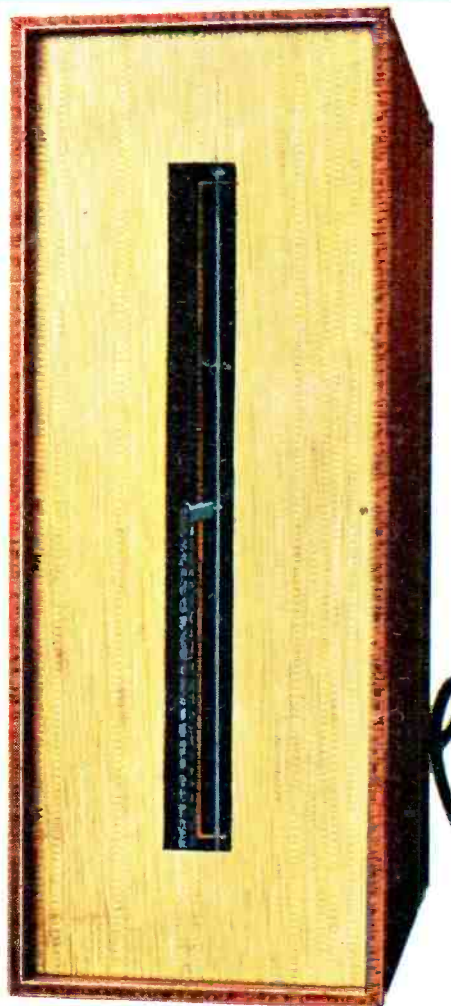
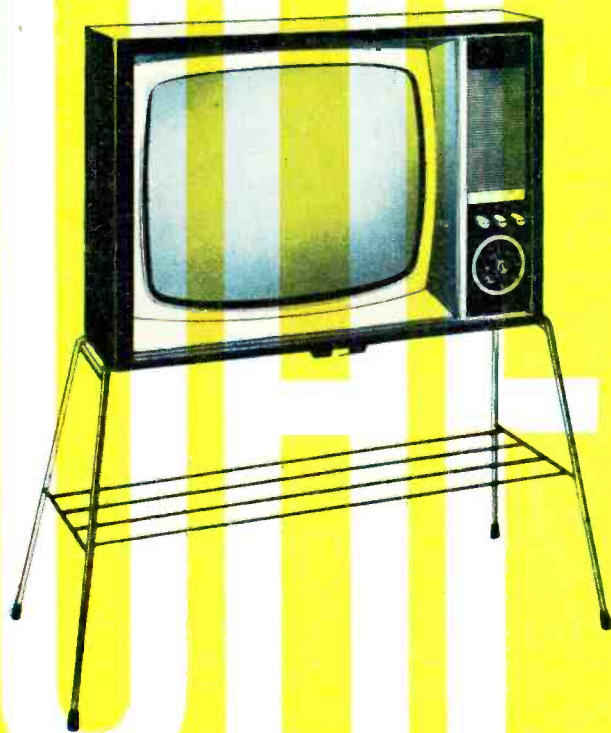


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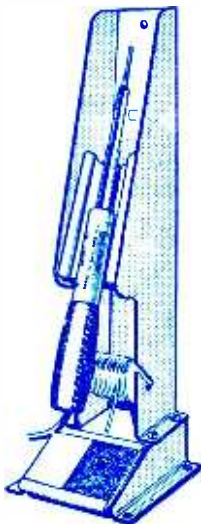
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Practical Television

JUNE 1965

LOOKING GLASS LAND

VOL. 15 No. 177

If Lewis Carroll thought he was indulging in flights of imagination when writing about Alice in her Wonderland, he would be green with envy at the Mad Hatter's Tea Party we call Colour Television.

Last month, before the event, we confidently predicted that Vienna would produce no unanimous agreement. They went even better, in fact, and have somehow succeeded in complicating ever further the existing involved situation.

Deadlocked in the insoluble three-cornered contest between NTSC, PAL and SECAM, adherents of the first two systems tentatively floated the idea of a compromise "merger" between NTSC and PAL, the hybrid thus produced to be named QUAM. Although this would narrow the field to two, what matter when the remaining sides have little intention of shifting?

