and in the same direction. L_6 is wound close against L_7.
L_8	36 D.S.C.	24		13 Mc/s		R_{26}	Close wound.
L_9	36 D.S.C.	33		10.6 Mc/s		R_{31}	Close wound.
L_{10}	36 D.S.C.	42		11.75 Mc/s		—	Close wound.
L_{11}	20 enam.	6		10 Mc/s		—	Close wound on ⅜in. polystyrene.
L_{12}	20 enam.	13		10 Mc/s		—	Close wound on ⅜in. polystyrene.
L_{13}	26 enam.	19		10 Mc/s		C_{15}	Close wound.
L_{14} L_{15}	26 enam.	19 20		10 Mc/s		C_{74} C_{75}	Each coil close wound in same direction. This transformer is left unscreened.
L_{16}	40 D.S.C.	110+110		—		—	Two piles wave-wound or piled between cardboard cheeks.
L_{17}	40 D.S.C.	90+90		—		—	As L_{16}.
L_{18}	40 D.S.C.	65+65		—		—	As L_{16}.

A TELEVISION aerial is really an electrical circuit containing resistance and reactance, which are distributed throughout its length. In any circuit containing resistance and reactance maximum current will flow when the circuit is tuned to the frequency of the current. The circuit is then said to be *resonant*.

Now the shortest length of wire which can be made resonant at a certain frequency is one which will allow an electrical charge to traverse its length in one cycle. As an alternating current changes its direction of flow every half cycle then the shortest length of wire which will resonate to that frequency will be one which is $\frac{1}{2}\lambda$ long.

Given that the speed of a radio frequency is 186,000 miles per second we have :

$$\text{Wavelength at f cycles per sec.} = \frac{186{,}000}{f}$$

$$\text{Therefore length of wire} = \frac{186{,}000}{f \times 2}$$

$$\text{Converting to feet} = \frac{492}{f(Mc/s)}$$

Actually, it is not quite so simple as that because we have to reckon with the effect of the insulators which support the wire, and the effect of nearby objects ; also the actual electrical length of the wire is not exactly the same as its physical length. However, for all practical purposes we can make the actual length 95 per cent. of its theoretical length. Our formula now becomes :

$$\text{Length in feet} = \frac{468}{f(Mc/s)}$$

This will enable us to calculate the length of a dipole for any of the B.B.C. stations.

Fig. 1 shows the current and voltage distribution on a dipole. It will be noted that when the current is at a maximum the voltage is at a minimum. The values of the current and voltage vary along the length of wire, hence the impedance will vary from a minimum in the centre to a maximum at the ends. At the centre, the impedance is approximately 70 ohms and it is the common practice to tap the aerial at this point.

Transmission Lines

A dipole of this kind will tune quite sharply, but the bandwidth will be narrow. In order to widen the bandwidth the " Q " of the aerial is reduced by reducing the length/diameter ratio to below 400. This is accomplished by using tubing for the elements.

For London reception the length of the dipole should be 10.55ft. If $\frac{3}{8}$in. tubing is used we have an l/d ratio of 337. As a general rule we can take it that $\frac{3}{8}$in. tubing is the smallest which will provide a reasonable bandwidth.

To convey the signal which is picked up by the aerial to the receiver we must use a transmission line.

Transmission lines for VHF work have a length which is much greater than the wavelength being received. This means that the line will tend to radiate power. To overcome this loss the two wires comprising the line are run close together so that the electromagnetic fields generated by one are cancelled by the other. The distance separating the wires is made small compared with the wavelength received.

Such a line is termed a twin lead line.

Coaxial cable can also be used. In this case the VHF currents flow on the outside of the centre conductor, and on the inside of the surrounding sheath ; thus the two fields generated cancel each other.

Every transmission line has an impedance which is peculiar to its own particular type. This impedance is termed its *Characteristic Impedance* (Z_0). Twin lead is manufactured in three main types which have a Z_0 of 300, 150 and 75 ohms. Coaxial cable is made in two popular types, 75 and 53 ohms.

In an emergency ordinary electric lighting flex can be used. It has a Z_0 of from 70 to 140 ohms.

Whatever type of transmission line is used it must be matched to the aerial and to the receiver.

Energy Transfer

The aerial can be likened to a generator of A.C. To transfer the maximum amount of power from the generator to the line we must make the line impedance equal the impedance of the generator. Therefore if we do not match our line to the aerial we shall not obtain all the power which is generated in it by the incoming signal.

Another point to consider is that a bad mismatch will cause reflections to occur. Consider a line which is badly mismatched to the receiver : a current wave will travel down from the aerial and due to the bad mismatch only part of the current is absorbed. The current left over will return back to the aerial as it has nowhere else to go. It will arrive back at its starting point out of phase with the currents already being generated there and so will turn round and go back to the receiver. Here it will arrive a little behind the main current and so cause a ghost image to appear on the screen.

In a really bad case several ghosts will appear on the picture. In a slight case the picture may appear slightly out of focus. It is not usual for ghosts to appear except with very long transmission lines, though the writer has seen as many as five ghosts from a line 50ft. long, due to a poor connection at the receiver end, where a small length of cable had been added to the original line.

Matching can be accomplished by using a transformer or other device. At the receiver end a transformer is used so that the line impedance is stepped up to the receiver impedance. The line is either connected to a small coupling coil or is tapped on to the main tuning coil.

At the aerial end the simplest method is to choose a cable whose Z_0 is equal to the aerial impedance.

In the case of a simple dipole we have approximately 70 ohms at its centre so we use a 75-ohm cable.

We have now a simple dipole feeding into a matched transmission line, which is itself matched into the receiver. The dipole is tuned to the desired frequency by adjusting its length and the l/d ratio is below 400. to provide sufficient bandwidth.

An aerial of this sort is very useful for points within about 25 miles of the transmitter, but as we get farther away something more elaborate is required. The dipole will cheerfully pick up the signal and interference from all directions. Something is required which will increase the actual signal strength in the aerial itself and to protect it from unwanted car ignition, etc.

Before we go any further let us clear up one little point. It is the question of db's. We hear of one aerial having a gain of so many db's against another. What does it all really mean?

Well, db's are a form of expressing power ratios; if you want to be technical we can say,

$$1 \text{ db} = 10 \log_{10} \frac{\text{Power sent}}{\text{Power received}}$$

but for normal comparisons we only need remember

TABLE I

Wavelength space	Director gains in db.	Reflector gains in db.
0.01	1.0	1.0
0.05	4.0	3.5
0.10	5.8	5.0
0.15	5.4	5.4
0.20	4.5	5.0
0.25	3.5	4.5
0.30	2.8	3.8
0.35	1.8	3.2

that a variation in signal strength of 1 db shows a just perceptible change in the strength of the picture, so that an increase of, say, 3 db represents an increase of three observable steps in the signal.

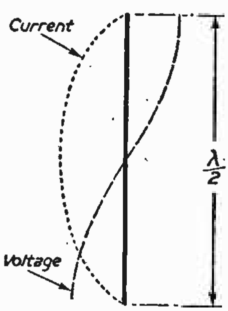


Fig. 1.—Voltage and current distribution along a wire which is a half wavelength long.

Comparisons

In order to compare different arrays, their performance is judged against that of a standard dipole; thus an aerial which is said to give a gain of 5 db's means one which will give a signal which is better by five observable steps over a standard dipole.

Now let us return to the aerial. The first thing to do to improve its performance is the provision of an additional element close to the existing dipole. It is not connected to the dipole in any way but is coupled to it electromagnetically.

It is termed a *parasitic* element.

The length of the element and the distance between it and the dipole greatly affect the relationship between the two. If the parasitic element is made about five per cent. shorter than the dipole and is placed between it and the station it is termed a *director*. If it is used behind the dipole and is made about five per cent. longer it is termed a *reflector*. (See Fig. 2.)

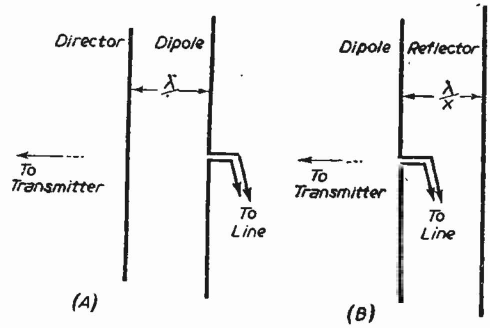


Fig. 2.—This diagram shows the essential differences between a director and reflector.

The spacing between the dipole and its parasitic element varies between 0.01λ and 0.5λ. Table I gives some figures of possible gains with directors and reflectors.

It will be seen that maximum gain is obtained from a director spaced at 0.1λ from the dipole. The reflector gives maximum gain at 0.15λ from the dipole.

The fitting of parasitic elements has another effect on the dipole: it alters its impedance. Table II gives approximate figures for the impedance at the centre of a dipole when fitted with a director or reflector.

It will be noticed that with the director spaced for maximum gain the impedance is only 15 ohms, and the maximum gain position for the reflector gives us 25 ohms.

This would result in a mismatch if the usual 75-ohm cable was used, and the gains obtained would be partially offset by the mismatch.

TABLE II

Element spacing wavelengths	Director ohms	Reflector ohms
0.05	11	9
0.10	15	15
0.15	20	25
0.20	35	42
0.25	52	60
0.30	60	67
0.35	62	70

Another disadvantage is that as the gain is increased the tuning becomes much sharper, resulting in a more directive aerial, but reducing the bandwidth, especially when the elements are close-spaced.

To improve reception conditions it is more essential to have a good front-to-back ratio rather than maximum gain, so that the aerial can be positioned to reduce extraneous interference. As the signal becomes weaker, greater amplification is required in the receiver and hence the interference becomes more pronounced. A correctly adjusted, close-spaced director will give a better front-to-back ratio than a reflector, but the adjustment is very critical.

A compromise has to be made between these conflicting conditions—a reasonable match, a good bandwidth, and high front-to-back ratio.

To meet these requirements it is usual to fit a reflector spaced at 0.25 λ from the dipole. This forms the popular "H" aerial. Under these conditions we have a theoretical gain of 4.5 db (though the practical gain may be a little less than this), and the impedance is 60 ohms.

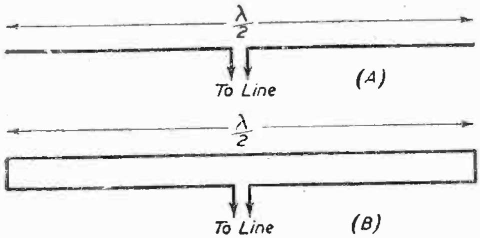


Fig. 3.—The simple dipole and a folded dipole aerial.

At this stage it should be pointed out that it is not possible to obtain accurate figures as each installation will have its own peculiarities.

Calculations

To calculate the length of directors and reflectors the following formulæ can be used :

Director. Length in feet $= \dfrac{450}{f(Mc/s)}$

Reflector. Length in feet $= \dfrac{498}{f(Mc/s)}$

The "H" aerial which has been described is not too selective and presents a fairly broad front to the incoming signal. There is very little variation in signal strength over an arc of plus or minus 30 deg., from a position dead in line with the transmitter. Behind the aerial is a "dead" area covering any arc of plus or minus 50 deg. over which very little interference is picked up.

For fringe area reception something more elaborate is required, and in these cases it is usual to combine one or more directors with a reflector.

The addition of further parasitic elements introduces a fresh set of problems. From the practical viewpoint the main items are (a) a great reduction in the impedance, (b) narrowing of the bandwidth, (c) the array begins to become unwieldy.

With regard to (c), where an aerial is mounted on a chimney, we are obviously limited to weight and size of the array ; a four-element array is about the maximum which can be used with safety—we have the winter blasts to consider !

It is not possible to estimate the gains obtainable with a three- or four-element array accurately as each parasitic element will affect the other. We cannot look at Table I and say "one director at 0.15 = 5.4 db, plus one director at 0.1 = 5.8 db totals 11.2 db"—it just doesn't work out that way ! The only method of obtaining an idea of the gains obtainable is by actual measurements in the field. Under these conditions it has been found that the maximum gain obtainable with a four-element array, with all elements at 0.2 spacing, was just over 10 db. The impedance in this case was 13 to 20 ohms.

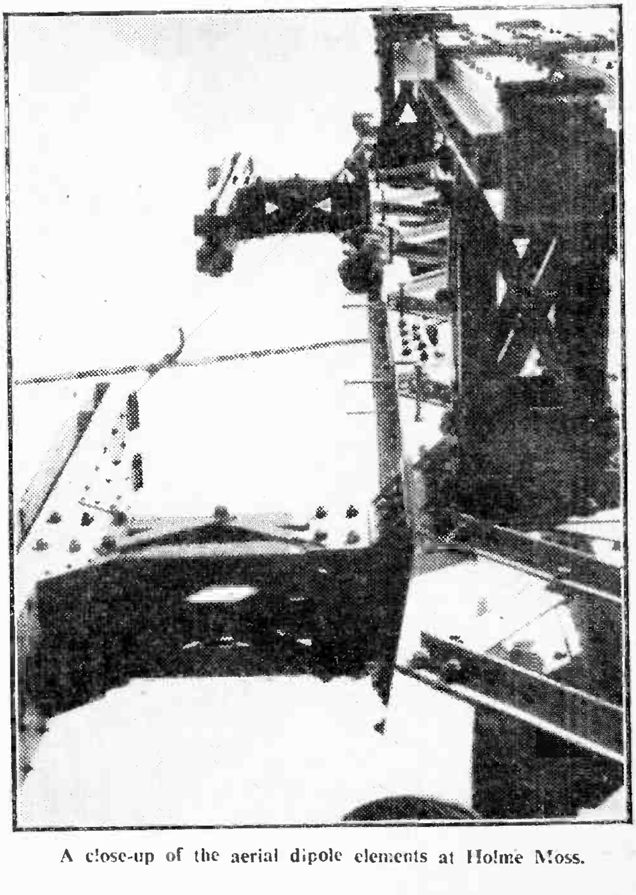
Unwieldy

Unfortunately the width of the array becomes excessive (A London array would measure over 12ft. across.) It is really too large for chimney mounting. A compromise can be made by reducing the spacing. Two directors, the first at 0.1 λ from the dipole and the second 0.1 λ from the first, with a reflector at 0.15 λ, will give a gain of approximately 9 db with an impedance of 4 to 6 ohms.

Coming further down the scale a three-element array with a director at 0.1 λ and reflector at 0.15 λ will give a gain of 8 db and the impedance is 10 ohms. This is only 2 db less than the four-element array first mentioned, and is much lighter.

Such an array is, of course, only suitable for fringe and difficult areas.

An outfit of this kind is sharply directional and signal strength begins to fall off sharply at points further than plus or minus 10 deg. from the direction of the incoming signal. They are therefore very useful where interference is bad.



A close-up of the aerial dipole elements at Holme Moss.

Mismatch

Having obtained the maximum gain possible, the next problem to overcome is the resultant mismatch. Taking the array we have last mentioned, we have an impedance of 10 ohms, while our standard transmission line is 75 ohms. There are two methods which are in general use in television to overcome this.

The first (which is used by some manufacturers) is the insertion of a short length of cable between the dipole and the transmission line, which has a different Z_0. This length is called the *matching stub*.

It will be recalled that every type of cable has its own characteristic impedance ; if a piece is cut $\frac{1}{4}\lambda$ long and inserted as mentioned above it will "tune out" the inequalities brought about by the mismatch.

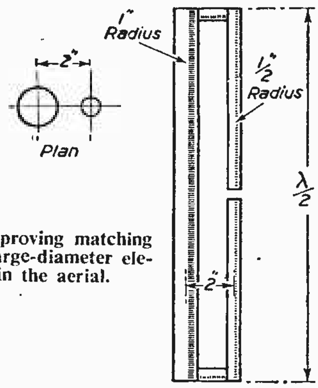


Fig. 4.—Improving matching by using large-diameter elements in the aerial.

A useful formula for calculating the characteristic impedance required for a $\frac{1}{4}\lambda$ matching stub is

$$Z_s = \sqrt{Z_0 Z}$$

where Z_s is the impedance of the matching stub,
Z_0 is the impedance of the line,
Z is the impedance of the dipole.

In our case we have to match 10 ohms to 75 ohms, therefore

$$Z_s = \sqrt{75 \times 10}$$
$$= 30 \text{ ohms approx.}$$

Therefore a $\frac{1}{4}\lambda$, 30 ohms cable will be required. The stub will cause about ½ db attenuation of the signal.

The $\frac{1}{4}\lambda$ mentioned above is quarter of an *electrical wavelength*. This is not exactly the same as the physical wavelength. To obtain the actual length the physical wavelength calculated, as given in earlier paragraphs, must be multiplied by the velocity factor (V) of the cable. This figure can be obtained from the manufacture of the cable, but as a guide, 53 and 75 ohm coaxial cable has a V of approximately 0.66 ; 75 ohm twin lead = 0.68.

The second method which is generally more favoured is the use of a folded dipole. This is formed by connecting across the ends of the dipole an additional rod which is the same length as the dipole itself (Fig. 3).

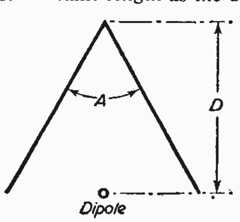


Fig. 5.—A corner layout for use in restricted places. Netting may be used for the reflector.

Looking at the dipole (Fig. 3a) from the point of view of the line the dipole is delivering a certain amount of power at a certain current. In Fig. 5b the current is divided between the two elements in parallel ; the power is the same as before, but the current is reduced ; therefore from the line's point of view the impedance has increased.

Actually, the impedance as seen by the line is raised four times. If a further element is added the impedance is raised nine times. In our case we have a 10-ohm aerial, and if the dipole is triple folded (three elements) it will give us an impedance of 9 x 10=90 ohms, which is not an unreasonable match to a 75-ohm cable.

It would be possible to use the dipole with the double fold as then the impedance would have been 10 x 4= 40 ohms. This would result in a mismatch of 1 : 2, and would give a loss of just over ½ db.

An even better match can be obtained by using larger-sized conductors, and this will assist in widening the bandwidth. Fig. 4 shows a typical case.

The dipole itself is made from ½in. tubing and the "fold" from 1in. tubing. The centre-to-centre distance between the two should be 2in., and they should be connected together electrically at the two ends. The impedance step-up in this case is eight times, and this gives us 10 x 8=80 ohms.

Corner Reflector

In really difficult places and for those who have the necessary space available, a *corner reflector* would probably be of some benefit. Fig. 5 shows the scheme. Chicken-wire netting can be used for the reflector.

The angle A should be 60 deg. The distance "D" from the dipole to the reflector can be anything from 0.1 λ to 0.5 λ, though the impedance will vary as "D" is altered. Where "D" is 0.25 λ and the angle is 60 deg., the impedance of the dipole is about 6 ohms. By using a folded dipole a reasonable match to a 75-ohm cable can be obtained. A gain of 11 db is possible.

The whole problem of aerial design offers a wide field for practical experiments, especially where wideband TV reception is involved. We have endeavoured to give you a grounding in the fundamental principles involved, and it is hoped that this will enable you to carry out your own ideas.

One last word of advice. If you wish to experiment, retain one standard form of aerial, such as a simple dipole, or an "H," against which you can compare results. You will then be sure that the signals being produced by the aerial under test are solely due to its design and not to varying atmospheric conditions.

