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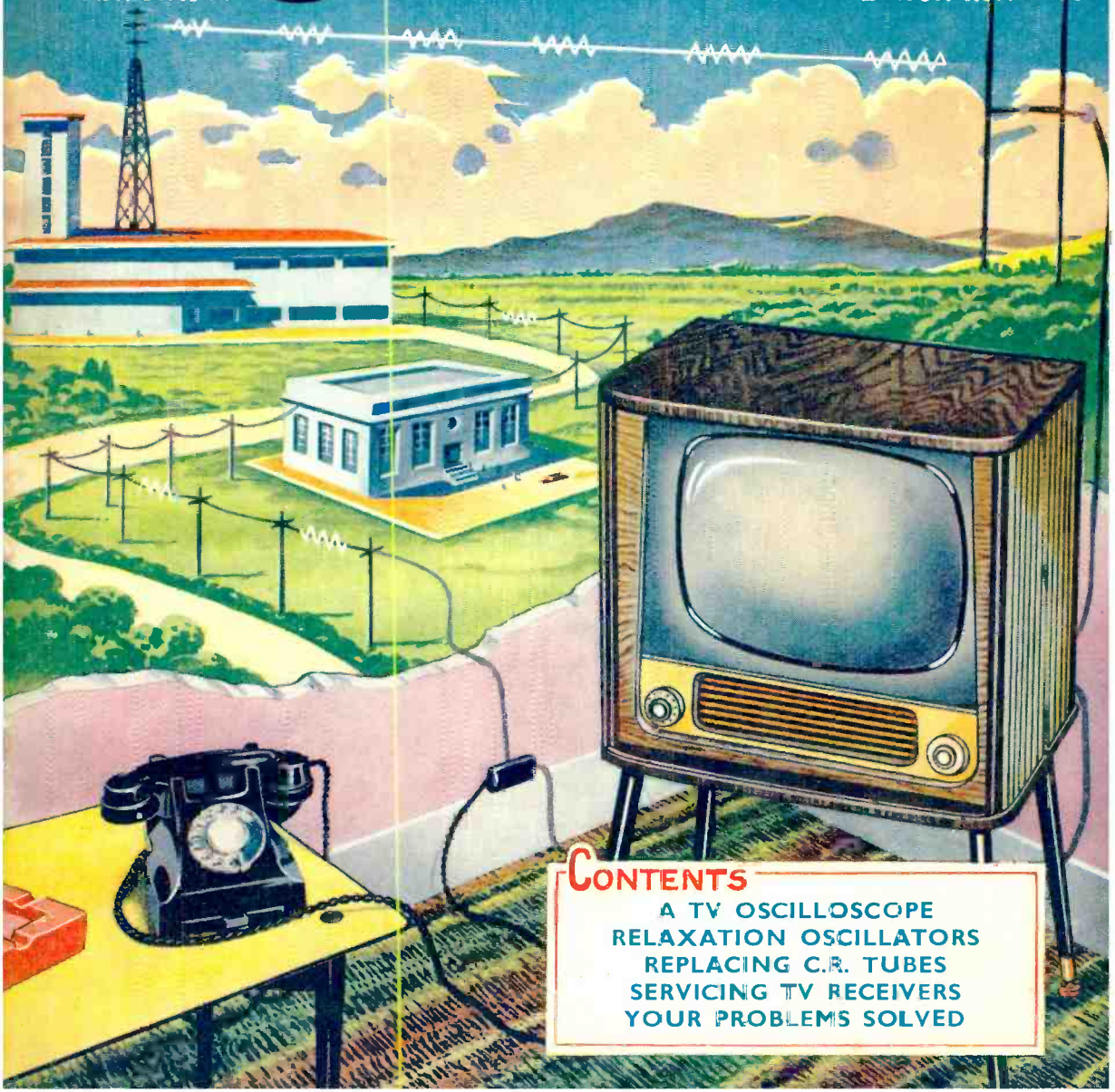
Practical Television

1/3

AND TELEVISION TIMES

MARCH 1959

EDITOR: F.J.CAMM



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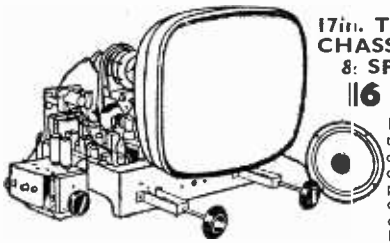
T/V TUBES · CHASSIS · SPEAKERS



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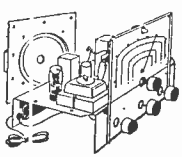

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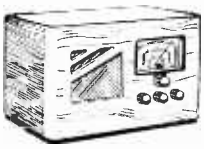

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Owing to the rapid progress in the design of radio and television apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

TELEVIEWS

RECORD YEAR FOR THE INDUSTRY

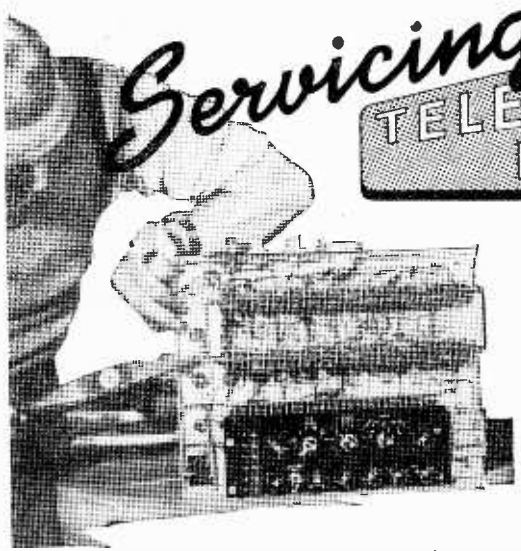
AS a result of the change in the rental and hire purchase controls, introduced last autumn, the television and radio industry has had a brisk year. Manufacturers have been working at peak capacity and it seems feasible that they will reach an annual output of 2,000,000 sets this year, compared with 1,870,000 last year. The large stocks which were accumulating in the factories have all been cleared. As we go to press, the imminence of the Budget will cause manufacturers to limit their stocks in anticipation of any further changes, such as in purchase tax, which the Budget may introduce. It is somewhat surprising to learn that in spite of the competition of television, the sales of sound receivers have shown a marked increase. On the other hand, the sales of gramophone record playing equipment, and this includes radiograms, has not been very good. Stereo sound introduced at the Radio Show last year gave the trade a small fillip, but nothing like what was expected. What was gained on the roundabouts has, to some extent, been lost on the swings, for the interest in stereo sound apparatus has had an adverse effect on the sales of radiograms and reproducers with only single amplifiers.

COLOUR TELEVISION

ALTHOUGH colour television was demonstrated by J. L. Baird in 1928, we are still far from having a colour television programme. Indeed, all interest in the subject seemed to have been lost between 1928 and 1946, when a somewhat luke-warm interest on a purely experimental basis was introduced. In America, however, considerable research was taking place to find a compatible system of colour television—that is to say a system which would serve existing receivers with a black-and-white picture and at the same time provide a colour picture to new receivers specially designed for the purpose. It was also necessary that the addition of colour signals could be accommodated in the existing radio frequency channels. As a result, the N.T.S.C. system (National Television Systems Committee) was introduced and provided a solution to both of these problems. The method is to use a three-colour camera to produce three signals which relate to the red, green and blue primary components of the coloured scene. These signals are combined in such a manner as to provide a standard black-and-white signal together with another signal which describes only colour. A conventional receiver will reproduce a standard black-and-white picture from the luminance signal in the normal way, but a colour receiver will reconstitute the red, green and blue primary signals and produce a colour picture on the screen of a tri-colour picture tube.—F. J. C.

Our next issue, dated April, will be published on March 20th

Servicing TELEVISION RECEIVERS



No. 45.—THE PYE CW17 SERIES, WIRED VERSIONS; ALSO COVERING INVICTA T123 SERIES AND PAM 754

By L. Lawry-Johns

IN order to embrace as many receivers as possible, without being misleading, no detailed description of the circuits will be given, as there are so many variations that the whole of this article would be taken up in confusing descriptions—"ifs and buts," etc. On this broad outline, therefore, it is possible to include earlier models such as the VT17 series, the PAM 752 and others in the family which employ a similar chassis, including the 21in. variants. The system of numbering the Pye CW, CS and CT range has become so complex, with three or four variations of each, and to add to the confusion, printed circuit models (still with the same model No.) that no amount of various identification dots, stripes, etc., would enable the writer to be comfortably sure that his efforts are comprehensive and easily understood, notwithstanding the confusion that exists in his own mind.

Therefore the diagrams cannot be regarded as applicable to every model, and are provided to enable the general layout to be appreciated. On most Invicta models the tube is mounted on the chassis and is thus withdrawn with it. It is general Pye practice, however, to mount the tube separately and several Invicta models are so constructed. However, to get on to the more common faults which can almost certainly be expected; the symptom of *no vision, no sound*, all valves lighting up normally, is perhaps the most common and easiest to diagnose.

No trace of hum will be heard from the loudspeaker(s), no whistle from the line timebase, and the receiver except for the valve heaters is dead. This, of course, indicates that no H.T. is being supplied to any part of the circuit and in most cases it is unnecessary to look further than the contact cooled metal rectifier, bolted to the inside of one of the chassis side walls on the left side as viewed from the rear. The fault is that the conductive path from the discs to the connecting tag has become open circuited. The type of rectifier found fitted will be a 14RA1-2-8-3. This type has now been superseded by the type FC31 which has the same connections and fixing holes, but is of different internal construction. As always, however, one can be wrong in the diagnosis, the rectifier may be entirely innocent. The impulse to assume the rectifier to be at fault because it usually is, should be resisted. The A.C voltage applied to the —tag should be checked. If a meter is not available, a test lamp (240 v.) may be connected from the —tag to chassis. If it lights up, or an A.C. reading is recorded on a meter, the rectifier *is* at fault and should be replaced. Incidentally, the test lamp may be touched to the + or H.T. tag to make absolutely sure. If the rectifier is at fault the lamp will not light up. Thus "juice" is going in but not coming out. However, it is often the case that A.C. is not being applied to the rectifier at all and a glance at the circuit will show that a surge limiting resistor is included in the circuit from the mains dropper to the rectifier. This is a

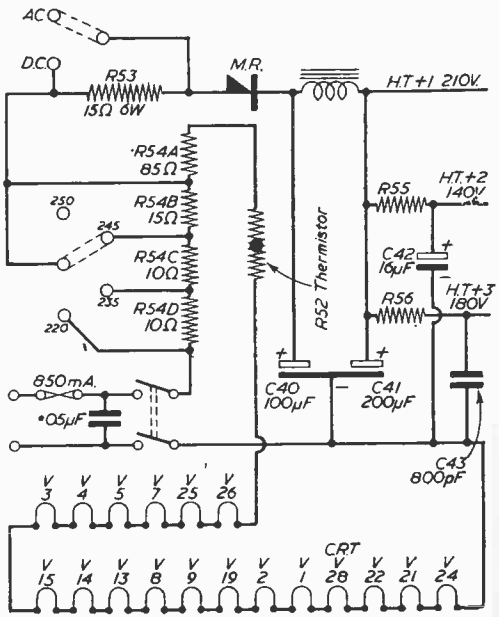


Fig. 1.—Mains supply, H.T. and tube heater chain.

15 ohm 6 watt cement-covered resistor which is normally shorted out when the receiver is set up for D.C. working. This may well be open circuited and the tags across which it is connected may be shorted to provide positive proof of its guilt. It should be replaced, not merely shorted out. The presence of this resistor prolongs the life of the metal rectifier. Thus the symptom of "no vision, no sound—heaters O.K." Now consider the above symptoms with the extra one of "no heaters" either. The meter or test lamp should be used to determine how far the mains supply can be recorded. Assuming the mains supply is in order and is actually applied to the receiver input terminals, check the 850 mA anti-surge fuse and use the meter to record mains voltage at the mains dropper and at the previously mentioned 15 Ω resistor. If indication is given at the mains selector and at the resistor, but is absent at the end of the larger dropper and thermistor (VA1015 or equivalent) check the dropper to ascertain which section is defective.

It comprises four sections, 10-10-15-85 ohms (in most models). If the mains can be checked at the input and the fuse is in order, but no voltage can be recorded at any tag on the dropper or mains selector, the on/off switch is at fault. This is integral with the volume control 1 MΩ, brilliance 100 kΩ dual unit or volume control 1 MΩ, tone control 1 MΩ in some models.

picture which continually breaks up or is unstable horizontally. This normally indicates a defective PCF80 line-oscillator valve, V24 on the layout diagram. It will be seen that this is situated in the centre of the chassis roughly to the front of the mains input plug.

There is a hole in the chassis just below and a little to the right of this plug. A screwdriver may be inserted to vary the frequency of the PCF80 oscillations to a more marked extent than the front-mounted horizontal hold. Therefore this latter control should be set midway, the sensitivity reduced to produce a weak picture and the pre-set control adjusted to lock the picture, switching the band switch so that a picture is locked immediately. This adjustment will be made quite easily provided the PCF80 is suitable for use in the V24 position.

The next fault condition to consider is that of "sound O.K.—no picture." Advancing the brilliance produces no raster on the screen at all. Remove rear cover and listen for the line timebase whistle. If absent or only a very weak whistle can be heard (by those of good hearing), check the 250 mA fuse. This supplies H.T. to the line output stage only. If it is blown replace it. If it fails again, check PL81 and PY81 for internal shorts. There are several possible causes for this fuse to fail excluding the PL81 and PY81 and it is not always wise to lay down any hard and fast

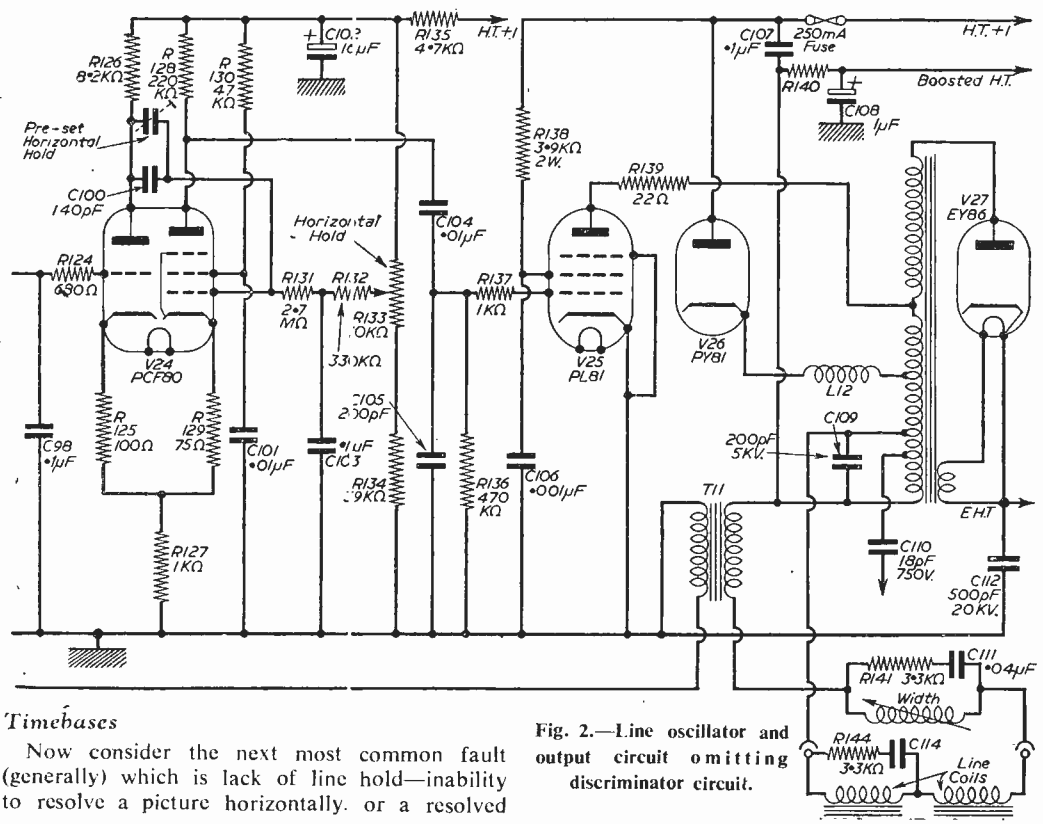


Fig. 2.—Line oscillator and output circuit omitting discriminator circuit.

Timebases

Now consider the next most common fault (generally) which is lack of line hold—inability to resolve a picture horizontally, or a resolved

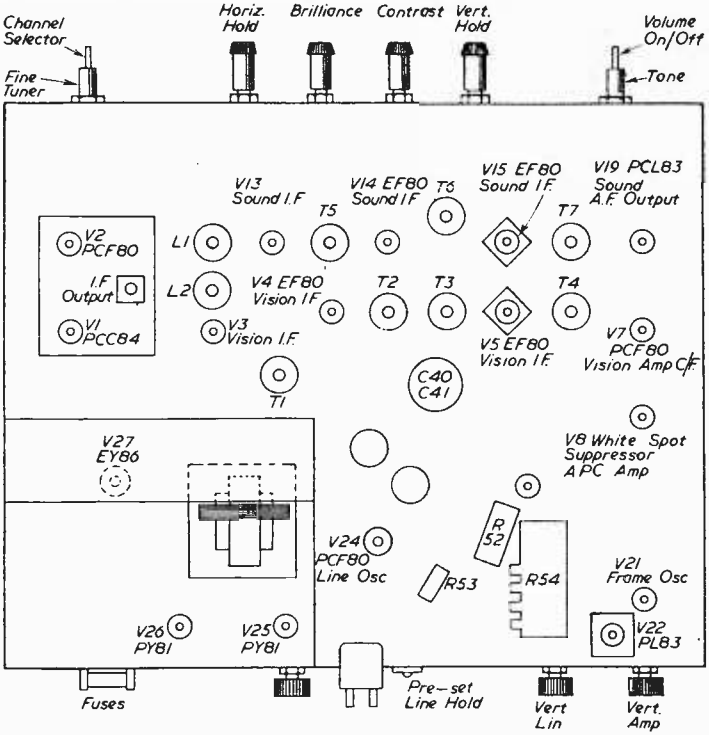


Fig. 3.—Top chassis view. Pye model CW17.

rules. In one case the writer found the cause to be the screened cable which connects to the line scanning coils. It had developed a short between the inner core and outer screen. In another, the leads in the scanning-coils plug had become detached and were shorting together, possibly as a result of heat over a period aided by the owner's happy habit of persistently removing the plug to clean the chassis (he said). However, assuming the fuse is not blown, check the PL81 and the 3.9 kΩ 2-watt screen dropping resistor (to pin 8). If, however, the line timebase whistle is audible, check the EHT at the top cap of the EY86. If the circuit is in order up to this point, a heavy spark will jump to the blade of a screwdriver advanced to its immediate area. The presence of such activity should naturally cause one to suspect the EY86 itself, the heater of which may be open-circuited. If the timebase whistle is rough and sounds "overloaded," check the conditions with the C.R.T. EHT clip removed as a short in the tube may be responsible.

Terms

To digress a moment, it may have been noticed that stress is laid upon the terms open circuit and short circuit. In all the articles in this series the writer attempts to introduce some basic principles for the benefit of the beginner. After dealing with electrical circuits for a period one becomes used to thinking electrically and complicated circuits then resolve themselves into a series of simple ones. It should always be borne in mind, however, that any circuit can exhibit only one of two faults. One is an open circuit (where the circuit is not completed) and the other a short circuit (where the circuit is completed prematurely). All faults are varying degrees of either.

Next month's article will give more servicing information on the Pye CW17 and will include the causes and cures of such faults as "Sound Without Picture," "Hum Bars" on the picture and "Hum on Sound," etc.

(To be continued)

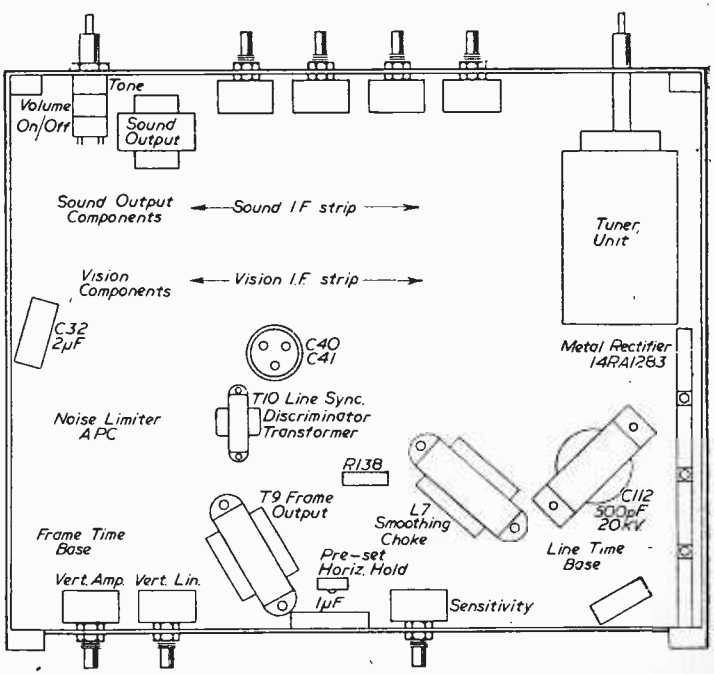


Fig. 4.—Simplified under-chassis view.

Replacing C.R. Tubes–3

MORE INFORMATION ON EKCO RECEIVERS

By H. Peters

(*Continued from page 349 of the February issue*)

TO clean the screen on these sets it is necessary to remove the chassis and ube cradle as outlined last month. and then remove the tube and cradle off the safety glass and mask.