To add to the hilarity, the individual camps are also subdividing, like so many evolving cells. At the last count, for example, there were no fewer than three alternative PAL's—PAL Mk I (the genuine and original product, accept no imitations), PAL Mk II (a modified version with no crystal oscillator in the decoder) and PAL Mk III (an Italian version with modified recognition signal).

And what about our brave "go-it-alone" policy? This too appears to be crumbling apart. First, colour TV needs money, lots of it, and the recent increase in the TV licence will not provide it. Secondly, the commercial companies are now worried that if the UK adopts a system not generally accepted in Europe, potential markets for tape recorded programmes will be lost. Thirdly, we hear that new developments in SECAM are in the offing and will have to be examined. And that hitherto undisclosed disadvantages in NTSC are receiving attention. This is all fact and is not an extract from a Goon Show!

Hey, ho! Perhaps it would be as well to forget all about colour TV until the Esquimaux introduce their IGLOO system, the Egyptians launch NASSER or the Friendly Islands come up with HULA. Even then, no doubt, the People's Republic of Outer Mongolia will shake the world with METOO!

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**OUR NEXT ISSUE DATED JULY
WILL BE PUBLISHED ON JUNE 24th**

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Television", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 29s. per year to any part of the world. © George Newnes Ltd., 1965. Copyright in all drawings, photographs and articles published in "Practical Television" is specifically reserved throughout the countries signatory to the Berne Convention and the U.S.A. Reproductions or imitations of any of these are therefore expressly forbidden.

TELETOPICS

UK EQUIPMENT FOR ARGENTINE STATION

A NEW television station which is to open later this year in Argentina will be equipped almost entirely by the Marconi Company of Chelmsford, Essex.

Marconi-made studio equipment—cameras, telecines, etc.—will provide programme output, while a 5kW Band III Marconi vision transmitter and 1kW f.m. sound transmitter will radiate the signals. The high-gain omnidirectional aerial system will also be provided by Marconi's.

The new station will provide television coverage for the town of Santa Fe and also for the neighbouring town of Parana.

Colour TV—Now a British System

A COMPANY based on the Channel Islands and calling itself Telycolour Ltd., claims to have developed a new system of colour television—a British system in fact.

In a recent Press release the Telycolour system is claimed to be fully compatible, less expensive and simpler than other present systems. In the receiver a single electron-gun c.r.t., which is presently being developed jointly by the company and Rank Electronic Tubes, will be used. This colour c.r.t. will be no larger than a black-and-white equivalent tube.

The cost of receivers built to the specifications of the Telycolour system should be only a third more than a black-and-white set and further, existing monochrome receivers would be convertible to receive colour transmissions.

Standard studio equipment, it is claimed, could also be converted to provide colour programmes on the new system at a low outlay, and the system as a whole can be adapted to accept the American NTSC standard.

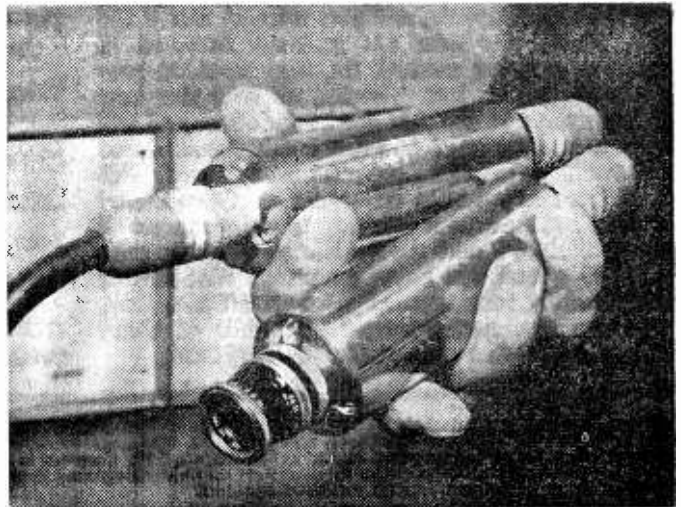
Technical details of the system were not included in the announcement, however, and so far no more information has been released.