A Technical Book Occasion

MR. F. J. CAMM, Editor of PRACTICAL TELEVISION, *Practical Engineering*, *Practical Mechanics*, *Practical Wireless*, and author of over 40 best-selling technical books at present in print, visited Southend-on-Sea on Monday, June 25th. Mr. Camm entertained a keen audience of over 100 technicians with an informal survey of technical progress and opportunity in many fields. He afterwards spent nearly an hour answering a quickfire barrage of questions on many topics. He neatly completed the meeting by turning the tables on the audience and asking them a few technical questions and offering cigarette-lighters (designed by himself) as prizes. The event was sponsored by Donald Bobin, local bookseller and book trade journalist. Mr. Clark Ramsay, Newnes' Book Publicity Manager, was in the chair.

"Surplus" Television on D.C.

A Power Unit to Provide A.C. Supplies from D.C. Mains

By D. HANSTEAD

THE published circuits of "surplus" television receivers are all intended for operation on A.C. mains. The home constructor who is on D.C. is therefore obliged to purchase a D.C. to A.C. converter, the cost of which may well exceed the cost of the rest of the receiver.

The writer, being on 200 volts D.C. mains, designed this power pack to be built round an ex-Government

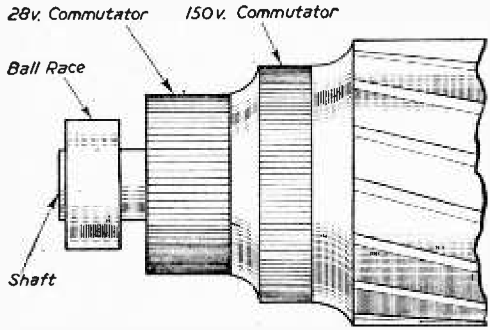


Fig. 1.—Original appearance of "A.C. end" of armature.

rotary transformer. The total cost was less than that for an A.C. power pack, and the complete receiver has been giving excellent results for over a year.

The method can be summarised as follows. A "surplus" television set needs the following supplies: E.H.T., 2,000 volts at about 1 mA; time base H.T., 500 volts at about 150 mA; receiver H.T. 350 volts at about 50 mA. and heater supply of 6.3 volts at about 5 amps. The rotary transformer is fed with 200 volts from the mains, and gives out 350 volts D.C., 15 volts D.C., and 15 volts A.C. The 350 volts is added to the mains voltage of 200 volts, making 550 volts, which after smoothing provides the 500 volts time base H.T. A dropping resistor reduces the 500 volts to 350 volts for the receiver H.T. supply. The 15 volts D.C. is reduced by a dropping resistor to 6.3 volts for the heaters, and the 15 volts A.C. supply is fed to the E.H.T. transformer, feeding a rectifier valve, giving 2,000 volts D.C. for the C.R.T. supply.

Alterations to Rotary Transformer

You must first obtain the rotary transformer. There are several types on the market which will suit our purpose, the essential characteristic being: Input 24-28 volts., outputs 300 volts, 150 volts and 12-14 volts. The machine measures 5in. in diameter by 12in. long. The writer's machine was American in origin, and was from a unit labelled "Dynamotor Unit PE-94-B."

First remove all connections to the brushes, and any external apparatus such as relays and voltage controllers. The field will probably be found to have more than one winding. We will be using only the winding having the highest resistance. Identify the pair of leads going to this winding, using an ohmmeter (the resistance will be about 40 ohms). Any other leads to the field can now be taped up at the ends and subsequently ignored.

Now withdraw the armature, having first removed all the carbon brushes. Identify the commutator, which was intended for 28 volts input (you will find the voltages marked on the frame of the machine near the corresponding brush holders). We are going to use this commutator to give a supply of 15 volts A.C. The appearance of this end of the armature will be similar to that shown in Fig. 1. Drill holes in the armature shaft as in Fig. 2. Take a 4 B.A. x ½in. brass screw and file the top of the head until the slot has disappeared. Slot the other end with a saw, and solder to it a piece of 18 s.w.g. tinned copper wire about 6in. long. Thread on to the wire a Paxolin washer, a length of Paxolin sleeve, which has been smeared thickly with shellac varnish both inside and outside, and a length of flexible sleeving as in Fig. 4. Now thread the wire and sleeving through the hole in the shaft, and solder the wire to the nearest segment of the commutator. Make sure that the segment is not shorted to an adjacent segment—a hot iron will be necessary. Next select the segment which is exactly opposite the segment just soldered and connect it to the armature shaft. 18 s.w.g. bare wire may be used, and it is best soldered to the shaft by first making a shallow saw-cut to receive it. The final arrangement will be as in Fig. 3.

The machine may now be reassembled. Omit the brushes from the 28-volt commutator, which is now being used for A.C. Arrange a piece of brass strip to press

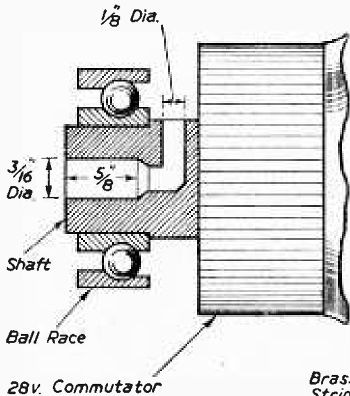


Fig. 2.—Details of holes for A.C. lead.

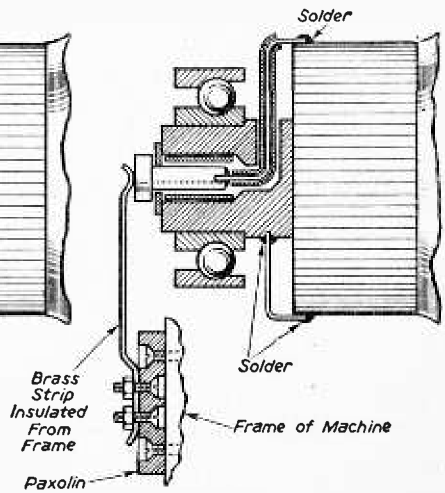


Fig. 3.—Final arrangement of "A.C. end."

lightly on to the brass stud, as in Fig. 3. The other end of the strip should be mounted on a piece of Paxolin, which in turn is mounted on the frame of the machine.

External Circuit

The external circuit is shown in Fig. 5. The voltages marked on the brushes in this figure are the *original* markings on the frame of the machine. The resistance R1 serves to limit the field current to that for which the field coil was originally designed. An example will show how its value is calculated. Suppose the machine

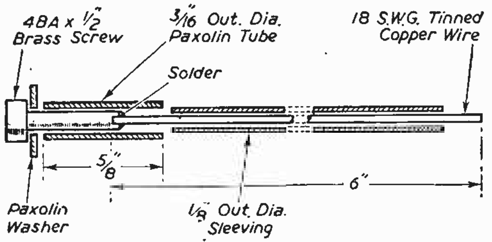


Fig. 4.—A.C. lead before insertion in armature.

was designed for 28 volts input, and the resistance of the field is found by measurement to be 40 ohms. Then the original current was, by Ohm's Law $I = \frac{E}{R} = \frac{28}{40}$ $= 0.7$ amps. If the mains voltage is 200 volts, the total resistance required to pass 0.7 amps. is given by $R = \frac{E}{I}$ $= \frac{200}{0.7} = 286$ ohms. But the field resistance is 40 ohms. Therefore R1, the extra resistance required, is $286 - 40 = 246$ ohms. The wattage rating required is given by: $W = I^2R = 0.7 \times 0.7 \times 246 =$ 120 watts. Hence we use for R1 a resistor of 250 ohms rated at 125 watts.

R2 is the dropper for the heater voltage. The value given is suitable for a 15-valve receiver. An adjustable resistor is preferable so that the heater voltage can be adjusted to exactly 6.3 volts.

The smoothing condensers may be of the paper type. Their function is mainly to suppress interference due to sparking at the brushes, since the output from the machine is already fairly smooth.

The E.H.T. Transformer

This is of the type which was originally designed for an input of 230 volts A.C., one output of 2,000 volts, and two of 4 volts. The 230-volt winding is not used. Instead, a 15-volt winding is added to the transformer. This will need about 100 turns of 22 s.w.g. enamelled copper wire, and on most E.H.T. transformers there will be room to add this outside the existing windings without having to dismantle the transformer. The number of turns should be finally adjusted with the power pack in operation and supplying the receiver, so that the 4-volt windings give exactly 4 volts. One of these windings is used to feed the heater of the E.H.T. rectifier valve, which may be the ex-Government VU133, and the other to supply the heater of the cathode-ray tube.

It will be observed that positive and negative of the E.H.T. output are brought out separately. One of these will be earthed according to whether the circuit used for the receiver requires a positive or negative earth for the E.H.T.

Use of Different Types of Rotary Transformers

The power pack may be arranged to use a rotary transformer which is designed for an input of 12-14 volts, provided that the other details are the same as for the one described above. The A.C. output will in this case be about 7.5 volts. The extra winding on the E.H.T. transformer should therefore be altered accordingly. About 50 turns of 18 s.w.g. enamelled wire will be suitable.

Noise

The disadvantage of using a rotary type of power supply is that a humming noise is produced while the receiver is working. While this is not sufficient to destroy the entertainment value of a programme, it may be eliminated altogether by mounting the power pack in a cupboard or in a room remote from the receiver, and connecting it thereto by means of a multicore cable. Care should be taken to allow the power pack unrestricted ventilation, in order to prevent overheating.

Remote Control

If the power supply is fitted in a remote cupboard it will, of course, provide scope for the enthusiast to build some form of remote control unit whereby the action of switching on the receiver will, at the same time, switch on the power unit and start up the converter. There would, of course, be some risk if the complete unit as shown in Fig. 5 were remote controlled, but there is no reason why the rotary section could not be so arranged and the E.H.T. transformer and rectifier left at the receiver end.

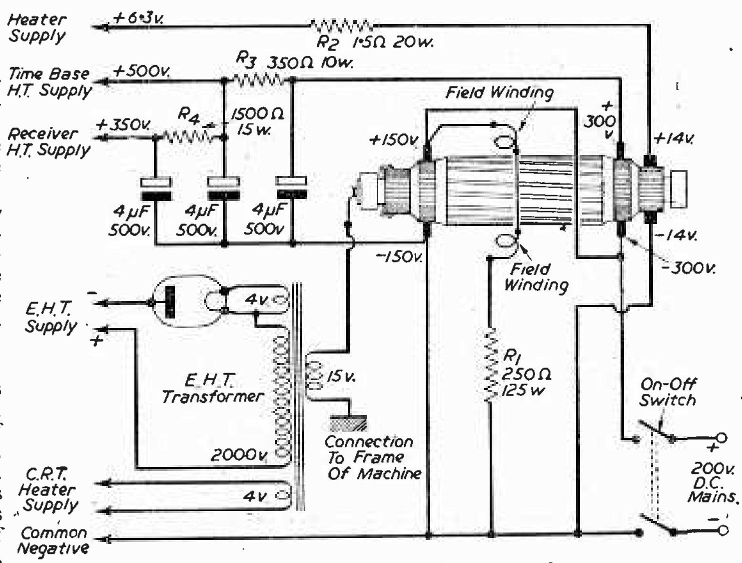


Fig. 5.—Complete circuit of power pack.

Television Theatre

A Plea for Improved Transmissions of Plays, etc.

By D. CHARLES OTTLEY

ALTHOUGH the televising of major sporting events has probably induced more people to invest in television sets than any other of its many activities, there is, nevertheless, an ever-growing demand for televised theatre, more particularly in the department of legitimate drama, and this being so, it is interesting to consider the various methods of presentation that might be employed with a view to creating and maintaining that certain atmosphere peculiar to the theatre.

From the point of view of the individual responsible for production, three angles of approach attach to any play, namely, the author's, the actors', and his own. Put another way, the author has something to say, and his own particular way of saying it, the actors have *their* own particular personalities which, whilst interpreting as exactly as possible the creations of another, must not be lost in the process, and the producer, whose job it is to merge the interests of both parties to the satisfaction of all concerned.

A fourth, and extremely important, approach is that of the audience, and it is mainly with this that I am concerned in the present article.

Although, on first thoughts, the average playgoer might, in common with Hamlet, be tempted to reiterate that oft-quoted phrase, ". . . the play's the thing . . .", if he cares to go into the matter a little more deeply he will undoubtedly add *and the theatre*. He means, of course, that theatre and play are inseparable, and that the chain of factual circumstance associated with the going will for ever be linked with the hardly less factual chain of events created for him when he gets there.

The memory of any play, good, bad or indifferent, is really a nostalgic exercise in two-dimensional (mental) projection. The fast-moving events of daily life pass, automatically, into the region of the subconscious mind, and when, for one reason or another, we have occasion to recall what has gone before, not only the event itself but its secondary associations are recalled with it. No matter which particular play we may decide to remember, or how long ago we may have seen it, along with the major theme (the play itself) will come others, associated with a miscellany of subjects such as where we sat, what we wore, with whom we went, how we got there, what time we arrived home, and the things that happened during the evening. In short, what we draw from the subconscious resolves itself into a composite image of imagination and sensation, comprised of fractional thoughts, each of which contributes its minute charge of energy to the scintillating picture we have resurrected from the archives of memory.

At the moment, television theatre is concerned only with the play, and as such is a medium but partially complete and partially satisfying.

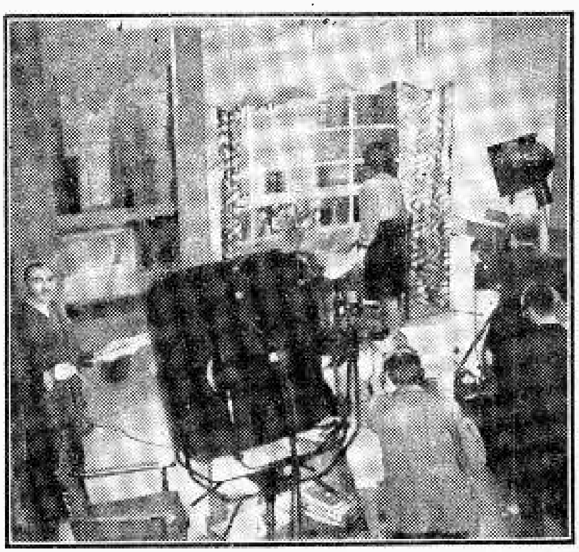
Whether we favour the gallery or the stalls makes little difference to what I would like to call the "incident" of being there. Indeed, there is as much fun, atmosphere and enchantment upstairs as downstairs, as much eager anticipation and excitement beneath the domed arch that spans the "gods" as upon the rich pile into which our heels sink when we glide to our throne in the stalls. Such things are integral to the play, are indeed, *theatre*. They constitute that vital difference between stage and screen, and explain why, to-day, legitimate drama yet retains an impregnable position, an ascendancy over any other of the visual arts.

Any reader who has at any time patronised the theatre, whether to renew an octogenarian acquaintance with, say, "The Mikado," or, as a questioning adolescent, to sample a new sensation in the realism of "A Streetcar Named Desire," will, I think, appreciate what I have written. We get so much *more* for our oft-times hard-earned price of admission than just the play . . . and it is just this *extra* that television can and should provide when it casts its miraculous "eye" beyond the footlights.

May I suggest that it lets us *see* the footlights sometimes, allows us, maybe, just one magic minute amongst a real audience, and lets us contemplate the gorgeous curtain behind which hides that world of make-believe, so like, and yet so unlike, the world to which, for better or for worse, we belong.

I recall, as a lad of eighteen, seeing the late Doris Keane in Edward Sheldon's "Romance." Although thirty-six years have passed since that memorable night (memorable not only because I was introduced to the lady but fell deeply in love with the La Cavallini whom she created), a number of incidents come vividly to mind which, although secondary to the play, are to me quite as important.

Might not television escort us "back-stage" once in



A typical scene in the studio during the televising of a play.

a while, to show not a predetermined and well-rehearsed sequence but a stray shot or two of star or starlet in the act of donning "the motley, the paint and the powder," essential ingredients to an art too old to die and too young to lose its appeal.

In making this suggestion I have in mind such past television achievements in the department of drama as Erckmann-Chatrian's "The Bells" and the brothers Capek "Life of the Insects." Excellent though both these productions were *as* plays, they each suffered appreciable loss through what I would venture to call absence of *theatre.* In the case of Irving's historic success, a success that dominated his life and changed the course of theatrical history for one management at all events, a better introduction than the smiling announcer would have been a view of the old Lyceum, majestic despite its present humility, with perhaps a pause upon that historic stairway which a crowned head ascended not many moons before the honour of knighthood was conferred upon a giant of melodrama.

And the "Insect Play." why not a visit to the mean little Opera House at Hammersmith to which, night after night, fashionable London migrated in the days of Nigel Playfair's greatness? Here was the home of the "insects" (literally as well as metaphorically), and no better example of true "theatre" is to be found anywhere in the world.

Whether or not the suggestions I have set forward may one day find incorporation in the production methods of the B.B.C. remains to be seen. As a disciple of an ancient art and a student of an ultra-modern one, I venture to hope they may.

New American Tubes and Valves

FEATURING electrostatic focusing, three new rectangular picture tubes are announced by the R.C.A. They are known as types 14GP4, 17GP4 and 20GP4, and require no focusing coil or focusing magnet, with resultant important savings in critical material.

Each of these new electrostatic-focus types uses an electron gun of improved design to provide good uniformity of focus over the entire picture area. Furthermore, focus can be maintained automatically with variation in line voltage and with adjustment of picture brightness. Need for alignment of a focusing magnet is eliminated, and therefore tube installation and adjustment for optimum performance are simplified. Because the electron gun is designed so that the focusing eletcrode takes very little current, the voltage for the focusing electrode can be provided easily and economically.

Type Numbers

The 14GP4 is of the all-glass type with external conductive bulb coating, has a maximum high-voltage rating of 14 kilovolts (design centre), and produces brilliant 11⅝in. by 8½in. pictures on a face made of Filterglass.

The 17GP4 is of the metal-shell type, has a maximum high-voltage rating of 16 kilovolts (design centre), and produces brilliant 14⅝in. by 11in. pictures on a relatively flat, high-quality face made of frosted Filterglass.

The 20GP4 is of the all-glass type with external conductive bulb coating, has a maximum high-voltage rating of 18 kilovolts (design centre), and produces brilliant 17¼in. by 13¼in. pictures on a Filterglass face.

Employing magnetic deflection, each of the three types has a deflection angle of 70 deg. and a horizontal deflection angle of 66 deg.

Technical bulletins on the 14GP4, 17GP4 and 20GP4 may be obtained from R.C.A. Photophone, Limited, 36, Woodstock Grove, London, W.12.

20-inch Rectangular Tube

The directly viewed, rectangular, all-glass picture tube 20CP4 is a 20in. tube, employs magnetic focus and magnetic deflection and has an ion-trap gun requiring only a single-field, external magnet. The deflection angle is 70 deg. and the horizontal deflection angle is 66 deg.

The 20CP4 has a maximum high-voltage rating of 18 kilovolts (design centre), and produces 17¼in. by 13¼in. pictures having high brightness and good uniformity of focus over the whole picture area.

A technical bulletin is available.

New Triode-Pentode Converter

A new, 9-pin miniature valve, type 6X8, containing a medium-mu triode and a sharp-cutoff pentode, is designed especially for use as a combined oscillator and mixer tube in television receivers utilizing an intermediate frequency in the order of 40 megacycles per second. In such service, a single 6X8 gives converter performance comparable to that obtainable with a 6AG5 as mixer and one unit of a 6J6 as oscillator.

The low grid-No. 1-to-plate capacitance of the pentode mixer unit of the 6X8 minimises feedback problems encountered in mixer circuits operating at an intermediate frequency of about 40 Mc/s., especially the troublesome feedback encountered when there is a small difference between the signal frequency and the intermediate frequency. The low output capacitance of the mixer unit permits the use of a high-impedance plate circuit, with resultant increase in mixer gain.