Boosting the Tube (A.C. Mains Only)

Remove the existing heater wires from pins 1 and 12 of the tube base. Short the two wires together and tape them back. at he same time altering the voltage flyleads C and D on the adjustment panel to the setting correct for 10 volts higher (e.g., from 230 v. to 240 v.). This will compensate for the removal of the tube from the heater chain.

Models with V.H.F. need different treatment when boosting the tube as the boost transformer will need to have its "live" wire switched out when the set is switched to V.H.F. Early sets have a spare set of contact on the "trombone" switch. but later series with V.H.F. on a single channel need to have one provided. This can be done by using the set of contacts that switch the tube out and the pilot lamp in on V.H.F.

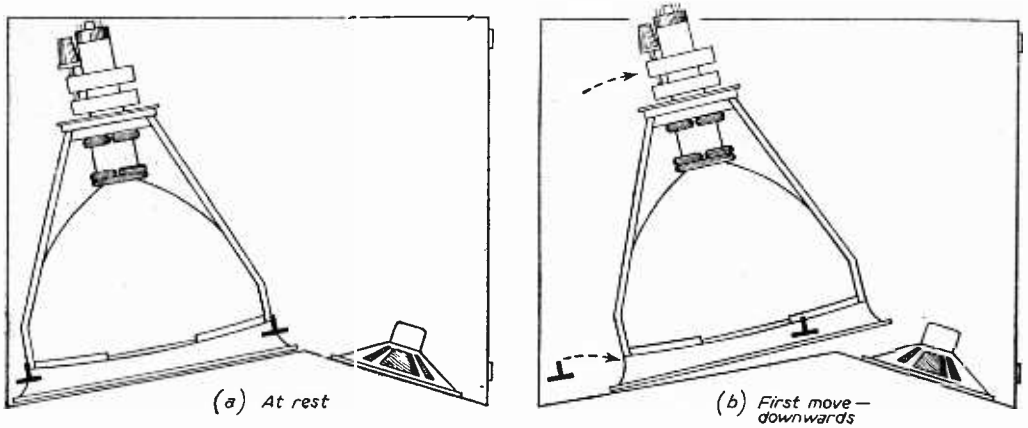


Fig. 5.—The stages in removing the tube cradle of the T231, as seen through the side of the cabinet.

The boost transformer secondary is then connected to the empty pins 1 and 12 of the C.R.T. base using short leads, whilst mains for the transformer primary can be picked up from between any convenient chassis point and the brown voltage adjustment flylead "A."

Variations and Notes

If a CRM172 is fitted in place of a CRM171 be sure to connect the graphite coating to chassis. This coating may be used instead of the EHT condenser.

On very early receivers a small resistor is fitted across the heater pins of the tube base and this should be removed when replacing the C.R.T.

On 14in. models the tube is clamped around the bowl by an aluminium band bolted at the sides and cushioned with a rubber strip.

During the course of time this rubber strip becomes bonded to the tube face and then the safest way to remove the tube from the cradle is to cut the strips of tape holding the rubber to the aluminium and lift the metal part of the cradle off leaving the rubber around the tube. This can then be removed by rolling back, grasped by a pair of long-nosed pliers in the manner of opening a sardine tin.

The wires are joined so as to disconnect the tube and leave the pilot lamp permanently "on."

Models T301, 311, 326, 327, 330, 331, 330F

These comprise the more recent range of Ekco sets and although similar to the preceding models are much easier to handle when changing tubes. Remove the chassis the same way as in the T231. but with the deflector coils. which do not unplug. These slide easily off the tube neck after the ion trap and focus magnets have been removed. The cabinet is then laid on its face and the four corner bolts holding the tube assembly are removed. There is no tube cradle as such and care must be taken when transferring the metal clamps which hold the tube bowl to ensure that they are sufficiently forward to prevent the front of the tube from touching the safety glass. thus making a small opaque spot in the middle of the tube. Screen cleaning on this range can be done without unboxing by laying the set on its side and removing the three brass

6 B.A. screws holding the gilt bar at the bottom of the safety glass.

Boosting the tube follows the general lines of the 231, with the addition of the switch rewiring as outlined under "variations" if the receiver incoporates V.H.F., but as the mains tapping arrangements are different it is necessary to alter flyleads "A" and "B" to the setting correct for 10 volts higher to allow for the removal of the tube from the heater chain. Mains for the boost transformer can be picked up between chassis and voltage flylead "B."

Early Ekco Receivers

The 12in. T161. (Also covering TU169, TU211, T216, TC196, and 196/1, T205, TC206, T207, T207/1, TC185, TC178, TC166, TC165, T164, TC162, TC155.)

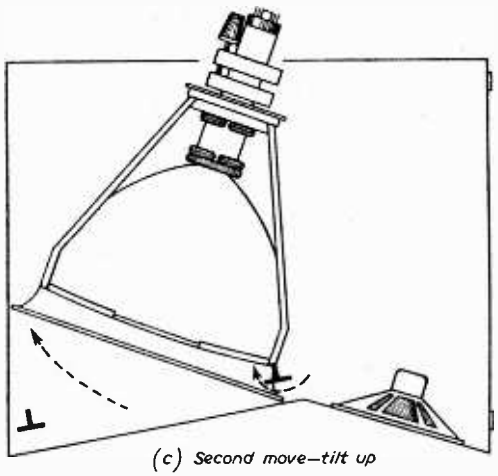
To unbox the set remove the back and loosen the control panel. Unplug the scancoil lead, EHT connector, C.R.T. socket and loudspeaker plugs. Remove the two 4 B.A. bolts holding down the rear of the chassis and withdraw the chassis and control panel. Turn the cabinet upside down on to a soft cloth then remove the 2 B.A. nuts (four in all) holding the tube cradle to the top of the cabinet. Lift the cradle clear of the screws, taking care not to hit the loudspeaker, and draw backwards out of the cabinet. Remove the four screws that hold the mask and put this on one side with the dust excluder rubber. Place the tube and cradle face down on a soft cloth; mark the scancoils to ensure correct refitting; remove the focus magnet by unscrewing the two 2 B.A. screws holding the assembly to the tube cradle and slacken off the four 4 B.A. screws that are now revealed, releasing the rubber clamp ring around the tube neck. Slacken off the two bolts clamping the aluminium band around the tube bowl and lift the cradle off the tube, noting the relative position of the anode cap to the cradle. Thoroughly clean all parts and the inside of the cabinet before reassembling in the reverse order.

The trickiest part is keeping the inside of the mask free from fluff and hair during reassembly and also the refitting of the rubber dust excluder. This is best done by stretching the rubber around the circular front clamp before refitting the mask, pulling it forward off the brass studs at each corner to which the mask is attached. Once the mask is in position the dust excluder can be slipped over the gap between the tube and the mask. Make sure that the mask is squarely on the tube at right angles to the line of the gun or else difficulty may be experienced in refitting the cradle to the cabinet.

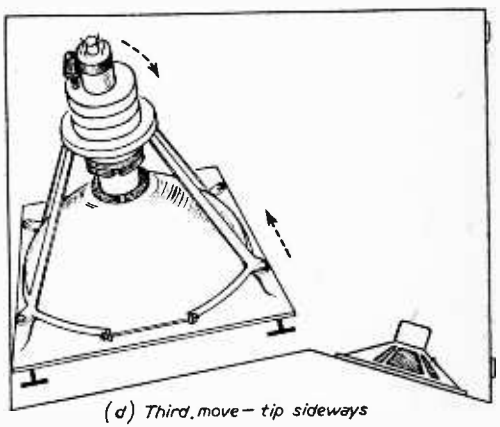
This is the next step, and any small gap between the mask and the cabinet may be taken up by inserting slotted washers provided under the appropriate 2 B.A. bolts. When the tube cradle is snug, tighten all down, invert the cabinet and refit the chassis.

Setting Up

Picture tilt is accomplished by the lever on top of the deflector coils, and picture positioning by moving the entire focus assembly around in the play provided by the two fixing screws. The focus lever should be vertical for correct focusing, and if this is not the correct setting the focus magnet should be slid up and down the tube neck, having slackened the four side screws, until good focus is obtained.



(c) Second move—tilt up



(d) Third move—tip sideways

Fig. 5.—(Cont.) The heavily printed T-shaped objects are the fixing brackets on the cabinet which constitute the major obstacle to pulling the assembly straight out.

Corner Shadow

This may be experienced if the tube gun is not central and may not be corrected by the adjustments provided. It is then necessary to rotate the tube in the mask until a clear position is found, taking care not to hit the anode cap on the side supports, nor to leave it too close to one of them, causing flashover.

Fitting C.R.T. Transformers (A.C. Mains Only)

On models having CRM141 and 153 a 13 volt transformer will be required, on models with the CRM121B, 123, 151 and 152, a 2 volt transformer is required. The universal models TU169 and 211

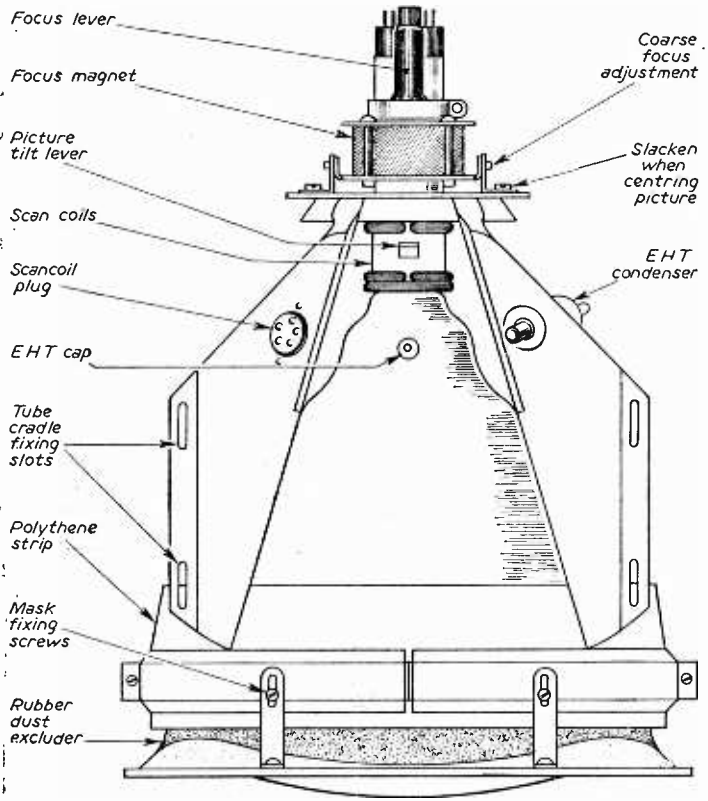


Fig. 6.—Detail of the T161 tube cradle assembly—top view.

fit the CRM122 which has a 7.5 volt heater in series with the heater chain and are treated similarly to the T231.

For the 13 v. and 2 v. types, remove the heater wires from the two pins on the tube adjacent to the keyway and tape them back. Do not short them together. Also remove all other components (particularly condensers) which are connected to the heater pins and connect the secondary of the C.R.T. transformer to the two empty pins by short freespaced leads. Mains for the primary may be obtained from between chassis and the copper bar behind the mains voltage adjuster.

If symptoms of heater-cathode breakdown cause intermittent bars of picture slip, a 1 K resistor can be fitted between heater and cathode. On models fitting the CRM122 the wires removed from the heater pins are taken across a 25 ohm 3 watt resistor to complete the heater chain. Mains for the transformer can be picked up between chassis and the green voltage adjusting lead.

Screen Cleaning

This involves removing the tube cradle as outlined above except the T205 and TC206 whose safety glass may be lifted up through the slot in the top of the cabinet after the metal fillet has been picked out.

Variations

On some consoles, such as the TC178, TC155, TC165, there is no need to remove the chassis before removing the tube cradle. This latter slides out complete on a wooden board which runs in a channel on the cabinet roof and is locked in position by two 2 B.A. bolts.

Earlier Models. T141 (Covering TU142, TC140, TRC139, TRC1124, 124, TC138, TS114, TS1114, TSC102, TSC1102)

In these models the tube is loosely mounted and is held firm by the mask, so care is needed in handling the chassis out of the cabinet. To unbox, remove the speaker leads and (on consoles) the control panel, remove the two 2 B.A. nuts and washers at the rear upper chassis corner flanges and withdraw the chassis complete with tube.

Remove the C.R.T. base and anode cap, slacken off the rubber clamp around the tube neck behind the focus bracket (which is all that holds the tube) and lift the tube out forwards. Replace in the reverse manner, adjusting the bowl support straps if necessary.

Boosting the tube is carried out as for the T161, with the exception of the TU142, which is treated as for the TU169. Console models with radio have an additional multiway plug connecting to the light behind the station names.

(To be continued)

Trans-oceanic TV

THROUGH the use of earth satellites as passive reflectors, trans-oceanic TV will be both economically and scientifically feasible, according to Dr. John R. Pierce, Bell Telephone Laboratories director of electrical communications research.

He told an IRE symposium in Washington that the best site for the relay system would be over the Atlantic between Newfoundland and Scotland. He proposed a series of 100lb. satellites 100ft. in diameter, with reflective metallised coating, revolving in a transpolar orbit 3,000 miles in space.

The satellites need have no electronic equipment in them. The signals would be bounced off them from 250ft. parabolic aerials on the ground, fed by 100 kW transmitters. He suggested frequencies of 1,500-2,000 or 8,000-10,000 Mc/s. A total of 24 such spheres would be sufficient for 99 per cent. continuity of contact, he added. He stressed the advantage of such passive reflectors: all of the electronic equipment is on the ground.

A TV OSCILLOSCOPE

THIS IS THE FIRST OF A SERIES OF ARTICLES DEALING WITH THE DESIGN OF A HIGH-GRADE OSCILLOSCOPE SUITABLE FOR TV EXPERIMENTERS

By R. Coates

THE oscilloscope is invaluable to the television experimenter, as he has to deal with repetitive circuits to a large extent. It is also particularly useful if it can be used to display the picture being received, without the use of the EHT supply and the magnetic deflection system, or even without the use of one of the timebases. The requirements of an oscilloscope designed specifically for television use are as follows :

1. The timebase should have a frequency range of at least 10 c/s to 15 kc/s, although an upper limit nearer 100 kc/s would be very useful on occasions.
2. The trace should be perfectly linear.
3. The fly-back should be suppressed.
4. The timebase should be capable of very accurate synchronisation.
5. The Y-amplifier should have a wide bandwidth, which is best accomplished by the use of negative feedback.
6. The gain of the Y-amplifier should be high, and a full trace should be obtainable from an input of three millivolts. The gain should also be variable.
7. Facilities should be provided for displaying the television picture on the screen.
8. The design should ensure maximum tube life consistent with adequate performance.
9. A refinement would be the provision of a valve voltmeter to measure the A.C. component of the signal being inspected.
10. The instrument should have a very high input impedance, so as to have a negligible effect on the circuit under observation.

The choice of tube colour, afterglow, etc., is a matter of individual preference, and will not be discussed.

The question of mechanical design will be discussed, but nothing will be specified, as these articles are not intended merely to set forth the details of one particular design for all to copy or leave alone, but rather to show the principles of design.

Mechanical Design

The majority of oscilloscopes built, both commercially and privately, consist simply of a box with the tube face vertical and flush with the front panel. This design is usually adopted because it is simple, but it suffers from some severe disadvantages. In the first place, it is rarely convenient to have the tube face vertical, as it should then be observed from its own plane, and the whole unit must then either be tilted back or raised to the level of the observer's eyes in order to allow the trace to be viewed with minimum strain. This can be overcome in several ways: one way is to make the box so shaped that the tube face is angled, but the top should still be horizontal, so as to allow other equipment to be placed on top. Alternatively, the box may open at the centre, with a hinge at the back so that the top half may tip up when in use: this type is economical in storage space, but not in bench space, as the top is not level when in use. Another alternative is to build the tube into a completely separate box, which may be of very small dimensions, and which may be placed conveniently anywhere. This type, however, lacks portability.

The second disadvantage of the majority of instruments is that the tube face is flush with the front panel. A hood then has to be fitted to the front in order to reduce the distractions owing to the reflection of stray light from the surroundings by the tube face. The hood is inconvenient as it collects dust and protrudes from the face of the unit: the best remedy is to build the unit with the tube face recessed in a matt black painted cavity in the front of the panel which will exclude all unwanted light. Another alternative is that the tube may be mounted vertically, and viewed by means of a mirror mounted at 45

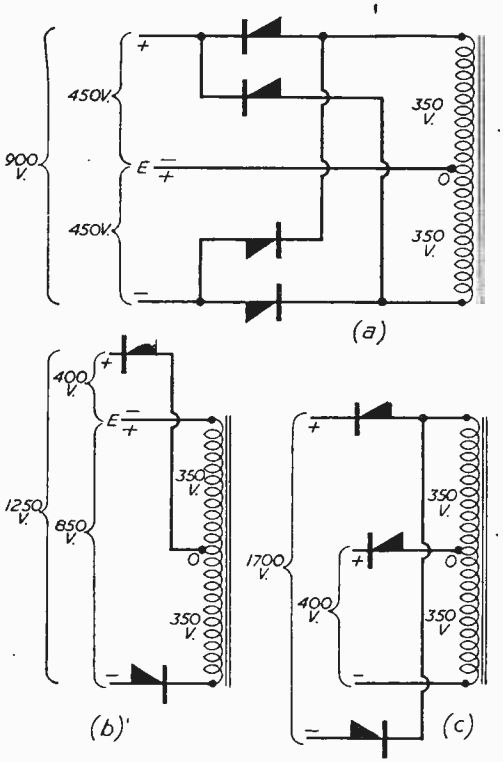


Fig. 1.—Power supply arrangements suitable for oscilloscopes : (a) full-wave rectifiers ; (b) half-wave rectifiers ; (c) voltage doubling.

deg. from the horizontal above it. The mirror should preferably be a metal one, in order to avoid the possibility of multiple reflections.

The front panel should be clearly marked, the knobs of adequate size and well spaced. As regards the internal layout, the high-gain sections appropriate to the X and Y channels should be kept well apart, and certainly screened from each other. The case may be made of wood or metal, but if the former is used care should be taken to ensure adequate internal screening. One factor which should not be overlooked is the possibility of picking up 50 c/s magnetic hum on the tube deflection system. The best safeguard against this is the provision of a mu-metal screen around the tube. The mains transformer is best situated near the base of the tube.

Choosing the Tube

The choice of tube is a very important matter, as this governs the design of the rest of the instrument in almost every detail. It is not wise to be guided by size alone: the tube is intended for viewing by one person at a time, so a large size is not necessary. Furthermore, the larger the tube face, the higher the voltages required to operate it, so not only does the tube cost more, but so do the power supply components and the amplifier and timebase units. Accordingly, the best choice seems to lie in the range between a 3in. diameter screen and a 5in., although 2½in. screens are very useful and are becoming popular for general purposes.

Power Supplies

The tube selected, data sheets can be consulted to determine what supply voltages are needed. Note that the highest voltages recommended should not necessarily be chosen. The higher the final anode voltage, the higher is the voltage required to deflect the spot the same amount. A typical deflection sensitivity, for instance, is $400/V$ mm. per volt, where V is the final anode voltage on the tube, so that if V is increased, then the outputs required from the amplifier and timebase units are also increased. Another point to bear in mind is that the tube life decreases with excessive final anode voltage, so it is better to use, not the highest value of EHT recommended, but rather the lowest.

The EHT voltage thus selected, the mains transformer may be specified. Remember that the D.C. rectified voltage will be higher than the A.C. voltage from which it is obtained: for instance, a 700 volt R.M.S. winding will probably give an EHT of about 900 volts after smoothing. This supply will be adequate for the operation of most small tubes, and it may easily be obtained by using the full winding of a 350-0-350 volt H.T. transformer. Higher voltages may be obtained with larger secondaries, or by voltage doubling. For economy, the same mains transformer should be used to supply the H.T. to the amplifiers and timebase circuits, and the value of the H.T. voltage is commonly about half that of the tube circuit. A number of suitable power supply arrangements are shown in Fig. 1. If higher or intermediate voltages are required, the secondary voltage of the transformer should be altered proportionately: the output voltages marked are those which may be reasonably expected, but will vary with the load and smoothing arrangements. The ratings of the rectifiers in cases (a) and (b) will be obvious, and the smoothing capacitors should all be connected to earth.

Valve rectifiers may be used if preferred, but care should be taken over the heater supplies: in (a) the top pair of rectifiers may be a conventional double diode, with its own heater supply, but the other two should be separate valves each with a separate heater supply. Similarly in (b), the two valves should each have their own heater supply. In (c), the H.T. rectifier is normal, and the capacitor should be connected in the normal way between + and −, but the other two rectifiers should each be of 700 volts R.M.S. rating, and two sets of smoothing capacitors should be used, one from each rectifier to the negative side of the H.T. supply. These capacitors should each be 1,000 volts working, that is, half the EHT voltage. Circuit (a) is recommended, as it provides full-wave rectification of both H.T. and EHT, and 900 volts will meet most needs. A valve rectifier is very suitable for the H.T. supply, but metal rectifiers are recommended in the other cases, owing to the additional heater supplies which would be required if valves were used. Circuit (b) should be used if the EHT obtainable from circuit (a) is insufficient, but suffers from being only a half-wave rectifier. Circuit (c) is not recommended except in exceptional circumstances, and two mains transformers are better.

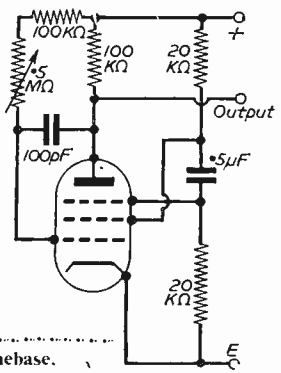


Fig. 2.—The Miller timebase.