AMONG the equipment seen on the EMI Electronics Ltd. display at the National Association of Broadcasters' Convention held in Washington recently was a new transistor CCTV camera which measures just 4½ in. long.

The new camera, which weighs only 1½ lb and is only 1.7 in. in diameter, contains a ½ in. vidicon tube and lens head unit and can therefore be conveniently held in the hand or placed in positions normally inaccessible to the standard camera. The amplifier head unit is contained in a second cylinder which can be connected to the tube unit by up to 100ft of cable. Both units are shown in the illustration on right. Camera control unit and other equipment comprising the whole camera channel can be located up to 1,000ft away.

Operation of the camera can be on 405, 525 or 625 lines, the standard being selected at the press of a button.

Hand-held TV Camera on Show

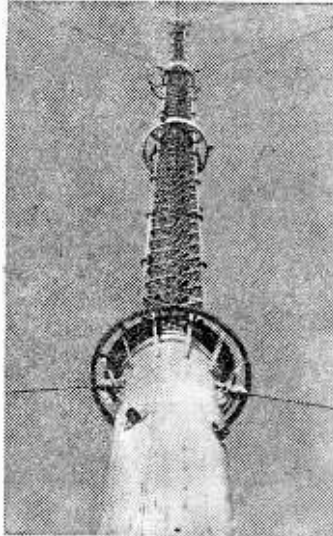


THE TALLEST TV MASTS IN UK NEAR COMPLETION

TWO of the three cylindrical television transmitting masts being built by British Insulated Callender's Construction Co. to carry both BBC and ITA aeriels are now nearing completion. One of them, at Winter Hill near Bolton in Lancashire, has already reached its full height of 1,015ft, while work on the other at Emley Moor, in Yorkshire, follows close behind.

Part of the Winter Hill mast is shown on the right. The cylindrical lower section which in actual fact reaches 650ft. high, has been formed from 9ft diameter steel rings. Above this level triangular cross-section lattice steelwork takes over and on this will be mounted the aeriels. Once these are in place the cylindrical appearance of the mast will be continued right to the top by curved glass fibre sheets which will completely enclose the aeriels and feeders, etc.

One disadvantage of the new masts is the fact that at the moment they are causing some limited interference to the ITA



transmissions from the existing aeriels at these sites. This interference is, however, inevitable but will be replaced by improved reception once the new aeriels come into service later this year.

TV will Link Spacemen with their Families

HOMESICK spacemen of the future based on the Moon or Mars may well be able to look forward to seeing their wives, families and friends on earth by long-distance television links. Such links could be used to overcome feelings of total isolation which psychologists fear might endanger the success of manned bases on other planets where astronauts would be stationed away from the earth for

periods up to three years.

This arrangement was suggested by R. W. Hallet, an aerospace engineer of the Douglas Missile and Space Systems Corporation of the USA, speaking at the ninety-seventh Technical Conference of the Society of Motion Picture and Television Engineers in Los Angeles recently. Regarding the problems of televising pictures over such vast distances, Mr. Hallet said

that television transmissions to spaceships roughly 200 million miles from earth is considered possible. Despite technical problems still to be solved, laser systems, with extremely high bandwidth associated with the high optical transmission frequencies, offer as a practical proposition live television between, say, Mars and earth. If the laser fails as a feasible method, he said, microwave energy could be used.

FRENCH—RUSSIAN TV AGREEMENT

AN agreement signed in Paris recently by the president of Compagnie Francaise de Television (CFT), M. Maurice Ponte, and the vice-chairman of the State Commission for the Co-ordination of Scientific Research of the USSR, Mr. D. M. Gvichiani, takes French and Russian co-operation on the development of the SECAM system of colour television another step further. This agreement follows the Soviet Government's decision of a few months ago to adopt the French system.

Co-operation on the development of a new colour tube for SECAM receivers is also proceeding between CFT and the Italian company SELIT—Societa Elettronica Italiana S.p.A. This new tube is claimed to give higher quality and brighter pictures than other colour c.r.t.s and is suitable for use in any other colour TV systems.