The 6X8 offers versatility to designers of AM/FM receivers. The pentode unit may be used in the AM section as a pentode mixer to provide high gain, and in the FM section either as a pentode mixer or as a triode-connected mixer depending on signal-to-noise considerations. The triode unit of the 6X8 makes a satisfactory oscillator for either the AM section or the FM section.

A technical bulletin is also available for this valve from R.C.A. Photophone, Limited.

Efficient Interlace Sync Separator

A Three-stage Circuit for the Experimenter

By L. F. ENGLEBRIGHT

THE circuit to be described in this article may be of interest to readers who, having built their own television receivers, are experiencing some difficulty in securing a steady, reliable synchronising pulse for frame oscillator triggering. The writer found that the majority of the orthodox sync separator circuits did not provide a consistent satisfactory interlace over a long period when used in conjunction with a transitron-Miller frame generator. This circuit requires a large pulse with a sharp leading edge to produce a well-interlaced flicker-proof picture. A number of sync separator circuits were tried which worked quite well, but could not be regarded as perfect. Experiments were therefore carried out with the object of designing a perfect interlace filter, using the minimum of components and keeping the circuitry comparatively simple.

The basic circuit employed was that shown in Fig. 1, utilising a surplus EF36 (VR56), and the main sync separator being the EF50 (VI). In this design it is important to ensure that the time constant of C1.R1 is 40 microseconds, and the values specified in the diagram conform to this requirement. Equally important is the bias applied to valve V2, since this stage must act as an amplitude discriminator. The valve has to operate at cut-off bias so that line pulses are prevented from entering the anode circuit and upsetting the frame sync. It is essential, for good interlacing, that no line pulses should appear in the frame sync circuit. The action of this stage is illustrated in Fig. 2, where the voltage at the grid of V2 is shown. It is apparent that the trailing edge of the first frame pulse is more positive than the trailing edge of any of the line pulses. The circuit is arranged so that, with V2 at cut-off, only the frame pulses are allowed to overcome the bias voltage shown by the dotted line, and consequently no line pulses can appear in the anode circuit. This inverse frame pulse (as it is called) is used to synchronise the frame oscillator. This is a well-known principle, and is extensively used.

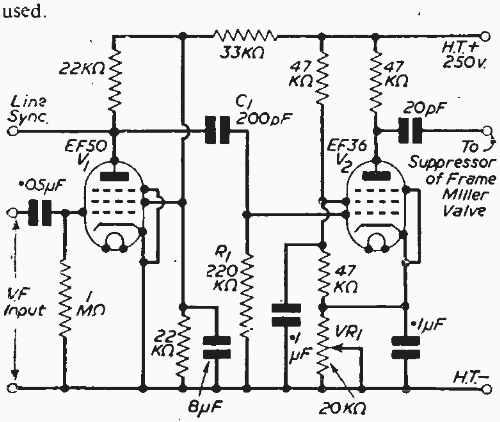


Fig. 1.—Original or basic circuit used by the author.

Interlace Fidelity

However, even with this circuit, the writer still encountered poor interlace. The bias of V2 had to be continually adjusted, and for this purpose VR1 was brought out to a convenient point at the rear of the cabinet, and was christened an "interlace fidelity" control. This continual adjustment during the course of a programme was extremely irritating, so after careful consideration of the design in Fig. 1, it was decided that the whole trouble lay in the fact that V2 was operating at cut-off bias. At this point on the valve characteristic curve, amplification is at its lowest. In addition, the

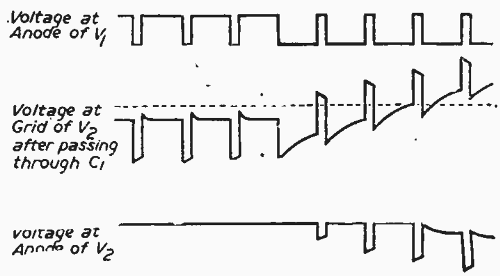


Fig. 2.—The action of V2 is illustrated in this diagram.

first frame pulse—the critical one for good interlacing—was necessarily of low amplitude. The solution finally decided upon was to use V2 as a high-slope amplifier, giving increased gain, and to use *just one more valve*—a miniature diode—as an amplitude discriminator.

The modified circuit is shown in Fig. 3. The VR92 can easily be suspended in the wiring, and takes up very little room. Before inserting this diode in circuit, it is advisable to examine the waveform to be applied to its anode. The writer used a home-constructed oscilloscope from war surplus parts to obtain a visual trace. If the time constant of the differentiator C1.R1 is correct, the pulses appearing at the anode position of the VR92 (with the valve removed) should be shaped as shown in Fig. 4a. The diode can now be inserted, and the frame oscillator valve should be removed from its socket.

Adjustment

VR1, which is now the 20 kΩ variable resistor in the cathode circuit of the diode, should then be adjusted until the oscillograph of the frame pulses appearing at the anode of V3 are of the form shown in Fig. 4b. As VR1 is rotated, it will be found that at one point line pulses begin to appear between the frame pulses. VR1 should be turned back until the line pulses are no longer visible, and this is the correct setting for the amplitude discriminator control. In practice, to allow for variations of circuit constants, it is advisable to set VR1 just a little short of the position where the unwanted line pulses disappear, to ensure that they are not likely to reappear after the receiver has been operating for an hour or so.

The EF36 (V3) is now being used as a high-slope amplifier, and the tiny initial positive pulses from the diode are now being amplified to such an extent that the frame oscillator triggers invariably on the first frame pulse, and correct interlacing is assured.

It is of paramount importance that no sound voltages should be allowed to enter into the circuits involved, because correct working may be seriously upset, the whole object of the interlace sync separator being thwarted.

Note that the condenser and resistor connected to the grid of the EF36 should be positioned as close as possible to the top cap, and the lead from the diode cathode should be screened, so that stray pulses from the line circuits are not picked up in the wiring.

The reason for the frame pulse being both negative and positive in Fig. 4b is the short time constant of the components connected to the grid of the EF36 (V3). The first pulse is the one that counts. It is a steep negative pulse of large amplitude, and its shape is maintained by choosing a relatively low value for the anode load resistor of V3.

One final point : the use of a valve between the EF50 sync separator and the frame Miller integrator is absolutely essential with the type of separator circuit shown, in order to avoid interaction between the two scanning circuits. The large pulses from the suppressor grid of the frame Miller valve can have a deleterious effect on the sync pulses to the line oscillator.

Checking

It might be as well before closing to remind readers how to check for correct interlacing. Some technicians recommend a study of the fly-back lines which should appear as single lines—not necessarily of various lengths or of the same length. A close inspection of the picture will sometimes show whether or not the lines are equally spaced (no "pairing"), but often the interlace varies with picture content or mains fluctuations. Probably one of the most satisfactory ideas is to reduce picture height slightly so that the top and bottom lines are just inside the mask edge. It should then be possible to see a half line at the top, starting at the centre and running to the right, and at the bottom there should be a half line starting at the left-hand edge and finishing in the centre. For the majority of transmissions these lines should remain perfectly stationary and the beginning and end of the two lines should be almost immediately above one another.

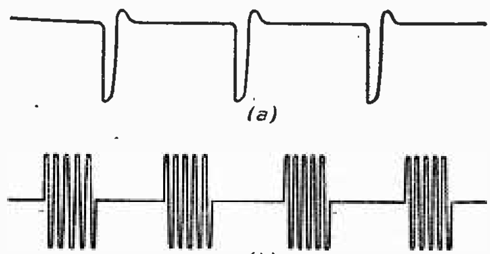


Fig: 4.—Waveforms for checking purposes.

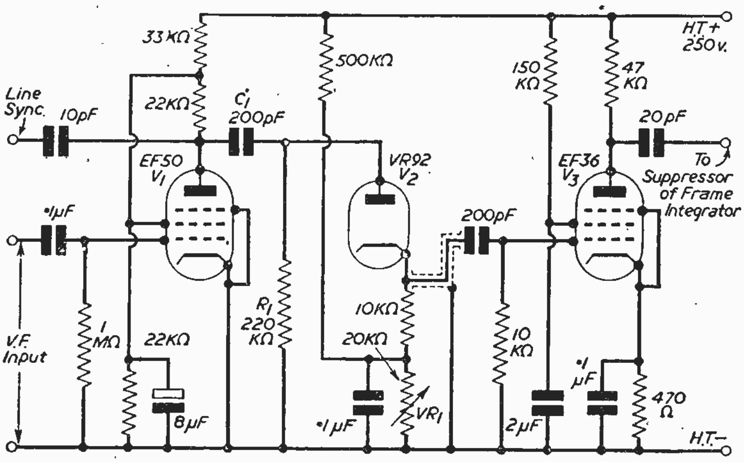


Fig. 3.—The final arrangement of the circuit.

Reports from the Clubs

BRITISH TELEVIEWERS' SOCIETY

MEMBERS of the British Television Viewers' Society attending the monthly meeting at Kennard's Restaurant, Croydon, on Monday, June 4th, were amply rewarded when they were addressed by Mr. Eric Fawcett, one of the B.B.C. Television Service's outstanding drama producers. In the course of a brilliant talk Mr. Fawcett gave details of his production of the opera "Pagliacci," which was also given later under his direction on the French television service. A question was asked regarding plays by American authors which he has produced, including the superb "Counsellor-at-Law," by Elmer Rice.

Members held diverse views on the matter of plays based on grim or sordid themes but it was generally agreed that such plays should be televised when they are truly representative of everyday life.

Mr. Fawcett was complimented on the excellence of his productions, many of which will be remembered and discussed for a very long time to come, and the meeting, the last of the present season, closed with a vote of thanks to the guest speaker proposed by the hon. treasurer, Mr. F. D. Brough.

NORTHAMPTON AREA TELEVIEWERS' SOCIETY

Hon. Sec.: G. T. Wilson, 95, Ennerdale Road, Spinney Hill, Northampton.

MEMBERS of the above Society visited Letchworth Television Society, when a dinner and dance was held at Icknield Halls on Thursday, May 17th.

Many well-known television personalities were present, including Avril Angers, Cyril Page, Eric Robinson, Stephen McCormack, Mr. J. W. Bell (Pye, Ltd.).

This Society is now affiliated to the British Television Viewers' Society. It is hoped to get well-known people down to a similar "Dinner Dance" to be held at Northampton in September or October. Members took their families down to the sea by coach on June 10th (Sunday).

The membership of the Society is now 200.

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HOW IT WORKS

The Amplitude Filter–1

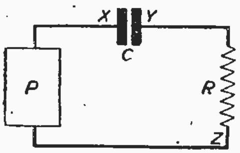
Details of One of the Most Important Parts of the Television Receiver

By A. DUNN

THE problems involved in the separation of the picture modulation from the synchronising signals are somewhat different from those concerned in the segregation of the line from the frame pulses. The resistor and capacitor, however, still have an important part to play.

In the previous article of this series the effect was observed of applying a series of pulses to a circuit of the type shown in Fig. 1, where R = 1 megohm and the pulse has an amplitude of 5 volts.

It is now proposed to take this analysis a step further by applying a sequence of pulses, the duration of which is equal to the interval between them. The effect is a square or rectangular waveform, similar to (h) Fig. 2.



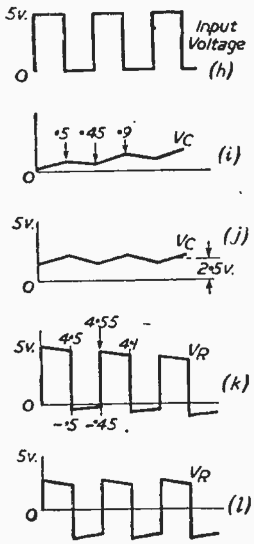
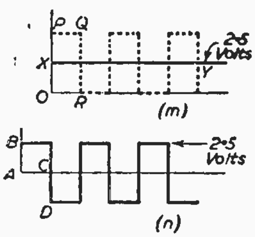


Fig. 1 (above).—The basic series circuit.

Fig. 2. (right).—Waveform variations due to capacitor action.

Fig. 3. (below).—The D.C. and A.C. components of a pulse signal.



The pulse period will be referred to as the positive half-cycle and the interval between as the zero half-cycle. Assume that the frequency is related to the time constant of the circuit so that the capacitor C (Fig. 1) will charge to one-tenth of the applied voltage.

During the first positive going half-cycle the Vc curve of (i) Fig. 2, which indicates the E.M.F. developed by C, will consequently rise to .5 volts (one-tenth of the 5-volt pulse). The effective anti-clockwise E.M.F. will now have dropped to 4.5 and the charging rate for this period will vary from 5 to 4.5 microamps (volts/megohms = microamps). As the input voltage collapses for the zero half-cycle the capacitor, discharging through R, loses one-tenth of its E.M.F., which drops to .45 volts. In this case the loss of charge was at the rate of only .5 to .45 microamps. So long as the charging current exceeds the rate of discharge, the effect of the signal will be a gradually increasing E.M.F. across C and the Vc curve will have a sawtooth form as shown. This, of course, cannot continue. Inevitably, a point will be reached where the charge accepted will equal the amount lost during two consecutive half-cycles.

Suppose Vc has developed an E.M.F. equal to 2.37 volts. Let the various voltages and currents which follow be tabulated as shown below.

TABLE I

	Positive half-cycle Begins.	Positive half-cycle Ends	Zero half-cycle Begins.	Zero half-cycle Ends
Input E.M.F. ..	5.00	5.00	0.00	0.00
Capacitor E.M.F. (Vc)	–2.37	–2.63	–2.63	–2.37
Effective E.M.F... (Vr) (P.D. across R)	2.63	2.37	–2.63	–2.37
Current in micro-amps	2.63	2.37	–2.63	–2.37

Observe that the effective E.M.F.s in columns 1 to 2, although of opposite sign, are identical in value with those in columns 3 to 4. The resultant currents are also equal and opposite in direction. It follows that the charge acquired is equal to that dissipated over one full cycle. Progressing from columns 1 to 4, Vc gains one-tenth of Vr (.26 volts) and loses a similar amount. It averages, therefore, 2.5 volts, and subsequent pulses produce only a variation of .13 volts above and below this value. The resulting undulations can be seen at (j) Fig. 2.

Consider C of Fig. 1 as the coupling capacitor and R the grid resistor in a stage of amplification. It is of considerable interest to observe how the pulse-signal emerges as Vr at points Y and Z.

The outline traced by Vr in (k) Fig. 2 represents the difference between the Vc curve at (i) and the input

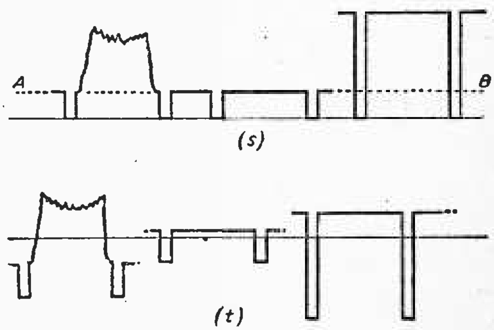
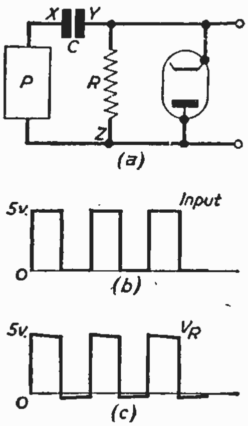


Fig. 4.—Three typical signal waveforms as they appear (s) after detection and (t) with D.C. component removed

E.M.F. at (h). The overall upward trend of Vc causes Vr to gradually sink below the zero line, the negative peaks increasing in amplitude. This process will continue until Vr has reached 2.63 volts. Reference can now be made to the appropriate line in Table I. The Vr values in columns 1 and 3 are equal and opposite in sign as are those in columns 2 and 4. The shape of curve (l) Fig. 2 obtained from the values given in columns 1 to 4 closely



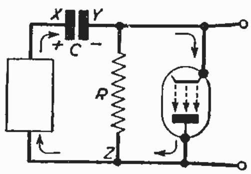


Fig. 5 (left).—The circuit of Fig. 1 with diode added.

Fig. 6 (above). — Diode conducts during zero half-cycle.

approaches that of the input waveform. It has, however, submerged until the projections on either side of the zero line are equal, and the positive and negative peaks fluctuate by .13 volts about the mean 2.5 volt value.

D.C. and A.C.

It may be advisable to agree to a precise definition as to the difference between the two waveforms shown at (h) and l) Fig. 2.

A steady potential of 2.5 volts is represented in (m) Fig. 3 by the line XY, while (n) shows an alternating voltage of similar peak amplitude. Adding these two gives the curve shown dotted at (m). Note that the two curves have their respective values at each moment added together—i.e., OX +AB gives point P, OX +CD gives point R (2.5 −2.5=0), and so on. The outline so obtained is a replica of the waveform of (h) Fig. 2. This, therefore, can be analysed into two parts: a D.C. component of 2.5 volts and an A.C. of 2.5 volts peak whose variations take place about zero.

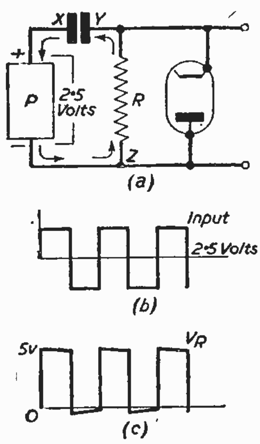


Fig. 7.—Action of circuit during D.C. restoration.

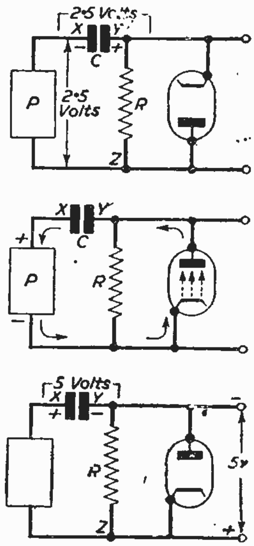
In the transmitted waveform the carrier amplitude varies between 30 per cent. and 100 per cent. of its maximum for the picture signal. The variation for the synchronising pulses is, therefore, from 30 per cent. to zero.

At (s) Fig. 4 three lines of the television signal are shown as they appear after detection. To the left, one line of typical picture, in the centre one black line and at the right one white line. The black level is shown dotted at AB.

The application of these waveforms to a resistance capacitance network should, from what has previously been said, result in the elimination of the D.C. component. The expected response appears at (t) Fig. 4. Observe that each curve settles down so that the area enclosed by the waveform on each side of the zero line is equal. Its ultimate position depends on the picture signal content, any variation producing a fluttering of the waveform about the zero line until equilibrium has been reached. For reasons which will presently appear, a voltage varying in this manner cannot be applied to the amplitude filter without seriously affecting its performance and critical triggering of the time bases, with the resulting sync pulses, is impossible.

Since it is desired to preserve the original form of the signal, action must be taken to prevent the capacitor of Fig. 1 developing a charge. If this could be accomplished all would be well and the voltage fluctuations across the resistor would be a more faithful reproduction of the original.

Let a diode be connected between points Y and Z of Fig. 5 (a) (Fig. 1 reproduced). The analysis which follows is simplified if the applied 5-volt signal is of the square form shown at (b). Subsequent developments will depend on the phase of the signal and the manner in which the diode is connected. Each condition will be treated separately.



Figs. 8, 9, 10.—Diode can be used to invert the waveform.

Condition 1

Retention of D.C. Component

The diode permits the passage of electrons in a clockwise direction from Y to Z.

The various voltages obtaining round the circuit during the application of one cycle of the waveform appear in Table 2 below.