In the tube data, will be found values given for the voltages on all the tube electrodes: these are normally supplied from a potential divider. We must therefore connect a bleeder chain across the EHT supply, and, for convenience, assume that this chain takes 1 mA and that the tube takes a negligible current. In the first place, the anode should be connected to the positive terminal of the supply, and we then look up the voltage required on the focusing anode: this will be variable, as this constitutes the focusing control, and may be from, say, 650 to 800 volts negative relative to the final anode. Thus, we require to drop 650 volts in the resistor to be connected as a part of the bleeder chain from the focusing anode to the final anode, and, as the chain current is 1 mA, we see that this resistor should be 650 kΩ. The focusing anode voltage must be variable, so the next resistor must be a potentiometer with the focusing anode connected to the slider: the voltage is required to vary by 150 volts, so 150 volts must be dropped in the potentiometer, whose value is thus 150 kΩ.

Similarly, if the cathode is to be at 75 volts negative with respect to the focusing anode, then 75 kΩ is connected between these electrodes. If the grid is to be variable (brightness control) from cathode potential to −25 volts from the cathode, then it is connected to the slider of another potentiometer of 25 kΩ this time, this being connected between cathode and EHT negative. We can now check our calculations, as the total resistance in kΩ between the positive supply and the negative should be equal to the expected voltage in volts. In the above example, we see that 650 + 150 + 75 + 25 = 900. Alternatively, the bleed chain current may be take as ½ mA, when all the resistance values will be doubled. There is no need to adhere rigidly to the calculated values, as the nearest preferred value will be good enough. Don't forget to connect the cathode to one side of the heater. When testing the tube circuit, do not allow the deflector plates to "float": they should be connected to the anode, each through a resistor.

Timebase Selection

So far as the amateur is concerned, linearity of the timebase is of supreme importance to him. There are a number of very good designs of timebase available, and one which was used very extensively at one time is the Puckle. Nowadays, however, it is being replaced by the Miller timebase, so called because it operates by virtue of a large capacity between anode and grid. The thyratron timebase, which many people still use, is now well out-dated by both these types. We will consider primarily the Miller, as it is well known that this circuit gives an output which can virtually be guaranteed to be linear without any investigation. Also, the Miller is economical, as it requires only one pentode, compared with the Puckle's requirement of two pentodes and a triode.

The circuit is given in Fig. 2 together with suggested values for the components. No attempt will be made to explain the circuit action, as this subject is well covered in the series "Relaxation Oscillators." The fine frequency control has a limiting resistor in series with it to prevent the grid from being connected directly to H.T. The value of the Miller capacitor shown will give a fairly high frequency output, and 0.001 μF or even 0.01 μF may be used here. The values shown for the screen-suppressor chain will give a fairly fast fly-back, and the only value which should need alteration to any great extent is that of the anode load: there is an optimum value for this resistor, which is easily found, as it corresponds with minimum frequency. If the value of this resistor is too large, the Miller capacitor will not charge adequately between strokes; if it is too small, the suppressor will tend to cut off the anode current too soon: each of these faults raise the frequency, so the resistor should be adjusted for minimum frequency.

Looking back at the original specification, we see that this circuit is capable of fulfilling all the requirements: the frequency range can easily be adjusted over a wide range, the trace is as linear as one can reasonably expect; fly-back suppression signal is available at the screen, and synchronisation may be injected at the screen in the form of negative pulses. The valve may be any high-gain pentode, such as the 6AM6, or EF91, and the output voltage may well be as much as 200 volts peak-to-peak. For a deflection sensitivity of 400/V mm./volt, and an EHT of 900 volts, this will give a trace of about 9 cm., which should be adequate for most applications. If it is too great, it may be reduced best by taking the output from a tap on the anode load: this tap may be variable, i.e., a potentiometer, if desired.

If the power supply arrangement is as Fig. 1 (a), i.e., the H.T. positive terminal is common with the EHT positive, also in Fig. 1 (b), then there is no need for a coupling capacitor between the timebase and X-plate: the anode of the pentode should be connected directly to the left-hand deflection plate, As the deflection plate will then have a mean voltage below that of the H.T. supply voltage, a shift voltage must be applied to the other plate in order to make the mean voltage between the plates equal to zero in order that the trace may be central. This D.C. voltage may conveniently be made variable, by connecting the X-plate to the slider of a potentiometer connected between H.T.+ and a point about 200 volts below H.T., this may be accomplished most easily by making the potentiometer, say, 1 MΩ and connecting a 1 MΩ fixed resistor between the lower end of this potentiometer and earth. The detailed adjustments of these values is not of importance.

Other Timebases

The circuit described above is the main member of a large family of timebases; many modifications have been put forward for its improvement, but it is quite adequate for our purposes in its original form. Other forms have appeared, some of them using more than one valve, but all depending on the negative feedback by the Miller effect for the linearity.

Practically all other timebase circuits depend for their action on the direct charging or discharging of a capacitor: this may certainly be made far more linear in output if the charging is done through a pentode connected so as to feed a constant current through the capacitor. This pentode often has a potentiometer fitted to control the voltage of one of the grids, which forms a control of the current in the capacitor circuit and hence a control of the rate of charge, which controls frequency. Coarse frequency is controlled by switching in various values of capacity, between anode and grid (see Fig. 2). The 0.5 MΩ potentiometer then forms a fine frequency control on each range.

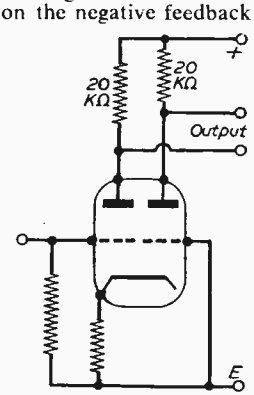


Fig. 3.—The "long-tailed" pair.

(To be continued)

Relaxation Oscillators—4

THE MILLER TIMEBASE OR SCREEN-COUPLED PHANTASTRON

By R. Couvela

(*Continued from page 349 of the February issue*)

THE Miller sweep generator is in a class of its own so far as operating principles are concerned, but it comes under the general heading with which we are concerned here, which is the reason for its inclusion. No attempt will be made to show the derivation of the circuit, we will merely deal with its operation.

A glance at the circuit of Fig. 1 will show why it is called the Miller circuit. The capacitor C is seen to be connected directly in parallel with the anode-grid capacitance, the cause of the Miller effect, which was so much of a stumbling-block in the early days of electronics. Since those days, several circuits have been published making use of the effect, or even, as in this case, increasing it.

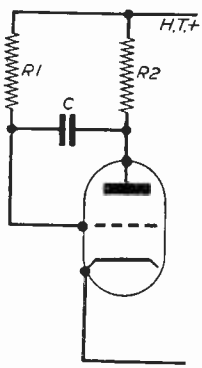


Fig. 1.—The Miller sweep generator.

The effect is that, by virtue of the anode-grid capacitance, any signal which is applied to the grid of the valve will, after being amplified, appear at the anode, and return through this stray capacity in the form of severe negative feedback. This effect naturally increases with frequency, and renders the triode useless at high frequencies, and led to the invention of the pentode.

Consider now the effect of applying H.T. to the circuit of Fig. 1. Current will flow in two paths: firstly, it will flow through R1 to the grid, and so to the cathode, using these electrodes as a diode. As the grid-cathode path is of very low resistance, the current will be approximately Ig = H.T./R1. If R1 is made sufficiently high, this current will be very small.

Let us assume, temporarily, that the valve will not conduct, in which case, the second current path will be rapidly charging C exponentially through R2 towards H.T. value. The lower end of C will be held at a potential very little above that of earth by the grid-cathode diode effect.

Now, suppose that Ia suddenly starts to flow. Immediately, Va will drop, and, as C is charged, Vg will drop by the same amount. But if Vg drops by more than a few volts, the valve will be cut off, so the circuit will find a point where balance is obtained somewhere between cut-off and full current, in fact, nearer to the former. Note the Miller effect of negative feedback, by which the change in anode voltage is immediately fed to the grid, opposing the change.

Now, observe that the bottom end of R1 has been taken below earth potential, while the top end remains at H.T. level. Current must flow in this resistor, but, since the grid is negative with respect to the cathode, grid current cannot flow as before. In fact, this resistor attempts to discharge the capacitor, and current flows from H.T. through R1 into C. Accordingly, current must flow from the other plate of C to the anode, and thence via the cathode to earth.

Thus, C discharges, but only very slowly, as R1 has already been stated to be of a high value. Notice that the bottom end of C is held just below zero, so the current in R1 will be for all practical purposes a constant value. As C discharges, its voltage reduces, and, as the discharge current is constant, the rate of reduction of voltage will be constant. Thus, the anode will reduce in voltage at a perfectly linear rate, and all the time the negative feedback Miller effect is holding the grid below zero in order to retain equilibrium, this fact causing the current through R1 to remain constant, thus preserving the linearity.

As the anode voltage of the valve falls to a very low value, so the current must increase in order to take up the additional voltage on R2. As the current increases, so the grid voltage must rise slightly. This rise will only slightly affect the current in R1 as the voltage across this resistor is given by $V_{R1} = H.T. - V_{g-k}$

As an example, if the H.T. is 300 volts, and V_{g-k} is, say, (−6) at the start of the discharge, the total voltage on R1 is $300 - (-6) = 306$ volts. If V_{g-k} falls to, say, −3 volts

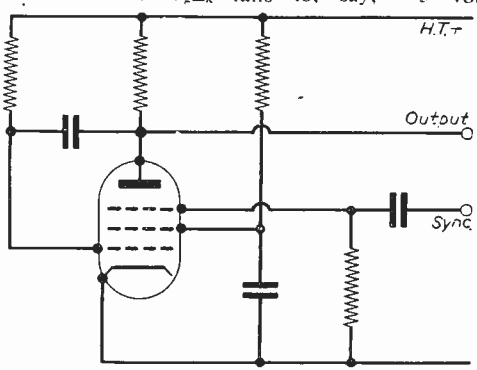


Fig. 2.—The practical version of the Miller sweep generator.

towards the end of the discharge, then the total voltage on R1 will become 300 − (− 3) = 303 volts. Thus, the total change in the voltage on R1 is less than one per cent., so the total change in current will be less than one per cent., and can be ignored. Thus we can say, with all confidence, that the run-down section of the waveform is a straight line.

There remains one point to be cleared up. You will recall that at the start we assumed that Ia was cut off, although grid current was

flowing. How is that to be brought about?

In Fig. 2 we have changed the valve to a pentode, and the required anode current cut-off can now be brought about quite simply, by applying a high negative potential to the suppressor grid. All the cathode current will then flow to the screen.

Thus, we see that we have the makings of a triggered sweep generator. The action is controlled by the reception of negative pulses at regular intervals on the suppressor. During one such pulse, the anode current is cut off, and the capacitor charges to full H.T. At the end of the pulse, we commence the linear run-down, which continues until the next pulse, when the anode is again cut off, and the action is repeated.

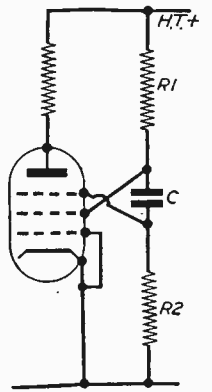


Fig. 3.—The transitron oscillator.

We now have to find a convenient source of large negative pulses, which we can obtain from the transitron relaxation oscillator. Readers will remember the transitron oscillator as described in Part 2 of this series, and the circuit is shown in Fig. 3.

This circuit, you will remember, gave a square wave output at the anode. In fact, the anode and screen currents alternated with equal time durations. Notice that in this circuit the anode and control grid, which are required for use in Fig. 2, are not used, thus making the arrangement eminently suitable in the present application. Thus, we can couple the two circuits together to produce the circuit which goes by the amazing name of the Screen-coupled Phantastron, shown in Fig. 4. The circuit components are so adjusted as to give an oscillation frequency in the transitron very considerably greater than that of the required timebase.

Now, if we consider the moment when the screen is conducting, the Miller capacitor is charging, and the anode is cut off, we find that the suppressor voltage is rising from a negative value towards zero. On reaching a suitable value, anode current is permitted to start, and the transitron action cuts off the screen current, and raises the suppressor voltage to a high value.

The anode current thus permitted is limited by the Miller action, and the run-down commences. Meanwhile the suppressor returns towards zero. On reaching zero, a landslide would normally take place, but this is effectively prevented by the fact that the control grid is now holding the cathode current to a low level, preventing any rise in screen current, thus preventing a landslide, and the valve operates under conventional pentode conditions.

Ultimately the voltage on the anode drops to a low level in the region of that of the screen grid, and the Miller action fails to function effectively when the curved portion of the characteristic is reached. Thus, the control grid potential rises, allowing cathode current to flow freely and the screen conducts, which results in a landslide. The screen goes into full conduction, the suppressor is well below zero, the anode is cut off, and the Miller capacitor charges. As the suppressor voltage rises to a suitable value, the return landslide occurs, and the action is repeated.

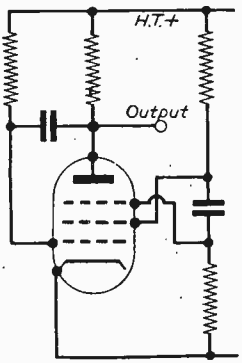


Fig. 4.—The Miller time-base generator (Screen-coupled Phantastron).

Note that the screen conducts heavily during the flyback. This permits the use of the pulse signal on this electrode as a means of flyback suppression, if required. The screen grid is then connected via a capacitor to the grid of the cathode-ray tube.

(To be continued)

Trans-Atlantic TV

THE possibility of transmitting satisfactory television signals across the Atlantic Ocean has occupied the attention of engineers for some time. A multiple cable would meet the case, but in view of the video signal bandwidth, it is commercially uneconomic. One suggestion which seemed quite feasible was to make use of existing aircraft which make regular trans-Atlantic crossings, by having low-powered radio transmitters installed in the aircraft. These machines would receive a television signal at a great height and relay it through the medium of the transmitter to another aircraft in flight, this process being repeated until the expanse of the ocean was covered in hops. The signals received finally at the other side of the Atlantic would be suitable for rebroadcasting.

Space Satellites

Now that space satellites have become a possibility, the latest suggestion is to use one or more of these man-made devices to relay or reflect television signals so that they can cover the required distance. Scientists have worked out the size of the satellite and the distance from the earth for this to happen when using a low-powered transmitter and with a number of these satellites in orbit round the earth, there would always be one in the correct position to relay the signals. Very high frequency carrier signals would be required and special dish aerials employed for final ground reception, but even so this nebulous idea has not been dismissed as impracticable. Indeed, some such scheme has undoubtedly been used both by Russia and the U.S.A. H. J. B. C.

Transistors in TV Receivers

THE THIRD ARTICLE OF A SHORT SERIES DEALING WITH THE USE OF TRANSISTORS IN MODERN TELEVISION EQUIPMENT

(*Continued from page 357 of the February issue*)

THE circuit used for the Beanstalk amplifier is shown in Fig. 8. The basic idea behind the operation is best understood by considering two transistors only, Tr18 and Tr19, and visualising the circuit above the point A as replaced by a resistive load of small value. Considering a fixed output current swing, the potential swing at point A will depend entirely on the resistance load owing to the high-impedance characteristics of the transistor. The potential swing at point B will depend entirely on the effective resistance in the base circuit of the transistor Tr19. If the resistance is low then the potential swing at point B will be small; all the swing will appear across the second transistor Tr19. If the resistance is high then the potential swing at point B will be large.

The information given in this short series is taken, with permission, from a Paper read to the Television Society by B. R. Overton, B.Sc.(Eng.), A.M.I.E.E., and published in the Journal of that Society.

In the Beanstalk video amplifier, the effective base resistance is made relatively high in a controlled manner by feedback via a low impedance potentiometer chain fed from the collector of the upper transistor (R88, R87). Thus, in the case we have been considering, the potential swings are shared equally.

In the television receiver being discussed five experimental transistors are used in series in the video stage. The potential swings are equalised across the five transistors by potentiometer chains R94, R93; R92, R90; R91, R89; R88, R87. To minimise the effects of the current taken in these potentiometer chains the lower resistances are appropriately valued and returned to convenient points up the chain rather than to ground.

The overall gain of the amplifier will depend primarily on the load resistance, the a^1/r_{in} of the lower transistor Tr18 and the emitter resistance, R86. If, at this stage in the description, it is assumed that the transistors will not limit the frequency response then we may consider the load network (R95, L34, etc.) chosen in the usual manner for an anode-compensated video stage. There will be some reductions in shunt capacitance of which advantage may be taken (e.g., collector capacitance lower than usual anode capacitance, no valve holder, no noise limiter, lower synchronising pulse separator loading, and possibility of less wiring-capacitance as the small video amplifier may be mounted close to the tube base).

With the load resistance (4.2 KΩ) and the emitter resistance chosen for this stage and the experimental transistor (Tr18) used at the bottom of the Beanstalk the overall voltage gain is approximately 50 times. Thus as the same potential swing occurs at the collector of each transistor the individual voltage gains will be: Tr18, 10 times; Tr19, 2 times; Tr20, 1.5 times; Tr21, 1.33 times; and Tr22, 1.25 times. From this distribution of the voltage gain a number of things follow.

First, the Miller capacitance effect for the first transistor Tr18 is considerable, and a low impedance signal source is essential. In order that the detector load impedance may be kept sufficiently high to achieve good efficiency a grounded collector stage (Tr17) is, therefore, used as a buffer. The presence of this buffer in turn means that the f1 of the lowest transistor is not so

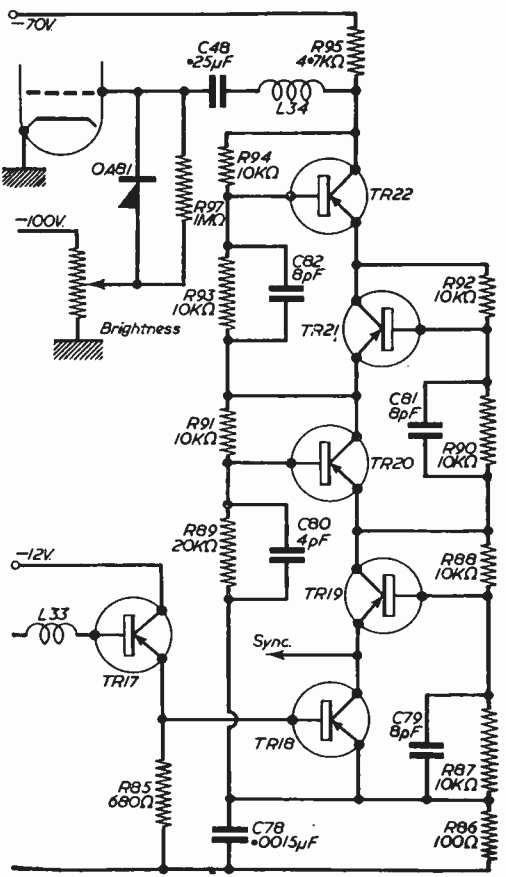


Fig. 8.—Beanstalk video amplifier.

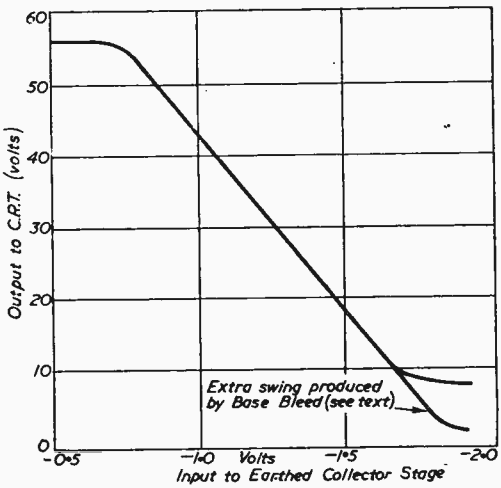


Fig. 9.—Transfer characteristic of video amplifier.

important. In fact, the driving impedance is so low that even with an $f1$ of 30 Mc/s and a gain of 10 times the transistor Tr18 does not influence the high frequency response of the amplifier.

Second, the upper transistors (Tr19, Tr20, Tr21, Tr22) are relatively non-critical so far as such properties as a^1 and $f1$ are concerned. This can be seen, of course, very readily by considering the top four transistors as subject to heavy negative feedback. In fact some compensation for poor high frequency performance of these transistors can be made by increasing the value of the capacitors, C82, C81, C80 and C79, which otherwise balance the effect of the transistor collector-to-base capacitance in the feedback potentiometers. High frequency compensation (R86, C78) is included in the emitter of the transistor Tr18. This compensation may be used to make up for deficiencies in the high frequency performance of the transistor Tr18 or, of course, the video output load network, or the I.F. amplifier. Also the emitter resistance R86 (being large in comparison with r_e) linearises the transfer characteristic.

The output from a video amplifier may be limited by the dissipation or the voltage rating of the transistors. In the example under consideration the dissipation limit of 50 mW per transistor was the limiting factor. Thus the total dissipation (250 mW) and the load resistor (4.2 KΩ) can be used to determine the maximum voltage (60 v. approximately) across the beanstalk by settling the position of the load line on the collector characteristic. The load line also shows the maximum current (15 mA approximately) which should flow for maximum output potential swing.