BBC -1 and -2 TV Relay Stations

VIEWERS in the service area of a new BBC relay station at Melvaig, in Ross and Cromarty, are now receiving boosted signals of the BBC-1 programme on channel 4. Signals are vertically polarised.

The Melvaig relay station is the latest to be brought into service, while the latest plans for further stations include one on the Isle of Skye at Skriaig. This new station will provide improved reception of BBC-1 over most of the island except for Portree and to cover this area another low-power relay station is being built at Penifiler.

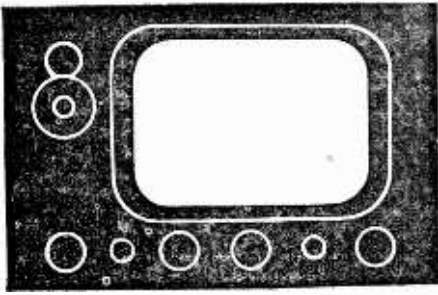
The Skriaig station will transmit on channel 3 with horizontal polarisation and should come into service during the autumn.

Improved reception will also result from a new relay station being built at Bengeo, Hertford, but here it is BBC-2 signals that will be boosted. Although within the service area of the Crystal Palace u.h.f. transmitter, viewers in this area have experienced poor reception because of local screening by high ground and other obstacles.

New Colour Tube

AMONG new developments shown on the Mullard stand of the RECMF component show was a 25in. 90° rectangular colour TV tube. This new tube—the A63-11X—does not require a protective shield between viewer and screen and an improved electron gun has been incorporated.

The A63-11X is now being supplied to British set makers for use in experimental colour receivers.



THE OLYMPIC II Transistor TV

by D. R. Bowman

Part Three I.F. Unit Alignment and Coil Data, and Power Unit

THE vision i.f. amplifier described last month is readily set up by applying to the input socket the modulated output of a signal generator and tuning each inductor in turn to the frequency given in the table of inductances (Table II). To check the output, a pair of headphones may be connected, in series with a 0.5 μ F capacitor, from the base of Tr8 to "chassis". For this alignment, like that of the sound amplifier, a battery supply of -12.6V is the simplest method—either four cycle headlamp cells or a small 12V accumulator. The total current consumption of tuner and both i.f. amplifiers is only about 25mA. Of course the -75V supply to the video output transistor is not yet connected.

The last step in alignment procedure is to re-tune the signal generator to the point where maximum sound output is received on the *sound* receiver, namely 38.15Mc/s. The volume control should then be operated so as to cut off the sound completely, and if this cannot be achieved, the loudspeaker should be disconnected and replaced by a 3 Ω resistor. When listening on the headphones to a very weak signal, extraneous noises can be very troublesome. Attach the headphones across C43 (still in series with a 0.5 μ F capacitor) and rotate the core of L18 until the sound disappears almost completely; finish off the process by increasing the signal generator output and rotating the core of L15 for minimum sound. The minimum obtained is quite sharp, and great attenuation is achieved.

The whole receiver is now aligned by plugging in the r.f. tuner and connecting power supplies. Set the signal generator to 37.5Mc/s and bring the output lead near the emitter of the frequency changer transistor Tr2. Tune the i.f. transformer i.f.t.1 for maximum sound as heard in the headphones still connected to the vision amplifier. For the alignment frequencies of the other vision i.f. tuned stages, see Table II.

When this process has been carried out all the cores so far adjusted should be locked with a suitable locking compound. If none is available plasticene makes a good substitute and is less messy than grease.

The alignment of the r.f. circuits is inherently a simple process, but may require some care. The first inductor to be trimmed must always be the basic one; the padding inductors are aligned in turn, step by step round the switch, until all are done. It is also important to align the Band I elements first, as because of proximity effects their setting is found to have a small effect on the Band

III elements. On each band, work from the highest frequency to the lowest. For each channel, the r.f. setting of the signal generator should be to mid-channel; for example Channel I requires a signal generator setting of 43.5Mc/s.