Between columns 1 and 2 the capacitor acquires a charge of .5 volts (one-tenth of the signal), since the anti-clockwise electron movement is through R, the diode being non-conductive.

Vc becomes the effective E.M.F. at the onset of the zero half-cycle and the diode, its anode, now being

TABLE 2

	Positive half-cycle		Zero half-cycle	
	Begins	Ends	Begins	Ends
Input E.M.F.	5	5	0	0
Capacitor E.M.F. (Vc)	0	−0.5	−0.5 to 0	0
Effective E.M.F. (Vr) (P. D. across R) ..	5	4.5	−0.5 to 0	0

positive (see Fig. 6), acts as a short-circuit across R and causes the immediate discharge of C. This explains the collapse of Vc in column 3 of the table.

The above arrangement functions almost exactly as desired. The diode reacts immediately the positive period terminates. In practice the time constant of the circuit is chosen so that the capacitor develops only 2 per cent. of the applied voltage and the slight malformation of the Vr curve of (c) Fig. 5, obtained from the values in line 3, is largely eliminated.

Condition 2

Restoration of D.C. Component

Where the D.C. component has been lost through capacitor action in a previous stage, the behaviour of the diode is somewhat different. The alternating component of the signal appears at (b) and the circuit at (a) in Fig. 7. The positive half-cycle of 2.5 volts peak causes an anti-clockwise current through R and C charges to .25 volts (Y negative). The following negative half-cycle and consequent clockwise electron movement through the diode instantly reverses the charge in C to 2.5 volts (Y positive). At this point it will remain, apart from transient fluctuations as the signal alternates (see Fig. 8). The capacitor E.M.F. now acts in series with the positive half-cycle and in opposition with the negative to produce 5 volts and zero volts respectively across R. The Vr curve (c) Fig. 7 illustrates the recovery of the D.C. component.

Condition 3

Reversal of Phase

Where the phase of the input signal is in the wrong sense to meet the needs of the following circuits the D.C. restoring diode can be utilised to correct matters. The connections to the diode are such that it conducts on the initial 5-volt positive pulse (Fig. 9). Electron movement being in an anti-clockwise direction plate Y will become negative when the capacitor charges to the full value of the input. This voltage appears across R as the zero cycle commences (Fig. 10). The capacitor E.M.F., however, is equal and opposite in direction to the ensuing positive pulse which consequently does not appear in the output (Fig. 11 (a)). The Vr curve (c) in this figure illustrates the inversion of the input waveform (b).

It is now apparent that the signal waveform can, by the use of a diode be delivered practically unimpaired irrespective of the type of coupling used in the post detector stages. Further interesting information has also emerged. By suitably arranging the connections to the diode the signal can be made positive or negative going as required.

Attention may now be given to elimination of the picture signal, the device employed being referred to variously as a sync separator, limiter, or amplitude filter.

When a screened tetrode or pentode is operated with some 20 to 60 volts applied to the screen and 4 to 10 volts to the anode, depending on its characteristics, the anode current drops to zero when the grid is made a few volts negative. The current increases rapidly as the bias is reduced until it reaches a maximum value at which it remains more or less constant, as the grid potential is made more positive. A typical anode current/grid volts curve is shown in Fig. 12, together with the input waveform applied to the grid at point X = −3 volts.

Note that saturation, indicated by the flat upper portion of the curve, sets in at about −0.5 grid volts when the current has a value of .7 milliamps.

Assuming that the peak value of the applied signal is 10 volts then, as the sync pulse ends, it will rise

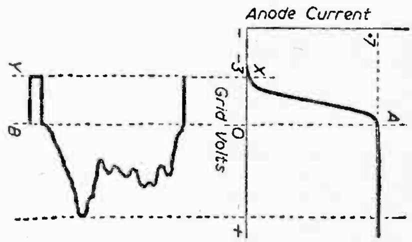


Fig. 12.—Valve characteristics required for sync separation.

instantaneously to 3 volts (black level). The grid of the valve will be driven in a positive direction to zero (point 0), and the anode current will jump from 0 to .7 milliamps (point A). Since all further voltage fluctuations during the picture cycle take place to the right of the line AOB, the anode current will remain substantially constant. At the onset of the next sync pulse, however, the input will drop to 3 volts (black level) and then to zero. The -3 volt bias will again appear and the anode current will cease (point X).

(To be continued)

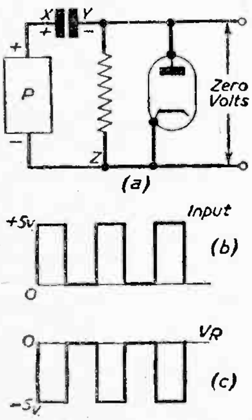


Fig. 11.—Another circuit showing the inverted waveform.

LONG-RANGE SO
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A Wide-band Low-noise Design for Use w

By T. M. I

THE following notes concern the circuitry of a vision and sound receiver for television reception at long range. No attempt has been made to deal with the layout or size of chassis as this article is intended for the more advanced constructor, who will have his own ideas as to how he wishes to lay it out.

The following points of design were considered to be of paramount importance : Full bandwidth, low "noise factor," full sound suppression on vision, high-oscillator stability and good quality sound with no trace of the vision signal on sound.

No attempt has been made to describe the "time bases" or "sync separator," but the output of the video amplifier has been designed to work into either the "Haynes" or the PRACTICAL TELEVISION sync separator and timebase circuits, which up to now the author has found to be among the best described for amateur construction.

To deal with the circuit : The R.F. stage is the "Cascode" circuit described by the author in a recent issue of PRACTICAL TELEVISION and no more time need be wasted on describing it. This R.F. stage is followed by another R.F. stage consisting of an R.F. pentode with its gain controlled by a 5KΩ variable resistance in its cathode circuit. This stage is in turn capacitively coupled to the mixer stage, which is a double triode. The reason for the use of this valve in the mixer circuit is because it is a quieter mixer than the pentode and also because one triode portion can be used for a vision mixer and the other can be used for a sound mixer. There is nothing unusual about this idea of using two mixers, and it has the advantage of the sound carrier being coupled electronically out of the vision I.F. If this were not done the sound coil, which is damped by the input circuit of the first sound I.F. valve, would tend to act as a rejector but with a rather broader tuning characteristic than the ideal.

The problem of drift is overcome in the oscillator circuit by the use of a push-pull oscillator which is mounted in a small box, and should be mounted in the set or cabinet away from any heat. As this is likely to be some distance from the mixer circuit the oscillator is link-coupled from the oscillator coil by a one-turn link. This is fed down a length of co-axial cable to the mixer grid coil, where it is injected into the mixer grid circuit by a two-turn link. Automatic bias for the mixer valve is obtained by the grid lead of 1 MΩ and the grid condenser of 100 pF. The 200Ω resistor and 1,000 pF condenser in the cathode circuit of the mixer valve are merely to protect the valve in case of a failure of the oscillator.

In the two anodes of the mixer stage are the two respective I.F. transformers. Dealing first with the vision I.F. frequency, it will be noticed that there are three stages of amplification, tuned anode with low values of grid leaks, and each stage is capacitively coupled to the next, the low value of grid leak providing the damping. Coupled to each of these I.F. stages is a sound rejector. The I.F. chosen is 15.5 Mc/s for sound and therefore the rejectors are tuned to this

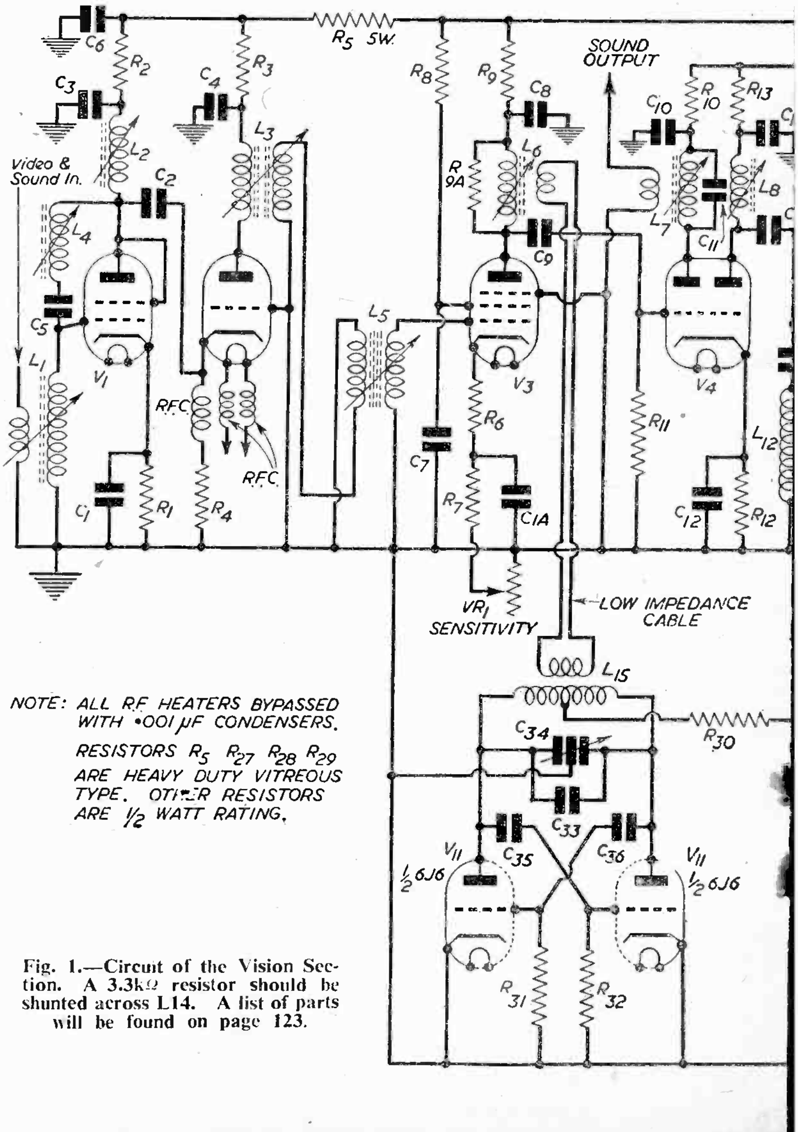


Fig. 1.—Circuit of the Vision Section. A 3.3kΩ resistor should be shunted across L14. A list of parts will be found on page 123.

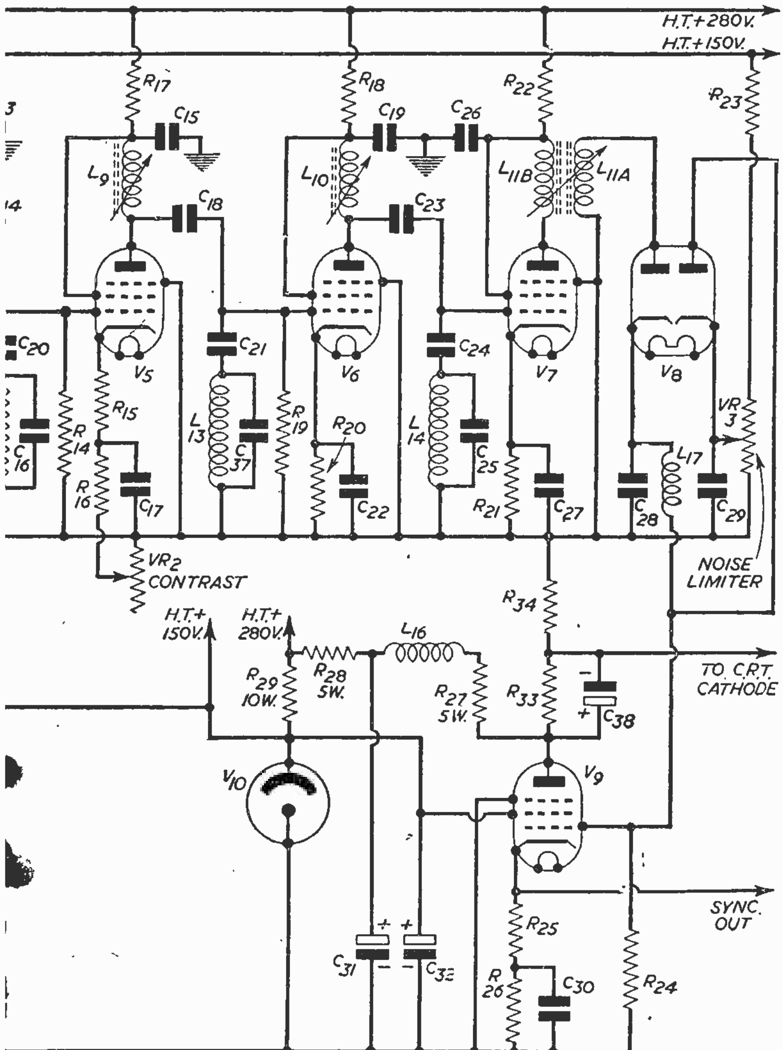
JND AND VISION VER

h Standard Timebases on Sutton Coldfield

RODWELL

frequency. The vision I.F. strip is staggered between 16 Mc/s and 19 Mc/s. The correct alignment of these I.F.s will be dealt with later. The vision signal is then passed to a double diode for rectification, one-half of the diode being used for this purpose and the other being used for the reduction of interference. The rectified signal is now fed via a filter network to the grid of the video stage, the grid resistor being 4,700Ω. The video valve is a 6AG7 and the anode load is 2,500Ω. This is decoupled by 1,000Ω resistor and a 16 μF condenser, and it will also be noticed that the anode circuit has included a compensating inductance. The screen supply to the video valve is stabilised by a VR 150/30—this stabilised supply also supplies the oscillator and mixer stages. The C.R.T. is fed from the anode of the video stage into its cathode. The sync pulses are taken from the cathode of the video valve.

There is no need to stick to this method of feeding the C.R.T. and sync separator If another type of sync separator is used the video stage can be driven negatively, its bias resistor reduced and a phase splitter added after the video stage, the C.R.T. fed from the anode and the sync separator from the cathode. The C.R.T. should be fed on the grid and the sync pulses are now positive going.



The Alignment

The I.F. stages should first of all be aligned. This should be done with the rejectors out of circuit. Mention should be made at this point about the slugs used in the coils. The coil formers specified are ¼in. diameter with screening cans; the slugs as supplied are dust iron, but as the wiring of various receivers may vary, and thus affect the stray capacity across the coils, it would be as well to obtain some OBA threaded brass rod and cut it up into slugs the same size as the dust iron slugs, cutting slots at each end. Should it be found impossible to tune the I.F. coils there will be no need to take any wire off the coil. Substitute a brass slug for the dust iron one, and no difficulty should be found. This expedient should not be resorted to in the case of the rejectors.

Remove the oscillator from the circuit, open up the video valve grid resistor at the earthy end and insert a 0.1 mA. meter in series with this resistor and earth, positive end of the meter to the resistance. Connect the signal generator to the grid pin of the mixer and feed in a signal at 16 Mc/s. There should be a reading on the milliameter. The I.F. stages should then be aligned as the accompanying graph shows; it will be noticed that there is a pronounced rise in the curve around 16 Mc/s and that the I.F. extends much lower than is required. This is because the rejectors are not yet in circuit. Having done this, connect the rejectors in circuit and align as the second graph. As the signal generator is swept from 19 to 16 Mc/s the reading on the meter should vary in sympathy with the graph. The rejectors should, of course, be aligned for minimum reading on the meter at 15.5 Mc/s. Now connect up the oscillator and the sound I.F. strip, inject a signal at

58.25 Mc/s into the aerial terminal of the receiver, rotate the oscillator tuning control and when the signal is heard at the sound receiver and a sharp dip is observed in the reading of the milliameter you know that the oscillator is on the right frequency.

The R.F. section can then be aligned in the normal manner and the final touching up can be done on Test Card C. A brief note about the sound I.F. section: this is a fairly normal arrangement, the first coil is coupled by means of a low impedance link to the sound mixer coil on the vision chassis. The sound I.F. section is separate from the vision strip. In all, it consists of six sharply-tuned circuits; these give adequate rejection to the vision signal. Two valves 6AK5 operated at a low anode potential are used as I.F. amplifiers, a 6H6 double diode is used as A.V.C. and noise limiter, and an EA50 is used as the detector. A 6C4 is used as a cathode follower, giving a low impedance output which is fed down a length of low impedance cable to the sound amplifier. This amplifier may be built in any manner the reader wishes, as no doubt each reader will have his own pet circuit which he will like to follow. The author's amplifier is shown for the sake of completeness. The reader would be well advised to follow the circuitry of the first amplifying stage; this is a triode operated in the grounded grid mode and gives an excellent match to the cathode follower in the I.F. strip.

It may seem to the reader that there are an unnecessarily large number of chassis in this receiver, but it makes for easier building, servicing and modification. In the case of the author's set, all units are separate and are connected by plugs and sockets, and to remove any unit on it is only the work of a few moments, no soldered connections having to be undone. If the reader wishes to incorporate a broadcast receiver in with the television and still use the sound amplifier that is in use—he should connect in parallel with the input

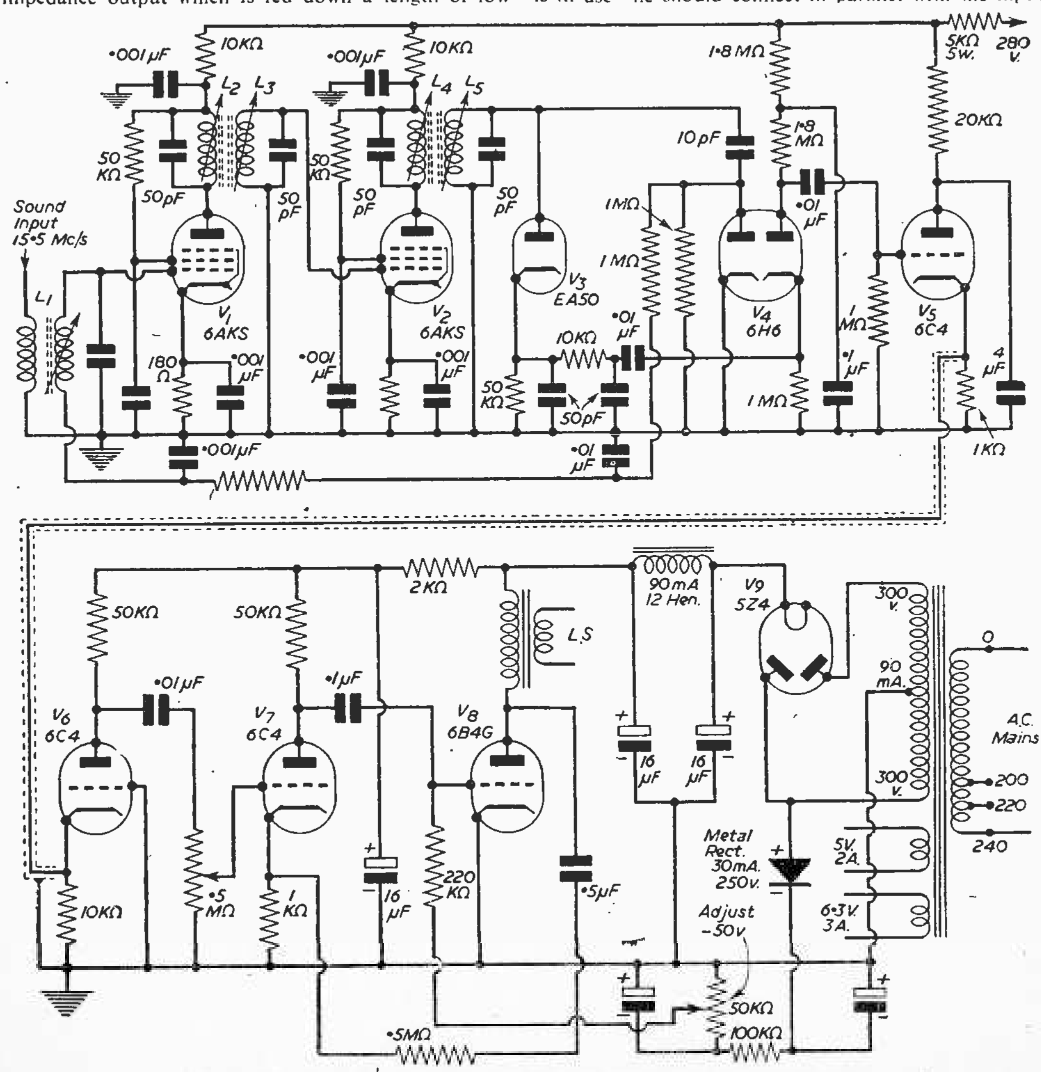


Fig. 2.—Circuit of the sound I.F. amplifier and sound amplifier power pack.

socket to the grounded grid amplifier another socket, and arrange that the output of the broadcast receiver he has built has a cathode follower and plug into the sound amplifier. When he wishes to use either the television or broadcast receiver there will be no need to switch the input from one to the other.