However, the theoretical swing is not achieved at the low collector potential for the following reason. At full collector current the base current is considerable. This must flow through the base bias network and the lowest collector potential will be set by the necessity to provide the base current. As an example take a base current of 0.1 mA corresponding to a collector current of 13 mA for transistor Tr19. A current of 0.1 mA flowing in resistor R88 (10 k) means that point A (the collector of Tr12) must be 1 volt more negative than the base. The excess potential at the collector of Tr20 includes that of the previous transistor (Tr19) but must, besides providing its own base current, take account of the current flowing in the potentiometer resistor R89. Thus the effect is cumulative. Of course, the potentiometer resistors can be reduced in value, but as they shunt the load resistor its value must be increased and also the H.T. potential must be increased to restore the voltage conditions for the transistors cut-off. Alternatively, resistors may be connected from each base to the video stage H.T. line valued (say, about 700 KΩ) to provide the base current for bottoming. The lower potentiometer resistor may be adjusted to restore the cut-off conditions. To be completely successful this method involves choosing the extra bleed resistors to suit the a^1 of the individual transistors.

The transfer characteristic of the complete video amplifier is shown in Fig. 9. The sharp limiting of the transfer characteristic means that a noise limiter is superfluous, at least at present, when the limited drive is likely to be used to its fullest extent.

The D.C. restorer is used to eliminate any D.C. drift in the video amplifier with temperature. Quite clearly this question of D.C. drift will be a very important problem if cathode drive has to be used and a conventional D.C. restorer could not be used conveniently. Furthermore, a direct coupled cathode drive arrangement requires a further negative bias supply for the cathode ray tube grid.

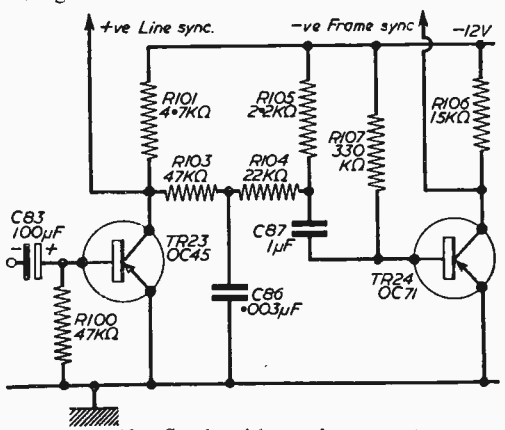
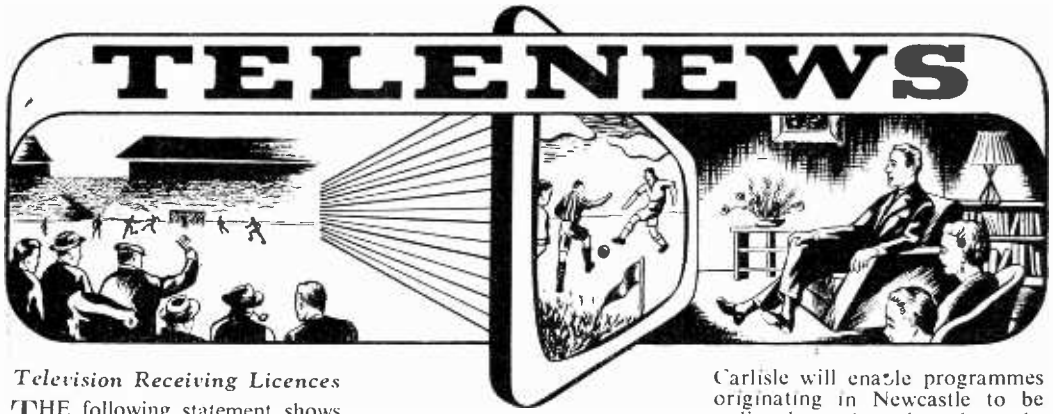


Fig. 10.—Synchronising pulse separator.

As has already been indicated the first really practical and cheap solution to the problem of video drive may be a compromise—the transistor designer contributing something and the tube designer something. Perhaps the transistor designer will make his contribution first and then the two or three stage Beanstalk may enjoy a temporary popularity. Here is a field in which there is plenty of room for ingenuity and invention.

(To be continued)



Television Receiving Licences

THE following statement shows the approximate number of Television Receiving Licences in force at the end of December, 1958, in respect of television receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland.

Region	*Total*
London Postal	1,654,716
Home Counties	1,135,782
Midland	1,394,921
North Eastern	1,440,666
North Western	1,230,017
South Western	720,061
Wales and Border Counties ...	520,778
Total England and Wales ...	8,096,941
Scotland	703,697
Northern Ireland	98,429
Grand Total	8,899,067

Training Young Scientists

TO help meet the national shortage of scientists and to assist Science teachers, the BBC is prepared to expand its present TV schools programmes. The Director General of the BBC, Sir Ian Jacob, told the School Broadcasting Council "If there is a national need, we are a national institution, with a duty of filling it." Sir Ian said that the Presidents of certain associations had called on him recently to urge that the BBC should do its best to interest people in science. The BBC, he said, proposed to put all the resources it could behind this job. As the world pioneer of schools programmes in sound radio, the BBC was well placed to expand its present experimental television service to schools. But TV costs six times as much as sound. Given the money, channel space and support from the educational authorities, the BBC was ready to increase its already great effort for education.

Post Office Links for I.T.A. Transmitter at Burnhope

NOW that I.T.A. has opened its new transmitter at Burnhope a variety of vision links have been provided by the Post Office. The station is joined by a single-way link to the Newcastle Studios of Tyne-Tees Television. Programmes from the main I.T.A. network are received over a single-way link from Telephone House, Manchester. The routing involves both land line and radio links, radio being used on the section between Carlisle and the Post Office radio station at Pontop Pike. A new Post Office network switching centre at Telephone House, Newcastle, has been set up to handle both network and local programmes.

Some eight miles of additional coaxial cable has been laid to provide the land lines and many new sections have been added to existing ductways. Later in the year the radio link will provide a two-way service and this with other new work at Carlisle will enable programmes originating in Newcastle to be radiated northward and southward to cover the whole I.T.A. national network.

New Soviet TV Installation

N. KUPREVICH, senior scientific worker at the Pulkovo Astronomical Observatory, designed a TV installation for astronomical observations and is perfecting it now. He has introduced new more sensitive transmitting tubes and reception tubes with increased brightness. He can take snapshots of the moon, Mars and Jupiter, etc.,

N. Kuprevich adjusts the reflector telescope to watch the moon.

with the aid of the reflector telescopes having a mirror with a diameter of 300 mm. and a focal length of 18 metres, and scores of photographs of the moon and Mars have already been taken.

BBC Appointment

THE BBC announces the appointment of Mr. J. S. Clemo as Engineer-in-Charge of the Rosemarkie Television and V.H.F. Sound Broadcasting Station in succession to Mr. M. Clough who recently became Assistant Engineer-in-Charge at the BBC's high-power station at Holme Moss.

Mr. Clemo joined the BBC at the Redruth Transmitting Station in 1944. After serving at a number of the Corporation's transmitting stations, first as a technical assistant and later as an engineer, he was transferred in 1954 to the BBC's television and V.H.F. sound broadcasting station at North Hessary Tor in Devon, from where he takes up his present post.

Southern ITV Increase

A MID-NOVEMBER survey of the Southern ITV area—the fourth carried out in that area by Television Audience Measurement Limited (TAM) since Southern Television Limited began operations on August 30th—reveals that 260,000 homes were then receiving ITV transmissions from Chillerton Down, an increase of 79,000 over the opening night total of 181,000.

An encouraging feature of ITV progress in the area was that after only two and a half months of ITV transmissions, 30 per cent. of all private households were receiving ITV programmes compared with 22 per cent. and 26 per cent. recorded in the Scottish and South Wales and the West of England ITV areas respectively, after a similar period.

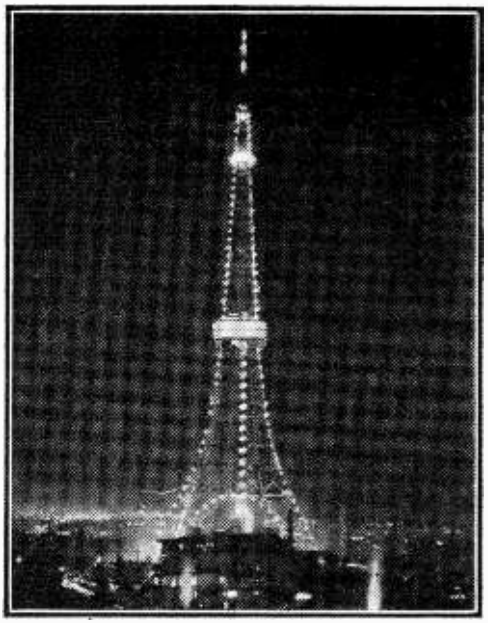
Independent Television in Northern Ireland

THE INDEPENDENT TELEVISION AUTHORITY has decided to accept, subject to contract, the application of a group under the chairmanship of the Earl of Antrim to provide the programmes for transmission from its Northern Ireland station to be built at Black Mountain, near Belfast. It is planned to begin programme transmissions from this station at the end of 1959.

The group will be controlled by residents of Northern Ireland and will have its headquarters and studios in Belfast.

It represents a wide diversity of professions and industries in Northern Ireland, together with varied educational, journalistic, social and cultural interests.

The Black Mountain station will bring independent television programmes within reach of over one million people and the service area will include practically the whole of Northern Ireland with the exception of Fermanagh, the western parts of the counties of Tyrone and Londonderry, a small part of County Down in the Warrenpoint and Kilkeel area and the Antrim coast from Larne to Portrush.



The giant Tokyo Tower illuminated after the opening ceremony had been performed by a six-year-old girl.

Giant Tokyo Tower

SIX-YEAR-OLD Yoshiko Maeda, daughter of the President of the Tokyo Tower Corporation, performed the ceremony of opening the 1,090ft. high TV tower in Tokyo, the world's tallest independent tower, recently. She took the place of Crown Prince Akihito who could not perform the ceremony because of prior engagements.

"Town and Around"

LONDON and south-east England, embracing over ten counties and a population larger than several European countries, now has its own news magazine on BBC television.

The programme goes under the title "Town and Around," and it has its own special team of presenters, distinct from the three National newsreaders, and a woman is among those selected after a series of camera tests in the news studio at Alexandra Palace. The initial panel consists of John Ellison, Nan Winton, Robert Gladwell and John Tidmarsh.

Two Million London ITV Homes

THE number of ITV homes in the London ITV area now exceeds the two million mark, it means that 44 per cent. of all London's 4,490,000 private households can now view ITV programmes, reports Television Audience Measurement Limited (TAM). This compares with a homes viewing audience of only 190,000 (5 per cent. of all homes) when ITV first began operations in the London ITV area slightly more than three years ago. As to individuals within these homes, the number of ITV viewers has multiplied almost ten times—from the opening night figure of 670,000 to the current total of some 6,680,000.

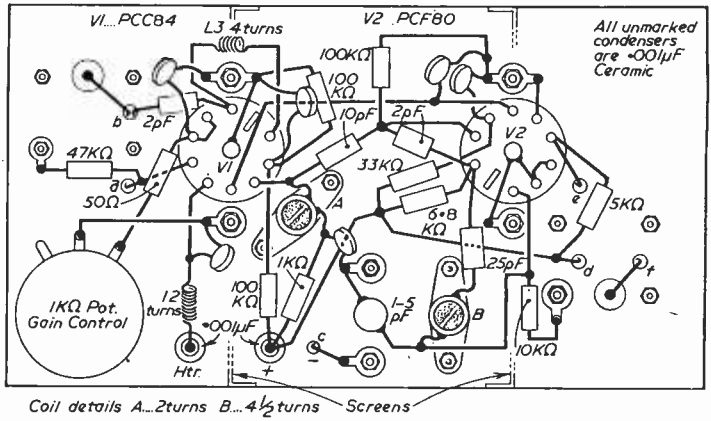
The number of ITV homes viewing both weekday and weekend programmes now regularly exceeds 1,400,000 at peak viewing periods.

A Home Constructed TV Receiver

ADDITIONAL INFORMATION ON THE RECEIVER DESCRIBED IN THE FOUR RECENT ARTICLES

By P. Green

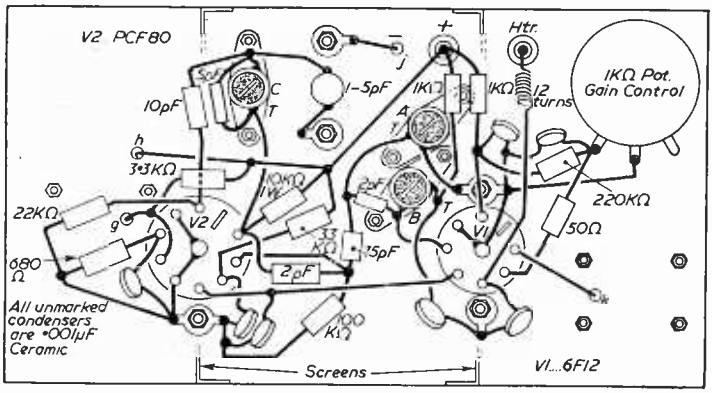
ALTHOUGH the article on this set is now complete, there are many readers who have difficulty in reading and working from a circuit diagram. The author, therefore, has prepared a set of five drawings, showing point to point wiring connections. Undoubtedly, these will be welcomed by many readers.



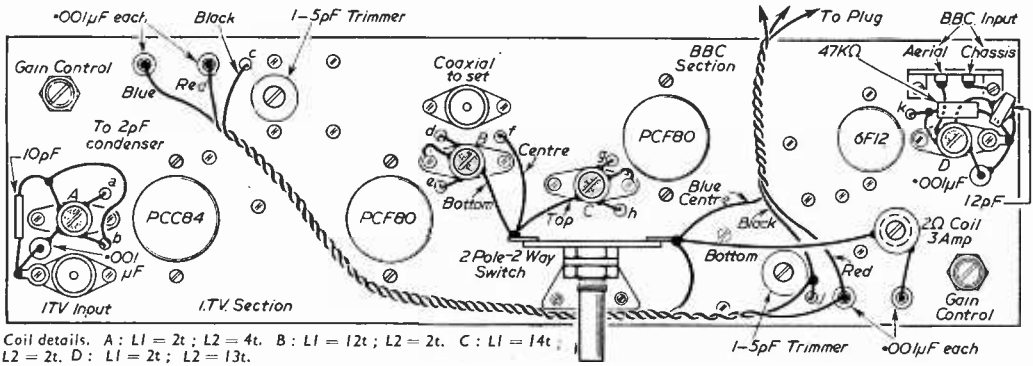
The ITV converter (with the screen removed).

Connections for ITV and BBC Converters

Three drawings show the connections for the ITV and BBC converters, with a top view of them bolted together. The screens are not shown, for clearness. All resistors are half watt, and the condensers close tolerance except the .001 µF ceramics. The top view shows the D.P. changeover switch, which switches off the heaters and the output coils of the converter not in use. Three leads from the power pack supply the chassis, and the heater lead is connected to the centre of one side of the D.P. switch. In the heater connection of the BBC converter a further 2 ohms coil is connected, as the voltage drop of



The BBC converter (with the screen removed).



Coil details. A: L1 = 2t; L2 = 4t. B: L1 = 12t; L2 = 2t. C: L1 = 14t; L2 = 2t. D: L1 = 2t; L2 = 13t.

View of the two converters from above. (Top, Bottom and Centre refer to positions on switch.)

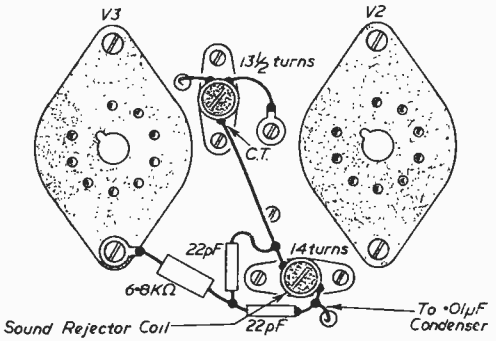
the two valves is less than those on the ITV converter. To prevent drift the chassis should be kept cool, and it is advisable to mount them clear of the cabinet sides to allow plenty of ventilation. In use the converters are easy to align, and the gain controls are an asset. Both pictures can be adjusted similarly, without further use of the brilliance control.

Power Pack

The power pack and timebase chassis is shown completely wired with all the modifications that have appeared from time to time in these pages.

POWER PACK AND TIMEBASE CHASSIS COMPONENTS LIST

R42—22 k.	R54—33 k.
R43—2.2 k.	R55—10 k.
R44—1 k.	R56—270 k.
R45—2.5 k.	R57—330 Ω
R46—47 k.	R58—6.8 k.
R47—330 Ω	R59—10 k.
R48—220 k.	R62—470 k.
R49—330 Ω	R63—1 k.
R50—2.2 k.	R64—250 Ω
R51—90 Ω	R65—5 k.
R53—47 k.	R66—330 Ω
C37—47 pF.	C41—.5 μF.
C38—.005 μF.	C46—.002 μF.
C39—.01 μF.	C47—.01 μF.
C40—.1 μF.	C48—.25 μF.

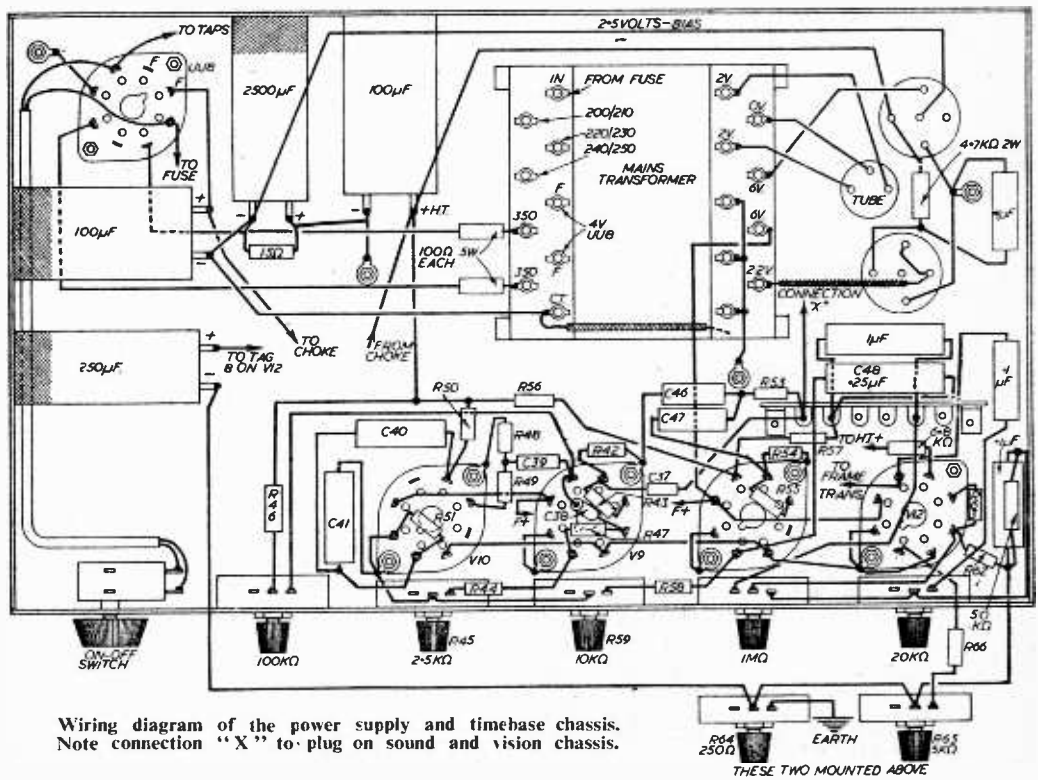


Location of the sound rejector coil.

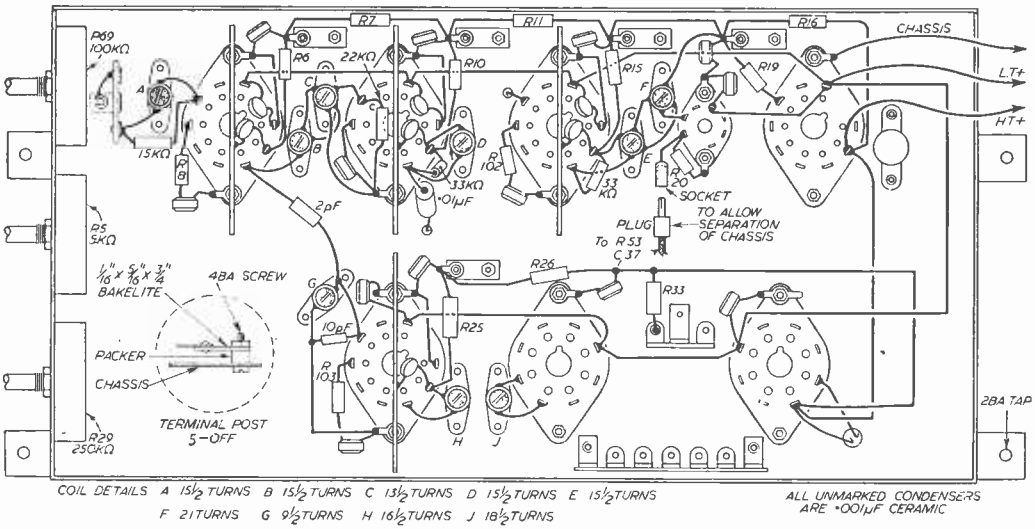
These have greatly increased its efficiency, with more latitude to the height and width controls. The mains transformer with rectifier supply gives more output and more voltage, with the addition of adjustments to the taps for a failing mains supply.

Sound and Vision

On the sound and vision chassis, modifications are only shown for use as an I.F. amplifier; the original rejector coils are now removed. The coils can be rewound, or additional turns added,



Wiring diagram of the power supply and timebase chassis. Note connection "X" to plug on sound and vision chassis.