Last of all, connect an aerial to the tuner unit, select the channel required and adjust the volume control. If all has gone well, the sound should be heard very clearly; if not a slight adjustment of the fine-tuning capacitor will bring it in.

Vision I.F. Response

Fig. 13 shows the response curve of the vision i.f. amplifier. Because of the vestigial-sideband nature of the transmissions the 3Mc/s bandwidth extends from 6dB down at the low-frequency band edge to 3dB down at the high-frequency edge. This is seen to be achieved very closely.

It will also be noted that the response at 41Mc/s is better than 25dB down. This ensures that when Channel I is being tuned the i.f. amplifier does not become unstable because of direct response to the signal on the sound or vision frequencies.

The vision signal can be heard on the headphones if the sound is tuned in correctly, but the actual appearance of the signal at C43 will be of interest. This amounts to half a volt or so, and can be applied to the Y- input of an oscilloscope.

It is useful at this stage to use a dry battery supply to the video output transistor, to make the final adjustment to the receiver. The 67 $\frac{1}{2}$ -V Ever Ready type B101 or equivalent is convenient, and if its + terminal is connected to the -12.6V rail of the receiver, -80V will be available. This is quite safe to use. A milliammeter should be connected in series, and VR2 adjusted until the transistor draws 4mA (including the bleed current through R37 and R38).

The inductor L22 is best adjusted later on, when the test card is being displayed.

THE POWER UNIT

Hitherto testing on the units constructed has been feasible with a dry battery, but the units next to be described take much heavier currents and unless a small 12V accumulator is available it may be found inconvenient to proceed. Accordingly, a

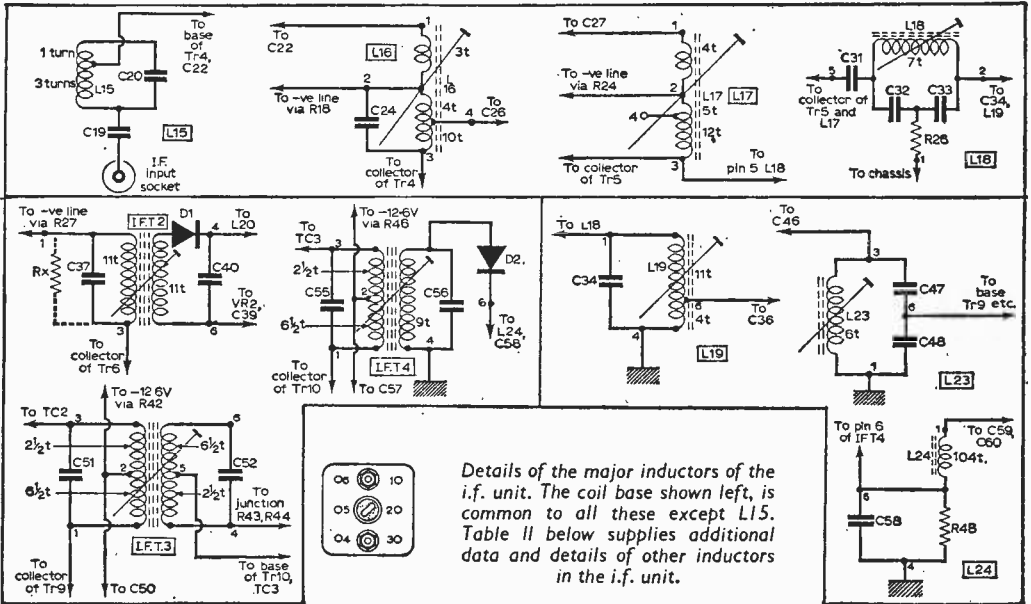


TABLE II

I.F. Amplifier Inductors:

All wound on bakelite or polystyrene 0.3in. diameter formers, as obtained with the popular canned assembly. Coils wound with the finer s.w.g.'s may be fixed in position with polystyrene cement.

L15 Sound I.F. Rejector:

Short coil former, no screening can. 4 turns 28 s.w.g. enamelled wire tapped 1 turn from end, turns spaced by wire diameter. Winding shunted by C20. Single v.h.f. (purple) dust core.