Coil Data

All coils except oscillator coil are wound on ¼in. Aladdin or Haynes formers with aluminium screening cans. L4 may, if desired, be wound on an open former.

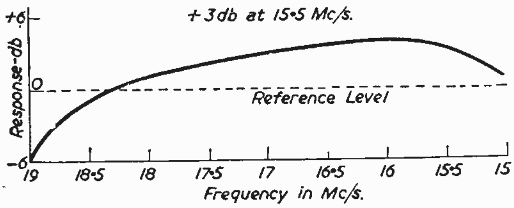


Fig. 3.—Response curve of the I.F. alignment before rejectors are fitted.

As all details for the cascode pre-amplifier stage have already been published in a previous issue of PRACTICAL TELEVISION, no details are given in this article.

LIST OF PARTS

R1 : 150 Ω.	**R17 : 4.7 KΩ.**
R2 : 10 KΩ.	**R18 : 4.7 KΩ.**
R3 : 10 KΩ.	**R19 : 3.3 KΩ.**
R4 : 150 Ω.	**R20 : 220 Ω.**
R5 : 4.7 KΩ.	**R21 : 220 Ω.**
R6 : 33 Ω.	**R22 : 4.7 KΩ.**
R7 : 220 Ω.	**R23 : 4.7 KΩ.**
R8 : 5 KΩ.	**R24 : 4.7 KΩ.**
R9 : 3.3 KΩ.	**R25 : 100 Ω.**
R9A : 3.3 KΩ.	**R26 : 100 Ω.**
R10 : 2.2 KΩ.	**R27 : 2.5 KΩ, 5 watt.**
R11 : 1 MegΩ.	**R28: 1,000 MegΩ, 5 watt.**
R12 : 150 Ω.	**R29 : 2,000 Ω, 10 watt.**
R13 : 2.2 KΩ.	**R30 : 10 KΩ.**
R14 : 3.3 KΩ.	**R31 : 22 KΩ.**
R15 : 33 Ω.	**R32 : 22KΩ.**
R16 : 220 Ω.	**R33, R34 : 47 KΩ.**

C1, C1A, C3, C4, C6 : 500 pF. TCC mica discs.
C2, C5 : 50 pF.
C7, C8, C10, C12, C13, C14, C15, C17, C18, C19, C22, C23, C26, C27, C30 : 1,000 pF. (if possible, tubular ceramics).
C5, C2 : 50 pF.
C9 : 100 pF.
C20 : 10 pF.
C11, C16, C25, C37 : 47 pF. negative temperature coefficient.
C21, C24 : 5 pF.
C28 : 10 pF.
C29 : .01 μF.
C31 : 16 μF. electrolytic, 350 v. wkg.
C32 : 8 μF. electrolytic, 350 v. wkg.
C33 : 50 pF. negative temperature coefficient.
C34 : 15 x 15 variable split stator, Eddystone.
C35, C36 : 15 pF.
C38 : 8 μF. tubular cardboard electrolytic.
VALVES
V1, 6AK5, V2, CV139, 6J6, ECC91, 6J4, etc.
V3, V5, V6, V7, EF91, Z77, or equivalents.
V8, 6AL5, D77, EB91, or equivalents.
V9, 6AG7. VR1, VR 2 : 5 KΩ.
V10, VR150/30. VR3 : 100 KΩ.
V4, V11, 6J6.

L5 8 turns 26 DSC 2 turn link tuned dust iron slug
L6 6 turns 26 DSC 2 turn link for osc. injection. Tune brass slug or dust iron depending on wiring capacity.

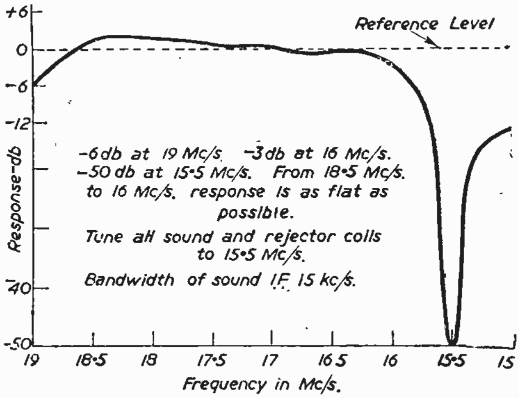


Fig. 4.—I.F. response after rejectors are tuned.

L7 18 turns 32 DSC 2 turn link sound output, tune dust iron slug.

L12—L13, L14. 18 turns 26 DSC. Vision rejectors tune with high "Q" dust iron slug. On no account is a brass slug to be used for tuning the rejectors.

L8, L9, L19, all 30 turns 32 DSC tuned with either dust iron or brass slugs to obtain the desired band-width.

L11a, 35 turns 32 DSC covered one layer Selo tape.

L11b, 32 turns 32 DSC wound over L11a.

L16, Video Boost, 180 turns 32 DSC single-section wave or pile wound. Tune with dust iron slug for maximum response at 3 Mc/s.

L17 (R.F.C.), 180 turns 32 DSC 3 pile wave wound.

L15, 8 turns 16-gauge tinned copper, ½in. internal diameter, air spaced to cover 7/10in., supported on C34, 2 turn link for osc. injection output.

New Zoom Lens

THE B.B.C. will shortly add permanently to its television outside broadcast equipment a new zoom lens. This device, when fitted to a television camera, enables any part of the scene to be magnified gradually up to five times its original size until a close-up view is obtained. The effect is as if the camera were moving towards this part of the scene, making it appear larger and larger until it fills the whole screen.

This lens is a prototype which has been tried out during selected outside broadcasts. It is a wholly British development and is the result of years of work on the part of its designer, Dr. H. H. Hopkins, a lecturer at Imperial College, London, and the makers, Messrs. W. Watson and Sons, Ltd., of Barnet, to whom Dr. Hopkins acts as optical consultant.

This new 5 : 1 zoom lens is a further improvement on the 2 : 1 zoom lens already in use by the B.B.C. which was an original development by Dr. Hopkins and Messrs. Watson's. Zoom lenses of various sorts are in use in film production and American television, but the special feature of the new zoom lens is that its ratio of 5 : 1 is appreciably greater than that of any previous lenses and, moreover, the sharpness of the picture is far in advance of any before seen or used.

From Electrostatic to Electromagnetic

Some Details of the Conversion and the Problems Involved

By B. L. MORLEY

THERE must be many constructors who are using ex-radar apparatus for their televisors: many of these employ an electrostatic tube such as the VCR97 and intend at a later date to convert to magnetic working.

A conversion of this nature is not difficult, though there are several important factors to consider, as the writer realised when he was presented with a job of this sort with the strict instructions to "keep the cost as low as possible."

Now apart from the mechanical features (tube mountings, etc.), the major factor was the conversion of the time base. This televisor, like many others made from ex-radar parts, used the popular Miller time base. The output from the saw-tooth oscillator was fed to the deflector plates by means of a paraphase amplifier (the well-known see-saw method).

It will be appreciated that with magnetic deflection power amplification is required, and not voltage amplification as is the case with electrostatic deflection. The simplest method of obtaining the necessary power would appear to be to feed the oscillator output into a power pentode or tetrode.

Unfortunately this is not possible; the output of the Miller time base is negative during scan This means that the grid circuit of the power pentode would change to positive during the fly-back with a consequent heavy negative on the anode. This negative builds up to a high figure due to the back E.M.F. caused by the scanning coils and thus the valve is forced through a region of low A.C. resistance on its characteristic curve. The circuit becomes very heavily damped thereby, and the fly-back period is prolonged.

There is a method of obtaining a positive-going signal from the Miller time base by a simple modification to the circuit, which uses a resistance in the cathode. This method was tried on the line time base, but it was found that the power generated was insufficient fully to scan the tube. For those who would like to experiment in this direction the circuit used is given in Fig. 1. The values of the components are given for the line time base. The oscillator is an SP61.

Having rejected the idea of using the existing saw-tooth oscillators all that remained of the time base was the D.C. restorer, the phase splitter and the sync. separator. By careful rearrangement of the circuit it was obvious that the first two items could be left out, leaving only the sync. separator. It was therefore decided to build a completely new time base.

The Circuit

Remembering my friend's instructions "keep the cost as low as possible," I searched round the spares box and decided the type of circuit I should use, after the search. It turned out to be a hard valve-type using blocking oscillators. The circuit is shown in Fig. 2. No special claims are made for it: it works and was built to suit the components on hand.

In order to effect the greatest economy possible the following points were observed:

The scanning coils were of the high-impedance type for the frame coils, which saves the use of a frame output transformer; the line coils were low impedance. One snag which arose from the use of these was that there appeared some interaction between the line and frame coils which produced a curtaining effect on the left side of the picture. Fortunately this was easily cured by connecting a 33KΩ resistor across each coil and earthing the centre point.

E.H.T. was obtained from the line transformer in conjunction with an EY51 rectifier, whose filament current was obtained from an extra winding on the transformer.

The chassis and tube supporting brackets were home-made from aluminium.

A permanent magnet focusing unit was used to save current in energising an electromagnet.

The circuit follows standard principles. The video output stage was altered, as shown in Fig. 2, so as to feed the cathode of the tube directly; the connection to the time base is made at this point. The cathode and anode of the detector existing in the vision receiver were reversed so as to obtain a correctly-phased signal, and video valve bias resistor increased to 300Ω

The sync. separator consists of two valves, the first one being a 6H6; the sync. pulse for the frame oscillator is taken from the second anode. The sync. pulse for the

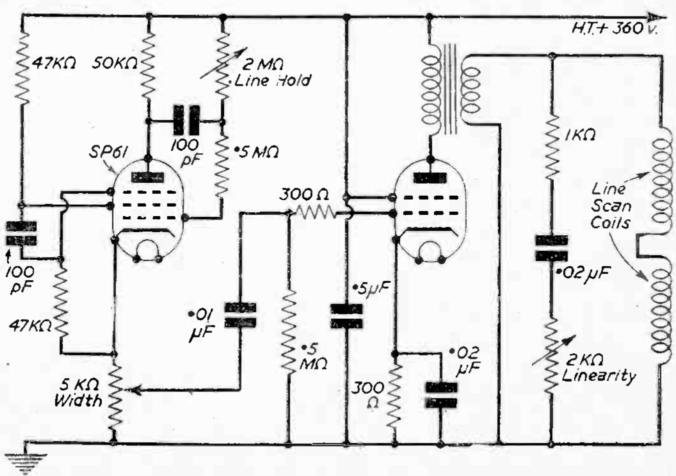


Fig. 1.—Experimental line time-base circuit.

line oscillator is obtained from the second valve (6V6). It will be noted that V2 is fed from cathode 1 of V1. This is to obtain a correctly phased sync. pulse for injection into the line oscillator.

An SP61 valve connected as a triode (used simply because it was available) forms the frame oscillator, the saw-tooth waveform being amplified by a 6V6. The anode load resistor is rated at 10 watts and the cathode resistor can be made of two 560-ohm resistors of 1 watt each (the resistors being connected in parallel) as a safety precaution. Both sides of C7 and C8 must be thoroughly insulated from the chassis.

The oscillator for the line time base uses an EF50 and feeds into an 807 power valve. The rating of the screen resistor is 10 watts and the cathode resistors 2 watts each. The width control is 4 watts.

The EY51 valve is mounted adjacent to the line transformer on top of the chassis and the EHT smoothing condenser close by. When fixing and wiring these components care was taken to avoid the possibility of corona discharges.

Connection between the video stage and the cathode of the tube was made in coaxial cable, the outer conductor being earthed.

Power Supply

Having built the time base the next move was to supply it with power. The electrostatic time base used an H.T. of 425 volts at 30 milliamps. The new circuit needed an H.T. of 400 volts at 160 milliamps—quite a considerable difference! The L.T. required 6.3 volts at 3.0 Amps, and as the old circuit supplied 6.3 volts at 3.5 Amps no alteration was required.

Now the original power pack comprised a single mains transformer which fed the sound and vision

MAIN COMPONENTS

Chassis—10in. x 14in. x 2½in.
T1—Osc. trans. (frame). Premier Radio.
T2—Line osc. trans. Haynes Radio, type TQ/116.
T3—Line output trans. Ediswan. type 72000.
Focus unit—Elac, type R25.
Tube—9in. G.E.C.. 6504A.

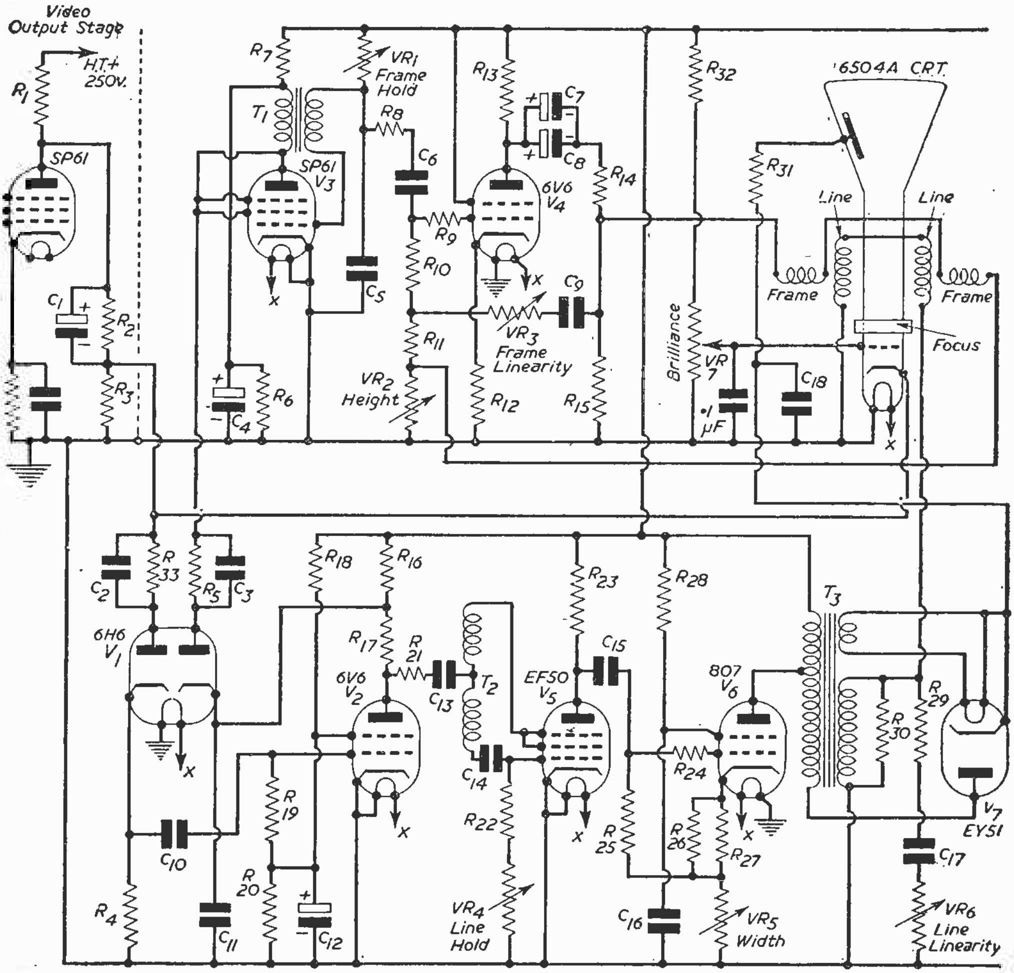


Fig. 2.—Complete circuit of the final arrangement.

receivers as well as the time base. This transformer was capable of providing 425 volts at 150 milliamps, so the whole of its output was devoted to the new time base.

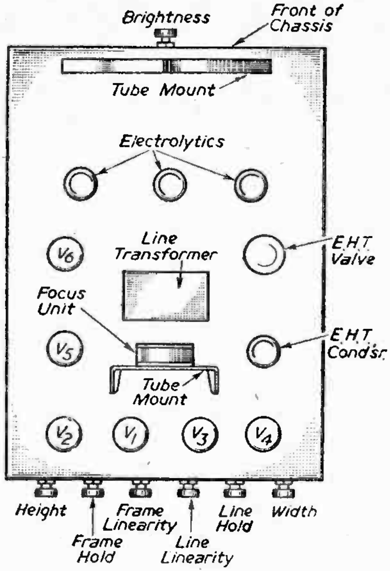
A new power pack was built to supply the vision and sound receivers. These required a supply of 250 volts at 120 milliamps. and this was met by using an ex-Gov. transformer which cost 17s. 6d. A 5U4G was used as a rectifier, but no smoothing chokes or condensers were required as these existed in the old circuit.

Fig. 3 shows the layout on the top of the chassis. The on/off switch was incorporated with the brightness control and the mains feed was properly fused.

A cabinet sold by Premier Radio was used to house the receiver in order to give it a professional appearance. Fig. 4 shows the disposition of the various units.

Cost

The total cost of the conversion, assuming that everything the spares box produced had to be bought, was £8 13s. This does not include the price of the cabinet and tube.



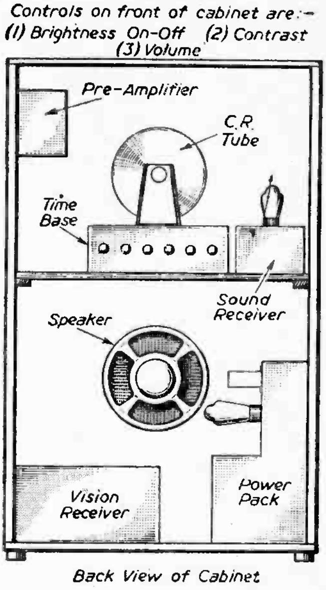


Fig. 3 (Left).—Plan view of the chassis and Fig. 4 (Right).—A rear view of the cabinet.

RESISTOR AND CONDENSER VALVES FOR FIG. 2

R1—4.7 KΩ.	R14—270 Ω.	VR1—2 MΩ.	C4, 12—8 μF.
R2, 3—47 KΩ.	R15, 30—33 KΩ.	VR2—5 KΩ.	C5, 9, 15—0.05 μF.
R4, 9, 20—22 KΩ.	R16, 18—220 KΩ.	VR3—2 MΩ.	C6, 16—0.1 μF.
R5, 19, 33—2.2 MΩ.	R17—10 KΩ.	VR4—250 KΩ.	C7, 8—32 μF.
R6, 21, 22—100 KΩ.	R23—220 KΩ.	VR5—2 KΩ, 6 w.	C10—0.25 μF.
R7, 31—47 KΩ.	R24—1 KΩ.	VR6—2 KΩ, 6 w.	C11—0.001 μF.
R8, 10, 11, 25—1 MΩ.	R26, 27—330 Ω.	VR7—250 KΩ.	C13—100 pF.
R12—270 Ω.	R29—1 KΩ, 6 w.	C1—4 μF.	C14—220 pF.
R13, 28—4 KΩ, 10 w.	R32—470 KΩ.	C2, 3—0.5 μF.	C17—0.02 μF.
			C18—0.01—7.5 Kv.