Modifications to "Viewmaster" chassis for conversion to I.F. amplifier. (All "Micadiscs" replaced with 0.001 μF ceramics.)

as given in the table on page 177 of the November issue. The new "T" sound rejector coil may be wound on one of the removed formers, and fitted on the chassis as shown on the drawing. In place of the mica discs, a small terminal post is used, to secure positions for the .001 μF ceramics and resistors. On the existing chassis only the decoupling mica discs should be shunted with .001 μF condensers to prevent instability on the lower frequencies. Other modifications to the sound side consist of a 2 pF condenser from the anode of V1 to grid of V6. The grid coil is shunted with a 10 pF condenser. All other connections are as given for the "Viewmaster."

As stated in the December issue the alignment of this receiver should be carried out with the aid of a signal generator, although the author aligned his on a transmission.

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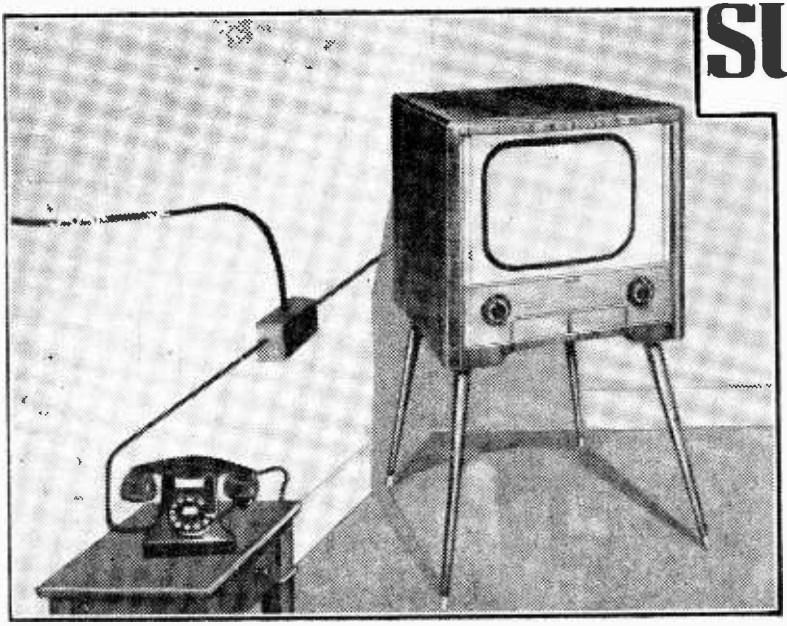


FOR nearly ten years there have been many discussions and several demonstrations given in the United States of America of schemes which will enable those responsible for producing an expensive television entertainment to collect payment from those viewing the transmission. This is not to be confused with the normal television broadcasts which are financed by private capital and the sale of advertising time on the air. The collection of a fee based on the type and duration of the programme from each set owner viewing it would, in effect, move the box office into the home, for the owner of the set is really paying an admission fee to go to the theatre or cinema in his own lounge.

"Pirate" Viewing

To prevent any form of "pirate" viewing, it is therefore necessary to devise methods for applying secrecy to the signals which are broadcast so that clear pictures may only be received on those sets incorporating a decoder which applies a correcting signal to the received broadcast. At the moment, Congress in the U.S.A. has imposed a temporary ban on some of the schemes proposed so that a full investigation of their implications can be undertaken.

The Coding Signal

The coding signal can be sent over the air or applied via a cable linked up with the potential viewer. There are several methods whereby this can be accomplished and one of the most interesting was that which intended to make use of the ordinary telephone line. Almost every home in the U.S.A. seems to possess a telephone, so the lines linking the house or flat provide a ready-made link which could be adapted for this purpose. Because of the nature of the scheme, it was called Phonevision and several demonstrations were undertaken to prove that the idea was a workable one. Details of the method will serve to show how this subscription television could collect the fees to provide for the special costly programmes.

Synchronising and Video Signals

The idea formulated and tried by Phonevision to ensure privacy for the transmissions was to bring about a change in the phase relationship between the synchronising and video signals. The shift was introduced deliberately, but at random intervals between the video or picture signal. The shift was only a small percentage of the horizontal synchronising period, but this did not persist all the time, the balance being that of a normal picture.

This random changing of the phase relationship produced a picture on the receiver which was in no way distorted but the image moved to the left and to the right at an irregular slow rate to give an exasperating blurring effect. Any ordinary television receiving set tuned into this transmission was therefore incapable of showing a locked picture and the only way to restore the picture to normality was to inject a key signal to neutralise the shift.

Secondary Control Line Link

The change from one mode to the other was undertaken during the vertical blanking period and in this way the circuits involved have sufficient time to reach stability. To enable the secondary control line link to be employed for its original legitimate purpose—in this case a telephone service—a special filter was incorporated in the telephone line and the band width of the key signal was limited to 120 cycles, the keying rate varying between 10 and 30 per second. In this particular system, the coded horizontal synchronising pulse causing the time displacement of the viewed picture was also fed into the shading generator at the transmitter to limit any possible flicker.

Coded Picture

In the television receiver employed to view the

TION TV-PAY AS YOU VIEW

JBSCRIBER PAYS ONLY FOR THOSE PROGRAMMES

By H. J. Barton Chapple, B.Sc.

coded picture, the horizontal synchronising pulse was fed into the small decoder unit after it had been separated from the main transmitted signal. The key signal sent over the line link activates the unit so as to apply the required amount of correction to the pulse triggering the horizontal sweep circuit.

The distribution of the key or decoding signal to the potential subscriber to the service is carried out by superimposing it on the customer's telephone line outside the normal aural band for voice circuits.

When the viewer has 'phoned for the decoding signal the picture resolves itself as shown above. Without the decoding signal, he sees a picture similar to the one on the left.

Fees

Looked at from the business or economic standpoint, the important question is the collection of the fees or payment demanded by the specialised service which is providing the television programmes. A flat rate monthly charge could be imposed, but this would be unfair to the subscriber who only desired to use the service on those occasions that the type of programme appealed to his taste. The idea was to make the programmes range over films, outstanding sporting events, plays with a star cast, etc., and a "box office season ticket" was not the best way to meet this.

In effect there are three principal problems to be dealt with:

(a) The subscriber intending to use the service must be able to make known his desire for the decoding signal for the programme or programmes of his choice.

(b) The correct type of decoding signal must be fed to this subscriber during the one or more programmes selected and not at any other time as otherwise the latter would be a free service.

(c) An exact record of all the transactions—date, time, duration, etc.—must be made so that a true account can be rendered to the customer.

The Decoding Signal

To preserve the right of selection by the customer, the idea proposed was for a call to be put through to the telephone exchange requesting that the decoding signal be applied to the appropriate telephone circuit at such and such a time on such and such a day. This decoding signal would have a time record made of its use and be associated with the subscriber's number. Depending on the type of telephone service involved, this could be done verbally or by digit codes, and although it was naturally hoped that subscribers would book the service ahead there would always be cases of viewers watching the coded picture at the beginning of a transmission and suddenly being intrigued by the nature of the programme and hastily telephoning for the key signal to be applied to the line.

Payment to the Company

Reimbursement to the programme company would be provided by quarterly or half-yearly collection of the sum of money calculated on the basis of the number of hours the viewer looked in, the time record being obtained from the telephone service. The idea is a novel one capable of adaptation in many different directions where secrecy in television transmission is required, but these coded schemes must now await the decision of Congress in the U.S.A. as to future developments.

It is difficult at this juncture to forecast whether or not such a viewing system will ever be used in this country. No doubt this will depend in some measure on further progress in this direction in the U.S.A.

TELEVISION TROUBLES

Their Symptoms and How They May be Cured—7

By G. J. King

THIS month's article deals with line and frame timebase faults in the Ekco T161 series which covers the models T161, T162, TC162, T166 and TC166. Model TU169 is similar in some respects but avoids the use of a mains transformer since it is designed for A.C./D.C. operation. The T161 series, however, adopts an A.C.-only chassis and features a mains transformer.

The series is still in extensive use, and quite a few specimens are finding their way into the hands of experimenters for service and modification. This article, though, is concerned primarily with timebase and synchronising faults and symptoms, in accordance with the originally adopted pattern.

Frame Scan Collapse

It sometimes happens that the frame reduces to about ½in. at maximum position of the height control, and that the voltage at the anode and screen of V1 (see Fig. 1), is well below the expected 52 v. A check of R1 reveals that this is of correct value, and it may well be found that C1 is also in order, and also the anode winding of T1.

In this case, the trouble is caused by V1 passing an excessive current as the result of its control grid being positive with respect to chassis. This condition is brought about by a slight leak in the 47 pF frame sync pulse coupling capacitor, shown as C2 in Fig. 1.

Various frame fault symptoms, ranging from complete collapse of the frame scan to intermittent collapse and foldover, may be produced by disturbance of the heater current in the 6L18 frame amplifier (V2 in Fig. 1). The 6L18 heater is the last in the chain, one side being connected to chassis and the other side to two parallel-connected chains forming the heaters of the remaining valves, the complete circuit being energised, by way of a ballast resistor, from a tap on the primary of the mains transformer.

A fault in the heater of the 20P1 line-amplifier valve has been known to promote an intermittent frame collapse, while at the same time being responsible for an horizontal waver of the picture when a vertical scan was present.

Similarly, trouble in the heater circuit of the 10F1 final sound I.F. amplifier has given a very bad frame scan with a foldover at the bottom and non-linear lines at the top, along with impaired sound and vision. In this case, 3 v. instead of the normal 6.3 v. was present across the 6L18 heater, and the symptom from the frame point of view was that of a low emission amplifier valve. When trouble of this nature is suspected, it pays first to check the heater voltage of the 6L18.

Frame Non-linearity

Excessive foldover at the bottom of the picture is frequently caused by a leak (poor insulation) developing in the 0.0047 μF between the anode and grid circuits of the 6L18 (given as C3 in Fig. 1). When this is the cause of the symptom, the foldover is not affected by adjustment of the height control, and the voltage at the cathode of the 6L18 is considerably above the normal 14 v. (it often rises to the region of 20 v.).

Similar trouble is caused by a leak in the 0.1 μF frame coupling capacitor (C4), but in this case operation of the height control invariably affects the symptom.

Bad cramping at the bottom of the picture resulting in the scan covering only the top half of the screen, should lead to a substitution test of the 500 μF electrolytic connected to V2 cathode (C5 in circuit). When this component is the culprit, little or no alleviation of the distortion is provided by adjustment of the frame linearity control.

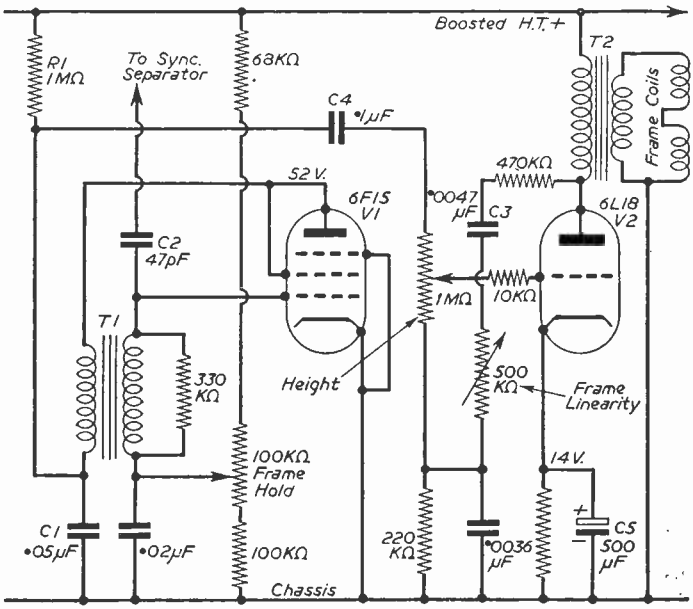


Fig. 1.—Frame timebase circuit of Ekco T161 series.

Poor Frame Hold

So as to provide an improvement of frame hold in poor reception areas, later versions of the T161 series feature a special frame oscillator transformer with a tertiary winding for the application of the sync pulses. The circuit is shown in Fig. 2. There may also be found a small metal rectifier in the frame sync circuit, which should be checked in persistent cases of poor hold.

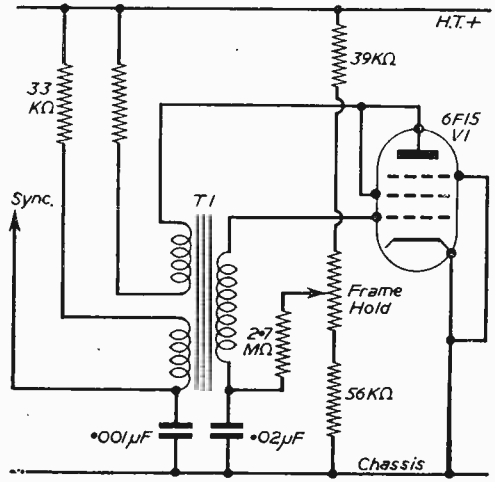


Fig. 2.—The modified frame oscillator.

A leak across the 2 μF electrolytic capacitor connected to the screen of the 20F2 sync separator valve (pin 5) is another frequent cause of the trouble, though does not appear to affect the line hold unduly. However, if a serious leak develops, the sync fails completely, and there have been cases of the capacitor shorting, sometimes aggravated by excessive pressure of the capacitor retaining clip, this pressing into the body of the component.

If poor frame hold is accompanied by a slightly reduced frame scan, and the smaller components appear to be in good condition, there is a possibility that the frame oscillator transformer is responsible. This would appear to develop a slight leak between the windings or the winding resistance may rise for some reason or other. The only conclusive test lies in transformer substitution.

Frame Jitter

This can be caused by a faulty oscillator valve (V1), trouble in the oscillator transformer or a leak in C1 or 0.02 μF capacitor connected to the slider of the frame-hold control. Where the frame components check normal, however, and substitution tests do not reveal the trouble, it often pays to check the condition of the 120 + 250 μF electrolytic, even though symptoms of hum are not in evidence.

Hold Control at End of Range

In receivers using the circuit as in Fig. 2, it may be found that the optimum position for the frame hold control is becoming progressively near one end of its travel. The cure lies in the replacement of the 2.7 M resistor connected between the centre tag of the frame-hold control and the frame oscillator transformer.

Line Oscillator Failure

Fig. 3 shows the circuit of the line oscillator/output sections along with the complementary reclaim and EHT networks. When these sections are working correctly, the 10 kc/s line whistle will be heard from the line output transformer (T2), the pitch of which can be altered by adjusting the line-hold control.

If lack of EHT is coincidental with lack of whistle, a possible cause is shorting turns in the line output transformer, but several tests should be made before transformer replacement is contemplated. In the first place, it should be established that H.T. is present at the cathode of V2 (part of U801) and that section A of the transformer possesses continuity (the correct resistance is 79 ohms, subject to slight deviation).

Next, a check should be made of the voltage on the screen of V1 (20P1). This should normally be in the region of 125 v., but if zero voltage, section A of T1 (normally 10 ohms) should be checked for continuity and the voltage at the junction of this winding and the 2.2 k. resistor should also be checked. Zero voltage should then lead to a check of the 3.3 k resistor, which will probably be found to be open-circuit.

If the line whistle occurs and EHT becomes available when the deflector coils are unplugged from the chassis, the 50 μF electrolytic capacitor connected to the line coils should be replaced.

Also, before the transformer is replaced, V1 and V2 should be checked, preferably by substitution, as also should the smaller components associated with the circuits.

Low EHT

The frame timebase circuits are energised from the boosted H.T. line (from the cathode of V2—see Fig. 3) and it has been known for a fault in the frame circuits to load the boost circuit to such an extent that operation of the line timebase is considerably impaired. A heater-to-cathode short in the 6L18 is one cause of the trouble.

A similar symptom, also showing as poor focus and sub-standard performance generally is caused by open-circuit of one of the surge-limiting resistors in the anode circuit of the H.T. section of the U801. Two 50-ohm wire-wound components are employed, one to each anode, and open-circuit of one considerably reduces the H.T. voltage, while also putting an abnormal load on the resistor left in circuit. It is, therefore, best to change both resistors when one fails.

Lack of EHT

If the line whistle is present, even though weak, and the anode of the U25 EHT rectifier is glowing red hot, the cause is shorting EHT as the result of insulation failure between the U25 heater winding and the line output transformer core. Transformer replacement represents the only sure cure.

It should be mentioned, however, that the same effect would result from a short across the 0.001 μF EHT filter capacitor, though this happens less frequently than the transformer short.

Non-linear Line Scan

This symptom should lead to a check of H.T. voltage (see Low EHT) and a substitution test of the two 50 μF electrolytics in the line circuit, one connected to V2 cathode and the other to the line coils (Fig. 3).

No Line Hold

If there is no trace of line lock, though the line hold control serves to adjust the oscillator frequency to steady the picture within its range of adjustment, attention should be directed to the 5 pF line sync coupling capacitor which is connected to the control grid of the 20P1. In areas of weak signal, enhanced line lock can be secured by increasing the value of this capacitor to 10 pF.

If it is found that the operating point of the line hold control falls to the end of the core adjustment, or if the correct locking point is outside the range of the adjustment, balance of the control can sometimes be achieved by either connecting or disconnecting the line hold control shunt winding on T1 to chassis, as indicated by the lead marked "X" on the circuit.

If this does not effect a complete cure, the trouble may be caused by an alteration in the characteristics of the 20P1. A substitution test proves this possibility without trouble. Attention should also be given to the 2 μF electrolytic coupled to the end of winding A on T1 in the event of line trouble.

(To be continued)

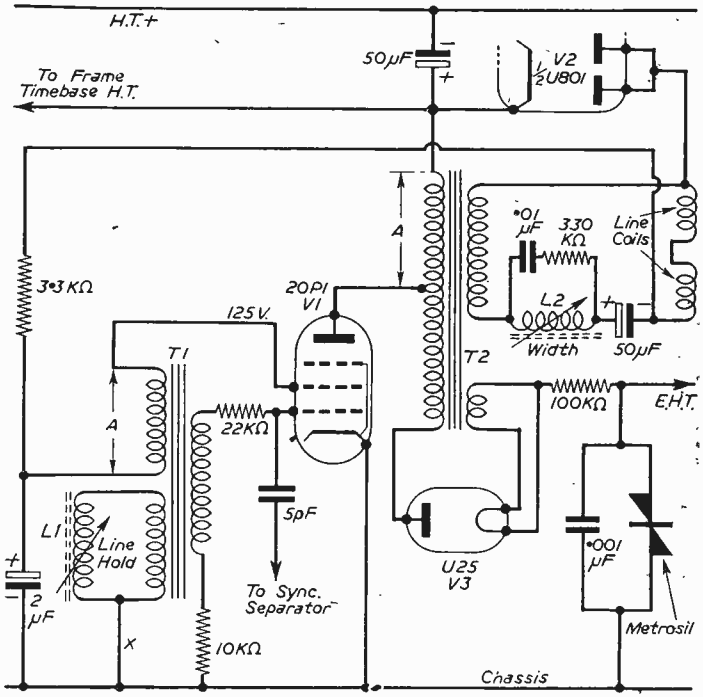


Fig. 3.—The line oscillator amplifier circuit.

Television in Iran

TELEVISION in Iran has made rapid progress during the three short months it has been on the air. Opened by His Majesty The Shah-in-Shah last October as the first commercial television station in the Middle East, Television of Iran has already built a large audience. Now on the air four hours a day seven days a week, over 80 per cent. of Television of Iran's programming is live. This in itself is most unusual and especially so in an area where none of the 60-odd employees had ever seen television prior to its opening three months ago.

One of its most popular programmes is the teaching of English, as developed in co-operation with the British Council in Tehran. This programme has generated a wide appeal among all income groups. It is now a common sight to see clustered around the receivers in the showrooms of the stores people from all walks of life not only watching the show intently but with pencil and notebook in hand taking down the words of the language as it is presented by this particular programme.

Television of Iran is unique in that this newest means of communication is given over to private enterprise. The owners of the station, the Habib Sabet family, are prominent business leaders in Iran.

The station manager of Television of Iran is Mr. A. Vance Hallack, who came to Tehran from Baghdad where he organised and managed Television of Baghdad.

Television of Iran is equipped with two major studios, the larger one being 75ft. × 45ft. and the smaller being 60ft. × 36ft. It has a complete complement of studio equipment plus a mobile unit for outside activities. To quote Mr. Hallack: "Television of Iran is another example of the ability of the Iranian people to master an instrument as delicate as television and through this, help develop Iran by presenting a medium that will not only further cultural and educational possibilties but build a new large commercial market in the field of television advertising."

Mr. Hallack was a pioneer in television in the United States and has also been a pioneer in television overseas.

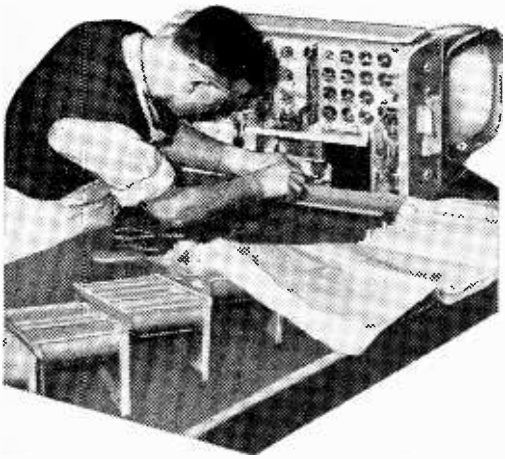
The receiver sales are higher than expected. The commercial sales of the station are expected to hit 50 per cent. by the middle of January—three months ahead of the established goal for this figure. A step forward in the advertising industry has been made as some international agencies have already set up divisions in Tehran.