British Radio and TV for the World

RADIO, television and electronic equipment, which British manufacturers have done so much to invent and develop, is now exporting to the value of nearly 18 million pounds sterling a year and is reviewed in a booklet published by the Radio Industry Council (Great Britain) for circulation overseas in connection with the next National Radio Show at Earls Court, London, from August 28th to September 8th, 1951.

Ten Chapters

Twenty-five different aspects of the industry are touched upon, 10 chapters being devoted to television development in Great Britain and the remainder to radio and sound reproduction, communications and navigational aids, electronics in industry, science and medicine, valves and cathode-ray tubes, and components and accessories.

Illustrations

The 44 photographs cover all subjects including the B.B.C.'s VHF broadcasting station at Wrotham, Kent, in which AM and FM transmitters have been tried out side by side ; a portable television camera slung over the operator's shoulder ; a TV camera working from an aircraft ; the large screen television cinema projector ; permanent equipment for televising surgical operations ; the sound reproduction system in the House of Commons ; and the equipment in the cockpit of the "Comet" jet airliner.

Radar

In dealing with radar it is emphasised that this was a British invention entirely and that every major development of it has been British. Ships are now being equipped with British commercial radar at the rate of one a day.

Surplus Electrostatic Cathode-ray Tubes

Differences in Design and Details of Reference Numbers

By E. G. BULLEY

TUBES of this nature have been in abundance on the surplus market and have been within fairly easy reach of the amateur's pocket. This has enabled the amateur to construct oscilloscopes and similar equipment that have been described in previous issues of this journal. Such equipment is essential to the experimenter, and was, prior to the war, outside the range of the average amateur's pocket. However, this article is written to enable the reader to appreciate such tubes, with special attention being paid to their screens.

The cathode-ray tube is essentially a device which provides the means of indicating or plotting of one quantity as a function of another quantity. Such a tube comprises of a heater assembled within an oxide coated cathode sleeve. The former operates as in radio valve practice, that is to say, to heat the cathode and thus cause electron emission. This emission is controlled by what may be called a grid, which is located adjacent to the cathode. The presence of such an electrode controls the light intensity of the image that appears upon the screen, in other words, it can be said that it controls the size or magnitude of the beam current. This grid is usually a metal structure with an aperture, through which the electron beam passes. It is this beam that passes on to and through the various anodes that are located along the neck of the tube, the number of anodes are dependent upon the type of tube.

However, if such a tube has two anodes, anode number one is used for focusing the beam, and is a metallic cylinder made from nickel or some similar material. Anode number two is more or less identical in design, and its purpose is to increase the kinetic energy of the electron beam, so that when the electron beam strikes the screen a visible trace or pattern is produced. Before proceeding too far, it is as well to mention that the cathode, grid and anodes form what is known as the "electron gun" and can be described as being the means of producing an electron stream, as well as controlling, focusing and accelerating it. Furthermore, the grid and anodes act in a very similar manner to an optical lens, this being the reason why a small spot appears upon the screen.

Deflection Plates

Many amateurs will find that some surplus tubes have a third anode; this, in fact, enables the beam to have further kinetic energy imposed upon it after the beam has been deflected, and is, therefore, located between the deflecting plates and the screen. This anode, however, takes the form of acquadag coating on the inside of the bulb, the connection to this electrode being taken through the bulb.

The next consideration is that of the deflection plates. These electrodes consist of two parallel plates, each pair being set at 90 deg. to each other. Now it is the presence of an electrostatic field being created between each pair of plates that causes the spot to be deflected upon the screen. In practice, one pair are known as the horizontal plates, and the other the vertical plates. It can, therefore, be appreciated that in an oscilloscope, if a specified voltage is fed to one pair of plates and likewise another voltage is impressed upon the other pair, a trace on the screen will indicate one quantity as a function of the other.

The Screen

Our next consideration is that of the screen, which is a fluorescent coating superimposed upon the inside face of the tube. This, when struck by the electron beam, creates a visible trace.

Many readers have no doubt been puzzled, sometime or other, whether or not the screen is suitable for their purpose. The reason for this is that some tubes have a long persistence, where others have a medium or perhaps a short afterglow. However, as previously mentioned, this article is written to assist the reader in selecting his tube.

There are various types of tubes on the surplus market, some having commercial equivalents, some not. However, by dealing with the American types first, the reader will be able to appreciate that, in the number of the tube, the last figure and letter denote the actual characteristic of the screen. This can be clarified by carefully studying the following table.

TABLE I

Type	Screen Trace	Persistence
P1	Green	Medium
P2	Green	Long
P4	White	Medium Short
P5	Blue	Short
P7	Greenish Yellow	Long
P11	Blue	Short
P15	Blue Green	Very Short

A typical American tube is the 3BP1, this being the commercial equivalent of the CV814. It will be noted that the last letter and figure of the tube designation is P1, indicating that the screen has a medium persistence and a green trace.

The British tube designations, do not, however, have a standard for indicating the type of screen, as most manufacturers have their own valve or tube coding. It is as well to mention, however, that some British manufacturers do indicate the type of screen in the tube designation by having a letter "g" in the title, this indicating a green trace, etc.

However, to return to the surplus tube market, the designations of these tubes do not indicate the characteristics of the screens, but it is hoped that the following paragraphs may prove of assistance.

The surplus tube type VCR97 (CV1097) is perhaps the tube that has been in most demand by the radio amateur, this tube has a green screen and an afterglow of something in the order of one tenth of a second or less, and it can, therefore, be seen why it was most suitable for amateur constructed television receivers. A typical substitute for this type is the ACR13, otherwise known as the CV1385. However, to assist those interested, Table II provides data appertaining to screens and their characteristics.

TABLE II

Commercial Type	Surplus No.	Screen	Afterglow
3FP7 (U.S.A.)	CV1761	Greenish Yellow	Long
3GP1 ,,	CV516	Green	Medium
3API ,,	CV602	,,	,,
3EP1 ,,	CV817	,,	,,
5AP1 ,,	CV832	,,	,,
5BP1 ,,	CV601	,,	,,
5BP4 ,,	CV836	White	Medium short
5CP1 ,,	CV600	Green	Medium
5CP7 ,,	CV838	Green Yellow	Long
5GP1 ,,	CV839	Green	Medium
5HP1 ,,	CV3583	,,	,,
5LP1 ,,	CV741	,,	,,
5MP1 ,,	CV740	,,	,,
4201/4/6 (G.E.C.)	CV1097	,,	,,
,, ,,	VCR97	,,	,,
ECR60 (Mullard)	CV1097	,,	,,
,, ,,	VCR97	,,	,,
ACR10	CV1383	,,	,,
ACR13	CV1385	,,	,,
VCR511	CV1511	Blue-Yellow	Long

Some types have, however, an extremely long afterglow, especially those used in PPI. These tubes are not in great demand by the average amateur, whereas those with green screens and having a medium persistence are most suitable for oscilloscope work. Tubes having a white screen and a persistence of medium short, are most suitable for television and equipment where the tube has to be viewed for considerable periods. This screen does, to an extent, avoid unnecessary eyestrain.

Furthermore, any tube having a short afterglow and a blue screen is most suitable for photography purposes, where records of traces are required. This characteristic is due to the high actinic value of the screen, and the short afterglow is necessary to prevent what may be a foggy photograph.

Back Projection

BACK projection of scenery is now being tried out by the B.B.C. in one of the television studios at Lime Grove, Shepherds Bush. The equipment for those back-projection trials has been lent by D. & P., Ltd., from Pinewood Film Studios, and was first used in a television transmission on May 9th for the "Here's Howard" programme. It is also being used in the "Passing Show" series, and in Children's Hour and other programmes.

Back projection, or "process projection" as it is now often called, is widely used in the film industry to supplement scenery and real backgrounds. The process consists of projecting the image of a scene on to the back of a translucent screen to form the background; action then takes place in front of this screen, and the camera televises the whole scene, including actors, real foreground scenery, and the projected background.

Requirements

The basic requirements for successful back projection in a television production are the same as those for film production. The image on the screen must be bright enough for the camera in use, and the brightness must not fall off appreciably at the corners. Stray light must be kept to a minimum, or the contrast of the image is reduced to too low a value. The image must, of course, be perfectly steady, and the projector must not make any appreciable noise.

Other requirements which must be met if a realistic effect is to be obtained are that correct perspective should be maintained between foreground and background, and that the lighting should match. This calls for careful planning, and means that the slide for the projector must be made from a photograph taken to suit the desired foreground, or that the foreground should be arranged to suit an existing background photograph. Since the edges of the screen must never be shown, the action when the floor is to appear in the shot, must take place on a rostrum, or else the foreground scenery must be so arranged that the join between screen and floor is hidden.

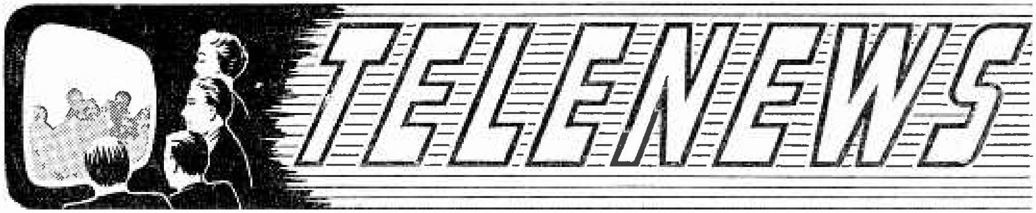
Camera Limitations

The amount of camera movement possible on a set employing back projection depends on the type of set, but is, of course, always limited by the edges of the screen. On a scene lacking in acute perspective, consisting of, say, a grassy bank on which the action takes place and a projected background of a distant landscape, the camera can be tracked and panned freely. On the other hand, a scene consisting of, for example, a colonnade in which the nearest few columns are real and the distant ones projected demands a fixed camera position. Most scenes fall between these two extremes.

18ft. Screen

At the moment the largest screen being used at Lime Grove is 18ft. wide, and using the projector lens of shortest focal length the required throw is 37ft. The studio floor space taken up when using back projection is, however, reduced by using mirrors to fold the light beam.

If back projection comes into general use it will make practicable some effects that are difficult to produce on painted backcloths and so give more scope to television scene designers.



Radio Show

A PORTABLE television camera no larger than the normal portable radio will be one of the features of the National Radio Show at Earls Court this year.

The show should be a great boost for the British radio and electronics industry and proof of this is given in the fact that £17,500,000 worth of equipment is exported per year, including specially built transmitters ordered from the United States.

New Transmitters

WHEN the new transmitter at Kirk o'Shotts is completed next year in Scotland, it will be the most powerful of its kind in the world. The mast, built on a site of about 25 acres, will be 750ft. high and as the ground there is over 900ft. above sea level, reception should be available to an area with a population of 3,500,000.

With the completion of the Wenvoe transmitter, 78 per cent. of the population will be within reach of television.

Radio Convention

A DINNER, attended by radio engineers and technicians from all over Europe and presided over by Admiral Earl Mountbatten, was held at the Savoy Hotel at the end of June, to mark the beginning of the Radio Convention to be held for a period of three months, being the largest ever held in Britain.

Reception in Holland

OWING to a freak change in the weather recently, television programmes transmitted from Leningrad and Moscow were seen by viewers as far away as Holland. The sudden change from fine to stormy weather enabled waves to travel much longer distances owing to the temperature differences of the upper atmosphere.

New Cinema Plans

PERMISSION is being sought from the Postmaster-General by a group of news theatres to televise public events by their own units for showing on their own cinema screens.

The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Television." Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed to: The Editor, "Practical Television," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

A licence cannot be granted before the question of copyright is finally settled.

No Colour Yet

FOLLOWING the announcement of the commencement at the end of June of regular colour television programmes by the Columbia Broadcasting System, it is also revealed that the B.B.C. has ordered equipment costing between £500,000 and £750,000 for experimenting in this field.

Until at least 85 per cent. of the population have the normal black and white service, however, a coloured picture cannot be expected here for some years and then only on a small scale.

British Television for Spain

SPAIN is to have a comprehensive television system which will provide both studio and outside broadcasts for Spanish viewers. An order for over £139,000 worth of transmitting, studio, radiation and outside broadcasting equipment has been won by Marconi's Wireless Telegraph Co., Ltd., who were recently awarded the contract to supply television equipment for the forthcoming Canadian system, and an order for television equipment for the United Nations Organisation, to be installed at their new headquarters in New York.

Broadcast Receiving Licences

STATEMENT showing the approximate numbers issued during the year ended May 31st, 1951.

Region	*Number*
London Postal	2,363,000
Home Counties	1,657,000
Midland	1,766,000
North Eastern	1,910,000
North Western	1,619,000
South Western	1,070,000
Welsh & Border Counties	731,000
Total England & Wales	11,116,000
Scotland	1,116,000
Northern Ireland	208,000
Grand Total	12,440,000

The above total includes 869,200 television licences.

Britain's Secrets

AT the B.B.C.'s research station at Kingswood Warren, Reigate, recently, 400 scientists, including Government officials, viewed some of Britain's latest secrets in radio, including colour and big-screen television and open-air photography for television over extra long distances.

9in. Tube

ALTHOUGH it was recently stated that the 12in. tube was to be standardised, this does not mean that the 9in. tube will become obsolete. Replacements for the latter will, we understand, be available for a long time, in the same manner as for old valves.

Crime and Television

IN New York State, recently, a policeman was shot by a man escaping with a stolen truck. A photograph of the truck was televised from five stations and following information submitted by a viewer, a suspect was charged with the murder 10 miles from Albany.

More Test Transmissions

LAST month, an additional test transmission was begun between 4 and 5 p.m. every day except Sunday.

Although only the "bars" were shown at first, it was hoped that the test card would be transmitted later. For a long time, the R.T.R.A. had requested the B.B.C. for longer periods of test transmission in order to assist technicians and engineers dealing with the repairing and installation of receivers, and now the extra hour in the afternoon will mean continuous television from 3 to 6 p.m.

For All to See

A RECENT programme in America entitled "Bride and Groom" showed viewers the full wedding ceremony between a college student and his betrothed, including the slipping on of the ring and the driving off for the honeymoon.

Impressions of American Programmes

LAST month, Mr Cecil McGivern, Television Controller for Britain, visited the U.S. and returned with a full report on American methods of programme planning.

Although, in the opinion of Mr. McGivern, documentaries, serious talks and discussions are better in Britain, the Americans are better where true variety and entertainment are concerned.

B.B.C. v U.S.A.

THE main advantage that the American viewer holds over his counterpart in this country is the great number of stations he can pick up on his receiver, whereas the British viewer has but one. Also, television in the States lasts for 15 hours per day compared with an average of four and a half in this country.

Aerial Trouble

MANY companies owning large blocks of flats in London prohibited the use of outdoor aerials to avoid the ugliness which would result from too many set owners in one block.

Now, however, following complaints from tenants receiving poor reception on indoor aerials, some companies are arranging for a wiring system to be installed so that one aerial suffices for one set of buildings.

Holme Moss Almost Ready

IT is hoped by the B.B.C. that transmission from the new Holme Moss transmitter will begin some time in the autumn, September 29th being mentioned as a probable date. Programmes for the opening ceremony are being drawn up in London.

Back Projection

SINCE the announcement in this column recently of experiments in back projection, conducted at the Lime Grove Studios, Shepherd's Bush, this method of producing background scenery has been used in such productions as "Here's Howard" and "The Passing Show."

In Parliament

AMONGST questions asked recently in the House was one by Mrs. Jean Mann, who asked the Postmaster-General what action he proposed to take on the Report of the Estimates Committee relating to the proposed television station at Kirk o'Shotts. Mr. Hobson replied that until the Government had considered the report and arrived at a conclusion no statement could be made.

Mr. Hobson said that some minor delays in the delivery of components had not held up progress in the erection of the television station at Wenvoe, and completion according to programme in mid-1952 was not thereby affected.

Export to Mexico

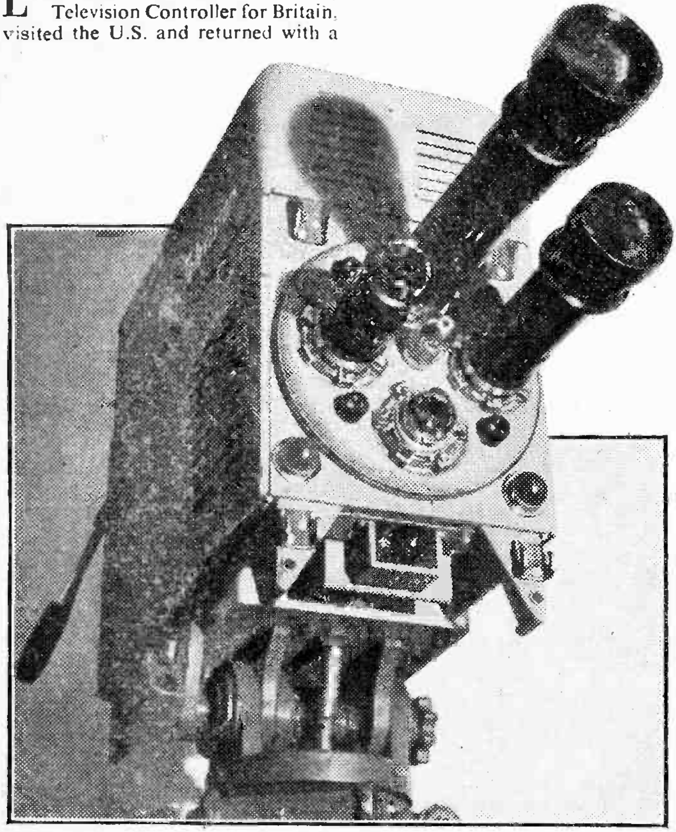
A MEXICAN firm, Cia. Mercantil Campbell, S.A., of Popocatepetl, 131, Mexico, wish to import British receivers made to operate on American standards—525 lines, 60 frames, etc.

R.C.A. Patents in U.K.

ARRANGEMENTS have been made by Electrical and Musical Ltd., to grant licences for television and sound receivers under all patents of the Radio Corporation of America, in Great Britain, Eire and Northern Ireland concerning inventions made both on and after the 1st January, 1945.

TV Affecting Cinema

AN American producer who recently visited England stated that one of his houses in Chicago had been forced to close because of the impact of TV and the hire-purchase money involved in it.



One of the new compact Marconi television cameras which are being supplied to Canada.

VALVES

6V6G, 6V6GT, 5Z4M, 1T4, 3S4, 1S4, 1R5, 1S5, 78, FW4/500, 6F6, 5U4, 6X5, VU39, 6C6, 6D6, VR150/30, 42, 80, 1C5, 0Z4, PEN46, 25A6G, 82, 25L6G. ALL AT 9/- each.
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1NL5, 7Q7, AC6PEN, EF39, EF36, EL32, 77, 41, 6SK7, KTZ41, MH41, EBC33. ALL AT 7/- each.
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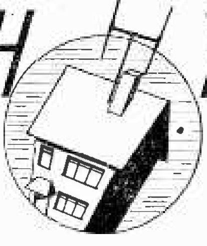


By Iconos

THE popularity of the Royal Family is reflected in the large amount of space in newspapers and magazines devoted to them. Recent statistics have revealed that about 22 per cent. of the footage of newsreels is concerned with Royalty, and the favourable reaction of cinema audiences endorses the newsreel editors' choice. Television has followed suit, and one of the highlights of this year of TV has been the transmission of the Trooping of the Colour. The telefilm of the event, transmitted the same evening, was also successful, though the choice of shots was not so varied as in the cinema newsreels and the close-ups of H.R.H. Princess Elizabeth not so effective.

FILM AND TELEFILM

THE quality of telefilm recording is improving steadily and the time is fast approaching when direct cine-camera shots can be intercut with telefilm recordings to give greater variety and pace to the TV newsreel. TV cameras are at present necessarily larger and more cumbersome than the small hand-held clockwork-driven newsreel cameras. Furthermore, the choice of TV camera positions is restricted by the cumbersome cables and large TV vans. The B.B.C. newsreel department now possess a large number of portable cine-cameras capable of giving first-class results without the use of a tripod, together with a good selection of special "gadgets" such as zoom lenses, camera cranes, telephoto lenses, combined sound and picture cameras and 16mm. equipment for special shots. The British clockwork-driven Newman Sinclair camera and the German battery driven Arriflex camera are probably the most useful all-round newsreels cameras, and the B.B.C. has several of them. Close-ups and extra shots obtained on these cameras could be "cut in" to the edited telefilm recording.

FROZEN ACTION

BY the elaborate process of optical printing, cinema newsreels are able to "freeze" action at certain moments of great interest. For instance, the last few yards of a great race can be repeated in semi-slow motion by re-photographing each film frame three or four times on an intricate instrument called the optical printer, and at the point of maximum interest—where a jockey falls—the picture can be frozen and held for critical examination by the audience. Similarly, a knock-out in boxing or a crab-catching episode in a boat race can be metaphorically put under the microscope. These processes can also be used by the TV newsreel, with the added advantage that slowing down or "freezing" processes could be manipulated on the B.B.C.'s Mechau film reproducers, if necessary, without special optical printing. In some of the little Pathé 9mm. home projectors there is a punching device which automatically holds a frame of picture for about ten seconds, for displaying inserted titles or other static shots, and then resumes film travel until the next "freeze punch." The principal object of this device was to economise in footage on views which were entirely without movement, and to treat them as lantern slides. Such a gadget would be of special use to the TV newsreel editors, and I hope the B.B.C. will take a note of this.

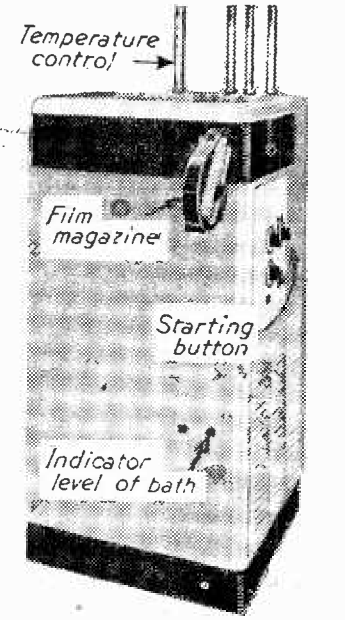
Recent visitors and returned travellers say that British telefilm recording is still well ahead of American telefilm results—known over there as "Kinescope recording-ing." Let us hope the very live B.B.C. TV film section will maintain the lead, with gadgets as well as steadily improving the picture-recording equipment. The Trooping of the Colour made one sigh for colour TV to reproduce the event in all its glorious "Teeveecolor"—but that development seems to be a thing of the very distant future.

BIG SCREEN TV IN U.S.A.

MEANWHILE, big business has taken a hand in U.S. television progress in its usual big way. Republic Pictures, one of the big American film-producing companies, has decided to release both new and old pictures for television, and has probably already concluded satisfactory business deals with several television networks. The cinema theatre interests answered this by buying up the television rights of the heavyweight boxing bout between Joe Louis and Lee Savold for big screen television, ordinary home television being barred. Thirdly, the R.C.A. have announced that they are evolving a system of coin-in-the-slot TV, by which it is also hoped that the "box office" values of different programmes can be assessed.

SERIES PROGRAMMES

APART from the big sporting events, the series type of programme, in which the same main characters appear each week, seems to be the most popular. Over here



One of the special high-speed processing tanks referred to on the next page.

we seem to have less of this type of production—the TV public having tired of some of them, with the notable exception of "Picture Page." The TV documentary series of features lacks the general appeal of "Scrapbook" and other sound radio series, largely owing to the propaganda hobby-horses ridden by the writers or authors. Attempts at TV family serials, on the lines of the Huggets, have lacked the appeal of Mrs. Dale's Diary. I have often wondered whether a dramatic series based on the Adventures of Sherlock Holmes would "catch on." The immortal detective has become popular again and his famous consulting rooms have been reconstructed as a part of Festival of Britain attractions. True, Sherlock has been seen on the stage and screen many times, but I am not aware that he has ever been a box office failure. William Gillette, Eille Norwood, Arthur Wontner and Basil Rathbone have played the part on stage and screen. Who, of our regular TV actors, would make a good Holmes and Watson? My vote would go to Reginald Tate as Holmes and Michael Shepley as Watson. Many years ago there were three silent film series of Sherlock Holmes films, totalling no less than forty-five two-reel (half-hour) episodes taken from the Strand Magazine short stories. The setting was modern and not in keeping with the original gas light and hansom-cab atmosphere of the stories, and Holmes, played by Eille Norwood, dashed about in taxis and used the telephone. But he still sought inspiration with his violin and asked Watson to pass the hypodermic before he solved his mysteries. "Elementary, my dear Watson," he would say, and the explanation given to the amazed Watson (and the audience) would clear up the weekly crime problem.

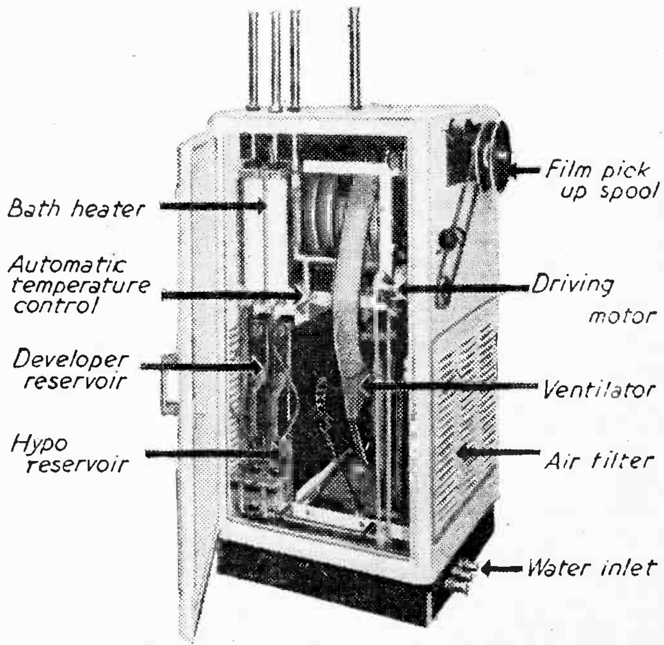
HIGH SPEED PROCESSING

ONE of the bi-products of the intermediate film process of big screen television has been the improvement in developing and printing film. The intermediate film system, in which a 16mm. negative was photographed and scanned, electronically reversed into positive and then transmitted, was one of the first high definition systems used by the Baird Company in England. This method has long been abandoned at the studio end of television but has regained popularity at the receiving end in connection with big screen television. The principal advantage of the system is the big increase of light available by making use of high-intensity arc lights, giving an incident light measurement on a large cinema screen of upwards of 20 foot candles. Nothing approaching this value can be obtained by direct TV projection at the moment, 8 foot candles being about the maximum figure—requiring a silvered screen instead of the usual opaque white screen, perforated for sound transmission. Until quite recently the high-speed developing machines have been rather of a hay-wire lash-up type. The automatic film developing machine is no recent invention and one of the very first was invented by Cecil M. Hepworth, the famous film pioneer. His machine was a big affair which developed, fixed and washed film, but, curiously enough, did not dry it. The wet film was festooned from the ceiling of a heated drying-room in a most primitive fashion. Since that time, drying cabinets have been added to this type of machine and the developing baths have been fitted with spray-jets, which almost atomises the developing solution as it is applied to the film. But these machines were large and not fast enough for intermediate film process television, and hot developing solutions and various other methods have been introduced to reduce the processing time from about an hour to a few minutes.

STREAMLINE DEVELOPING MACHINES

DURING the last few weeks the French camera engineering firm of Debrie introduced a new high-speed developing machine of streamlined design. It is quite a small affair, looking like a large refrigerator, and, as the designers say, is neat and clean and can be used in your drawing-room! The film magazine of exposed film is clamped on one side of the cabinet and a foot or so of film inserted into a slot. The mechanism then takes charge of it and automatically—without the usual "leader"—the film finds its way through the machine and comes out the other end, dry and ready for use.

This is the kind of thing now available for the B.B.C. newsreel and will give the TV film department complete mastery over its own affairs. In the meantime, if an important news story "breaks" at a week-end the commercial film laboratories cannot always handle it for Trade Union reasons, and the negative has to be flown to the Continent for processing. Fantastic, but true!



Details of the high-speed processing tank referred to above.

KIRK O'SHOTTS STATION

Some Official Details of the High-power Scottish Transmitter

THE television transmitting station now being built at Kirk o' Shotts will be the third high-power station to be completed under the B.B.C.'s post-war plan for the expansion of television coverage; when it is in service more than 70 per cent. of the population will have been brought within reach of television. With the completion of the fourth new station at Wenvoe next year this figure will be increased to 78 per cent.

Ready by 1952

Construction at Kirk o'Shotts began last year, and it is hoped that the station will be ready to start broadcasting television programmes early in 1952. The site is 900 feet above sea level, about 17 miles from Glasgow on the Edinburgh-Glasgow road. Many other sites were investigated by the B.B.C's research engineers before this one at Kirk o'Shotts was finally chosen. The possibilities of the more likely sites were investigated by setting up at each a mobile transmitter which radiated test signals from an aerial suspended by means of a balloon 600 feet above the ground and recording the strength of the signals received from it, using a van in which a continuous recording could be taken as the surrounding countryside was toured. From these records field-strength contour maps were prepared showing the probable service area that would be obtained with a high-power transmitter at each site, so that the merits of each could be compared.

The site covers an area of about 25 acres, and on it are being constructed a building for the transmitters, an annexe for a sub-station and garage, and a 750-foot mast to carry the transmitting aerial. In plan the main building is similar to those at the Sutton Coldfield and Holme Moss stations, being shaped like an L. One wing is for the transmitters and their associated equipment, while the other will be for offices, a viewing room, and amenities for the staff.

The building contractors are McLean and Co., of Wishaw, Lanarkshire.

Duplicated Equipment

In the main building there will be two transmitters one for vision and one for sound, designed and manufactured by Electric and Musical Industries, Ltd., and by Standard Telephones and Cables, Ltd., respectively. The vision transmitter, with a power output of 50 kilowatts, will be the most powerful television transmitter in the world. Its valves will be air-cooled, except for those in the output stage, which will be water-cooled, and it will employ low-power modulation. In addition, low-power transmitters for both sound and vision are to be installed as a stand-by.

The electricity supply for the station will be from the British Electricity Authority. Two independent supplies are being installed so that in the event of an interruption on one the station will still be able to carry on by changing over to the other.

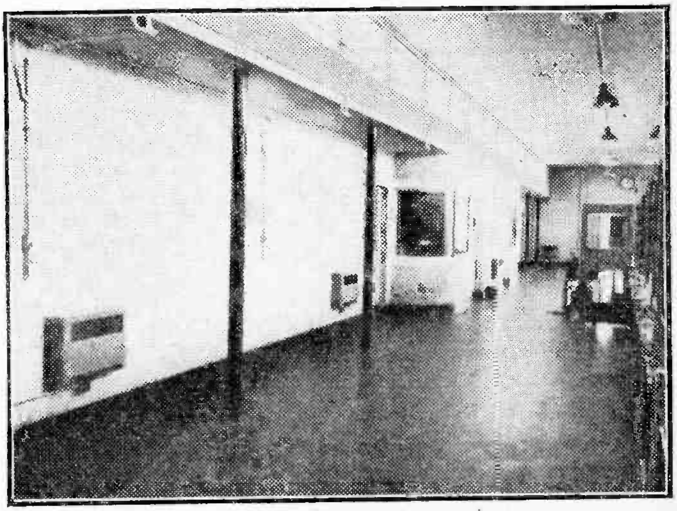
750-foot Mast

About 25 yards from the main building is the mast for the transmitting aerial. This mast, when completed, will be 750ft. high and will have an all-up weight of over 100 tons. For the first 610ft. above the ground the cross-section is triangular, each face being 9ft. wide; above this there will be a cylindrical section, 100ft. high and 6½ft. in diameter; and finally a tapering square-section topmast, 40ft. high, to which will be fixed the transmitting aerial. In the surface of the cylindrical section there are to be 32 slots forming a V.H.F. (very-high-frequency) aerial system designed by the B.B.C. for use with a V.H.F. transmitter for sound broadcasting if this is installed at Kirk o'Shotts in the future. The mast is held vertical by four sets of stays of pre-stressed steel wire rope, some of which weigh as much as 9lb. per foot run. In the main, the mast is similar to those at the Sutton Coldfield and Holme Moss stations. Following the usual practice, the base is located by a small steel ball mounted in a socket, forming a pivot which allows the mast some angular movement in high winds. The mast was designed and is being erected to the B.B.C.'s specification of structural requirements by British Insulated Callender's Construction Co., Ltd.

Eight Dipoles

The transmitting aerial from which both the vision and sound components of the television programme will be radiated has been designed in co-operation with the B.B.C. by Marconi's Wireless Telegraph Co., Ltd., who will erect it to the B.B.C's specification. It will consist of eight vertical dipoles arranged in two tiers, each dipole

(*Continued on page* 140)



The main Transmitter hall at Sutton Coldfield upon the lines of which the new Scottish station is being modelled.

Correspondence

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

THE "CASCODE" AMPLIFIER

SIR,—I am in a rather difficult position in the discussion concerning the "Cascode" circuit. Mr. Thomasson in his last letter "lays down the discussion" then proceeds to pick it up again. Consequently, although naturally I am only too willing to avoid this "home-work," I find myself unable to do so. Again I will deal only with the points in Mr. Thomasson's letter, and in the same order as he writes. In putting to some use an impedance in the grid lead of a valve, this valve no longer operates as a grounded grid stage and I would have thought that this was so obvious a fact as to brook no argument. It is possible to neutralise, with a suitable circuit, the actual connection impedance of a grounded grid stage, indeed I have no doubt that one can also reverse its sign if desired. At television frequencies a valve can and will operate as a grounded grid stage, also at television frequencies it is not by any means impossible to measure all of the values precisely and to employ these values in determining what performance should be obtainable.

Concerning my suggestion for receiver testing: Mr. Thomasson, in providing an example to show what he terms a "trap" in employing this method for checking the response of a television receiver, uses arithmetic to suit his own purpose. The inaccuracy which he states is possible, cannot exist if the fixed frequency signal generator is correctly adjusted and he gives himself the usual method for achieving this. The method he suggests as an alternative will not work unless the signal generators are of a most unusual and undesirable type. To modulate directly a signal generator at frequencies up to 3 Mc/s assumes circuit values which almost certainly will not obtain in a reasonably efficient oscillator as fitted to such units. I am sure, as Mr. Thomasson states, that the response tends to fall off at the higher modulation frequencies. Indeed it will almost certainly fall to zero before the modulation frequency is high enough to be of any value for receiver testing. Apart from this difficulty there will be present an undesirable degree of frequency modulation. I would also mention that when adjusting the frequency of a signal generator by beating with a B.B.C. transmitter a zero beat should not be expected and if it is obtained pulling of the signal generator's oscillator can be suspected which will, of course, produce considerable inaccuracy of adjustment.

In concluding I must add that Mr. Thomasson and I are in complete agreement on one thing, we are shaken by Mr. Lambert's careless rejection of the "Cascode" circuit, but we are still convinced of its superiority.—S. S. WEST, M.B.E. (Gt. Yarmouth).

SIR,—I cannot agree with Mr. West's closing statement in your last issue; he states that a grounded grid amplifier at television frequencies is inferior to the normal R.F. stage.

I maintain that it is, in fact, much superior. For example, connected as an input stage, it offers an input impedance of only a few hundred ohms, compared with several thousands on the grounded cathode R.F. stage, a factor of considerable advantage in V.H.F. work.

Further, the output impedance remains high, and oscillation is practically non-existent, due to the earthed grid between input and output circuit. It is an extremely simple circuit requiring a minimum of components and in view of these advantages is, in my humble opinion, to be preferred to any other method.—G. BULLAND (Hounslow).

VCR97

SIR,—Mr. J. L. Farrant would like other readers' experiences regarding the VCR97. I made my own receiver 16 months ago, using this tube. EHT was 2,000 v. or slightly under, the L.T. was 4 v. exactly. After having been in use for seven months I found the brilliance was getting worse day by day. After approximately eight months the tube emission was very bad. When turning the brilliance up I got a negative picture, blacks turning white and vice versa. I decided to buy another tube, thinking the first one faulty; a new one taken from a crate and installed has gone exactly the same after approximately seven months' use. It seems I have to buy yet another tube and will have to keep on doing so every few months. Has any other reader had the same experience and can anyone help?—P. JENNINGS (Birmingham).

"ARE WE WATCHING ANOTHER WORLD?"

SIR,—I have read with interest the correspondence in your magazine under the above heading. Your correspondents appear to have overlooked the fact that to be of value the picture size must be related to viewing distance. It is the angle subtended by the screen to the eye which is important.

Mr. E. F. Worker states that a 4ft. x 3ft. screen is normal for amateur ciné projectors in the home. I would doubt this, or, if it is the case, would suggest that in most instances the screen is too large for comfortable viewing. I personally use a screen of this size, but am able to use a room for projection where the spectators can be seated at least 12ft. from the screen. This is exceptional for the average house, and I find when showing films in other rooms that it is necessary to use a smaller screen to avoid eye strain.

In regard to television one finds that in most homes the set is within about 6ft. or 8ft. of the viewers. At this distance the angle subtended by a 12in. tube is about the same as that subtended by a standard cinema screen to the best seats at the back of the theatre. If cinema managers shared your correspondents' views they would no doubt transfer the more expensive seats to the front rows.—L. A. FOUNTAIN (Enfield).

"THE TV ACCIDENT"

SIR,—*Re* your editorial in the July P.W.; in the course of my occupation I inspect numerous receivers, both TV and broadcast, in the course of a day, and since the accident you mention it has been my practice to check each receiver I come into contact with and I am finding in 80 per cent. of these visits that the receiver is A.C.-D.C. chassis, and is connected to the mains in such a manner that the aerial, metal speaker fret and other external metal fittings are live. From the point of view of the aerial alone, even if a fatal shock were not received, it would undoubtedly cause any person touching it to lose balance and fall from a roof, and where only a single pole switch is fitted on the TV receiver, the aerial is "live" whether the set is switched on or not, and in the majority of cases the chimney brackets, etc., are also live.

In view of the small amount of D.C in this country, the use of A.C.-D.C. chassis on A.C. mains should, in my opinion, be either banned or there should be an order insisting on an indicator showing when the chassis is incorrectly connected to the mains.