A NEW SERIES

Analysing and Servicing TV Receivers

No. 5—The Line Timebase

By "Diadem"



A SELF-OSCILLATING line timebase is shown in Fig. 22. The oscillator feedback capacitor is C1 and the line hold control is R1. A leakage across C2 will prevent the line from locking to the correct frequency. The booster diode V2 rectifies the line flyback energy developed across the scan coil winding giving an increase of 250 v. over the H.T. line voltage. This increased voltage is fed to the line oscillator anode V1 with the H.T. voltage. The voltage from the diode when smoothed also feeds the tube's first anode. The EHT overwind between points A and B provides a step up in voltage to 9 kV. This is then rectified by V3 and fed to the tube anode. The brilliance control, R3, in conjunction with R2 forms a potential divider across the H.T. line. The variable trimmer, C6, is a "striation" control for the removal of vertical bars (line ringing). The scan coil D.C. isolating capacitor is C9. The last two components are the ones referred to in the faults section. A fuller description of line timebase working will be found in the EHT section. To prevent confusion a "booster," "efficiency," "economy" or "reclaim" diode are all the same thing, a damping diode does just what the name suggests and is connected in place of the resistor/capacity combination across the scan coils in Fig. 24. In the case of the damping diode the flyback energy is not fed back to boost the line transformer primary voltage to V1 anode.

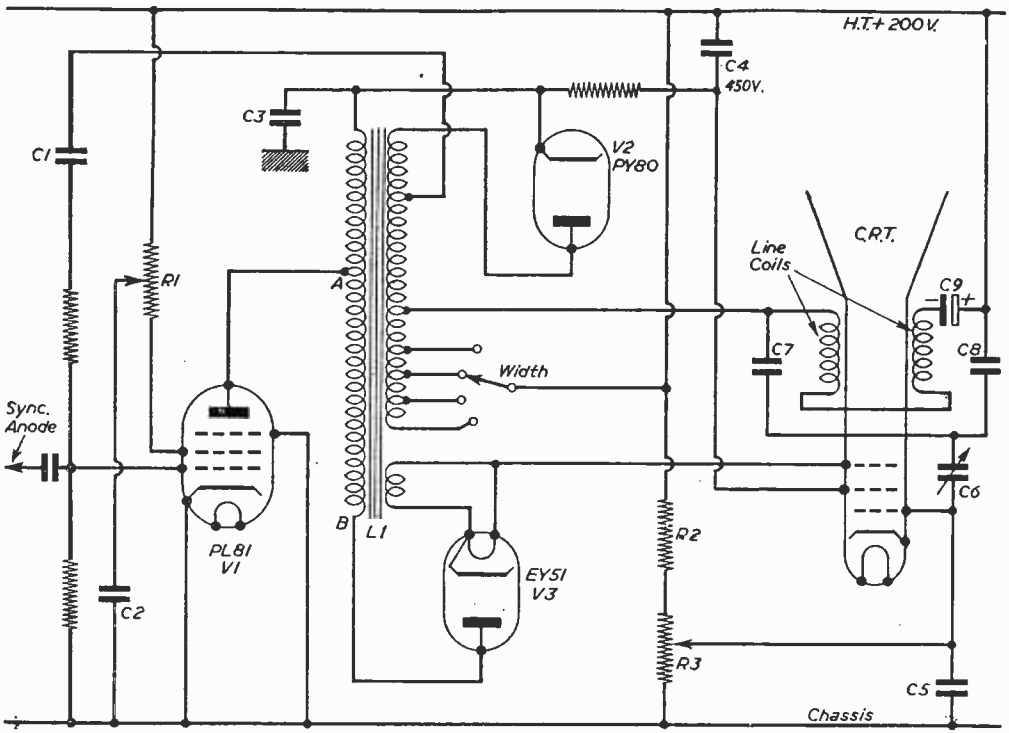


Fig. 22.—Circuit of a self-oscillating line timebase.

Fig. 23.—As we have already discussed the function of the sync separator we will take this diagram from V1A anode. Its output is negative going line sync pulses which are fed into the grid of the line pulse clipper V1B which clips the negative going end of the pulse. The output is inverted and passes to the differentiating network C1 and R1. A pulse is then produced with a positive going leading edge and a negative going trailing edge. This pulse is fed to V2A which removes the negative trailing edge. It is then fed from V2A via C2 to the anode of the line blocking oscillator V2B. Variation of the line hold control alters the grid voltage on V2B. The charge condenser is C3. The working of a blocking oscillator will be described in the frame timebase section.

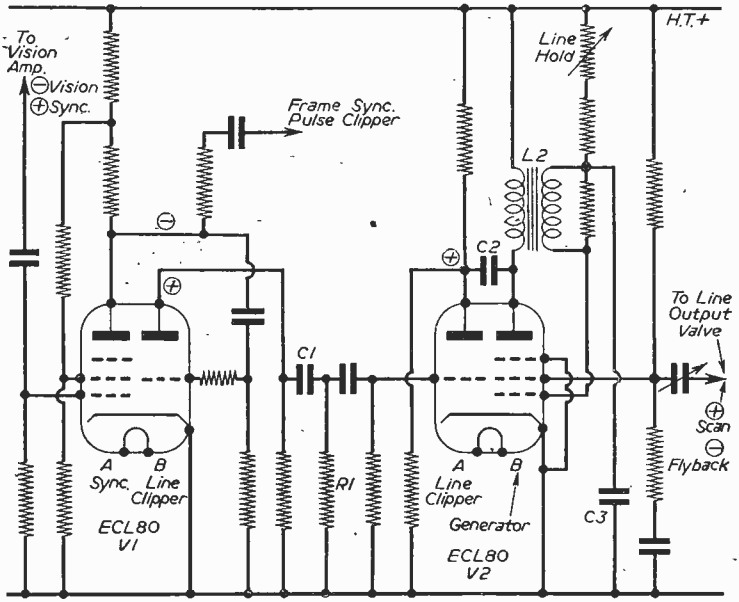


Fig. 23.—Sync separator and line timebase generator.

Fig. 24—This is a gas-filled thyratron generator often known as a "soft valve" timebase. This type of timebase requires a positive going sync pulse. It is important that all the condensers have excellent insulation particularly the charge condenser C2. C2 charges through R4 from the H.T. line to the firing voltage of the valve. When the valve conducts, or in other words the gas ionises, the resistance of the valve drops to a low value and C2 is rapidly discharged. The voltage across the valve falls; its high resistance returns and C2 commences to charge again. R5 is a safety limiting resistor to prevent damage to the valve on the discharge of C2. The length of time taken for the valve to build up to its "firing" voltage is determined by R4 and C2 and by its bias voltage. This is controlled by R6 which is also the line hold control. This is how the valve worked in an unsynchronised state. Under synchronisation the valve function is slightly different.

When a positive sync pulse arrives at the grid the bias is reduced, this causes the valve to conduct and C2 is discharged. R6 is set so that the valve is just about to conduct as the sync pulse arrives. This positive pulse locks the frequency of the generator to that of the transmitter when the hold control is set correctly.

The sawtooth output of V1 is fed to the line amplifier by coupling condenser C3. An older form of linearity circuit is shown. The linearity components are C4, R1, R2. This type of line transformer deals with scanning power only and does not possess an EHT overwind. The width is controlled by varying the bias on V2 by R3.

Fig. 25.—This circuit shows another form of linearity network. This is a line amplifier stage with flyback EHT. The sawtooth output to the grid is supplied by a separate generator. Variation of the bias voltage by R3 aids in making the scan linear. When checking for faults in linearity do not forget C1 and R1. These components work in conjunction with C2, the feedback condenser from the line scan coils. The damping components R2 and C3 across the deflecting coils will also affect linearity if they vary in value. The first components to check should be the valve and the bias electrolytic capacitor.

(*Note.*—Figs. 24 and 25 will be given in the next article.)

Faults Associated with the Line Timebase

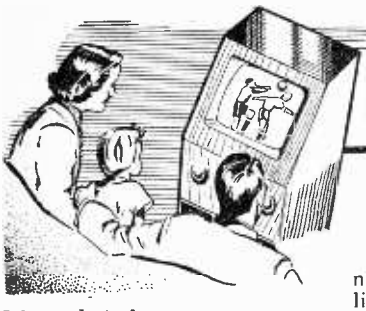
Striations.—Several vertical white bands about half an inch wide starting at the left and losing intensity towards the centre of the screen. The lines are usually caused by parasitic oscillations—adjust balance capacitor fitted on or near scan coils, check the damping or efficiency diode, the line output valve and the scan coils. Before condemning the line oscillator or output components, check the chassis and make sure every nut, bolt, screw, valve can and coil can is secure.

Irregular or torn vertical white bands.—Check for insulation breakdown in line output transformer; change booster diode.

Picture moves bodily to the left.—Check scan coil electrolytic condenser for leakage. D.C. in the coils is the trouble here. This fault should not be confused with the effect caused by a sync pulse which is too strong, or by a drifting horizontal frequency. If D.C. is in the scan coils, altering the line control will not correct it and the picture will not move over to the right with the adjustment of the picture centring controls if the scan coil condenser has a bad leak.

Line tearing, jitter, intermittent slipping. Jack of width. Check line oscillator valve, some ECL80's show this symptom and 6K25 thyratrons.

(To be continued)



UNDERNEATH THE DIPOLE

A MONTHLY COMMENTARY

By Iconos

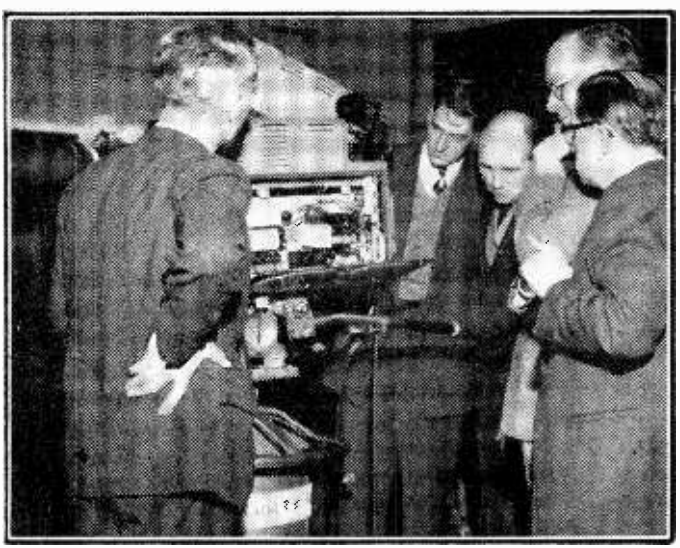
Mutual Aid

THE healthy and prosperous state of the British television industry is reflected in the thirst that has developed amongst its technicians for technical education.

The Television Society and the British Kinematograph Society, independent of one another and yet co-operating amicably in the arrangements for their meetings, are receiving strong support from both BBC and I.T.A. engineers. The programme companies are supporting these societies financially by becoming patrons or providing facilities for lectures and studio visits. Special "refresher" courses are being fully attended, which are followed by lively discussions in which many a new idea is put forward—and noted by the equipment manufacturers present. The London Polytechnic is now considering the establishment of a British School of Cinematography, which will organise a two-three year course on film production, this term to cover film production for television, including photography and sound recording. There has long been a need for such an educational centre, but it has required the impetus of television to get things going. Schools of this type already exist in Paris, Warsaw, Moscow and Hollywood, and these are already tending to take the television aspects into their curriculum. At the moment, 35 mm. and 16 mm. film is the basis of all of these educational schemes, but it cannot be long before magnetically recorded pictures come under the terms of reference.

Provincial Centres

THE lecture activities of these societies are mainly confined to the London area, but in the case of the B.K.S., there are active branches at Manchester and Leeds. The Granada Television Network, Manchester, has given great encouragement to these branches by providing a preview theatre for lectures and conducted studio visits. The Television Society has not yet penetrated the provincial cities, but will sooner or later have to consider this step. In a curious way, these societies do not appear to overlap. Broadly speaking, the Television Society deals with problems of design and the B.K.S. with problems of operation. The former covers research development and maintenance, while the latter includes production techniques, art work and set design, telerecording of all kinds (including video-tape), lighting and camerawork.



The inner workings of an image orthicon camera being explained to an interested party, following a lecture by Mr. R. Hammonds, the Chief Engineer at Granada, Manchester.

Video Tape Problems

THE Ampex magnetic video tape system is rapidly becoming a world standard for internal use in television studios. I say "internal use" because the magnetic recording of pictures at British television studios is naturally on the 405 line standard, whereas the Americans use 525 lines and most other countries use 625 lines. However, as a delayed programme storage, more uses are being found for Ampex equipment every day. The lecture by W. H. Cheevers to the B.K.S. on "Practical Experience with Video Tape Recording" at the Royal Society of Arts attracted much attention, and the demonstration and paper were followed by a lively discussion, which revealed many of the operational advantages — and difficulties—of picture recording on tape. One interesting disclosure was the possibility—and difficulty — of editing the recorded material. Mr. Cheevers stated that joints in the video tape could be made, but required great skill and took about 45

minutes to do! Every effort was being made to reduce this, but so far, it was only achieved at the risk of picture disturbances, rolling, breakage of tape and similar faults.

Paramount Films, Hollywood, were said to have evolved a splicing device that was reasonably reliable, but this was not yet available. Part of this lecture was given by playing back from the Ampex recorder at Associated Rediffusion's Studio in Kingsway, a recording made earlier of Mr. Cheevers talking into a television camera. This was sent by line to the Royal Society of Arts and reproduced on two large monitor sets. Various possible faults in recording and drop-outs on the tape were simulated, as well as normal first-class reproduction of recordings made of live television and films that had actually been transmitted to the public. Though video recording was now quite reliable, Mr. Cheevers said that telerecording on photographic film would be with us for many years, especially for exporting recorded programmes abroad.

Repertory Companies

MY recent remarks in this column about the aid that commercial television contractors are giving caught the eye of the theatrical newspaper, *The Stage*. Whilst supporting my theory that the repertory movement needed audiences as well as money, the repertory editor doubted the effectiveness of a "what's on" list of theatres appearing in a free TV advertising slot. I agree that a long list of theatres such as appear in the London and national newspapers, would not mean very much. But in some of the new smaller I.T.A. areas, such as T.W.W., Southern, Tyne-Tees and Anglia, the number of live theatres is regrettably low and patrons often travel many miles to see a play, musical comedy or music hall. An announcement covering the few remaining theatres would be a service to the playgoers who are also television viewers. After all, plenty of free space has been given to films in one way or another in such items as *Picture Parade*, *Picture Profiles* and *Close Up*.

Everlasting Series

FOR some reason that I have been unable to fathom, television series, whether live or on film, seem to aim at a total number of 39 episodes. Of course, some of them fall by the wayside before reaching this figure and a few—very few—seem to go on for ever. Both the BBC and I.T.A. wisely rest the popular ones for a few months, before they outstay their welcome. *Waggon Train*, *I Love Lucy*, *Robin Hood*, *Burns and Allen* and *The Army Game* have all had phenomenal successes, and one cannot help admiring the ingenuity of the producers in keeping the ball rolling. *Emergency-Ward Ten* (A-R) has proved very popular, but the other medical serial *Mary Britten M.D.* (Southern) has not stayed the course on the commercial networks.

It was most praiseworthy and ambitious of Southern to enter the highly competitive field of the network so early in their operations. I hope it will be followed up with a rather more active serial, with less throw-away lines and padding. This serial suffered from poor acting in the smaller parts—all the principals were first class. *Emergency-Ward Ten*, on the other hand, is excellently cast in all the parts, even the smallest. However, some of the pretty nurses are inclined to be a little inaudible at times.

Vidicon Cameras

THE BBC studios in London are at present more or less standardised on Marconi 4½in. image orthicon cameras and C.P.S. Emitron cameras of the new sensitive type. Each type of camera has its special advantages. The C.P.S. Emitron has a very good grey-scale and photographic quality, which flatters the "victim." The 4½in. image orthicon gives a very sharp picture indeed and is slightly more sensitive. BBC engineers are divided on which is the better camera, but each has advantages for particular fields. When a play calls for delicate lighting effects and many close-ups, the C.P.S. is preferred. For other shows, with quick action and detail required in long shots, the image orthicon wins. But there is now another type of camera which is steadily improving—the vidicon. Originally used for industrial purposes, clock dials and telecine, this type of camera has been improved rapidly in the last few months and is found in many BBC and I.T.A. presentation or interview studios. Main improvement has been in the camera tube, which rivals the C.P.S. camera in its photographic qualities when a specially selected tube is carefully lined up. Naturally, as the camera is less than half the price of the big ones and very nearly half the weight, it is having a big appeal to television engineers.

Complete Walkie-Talkie 25/-

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Band III Converter

Suitable Wales, London, Midlands, North, Scotland, etc. All the parts including 2 EF80 valves, coils, fine tuner, contrast control, condensers, and resistors. (Metal case available as an extra.) Price only **19/6**, plus 2/6 post and insurance. Data free with parts or available separately, **1/6**.

Please send two more kits, the one you sent last week is performing magnificently.

We receive this sort of letter every day of the week, so if you have hesitated because you thought our kits too cheap you need hesitate no longer.

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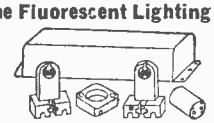
FREE GIFT

All purchasing this month, will receive as a free gift, a pair of heavy duty charging clips.

Cathode Ray Bargain

VCR517C 6½in. (medium persistance) plug in replacement for VCR97 offered at the bargain price of 8/6 each, plus 3/6 carriage.

The Fluorescent Lighting Kit



For customers wishing to use fluorescent lighting without metal work, for shop window lighting, etc. We offer complete kits of parts. Five items as illustrated comprising best quality choke ballast, canister starter and white bakelite holders. 40 watt kit 22/6, 80 watt kit 26/6 plus 2/- post and insurance.

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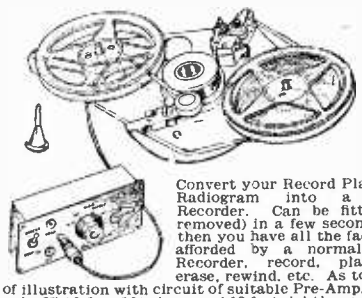
Undoubtedly a most useful instrument by a firm long famous for fine instruments, entirely re designed, it has a square movement with diacon plastic cover, this makes for a brighter more readable scale, extra scale length and wide rangle of vision. With the test set is included a pair of combined test prods and crocodile clips also a stand for inclining the meter at the best reading positions. Ranges A.C. Volts : 0-10, 0-25, 0-100, 0-250, 0-500, 0-1,000, ditto D.C. A.C. Current 0-100 mA. D.C. Current 0-2.5, 0-10, 0-100, 0-500 mA. Resistance : 0-1M and 0-10K. All at 10,000 ohms per volt—Price **£12.7.6** or **£1** deposit and 24 Fortnightly payments of **10/-**, non callers add 5/- carr. & ins.

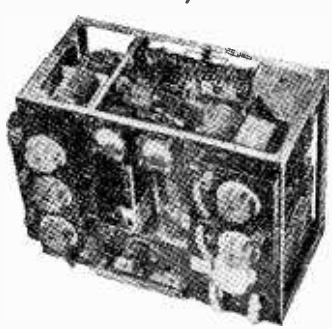
FREE GIFT.—All purchasers of the above item this month will receive Range Extender scale and data which add : capacity 2pF.—1mFd., in two ranges. Inductance 0-100 henrys. etc., etc.

Gram into Tape Recorder



Convert your Record Player or Radiogram into a Tape Recorder. Can be fitted (or removed) in a few seconds and then you have all the facilities afforded by a normal Tape Recorder, record, playback, erase, rewind, etc. As top part of illustration with circuit of suitable Pre-Amp. Price only **£7.10.0** or **10/-** down and 16 fortnightly payments of **10/-** or as per illustration that is with Pre-Amp., **£13.2.6**, or **£1** down and 26 fortnightly payments of **10/-**.

Famous Transmitter Virtually Given Away



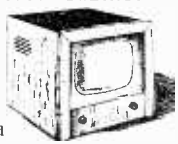
The famous R1154—unused but slightly soiled and not tested. Covers 200-500 kc/s., 3-5.5 Mc/s and 5.5-10 Mc/s. Has unique "click stop" mechanism (7 stops) and permits selected frequency to be held, returned to, etc. Hartley oscillator, power amplifier, keying and speech. Wonderful breakdown value meters, relays, switches. Complete with valves—real bargain at 29/6, plus 10/- carriage.

Hi-Fi Snip

Infinite Wall Baffle

Nicely veneered and polished. Corner fitting (attaches to picture rail), Takes up no floor space. Gives really fantastic results with only low-priced 8in. speaker. Fitting for tweeter. Only 45/- each. Carriage and insurance 3/6.

14in. T.V. Cabinet



14in. T.V. cabinet of latest styling made for one of our most famous firms—beautifully veneered and polished—limited quantity—15/- each. Carriage and packing 3/6 extra.

MULTI-SPEED MOTOR

Works on A.C./D.C. mains; fitted with gear-box gives any speed from 1 r.p.m., 22/6, post and packing 1/6.

Break-up Bargain

The unit 3515 less valves and I.F. strip. This contains components valued at least £10 as follows :

20—Paper tubular condensers up to 1 mfd.
60—Carbon Resistors many high stability.
40—Silver Mica Condensers.
30—R.F. Chokes.
13—Octal Valve Holders.
1—Yaxley Switch.
1—A.F. Choke.
2—Miniature Variable Condensers.
1—Transformer.
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1—Useful chassis size 18in. x 11½in. x 7½in. with outer case.

Plus hundreds of miscellaneous items, nuts, bolts, washers, tag trips, I.F. sockets, etc. All for 6/6, plus 5/- carriage up to 250 miles.