In the case of the metal speaker fret, in all the cases I have met (different manufacturers), the metal fret is in contact with the chassis and this should be brought to public notice very widely in view of the danger, however remote.—M. SMITH (Manchester).

VARIABLE E.H.T. GENERATOR

SIR,—There appears to be a slight error in the component value of condenser C4 in my article entitled "A Variable E.H.T. Generator." This condenser, C4, should be 50 μF 12 v. working, and not .02 as stated.

With regard to C12—the value of this condenser is not critical, .01 to .1—any condenser of this range will do. R3 is not critical, merely serving to limit the discharge current through the Thyraton to a safe value ; any value between 200 and 500 ohms—I personally use 330 ohms. VR1—10K, VR2—.5 meg., both these being variable. C4 can, with some small advantage, be increased to 25 μF 12 v. working. The discharge circuit is, of course, R3 C1, R2 being the charge resistance. Although I have stated in the article that C10, C11 are .001 at 10 Kv. working, these are admirable, but to save expense I have found that some government surplus .01 condensers rated at 4 Kv. working are ideal, and in my case have never given me the slightest trouble even on the highest voltage range ; but this is a matter of choice.—T. M. RODWELL (Waddington).

5 B.P.1 TUBE

SIR,—Recently I have been trying to cure astigmatism in a 5 B.P.1 electrostatic tube. I took the normal precautions, i.e., the correct potentials in the X.Y. assembly, but without success. However, after a week of experimenting I came to the conclusion that the tube was at fault. Physical inspection did not reveal anything except that the spot welding of the gun supports was a bit crude. It was then I realised what the trouble was—a more or less shot in the dark. Could these joints hold very slight residual magnetism ? I hurriedly proceeded to rig up a demagnetising coil which took the form of an old scan coil, using the watchmaker's method of drawing slowly over the neck of the tube.

I replaced the tube and focusing is perfect, regardless of spot position.—A. EDWARDS (Salford, 6).

D.C. RESTORER

SIR,—With reference to the discussion on the D.C. Restorer circuit arising from Mr. Barnard's article in the February issue, may I offer the following brief explanation.

Referring to the diagram (Fig. 4 of the article), an alternating voltage consisting of negative sync pulses and positive picture signal is applied across the input.

On the negative half cycle (or sync pulse) current flows through the resistor and diode in parallel. The diode conducts, and the condenser becomes positively charged to the peak value of the sync pulse. A smaller current passes through the resistor, since its resistance is high compared with that of the diode at the moment of conduction. The charge remains on the condenser until the sync pulse reverts to zero.

On the positive half cycle (or picture signal), the diode does not conduct, and the charge on the condenser leaks away through the resistor.

Therefore in the resistor there is a small alternating current due to the sync pulses and picture signal ; also a direct current due to the discharge from the condenser, while through the diode there are only D.C. pulses due to the sync pulses.

No doubt the foregoing can be proved mathematically, but is it really necessary ?—R. BAKER (Mitcham).

STATIONARY SPOT

SIR,—With reference to the stationary spot produced when some types of television receiver are switched off I suggest that the simplest, cheapest and most convenient method of safeguarding the tube is to rub the protective screen with a cloth of some material, preferably silk.

This produces an electrostatic charge which will usually send the spot completely off the working part of the tube face.

I have only used this method on the plastic type of "black filter," but I can see no reason why the usual armoured glass cannot be treated in the same way.

It is of interest to note that with my receiver, a Pye BV20, a glow can be produced on the tube face by this method even when the set has been out of use for some time, and the tube heater has been allowed to cool. Perhaps someone can offer an explanation of this phenomenon.—L. W. COVERDALE (Hull).

AERIAL CONNECTIONS

SIR,—In your reply to the question raised by Mr. Straker you state that the point to which he refers is a controversial one. This state of affairs exists because the majority of the installations using a coaxial feeder are incorrectly connected to the dipole elements, in that an unbalanced feeder has been connected directly to a balanced system (dipole) and the efficiency of the power transfer system has been reduced for the sake of an extra yard of cable. The fact that this false economy is so widespread has caused the correct method of connection of the feeder to be overlooked, and both constructors and dealers argue over the "correct" way to do something which is technically wrong.—C. EDWARDS (Cambridge).

KIRK O'SHOTTS STATION

(*continued from page* 138)

having a built-in electric heater to prevent the surfaces from being covered by ice or snow, which would spoil the performance of the aerial.

There will also be a smaller mast, 150-foot high, with a simpler aerial to serve as a standby in case any trouble develops on the main mast or aerial.

The Kirk o'Shotts station will broadcast the same programme as Alexandra Palace. The vision signals will come from London via Birmingham and Manchester, and thence by the radio link which the G.P.O. is installing.

Area Covered

The area within which it is expected that reception of the television programme from Kirk o'Shotts will be reliable is bounded by a line through Wemys Bay, Aberfoyle, Aberfeldy, Kirriemuir, and Arbroath in the north, and through Turnberry Point, Old Cumnock, Selkirk, Melrose, and Cockburnspath in the south. This area has a population of $3\frac{1}{2}$ millions. Whether or not reception will be satisfactory at any particular place near the boundary of the expected service area cannot be predicted, because the answer depends upon several local factors, including the height of the receiving aerial and the strength of electrical interference in the vicinity.

Frequencies

The vision transmitter will operate on a carrier frequency of 56.75 Mc/s. (5.3 metres) and the sound transmitter on 53.25 Mc/s. (5.6 metres).

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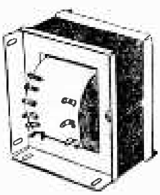

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TRADE TOPICS

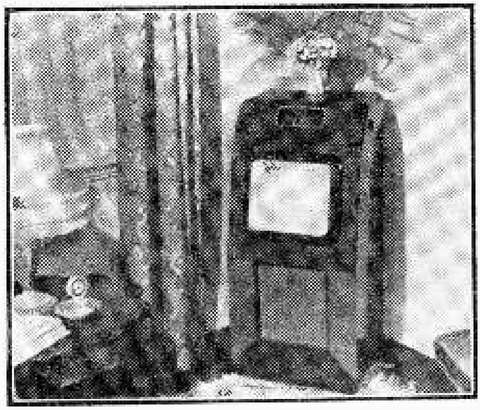
Change in " Osram " Valve Bases

THE GENERAL ELECTRIC CO., LTD., is increasing the diameter of the bases of the following types of Osram valves from 30 millimetres to 34 millimetres: types X61M, W61, DH63, Z63, H63, L63 and W63. Some types have already been changed and others are being changed in the near future, but the increased size should be borne in mind in connection with screening cans.

The new design will eliminate the trouble of bases becoming loose.

Marconiphone Television

LATEST Marconiphone television receiver to be released for the Northern Service Area is Model



Marconiphone model VRC 54/74.

VRC84DA, a high-quality television-radio console with a 10in. Emiscope tube.

In appearance and performance the new model is identical with its already well-established London and Midlands counterparts, Models VRC54DA and VRC74DA.

The price of Model VRC84DA is £57 18s. 1d., plus £26 6s. 11d. purchase tax.

H.M.V.'s New Addition

"HIS MASTER'S VOICE" also announce the addition of a 12in. console model to their wide range of high-quality television receivers.

This interesting new model is available in three versions: Model 1811 for the London frequency, 2811 for the Midlands frequency, and 3811 for the Northern frequency.

The 12in. aluminised Emiscope tube fitted in this model provides large, high-definition pictures, photographic in quality and of sufficient brilliance for satisfactory viewing in daylight.

Many special features are embodied in the advanced circuit design to ensure simplicity of control, minimum of interference on sound and vision, and enduring reliability.

The price of Models 1811/2811/3811 is £70 14s. 5d., plus £32 3s. 7d. purchase tax.

" Viewmaster " Resistor Kits

MESSRS. M. WATTS & CO. are putting up some complete kits of the resistors used in the Viewmaster.

These kits are available for London and Birmingham versions of the set. The prices are: London, 26s. and Birmingham, 24s. 9d. A kit for the Northern model will be available as soon as details are announced.

New G.E.C. Tubes

THE GENERAL ELECTRIC CO., LTD., announces the introduction of two new 12in. cathode-ray tubes with aluminised screens, for television purposes.

The new tubes differ from the earlier 12in. tubes in that the screen face is much flatter (radius of curvature 700 mm.) and they can be used at H.T. voltages up to 10,000, against a previous maximum of 8,000.

The screen colour is white and the list price of both types of tube is £12 15s. 0d. plus £6 12s. 8d. purchase tax.

Type 6705A has a 6.3 volt, 0.5 amp. heater and type 6706A a 10.8 volt, 0.3 amp. heater.

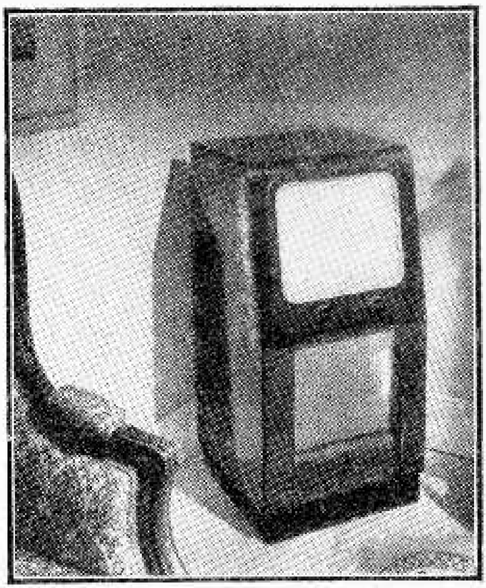
Earlier types of 12in. G.E.C. tubes will continue to be made in small quantities for maintenance purposes.

Earl Services

AS from 21st June, 1951, the address of Earl Services is 9, Palace Gate, Exeter, and all inquiries should be made there.

The facilities offered by Earl Services, as listed below, remain unaltered.

Electronic Section: Design, Development, and Construction of Electronic Apparatus, Preparation of Technical and Critical Reports, etc. Transformer Section: Manufacture and Repair of all wound components, sub-assembles, and specialised equipment.



H.M.V. models 3811/2811/1811.

YOUR Problems SOLVED

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed.

RESISTOR RATING

" My receiver has been working well for just over a year, but recently it broke down and I found a resistor was blackened, but as the colours were readable I replaced it by a similar part. It worked quite all right for about three months and then broke down again and on looking under the chassis I found the same resistor had gone. Is it possible that there is some fault which causes it to go and should I have the set properly tested before fitting another resistor ? "—T. S. Reynolds (Surbiton).

This type of trouble arises in ordinary radio receivers as well as television equipment and must be tackled from two angles. First, it is unlikely that the manufacturers of a television receiver would have chosen a resistor of too low a wattage rating, but it is possible. Secondly, if of the correct rating the fact that it overheats and burns out indicates that excessive current is being passed. Therefore, a meter check should be made on the " earthy " side of the resistor to check the possibility of short-circuits or leaky condensers, and a new resistor should be placed in and the current through it checked. Calculation will then show what wattage the resistor should be and if it is much greater than the resistor size would indicate then all current sources flowing through the resistor should be checked to find a faulty valve or component, etc.

HUM

" I find that my home-made receiver gives very bad hum on sound and there are dark lines on the picture. It is difficult to describe these but it looks as though you are looking at the picture through an opened venetian blind although the lines do not move. If I turn it up very bright the lines are not so noticeable, but the picture quality is spoilt. Could you tell me what is wrong in this case ? "—E. K. Clarke (Teddington).

As you refer to a venetian blind effect we presume there are more than two lines. Two dark bands are usual when the mains smoothing in a full-wave rectifier circuit is inadequate due to a condenser becoming open-circuited. A number of lines are usually due to hum from another source and this can be line interference on the frame scan and bad smoothing in the E.H.T. supply, but usually this produces a wavy edge to the raster. We think, therefore, as you do not mention any waviness that the frame timebase is receiving line pulses due to a fault between the sync separator and the frame oscillator.

MICROPHONY

" I have found a fault develop in my receiver which takes the form of ripples up the picture from bottom to top and this appears to be in sympathy with the speech or music. I was told this was sound break-through on vision and when I went to adjust the coils I found them all sealed with red wax which is quite hard and I don't see how they could have varied. Can you confirm this is the trouble before I break the seals and perhaps upset the coils ? "—M. Keeling (Rushden).

There is another cause of the trouble, although faulty tuning is the most usual cause. It is not essential for an adjustable core or pre-set condenser to move to upset the tuning, as it is possible for a valve to change its characteristics after a long period of working and in some receivers this can modify the tuning. The other cause of the trouble is a microphonic valve in the vision receiver and this is being affected by the sound waves from the loudspeaker. You can easily check this, however, by turning down the volume until the signals are inaudible. If the lines still persist adjustment is indicated either to the vision coils or a rejector circuit. If the trouble is not apparent but appears again when the volume is turned up, and is worst when the set is reproducing maximum volume, then a microphonic valve is responsible and each valve in the vision section should be lightly tapped whilst the set is working (exercising the usual precautions in view of the E.H.T. being present) and it will be obvious on the screen when you tap the faulty valve. It should be replaced.

WRONG VOLTAGES

" I have obtained a commercial make TV chassis. The set seems very good except that the picture is not in the right proportion. The circle in Test Card C is a peculiar shape and is not quite in the centre of the screen. When figures appear on the screen they appear to be cramped up at the R.H. side and elongated to the left. There is also a cramping at the top and the bottom which cannot be altered by moving either frame amp. or frame lin."—K. S. Barraclough (Leicester).

As you mention a chassis (as distinct from a complete receiver) we wonder whether you have obtained a manufacturer's surplus which might be faulty, or which is not being operated at the correct voltage. Poor linearity on *either* the frame or line can be caused by a faulty component or wrong adjustments, but on *both* frame and line the indication is that the H.T. supply is incorrect. Can you check this from the data in your possession ?

LENS DISCOLORATION

" Can you please tell me if there is a cure for discoloration in magnifying lenses ? Mine has acquired a very definite yellow tinge and makes daylight viewing very difficult."—W. Kerr (Redbourne, Herts).

The only cure is to replace the liquid with which the lens is filled. We understand that there are two types of discoloration, one due to the effects of strong sunlight and the other due to the electronic bombardment from the tube. We also understand that the liquid used in the lenses varies according to the make, but that ordinary liquid (toilet) paraffin may be used. It is, of course, possible to use ordinary water, but the diffraction is different and a new position will undoubtedly have to be found for the magnifier.

USING LARGE TUBES

" I built your televisor and whilst I have been perfectly satisfied with the 9in. tube I am now anxious to have something much bigger. I have seen that 15 and 16in. tubes are now on the market and I wonder if much alteration

would be required to put one of these into the set—apart from the mechanical modifications. Could you give any lead as to the amount of work involved ? "—B. North (Hendon).

The deflection angle of standard tubes is constant, and therefore (in theory) it is only necessary to replace a 9in. tube by one of 12in. and no alteration has to be made to the circuit constants. As pointed out before, however, the increased length of scanning beam will result in a slightly darker picture and an increase in E.H.T. may be called for. In turn this will necessitate an increase in scanning power of the line time-base. (Usually there is ample power available on the frameside.) However, so far as we can trace the only 15 and 16in. tubes available call for different techniques—the 15in. requiring an ion trap magnet to be fitted to the tube, and the 16in. calling for new deflection coils—those specified for our receiver being unsuitable.

MASK SIZE

" I have recently made a televisor and after considerable difficulty have now got a reasonable picture. I had a lot of trouble with line linearity, but after replacing some components and changing values of others have got a good balance on Test Card C except for one thing. All the squares seem to be true in the background, but I cannot get the outsides to match the edges of the mask. I have to have a border round this and if I get the picture the right shape it appears that the squares become out of shape. Can you explain this, please ? "—H. G. Royston (Harrow).

It would appear, as the squares in Test Card C are correct, that your mask is unsuitable. At one time the aspect ratio, that is the proportions of width to length of the picture, was 5 to 4, but it has been changed to 4 to 3. You may, therefore, have an old mask and if you do not want to replace this you should adjust your amplitude control until the dark border is cut out and lose the slight amount which will then come under the mask at the sides. Alternatively, a new mask may be obtained and fitted.

REJECTORS AND INSTABILITY

" I made up a receiver using part of the P.W. design and part of the Viewmaster. So far I have managed to overcome all the troubles but one which this combination produced. The trouble is this : I could not cut out sound breakthrough on vision. I have proved, according to the information given recently in these pages, that it is actually sound tuning in the vision circuit and not microphony. Now it was obvious that a rejector or two was needed (I am using double sideband reception), so I made up one coil and connected it in the " sucker trap " arrangement. This did not prove of much value, so I decided to try cathode rejection. I disconnected the cathode bias resistor and condenser in the last R.F. stage and connected the rejector between the bias circuit and the cathode. When I switched on the tube lit up bright all over with only a very faint picture. I tested the coil and it was in order. I made a screen and this was fitted over the rejector circuit without any improvement. I then decoupled the rejector by fitting a 33 ohms resistor between cathode and rejector, but it still does no good. Can you tell me what to do to get this rejector working ? "—K. Langham (Cricklewood).

We think that the trouble is merely instability. A rejector circuit in the cathode of an R.F. stage can cause such instability until it is correctly tuned. It may actually be tuned at present to the vision signals, and you do not mention anything about tuning the rejector. Ignore the brightness on the tube face, therefore, and adjust the core of the rejector, when we are sure you will find that when it is correctly tuned to 41.5 Mc/s. the flaring will disappear and the sound interference will be removed or at least considerably reduced. A further trap may, of course, be included in the stage preceding this.

E.H.T. SUPPLY

" I have just been testing my E.H.T. supply and am in some difficulty regarding the testing of the heater of the small rectifier, I had not known that this part of the circuit was so tricky and burnt out my meter in trying the anode volts. I had this repaired and then found that I could not check the heater to the rectifier. The winding I put on the line output transformer was supposed to give 6.3 volts, but I cannot get this reading on my meter and am afraid of burning it out again. Can you tell me the best way to check this supply, as I think mine is faulty ? "—G. Glazer (Kidderminster).

We presume you are referring to the small EY51 valve in your unit, and the most satisfactory check for this is the colour of the heater when it is running. The best plan is to wire this valve to an ordinary 6.3 volt heater circuit and note the colour of the heater when it has been running for a few minutes. Then connect it to your line transformer winding and compare the brightness. You should be able to see whether or not it is being either over- or under-run. To check the E.H.T., the most satisfactory plan is to measure the current through a bleeder. Make up a total resistance chain of at least 40 megohms, preferably using the special resistors made to take the high voltage across them without flashover. Include a good current meter in the *earthy* end of this chain and by Ohms Law you can calculate the voltage across the resistor chain. The alternative is to use a reliable electrostatic meter.

E.H.T. RANGES

" I have a very old receiver which I am modernising and among the improvements I propose to fit is the provision of a new E.H.T. unit. The present unit includes a 4 kV unit with valve rectifier and I am uncertain whether to use fly-back or R.F. supplies. Could you give the merits of these, and also whether it is better to err on the side of a low voltage or a high, please ? "—H. G. Gowing (Pimlico).

There are many points to be considered in this problem and probably the main thing is the versatility of the units. An R.F. unit would be capable of replacement at any time to give more E.H.T., for instance, if an aluminised tube were to be adopted, or in case of replacement. A fly-back unit, on the other hand, being part of the line output stage and having a separate winding for the deflection coils, would not be so simple to replace. Furthermore, adjustments of line circuit may affect E.H.T., whereas the R.F. unit is practically independent of circuit alterations, provided it can receive the correct H.T. input supply. It is preferable to keep near the maximum E.H.T. voltage to prevent ion burn and provide a smaller spot size.

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