A.C./D.C. Multimeter Kit

Ranges : D.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. A.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. D.C. milliamps 0-5, 0-100, 0-500. ohms 0-50,000 with internal batteries. 0-500,000 with external batteries. Measures A.C./D.C. volts, D.C. current and ohms. All the essential parts including metal case, 2in. moving coil meter, selected resistors, wire for shunts, range selector, switches, calibrated scale and full instructions, price 19/6, plus 2/6 post and ins.

If ordering by post, address your order to the Company nearest to you and please include postage.

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Phone : Eastbourne 6565.
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42-46, Windmill Hill, Ruislip, Middx.
Phone : RUISLIP 5780.
Half day, Wednesday.

Electronics (Croydon) Ltd.
266, London Road, Croydon.
Phone : CRO 6559.
Half day : Wednesday.

Electronics (Finsbury Park, Ltd.,
29, Stroud Green Rd., Finsbury Park, N.4.
Phone : ARChway 1049.
Half day, Thursday.

Completion of I.T.A. Service

PLANS for the practical completion of its present television service by 1960 have now been provisionally approved by the Independent Television Authority.

According to these plans, the last programme companies will be appointed this year and the last major service areas will be provided with programmes in 1960, four years before the end of the ten-year life of the Television Act of 1954.

The Authority has so far appointed ten independent programme companies:

Programme Company	Service Area	Air Date
Associated-Rediffusion	London (weekdays)	September, 1955
Associated TeleVision	London (weekends)	September, 1955
Associated TeleVision	Midlands (weekdays)	February, 1956
A.B.C.	Midlands (weekends)	February, 1956
A.B.C.	North (weekends)	May; 1956
Granada	North (weekdays)	May, 1956
Scottish Television	Central Scotland	August, 1957
T.W.W.	South Wales and West	January, 1958
Southern Television	Central South	August, 1958
Tyne Tees Television	North East	January, 1959
Anglia Television	East Anglia	Late, 1959
Ulster Television	Northern Ireland	Late, 1959

Of these ten companies, seven are already supplying programmes for the Authority's service, while programme transmissions in the service areas of the last three begin this year: the north-east coast in January, and East Anglia and Northern Ireland towards the end of the year. (The name of the recently appointed Northern Ireland company is not yet final.) More than 91 per cent. of the population will then have been brought within the Authority's service areas.

The completion of the Authority's first service will then require:

1. *Three New Service Areas*

Three new service areas are still to be created, making a total of thirteen within the first service. The Authority hopes to begin transmissions in all of them in 1960 or at the latest in the winter of 1960-61. They are:

(a) *South-west England*

This service area will include about one million people living in Devon and Cornwall. This area cannot be covered by one Band III transmitter, and the Authority hopes to build two stations, one in Devon and one in Cornwall, to come into simultaneous operation and to radiate the same programmes. Various sites have been examined, but none has been finally selected and submitted for Post Office approval. The extension of the I.T.A. service to the South-west has been approved in principle by the Postmaster-General.

(b) *North-east Scotland*

This service area will serve the population of some 600-700,000 people living broadly within the large triangular area of which the points are Fraserburgh, the Moray Firth, and Forfar. As a result of the capital expenditure restrictions still imposed upon the Authority, it has not yet been possible for the Postmaster-General to give formal approval for transmissions by the Authority in this area, but preliminary work has already been undertaken. The transmitting station will almost certainly be built in Aberdeenshire.

(c) *The Solway*

This service area includes about 450,000 people living on both sides of the Border around the Solway Firth in Cumberland, Dumfries, Kirkcudbright and Wigtown. This station, which has the Postmaster-General's approval, will be placed on the English side of the Border, but the site is not yet determined.

2. *Four to Six Satellite Stations*

Beyond these 13 main service areas, the Authority sees the need for four to six satellite stations to serve areas not reached by its transmissions but too small to require or make financially possible the operation of independent companies. The first of these, which has been approved, will be opened near Dover in the winter of 1959-60. Further satellites are being considered for the Berwick area, West Wales, Inverness, and the Channel Islands and the Isle of Man. Consideration is also being given to the possibility of building some small satellite stations along the west coast of Scotland, but this is not an immediate prospect.

3. *Improvement of Two Existing Stations*

In two important cases the Authority is transmitting from stations which fall short of what is technically possible. In the time available, it was necessary to begin transmissions in London from the present temporary station at Croydon and from a tower of only medium height at Lichfield. The Authority intends to radiate its London signal from a higher and more powerful aerial and to substitute a tall mast for the present tower at Lichfield. These improvements are expected to add about 800,000 people to the London service area and about the same to the Midlands.

The completion of this programme should give the Authority's first service something like 99 per cent. coverage. This will have been broadly achieved by the use of only four of the eight Band III channels, leaving the remaining four available for a new television service. If by the time of its completion in 1960-61 there is still no decision about a third television service, the Authority's programme of construction will be finished except for keeping pace with technical change and giving consideration to the possibility of filling in such small gaps as remain in isolated towns or remote regions.

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).

UNIT "161"

SIR,—I used the "161" unit, which was the subject of an article in the December, 1958, issue, to receive the early test transmissions and later the programmes from ITV. At that time it was advertised as 160/220 Mc/s with an I.F. output of 16.5 Mc/s and the 178A I.F. amplifier was offered as the complementary unit. I also, like your contributor, used the unit as a front end converter but replaced the I.F. transformer L4, L5, L6, L7, with a single Aladdin coil wound to 45 Mc/s as has since become common practice in this type of circuit.

By removing the switch mechanism it is possible to use any pair of the eight turret coils thereby obtaining a varied selection of I.F. outputs.

Fitting the appropriate I.F. transformer renders the unit suitable for use as a front end converter for any channel or for injection into the I.F. section of any receiver. The versatility can be further increased by rewinding the turret coils as required, which is by no means difficult if one first removes the two screws holding the brass cores which can then be used to size the coil diameter.—W. HIGGINS (Beckenham).

SPECIAL NOTE

Will readers please note that we are unable to supply Service Sheets or Circuits of ex-government apparatus, or of proprietary makes of commercial receivers. We regret that we are also unable to publish letters from readers seeking a source of supply of such apparatus.

SERVICING DATA

SIR,—Your correspondents who complain of unwillingness on the part of certain manufacturers to supply technical information have my sympathy.

I purchased a television set and within a fortnight it had broken down. The set sent in replacement started giving trouble within three months.

Complaints and requests for information have produced a lack of interest on the part of the manufacturer that I would not have thought possible had I not experienced it. Even a solicitor's letter produced the same result. Apparently it is merely my misfortune to have acquired two pieces of inefficient apparatus.

Your correspondent in the January issue who has given up and contemplates purchasing another receiver is merely playing into the manufacturers' hands. The industry will have sold two receivers.

There must surely be some remedy for those who are dissatisfied with the standard of the equipment they buy or the service, or lack of service, they obtain.—D. MAINSTONE (Goring).

[*In certain cases the purchaser can sue for breach of implied warranty.*—ED.]

LINE TIMEBASE

SIR,—In my experiences as a service engineer I have found quite a few faults which occur in the line timebase circuit that can be quite puzzling. One example that caused a considerable amount of search was where the line slipped after a short period and needed continual resetting. Sync was at first suspected but sync pulses were arriving O.K. The trouble turned out to be two condensers in the feedback circuit, altering their capacity with change of temperature. A change to silver mica condensers effected a cure.

A further interesting line fault was where the line output transformer was overheating. The horizontal drive control was checked and was apparently incorrectly set. However, this was due to the anode resistor of the line oscillator valve going high in value, causing incorrect line drive. By the way, an indication of incorrect horizontal drive is often a white vertical bar down the centre or slightly to the left of picture.—F. E. A. (London, W.6).

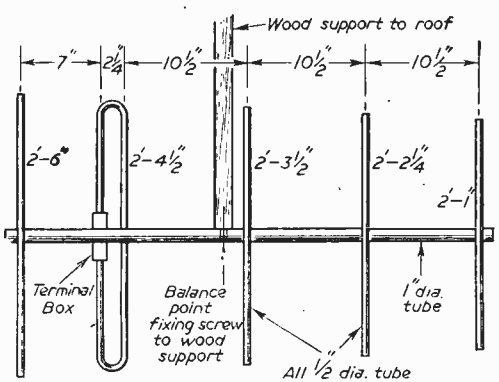
9in. PYE MODIFICATION

SIR,—I have heard that it is possible to dispense with the heavy mains and EHT transformer in the early 9in. Pye and similar TV sets. Apparently the method was a heater transformer for the valves and tube, and H.T. from rectified mains current. The EHT of some 3,000 v. is obtained by two high voltage ex-Government rectifying valves on the line flyback.

Could any reader give details of this modification, especially a circuit with component values given.—C. W. BROOKS (Oxshott).

ITV AERIAL

SIR,—I have recently constructed a five-element, Channel 9, ITV aerial which gives excellent results. It is installed in the loft space of my house, and is supported by a single piece of wood which is fastened to a roof member. The sketch below shows the dimensions and construction of the aerial.—P. G. (Manchester).



The home constructed ITV aerial.

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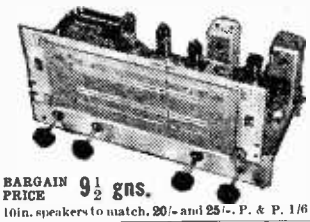

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16/500 v. Dub.	4/-	250/350 v. B.E.C.	8/6
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32+32/450 v. T.C.C.	6/6
32+32/350 v. B.E.C.	8/6
60/350 v. T.C.C.	6/6
60+100/350 v. B.E.C.	11/6
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6S7	8/6	ECC84	12/6	EY86	14/6
6V6	7/6	ECF80	12/6	EZ40	8/6
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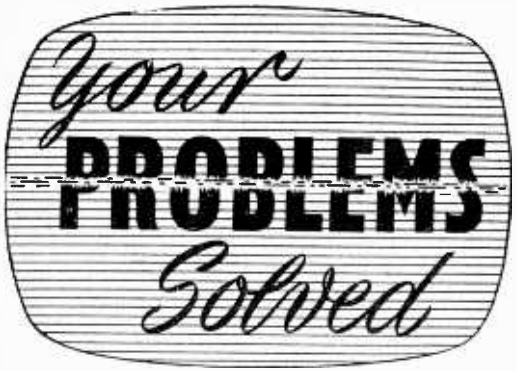

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 425 must be attached to all Queries, and if a postal reply is required a stamped and addressed envelope must be enclosed.

PYE CONTINENTAL

My trouble is that when the set is switched on the picture height is insufficient, and leaves at least an inch at the top and bottom of the screen. As the set warms up the picture height increases, but stops about a quarter of an inch from the edge of the screen. The picture height controls only distort the picture if used to remedy the fault.

The dealer who supplied the set suggested that stepping up the voltage would probably cure the trouble. I tried this as an experiment, but although there was some improvement it did not completely rectify the fault. In any case I am not prepared to over-run the valves in this way.

My limited experience of television suggests that the trouble is due to loss of emission of the frame timebase. I would have tried changing this valve but have no circuit data to show which valve it is.—A. Steventon (Pinner).

The frame timebase valve is the PCL82 near the back of the chassis adjacent to the voltage selector panel. We agree that this is the most likely cause of your trouble, but if replacement is ineffective, check the H.T. rectifier.

COSSOR 938

The picture is shimmering. If viewed on test card C all the uprights are ragged, but the horizontals are O.K. The set only resolves 2.0 Mc/s, the corner wedges are ragged or stepped. If you displace the picture about 1½in. to the left with the line hold the set clears itself, but as soon as you lock it, it becomes ragged.

I have changed V10, V11, V14, V16, V12. This set uses the sync circuit 4 pF with 150 KΩ and I have changed both. I have a service sheet and I would be grateful for any modification or help in clearing the fault.—S. W. Topping (Tredegar).

Your set is displaying the symptoms associated with low gain. We suggest you check the 7AN7 (PCC84) R.F. amplifier in the turret tuner as this is the usual cause of the symptoms.

FERGUSON 992T

I have had repeated trouble with the line timebase. The PL81 overheats and emission drops. This has happened three times in four months. I have checked voltages in the line timebase and everything seems to be in order. PY81 and EY51 have been checked and are O.K.

This set is a Sch.D. using an ECL80 as line generator, but I have no circuit for this section.—W. Wilson (Co. Durham).

We note that you have not changed the ECL80. This you should do since the PL81 depends upon the drive from this valve for its bias, and scanning efficiency. If the valve is not at fault, check associated resistors and the preset drive capacitor which could have an intermittent leak to chassis.

FERRANTI 14T3

From a perfect picture to a blank screen overnight. Shorting EY51 to chassis shows spark ⅝in. long. All valves EF80s, ECL80, EB91 exchanged. No result. I earthed cathode of tube with a wire and got a raster and dim picture quite clear and in shape, but it faded away slowly to blank. Switching off shows ¼in. square, centre of screen, which fades away to fine pin point in five seconds. Only valves not checked by replacement are EY51 and PY81, but appear to be O.K. No resistors or condensers appear burnt or boiled. Can you please give me a clue to fault.—C. Sharp (Hull).

Check position of ion trap magnet on tube neck which may have been displaced. Then check tube base voltages if possible. Pin 11—cathode—100-150 v. Pin 2—grid—0-150 v., depending upon brilliance control. Pin 10—first anode—low reading on average meter owing to 4.7 MΩ resistor wired in series (this and the 1 μF to chassis should be checked). Check heater voltage across pins 1 and 12—6.3 v. approximately. If voltage at pin 11 is high, check 8.2 KΩ load resistor at video amplifier—trace lead from pin 11.

FERGUSON 988T

Sound O.K. but vision nil. Just thin line across screen.

There appears to be a leakage of oily appearance on the chassis in the centre. There appears to be overheating in the set as the wax has run on most condensers.

Set was working O.K. Can you give details of necessary replacements?—C. R. Hill (E.17).

The waxy appearance of the resistors, etc., may be ignored. Check the ECL80 valves on the left centre of the chassis and the components associated with their bases. Check height control and .1 μF coupling capacitor in particular and H.T. to pins 1 and 6 on ECL80 valve bases.

PHILIPS 2337A-15

When I increase brightness, the picture enlarges and fades out. I have also tried to get ITV with a converter but it does not seem to make any difference. The sound from the BBC comes on as clear as ever with a poor picture BBC.—D. McNeil (Motherwell).

The symptoms denote a failing EY51 in the voltage tripler unit (EHT sealed can), or a defective

valve in the EHT section (check ECL80, PL38 and PZ30, etc.), or a faulty resistor under the unit or a faulty EHT blocking oscillator transformer. Check in order given.

Conversion should be by means of a turret tuner such as the Brayhead 10s or Cyldon P10L. If an add-on converter is tuned, use coaxial socket and make connections as direct as possible.

H.M.V. 1826

The picture only goes down to just below half way on the screen, the lower part remaining blank and unlit. There are two rows of everything on the picture and these are in triplicate and elongated horizontally.

For instance, the circle on the test card is oval and there are about three of them in one row about a quarter of the way down and then underneath this there is a similar row.

I have also noticed that there is a small blank space in the top right-hand corner of the screen, and the picture is rather weak.

When I move the horizontal hold control to another position I can get the test card to appear almost its proper size and single, but it is distorted, wavy, and I can't straighten it out. The lower part of the screen remains blank at all times.

I have changed the valve V15 which is an ECL80, but there was absolutely no difference and I have tried a new RM4 rectifier also without result.—D. Fitzgerald (Chepstow).

You should check the 100 μF electrolytic connected pin 3 of LN152 (ECL80) to chassis and the .1 μF capacitor connecting to pin 9. Also check 2.2 MΩ resistor to pin 9 and components in the linearity network. We will advise you further if necessary.

ULTRA TV MODEL V817

Originally the picture closed up to about 6in. On replacing the 6K25 frame generator valve I cured this fault for about a week, then it occurred again. I again replaced this valve and it was all right for about another week when the fault developed again. This time the replacement of this valve did not cure the fault. I had all the valves associated with the frame circuit tested and found to be O.K. I replaced the 3.3 M resistor which was suspect, but still the fault persisted. On switching on the following night there was a flash from under the chassis near valves 13A and B. I traced this fault to R51 and R53 which had gone open circuit. I replaced this with two 5 watt, 50 ohm resistors in series as I could not get a direct replacement of the component. I replaced the fuses and switched on again, this time only half the valves were lit up. I again traced the fault to an open circuit heater on V7 10F1. I replaced this valve only to find that the same thing happened again, the heater went o.c.—C. Chadwick (Leeds).

It would appear that V9 or V8 has developed a heater-cathode short, resulting in a heavy flow of current. We could be mistaken in the valves suggested as it is possible for the fault to be caused by a number of heater circuit faults, check V6. Regarding the lack of height, check the 47 KΩ in series wtih height control, also .5 μF in series with 3.3 MΩ.

MURPHY VU150

I wish to convert this set, preferably by turret tuning. However, I find some difficulty in finding data of I.F.s used on this model.

Should the Murphy VU150 use I.F.s requiring the oscillator to be on the other side of signal frequency. Do you consider it would be economical to attempt to readjust this tuner?—E. J. Russell (Sandiacre).

The Murphy V150 I.F.s are 15.5 Mc/s sound, 19.0 Mc/s vision local oscillator beating low. Thus the Cyldon tuner you would require is type U/16/L, which is a plug-in type and has the local oscillator on the correct side.

EKCO 14in. T205

Since fitting another tube (re-vacuumed) the following faults have appeared.

After switching on, and adjusting the contrast or brightness, for a fairly bright picture, I get a black band on either side of any highlights in the picture called black after white I think.

Also the definition of the picture appears to be very soft and gives the appearance as if the vision interference limiter is screwed in for maximum limiting.

If I turn contrast or brightness down, the symptoms I have described disappear and the picture seems quite normal except, of course, for the low level of brightness.—J. Lepley (Ebbw Vale).

We suggest that you fit a 2 watt carbon resistor for your video amplifier anode load. We do not think that this is your fault, however, as your symptoms describe a faulty C.R. tube, and if there is a guarantee on your new tube we suggest you have it tested.

EKCOVISION T221

I get a very good picture with this set, but am troubled by five thin white horizontal lines, unevenly spaced, across the picture's full width. Please could you advise me?—R. F. Brain (Swindon).

Your fault may well be due to parasitic oscillations in the frame output valve which is a type 20P5 and is situated in the centre of the chassis beneath the scan coils.

PHILIPS 1800 A/15

This set suddenly burst into a loud harsh roar, which at first blotted out sound and picture, picture being blacked out by a patch of black wicker-work of interference across the middle.

I tried the various controls and gradually picture interference disappeared leaving a pale raster of light which could be adjusted to a full width 1in. deep white line. Once or twice I obtained a black cross full size which was torn and stretched beyond recognition, adjusting controls made it worse.

Frame is only a few inches deep in centre of screen, but full width there appears to be hardly any control over width which seems to be filtering all the time. I have tried a new UCH42 and

(Continued on page 425)

UL41 in frame timebase and changed UCH42 and UL44 in line, with no difference.

Sound was obtained clear and reasonably loud, but to get this contrast and volume, controls were both at their limits, the roar is constant with or without aerial, but changes pitch on change of scene (I presume).—T. W. Carr (Hull).

The symptoms indicate an open circuited smoothing capacitor. One of those standing (tags uppermost) along the chassis is likely to be at fault. For test purposes only, use a wire ended 450 v. working 32 μF capacitor and shunt this across each tag in turn (+ or Pos. to tag, —or Neg. to chassis). When a position is found where the roar stops, check that capacitor and replace with one of the correct type.

PYE VT4

Firstly there is no picture, owing to the fact that the EY51 valve does not light up.

I assume, therefore, the fault is in the Line O.P. transformer. I think the heater winding is at fault.

Can you tell me if I can get another similar transformer, what is the make and where can I get one?

Or is it possible to rewind the heater winding or to have it new?—C. P. Charlton (Leicester).

You order an exact replacement line output transformer from your Pye dealer. It will cost about £2 10s. Before doing so check the three line timebase valves ECL80, PL81, PY81, the 47 ohm resistor in the PL81 anode, the top H.T. fuse, and the scan coils. This is done by disconnecting the line feed (green and pink wires) beneath the scan coils. If this restores EHT, the scan coils are faulty.

EKCOVISION TC162N

On switching on sound O.K., tube lights up, 2in. to 3in. band across screen, no amount of adjustment of controls makes difference. All valves been tested and found good.—G. Brookes (Monkwood).

We advise you to check the 500 μF cathode bias condenser which decouples the 6L18 frame output valve. If this fails to cure your fault check the 4,700 pF feedback condenser between the frame output transformer and frame linearity control.

PYE FV1

Recently I have moved from a district supplied with 230 volts to one supplied with 200 volts which appears to be mostly overloaded. In the previous district the picture was good. In the latter, foggy, dark and under screen size, varying according apparently to the load. This improves at the week-end, but still not up to standard.

Owing to age of set (six years), would some improvement be made if the metal H.T. rectifier was replaced?—F. W. Johnson (Cardiff).

We certainly agree that the metal rectifier should be replaced, especially if it is the original one. The type you require is a 14A86 or its equivalent and we assume that you have already altered the voltage selector tappings to agree with your new voltage.

MURPHY V160

The line oscillator screen grid feed is from the cathode of the audio output valve, this being used as a constant current generator. The fault in this receiver is that "sync" pulses(?) are fed into the audio output from the line oscillator drowning the signal. The audio circuit behaves normally if its base end is earthed. The line oscillator valve 20P1 has been tested.—A. L. Humphreys (W.11).

The cathode of the sound output valve is heavily decoupled by two 40 μF electrolytics, one at the cathode itself, and the other at the lower end of the horizontal hold control. We suggest you replace these condensers which are the most likely cause of your fault.

INTERFERENCE

I am having trouble with interference to M.W. and L.W. from my parents' television set. As my vertical rod aerial is only about 10 yards from the television aerial, a whistle is picked up. This is audible on Home and Light Programme wavelengths, but as I have an F.M. tuner I am not worried about them. The real trouble starts if I am listening during the afternoon to Berlin or Hilversum and other distant M.W. stations, which do not come in with very great strength. Is it possible to incorporate in the television aerial lead some form of filter which will remove this radiation?—J. Webster (Stroud).

We advise you initially to check that it is in fact the TV aerial which is radiating the signal. This is simply done by running the set with the aerial unplugged. If the interference persists radiation is either direct or via the mains supply. The latter can be reduced by fitting a filter at the TV end, but the first two conditions can only be improved by removal of both sets and aerials as far away from each other as practicable.

MURPHY V120C

My trouble is loss of power. If the set is connected to the 220-240 v. tags, the highest reading I can get is 80 v. If I connect to the 200-210 tag, I get a reading of 110 v. I have lost EHT. Before this happened, the fuse kept blowing and I suspected the UU8. I have had this valve tested, and it seems to be O.K.

The fuse went as soon as I switched on, but at times it lasted quite a few minutes. When this happened, I could see the UU8 very slowly going blue.

We would say that you have a faulty 200 μF smoothing condenser, faulty UU8, or both. We would not recommend setting your mains voltage tapping to a lower figure in an attempt to increase your A.C. voltage.

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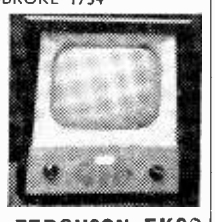

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6CH6	11/-	35Z5GT	8/6	EF95	7/6	UABC80	10/-
6D2	4/6	38	7/6	EL32	4/-	UAF42	9/-
6D3	6/6	35L6GT	9/6	EL33	11/-	UB41	9/-
6D4	3/-	42	7/6	EL37	9/6	UBC41	8/-
6D6	5/-	43	7/-	EL41	9/6	UBF80	8/-
6F6G	7/-	45	7/-	EL84	10/-	UBF89	9/6
6F1	9/6	53KU	11/-	EL85	12/-	UCC85	10/-
6F12	6/6	54KU	11/-	EM34	8/-	UCF80	9/-
6F13	9/6	56	7/-	EM80	10/-	UCF82	9/-
6F14	11/-	61BT	9/6	EM81	10/-	UCH42	9/-
6F15	11/-	618PT	11/-	EN31	19/-	UCH81	10/6
6F33	6/6	71A	4/-	EY51	10/6	UCL82	14/6
6H6M	2/6	76	7/-	EY86	13/6	UF41	9/-
6H6GT	2/-	77	6/6	EZ40	8/-	UF42	9/-
6J5G	3/-	78	5/-	EZ41	10/-	UF80	10/-
6J5GT	4/6	80	6/6	EZ80	8/6	UF85	10/-
6J5M	5/-	83	6/6	EZ81	9/-	UF86	15/-
6J6	4/6	185BT	16/-	FW4/500		UF89	10/-
6J7G	5/-	807E	5/-		9/-	UL41	9/6
6K6GT	7/6	808	15/-	GZ32	10/-	UL44	9/6
6K7G	4/-	813	35/-	HL23DD		UL46	9/6
6K7GT	5/6	5763	6/-		8/6	UL84	10/6
6K8G	7/-	AC/P	6/-	HL41DD		UM80	10/6
6K8GT	10/6	B36	11/-		11/-	UU6	9/-
6K25	9/-	CBL1	12/6	HVR2	5/-	UU7	9/6
6L1	12/6	CBL31	12/6	KBC32	7/6	UU8	12/6
6L6G	8/6	CCH35	8/6	KF35	7/6	UU9	11/6
6L7M	6/6	CL33	11/-	KK32	7/6	UY41	8/-
6L18	9/6	D15	5/-	KL35	7/-	UY85	9/6
6L19	11/6	D77	4/6	KT33C	9/6	VP41	6/6
6LD20	9/6	D63	4/-	KT36	11/-	VP133	10/-
6P25	9/6	D152	5/-	KT44	12/6	VP133	10/-
6P28	11/-	DAC32	10/6	KT45	9/6	VR150	30
6Q7G	8/6	DAF91	8/-	KT61	9/6		7/6
6Q7GT	10/6	DAF96	9/6	KT66	9/6	W76	6/6
6SA7M	7/-	DD41	4/6	KT81	8/-	W77	5/-
6SG7M	5/6	DF33	10/6	KTW63	7/-	X61M	9/6
6SH7	5/-	DF96	9/6	KTZ63	7/6	X65	11/-
6S87	5/-	DH63	9/6	L63	3/-	X66	11/-
6SJ7M	7/-	DH77	7/6	LN152	11/-	X78	10/6
6SK7GT	7/-	DH147	9/-	LZ319	9/-	X79	9/6
6SL7GT	7/-	DK92	10/-	MS/PEN	9/-	Y63	6/-
6SN7GT	5/6	DK96	9/6	MU14	9/-	Z63	7/6
6U4GT	11/6	DL35	11/6	N37	9/6	Z66	9/6
6V6G	6/-	DL82	9/-	N78	11/-	Z77	5/-
6V6GT	7/-	DL92	7/6	N109	11/-	Z152	8/-
6X4	6/-	DL94	9/-	P3	6/-	Z719	7/-
6X5GT	6/6	DL96	9/6	P41	4/6	Z1052	8/6
7A7	11/6	DN143	8/-	P61	2/6	Z77	6/6

Post per valve, 6d.; 2-6 9d.; 7-11 1/-.
12-PAGE LIST OF 750 SNIPS FOR 6d.
All items less 5% and post free for a dozen.

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350/352, Fratton Road, Portsmouth

C.R.T. ISOLATION TRANSFORMER
Type A. Low leakage windings. Optional 25% and 50% boost on secondary. 2 v. or 4 v. or 6.3 v. or 10.8 v. or 13.3 v. with mains primaries ... ... 12/6.
TYPE A2. High quality, Low capacity, 10/15 pF. Optional boost 25%, 50%, 75% 18/6 each.
Type B. Mains input. Multi Output 2, 4, 6.3, 7.3, 10 and 13 volts. Boost 25% and 50%. Low capacity 21/-.

TRIMMERS, Ceramic. 30, 50, 70 pf., 9d. ; 100 pf., 150 pf., 1/3 ; 250 pf., 1/6 ; 500 pf., 750 pf., 1/9.
RESISTORS. Preferred values. 10 ohms to 10 meg., ¼ w., 4d. ; ½ w., 4d. ; 1 w., 6d. , 1½ w., 8d. ; 2 w., 1/-.
HIGH STABILITY. ½ w., 1%, 2/- Preferred values. 100Ω to 10 meg. Ditto, 5%, 100 Ω to 5 meg. Ω, 9d.

	WIRE-WOUND RESISTORS	
5 watt	25 ohms—10,000 ohms	1/3
10 watt		1/6
15 watt		2/-

15,000 ohms—50,000 ohms, 5 w., 1/9 : 10 w., 2/3.

12/6 PURETONE RECORDING TAPE
1,200 ft. on standard 7" Metal reels. Spare Reels 7" plastic, 4/- ; 7" metal, 2/3.
SUPERIOR 1,200 ft. Plastic Tape on 7" Plastic Reels, Quality Guaranteed, 21/-.
"Instant" Bulk Tape Eraser, 200/250 v. A.C. for any make or size of tape. 27/6.

O.P. TRANSFORMERS. Heavy Duty 50 mA., 4/6. Multiratio, push-pull, 7/6. Miniature, 3/4, etc., 4/6.
L.F. CHOKES 15/10 H. 50/65 mA., 5/- ; 10 H. 85 mA., 10/6 ; 10 H. 150 mA., 14/-.

MAINS TRANSFORMERS 200/250 v. A.C.
STANDARD. 250-0-250, 80 mA., 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier 6.3 v. 1 a. 5 v. 2 a. or 4 v. 2 a., ditto, 350-0-350 ... 22/6
MINIATURE. 200 v. 20 mA., 6.3 v. 1 a. 10/6
MIDGET. 220 v. 45 mA., 6.3 v. 2 a. ... 15/6
SMALL. 220-0-220, 50 mA., 6.3 v. 3 a. ... 17/6
STANDARD. 250-0-250, 65 mA., 6.3 v 3.5 a 17/6
HEATER TRANS. 6.3 v. 1½ amp. ... 7/6
Ditto, tapped sec. 2, 4, 6.3 v., 1½ amp. 8/6
Ditto, sec. 6.3 v. 3 amp. 10/6

ALADDIN FORMERS and core, ½in., 8d. ; ¾in., 10d. 0.3in. **FORMERS 5937/8 and Cans TV1 2.** ¾in. sq. x 2¼in. and ¾in. sq. x 1¼in., 2/- ea., with cores.
TYANA.—Midget Soldering Iron. 200/220 v. or 220/250 v., 16/9. **Famous Instrument Iron, 17/6.**
MAINS DROPPERS. 3in. x 1¼in. Adj. Sliders, 0.3 amp., 750 ohms, 4/3. 0.2 amp., 1,000 ohms, 4/3.
LINE CORD. .3 amp., 60 ohms per foot, .2 amp., 100 ohms per foot, 2-way 6d. per foot, 3-way, 7d. per ft.
LOUDSPEAKER P.M. 3 OHM. 2½in. & 5in. 17/6. 8in. Plessey, 19/6. 7in. x 4in. Goodmans, 21/-. 8½in. Goodmans, 18/6. 10in. R. & A., 30/-. T81, Tweeter, LS1/3, 8/6. 12in. Plessey, 30/-.
STENTORIAN HF1012 10in. 5 to 15 ohm 10 w. 99/6 12in. Baker 15 watt 3 ohms, or 15 ohms, 105/-.
CRYSTAL DIODE G.E.C., 2/-. **GEX34, 4/-.**
HIGH RESISTANCE PHONES. 4,000 ohms 16/6 pr.
MIKE TRANSF. 50 : 1, 3/9 ea. ; 100 : 1, Potted, 10/6.
SWITCH CLEANER Fluid squirt bottle, 4/3 tin.
TWIN GANG TUNING CONDENSERS. .365 pf. miniature 1in. x 1¼in. x 1¾in., 10/-. .0005 Standard with trimmers, 9/- ; less trimmers, 8/- ; midget, 7/6.
SINGLE. 50 pF., 2/6 ; 100 pF., 7/- ; 150 pF., 8/6. Solid dielectric 100, 300, 500 pF., 3/6.
SPEAKER FRET. Expanded Metal Silver, 15¾in. x 9¼in., 2/- each
GOLD CLOTH. 17in. x 25in., 5/- ; 25in. x 35in., 10/-. **Tygan** 40in. 6in. wide, 10/- ft. ; 20in. 3in. wide, 5/- ft.

All Boxed VALVES 90-day Guarantee.

1R5	8/6	6K8	8/6	EABC80	HABC80
1S5	8/6	6L6	10/6		12/6
1T4	8/6	6N7M	7/6	EB91	5/6 HVR2A 7/6
2X2	3/6	6Q7	10/6	EBC33	8/6 MU14 10/6
3S4	8/6	6SA7	7/6	EBC41	10/6 P61 6/6
3V4	8/6	6SJ7M	10/6	EBF80	10/6 PCC84 12/6
5Y3	8/6	6SN7	8/6	ECC84	12/6 PCF80 11/6
5Y4	8/6	6V6G	7/6	ECF80	11/6 PCL82 11/6
5Z4	10/6	6X4	7/6	ECH42	10/6 PEN25 6/6
6AM6	8/6	6X5	7/6	ECL82	12/6 PL82 10/6
6B8	5/6	12AH8	10/6	EF39	7/6 PY80 10/6
6BE6	7/6	12AT7	9/6	EF41	10/6 PY81 10/6
6BH6	10/6	12AU7	9/6	EF50	5/6 PY82 10/6
6BW6	10/6	12AX7	9/6	EF80	10/6 SP61 5/6
6C6	7/6	12BE6	10/6	EF91	8/6 UBC41 10/6
6F6	7/6	12K7	8/6	EF92	5/6 UCH42 10/6
6H6	3/6	12Q7	8/6	EL32	5/6 UF41 10/6
6J5	6/6	35L6	9/6	EL84	10/6 UL41 10/6
6J6	7/6	35Z4	9/6	EM81	12/6 UY41 10/6
6J7	8/6	80	10/6	EZ40	10/6 U22 10/6
6K6	6/6	954	1/6	EZ80	9/6 VR105 8/6
6K7	5/6	EA50	1/6	E1148	1/6 VR150 8/6

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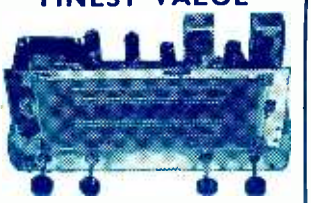

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THREE WAVEBANDS FIVE VALVES
S.W. 16 m.—50 m. LATEST MULLARD
M.W. 200 m.—550 m. ECH42 EF41, EBC41,
L.W. 800 m.—2,000 m. EL41, EZ40,
12-month guarantee.
A.C. 200/250 v. 4-way switch ; Short-Medium-Long-gram. A.V.C. and Negative feedback 4.2 watts. Chassis 13½ x 5¼ x 2¼in. Glass dial 12¼in. x 5¼in. horizontal or vertical 10in. x 4¼in. 2 Pilot Lamps, Four Knobs Walnut or Ivory. Aligned and calibrated. Isolated Chassis.

£9.10.0 Carr. 4/- Ins. 4/6

TERMS : Dep. £5.5.0 and five monthly of £1.
MATCHED SPEAKERS FOR ABOVE CHASSIS. 8in. 17/6 ; 10in., 25/- ; 12in., 30/-.

UA8 World's Finest 4-Speed Autochanger
OUR PRICE **£6.19.6**
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Stereo Model UA12 £11.17.6

COLLARO LATEST MODEL
HIGH-FIDELITY AUTOCHANGER
4-SPEEDS—10 RECORDS
With Studio "O" pick-up
BRAND NEW IN MAKER'S BOXES
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Ready for immediate assembly.

4-speed Collaro "Junior" Unit ...	£4 12 6
Handsome case, 17½ x 13¾ x 7¼in., with room to play 12in. records ...	£2 5 0
Ready-built 3-watt amplifier with two valves and loudspeaker	£3 12 6

or **£9.15.0** complete kit post free.

ALUMINIUM CHASSIS. 18 s.w.g. undrilled. With 4 sides, riveted corners and lattice fixing holes, 2¼in. sides, 7 x 4in., 4/6 ; 9 x 7in., 5/9 ; 11 x 7in., 6/9 ; 13 x 9in., 8/6 ; 14 x 11in., 10/6 ; 15 x 14in., 12/6 ; 18 x 16 x 3in., 16/6.

TRANSISTORS, GENUINE PYE GOLTOP. Audio, 10/-. R.F. (3 Mc/s average), 18/- Power, 20/-. Complete data sheets supplied.

HANDY VOLT METERS. 0-25 v. and 0-250 v., D.C. with leads and leather case, 9/6.

CRYSTAL MIKE INSERT by Acos, precision engineered. Size only 1in. x 3/16in., 6/6.

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TELETRON "TRANSIDYNE" MIDGET SUPERHET PORTABLE 6" x 4" x 1½" 6 transistors, printed circuit, Ferrite aerial. All parts and cabinet, **£11.19.6.**
We include 6 Pye Goltop Transistors for maximum performance. Plans 9d.

GARRARD 4SP. SINGLE PLAYER
AUDIO PERFECTION
Designed to play 16, 33, 45, 78 r.p.m. Records 7in., 10in., 12in. Lightweight Xtal pick-up. GC2 turnover head, two separate sapphire styli.
OUR PRICE **£8.0.0** each. Post Free
De luxe cabinet, quality amplifier and 6½ in speaker, £8.15.0 or complete kit, £14.10.0.

Volume Controls
Long spindles. Guaranteed 1 year. Midget 5K ohms to 2 Meg. No Sw. 4/6 ... 3 ... 4/9
Linear or Log Track.

80 ohm COAX CABLE
Semi-air spaced Polythene insulated ¼in. dia. Stranded core 9d. yd. Losses cut 50%. Fringe Quality Air Spaced 1/6 yd.

COAX PLUGS 1/- DOUBLE SOCKET ... 1/3
SCCKETS 1/- OUTLET BOXES ... 4/6
BALANCED TWIN FEEDER yd. 6d. 80 or 300 ohms.
DITTO SCREENED per yd. 1/6. 80 ohms only.
WIRE-WOUND POTS. 3 WATT. Pre-set Min. 1 V. 1/3. All values 2½ ohms to 30 K., 3/- ea. 50 K., 4/- Carbon 30 K. to 2 meg., 3/6.
WIRE-WOUND 4 WATT. Pots, 2½in. Spindle Values, 100 ohms to 50 K., 5/6; 100 K., 6/6.
CONDENSERS. New Stock. .001 mfd. 7 kV T.C.C., 5/6; Ditto, 20 kV., 9/6; 100 pf. to 500 pf. **Micas, 6d.;** Tubular 500 v. .001 to .01 mfd., 9d. .02, .1, 1/-, .2, 1/6; .5/350 v., 1/9; .1/350 v., 9d. .01/2,000 v., 1/9; .1 mfd., 2,000 volts, 3/6.
CERAMIC CONDS. 500 v. .3 pf. to .01 mfd., 10d.
SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/-; 600 pf. to 3,000 pf., 1/3. Close tolerance (±1 pF.) 1.5 pF to 47 pF., 1/6. Ditto 1% 50 pF to 815 pF., 1/9; 1,000 pF to 5,000 pF., 2/-.

I.F. TRANSFORMERS 7/6 pair.
465 Kc/s Sing Tuning Miniature Can. 2½in. x 1in. x 1in. High Q and good bandwidth. By Pye Radio. Data sheet supplied.
Wearite M800 I.F. 465 Kc/s. 12/6 per pair.
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NEW ELECTROLYTICS. FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350v.	2/-	64+64/350v.	5/6	8/500v.	3/-
4/450v.	2/3	16+16/275v.	2/-	16/500v.	4/-
4/450v.	2/3	200/25v.	2/6	32/350v.	4/-
8/450v.	2/3	500/12v.	2/6	100/275v.	3/6
8/500v.	2/6	8+8/450v.	4/6	2,500/25v.	4/-
16/450v.	3/6	8+8/500v.	5/-	6,000/6v.	3/-
16/500v.	4/-	8+16/450v.	5/-	32+32/250v.	4/6
32/450v.	5/6	8+16/500v.	5/6	50+50/350v.	5/-
25/25v.	1/9	16+16/450v.	5/6	64+120/275v.	7/6
50/25v.	2/-	32+32/350v.	4/6	64+120/350v.	11/6
50/50v.	2/-	32+32/500v.	7/6	100+200/350v.	12/6

SENTERCEL RECTIFIERS. E.H.T. TYPE FLYBACK VOLTAGE. K3/25 2 kV., 5/-; K3/40 3.2 kV., 7/-; K3/45, 3.6 kV., 7/6; K3/50 4 kV., 8/-; K3/100 8 kV., 14/6; 50 c.p.s. voltage, 30% of above.
MAINS TYPE SELENIUM 300 v. 85 mA., 7/6.
CONTACT COOLED 250 v. 50 mA., 7/6; 60 mA., 8/6; 85 mA., 9/6.
COILS Wearite "P" type, 3/- each. Osmor Midget "Q" type adj. dust core from 4/-. All ranges.
TELETRON L. & Med. T.R.F., with reaction 3/6
FERRITE ROD AERIALS. M.W., 8/9; M. & L., 12/6
T.R.F. COILS A/HF, 7/- pair. **H.F. CHOKES, 2/6**
FERRITE ROD 7in. x 3/8in. dia., 2/6.

JASON F.M. TUNER COIL SET. 26/-. H.F. coil, aerial coil, Oscillator coil, two I.F. trans., 10.7 Mc/s. Ratio Detector and heater choke. Circuit book using four 6AM6, 2/-.
COMPLETE JASON F.M. KIT WITH VALVES, £6.15.0. Fringe area kit, 22/6 extra.
MULLARD 3-3 AMPLIFIER READY BUILT. Spare Power for Tuner, etc., £7.17.6.

FULL WAVE BRIDGE SELENIUM RECTIFIERS 2, 6 or 12 v. 1½ amp., 8/9 ; 2 amp., 11/3; 4 a., 17/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ amps., 15/6. 2 amp., 17/6; 4 amps., 22/6. Circuit included.
VALVE and T.V. TUBE equivalent books, 5/-.
TOGGLE SWITCHES. S.P. 2/-, D.P. 3/6, D.P.D.T. 4/-.
WAVECHANGE SWITCHES
1 p. 4-way 2 water long spindle ... 3/6
2 p. 2-way, or 3 p. 2-way short spindle 2/6
2 p. 6-way, 4 p. 2-way, 4 p. 3-way long spindle... 3/6
4 p. 4-way, or 1 p. 12-way long spindle ... 3/6
VALVEHOLDERS. Pax. Int. Oct., 4d. EF50, EA50, 6d. B12A, CRT, 1/3. Eng. and Amer. 4, 5, 6, 7 and 9 pin, 1/-. **MOULDED MAZDA** and Int. Oct., 6d. B7G, B8A, B8G, B9A, 9d. B7G with can, 1/6. B9A with can, 2/6. CERAMIC EF50, B7G, B9A, Int. Oct., 1/-, B7G with can., 1/9.

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