L16 Vision I.F. Inductor:

'Short' can assembly. 4 turns 28 s.w.g. enamelled wire, taps at 10 and 14 turns from 'collector' end. Single layer C24 included inside can. Single v.h.f. dust core. Tunes to 37.5 Mc/s. close wound.

L17 Vision I.F. Inductor:

As for L16, but taps are at 12 and 17 turns instead (from 'collector' end). No internal capacitors fitted. Single v.h.f. dust core. Tunes at 37.5 Mc/s. Tap at tag 4 is for future 625 line conversion.

L18 Sound I.F. Rejector:

'Short' can assembly. 7 turns 24 s.w.g. enamelled wire, single layer, spaced by wire dia. C31, C32, C33 and R26 fitted inside can. Single v.h.f. dust core. Tunes to 38.15 Mc/s.

L19 Vision I.F. Inductor:

'Short' can assembly. 15 turns 28 s.w.g. enamelled wire, single layer, close wound. Tapped at 4 turns from 'earth' end. C34 fitted inside can. Single v.h.f. dust core. Tunes to 36.5 Mc/s.

L20, L21 Vision I.F. Rejector:

'Short' coil former, no screening can. 110 turns 40 s.w.g. enamelled wire, close wound single layer. Standard dust core—set to maximum inductance fully within coil winding—no further adjustment necessary.

RFCl:

As L20, L21—no dust core. Should be mounted at right angles to L22.

L22 Video Correction Inductor:

'Short' coil former, no screening can. 200 turns 40 s.w.g. enamelled wire, in three layers of 70, 68 and 62 turns respectively. Each layer insulated by 1 turn Sellotape. Standard dust core—set to maximum inductance.

L23 Sound I.F. Inductor:

'Short' can assembly. 6 turns 28 s.w.g. enamelled wire, space by wire diameter. Single v.h.f. dust core. C47, C48 fitted inside can. Tunes to 38.15 Mc/s.

L24 Sound I.F. Rejector:

'Short' can assembly. 104 turns 40 s.w.g. enamelled wire, single layer. Standard dust core, set to maximum inductance. C60, C58 and R48 also fitted inside can.

I.F.T.2. Vision Detector Transformer:

'Short' can assembly. Bifilar wound, primary and secondary interwound. 11 + 11 turns 28 s.w.g. enamelled wire, close wound, single layer. Rx, a 10kΩ damping resistor, C37, C40 and D1 are fitted inside can. Single v.h.f. dust core. Tunes to 35.25 Mc/s.

I.F.T.3. I.F.T.4 Sound I.F. Transformer:

'Long' can assembly (3/4 x 3/4 x 2 1/2 in.). Primary—9 turns 28 s.w.g. enamelled wire, spaced by wire diameter, single layer, tapped at 2 1/2 turns from 'TC' end (inner) for negative supply connection. Single v.h.f. dust core.

Secondary—as primary, tap at 2 1/2 turns from 'R43/R44' end (inner) for Tr10 base. Single v.h.f. dust core (I.F.T.4 has no tap on secondary for base connection).

Primaries and secondaries are wound side by side on the formers but are spaced 1/4 in. between windings.

mains power supply is next detailed conforming to the following specification:

Mains input: Any a.c. voltage between 180 and 240V 50c/s.
 Output: 11 to 18V regulated, adjustable.
 Hum level: < 25mV at 100c/s.
 Circuit: Series stabilised.
 Current output: Maximum of 1A.
 Regulation at 12.5V output: Zero load 12.50V, at 1A load current 12.52V.

This unit is quite sufficient to supply all the needs of the 405-line receiver, and with an

extremely simple modification, to be described when conversion is made to 625-line standards, will cope easily with the extra power required.

Power Supply Circuit

The circuit diagram is shown in Fig. 14, and the simplicity will be evident at first glance. This is made up, in the prototype, on a chassis 6 x 4in., of 18s.w.g. aluminium. This will support the mains transformer easily as well as the active components. For safety and appearance it should be totally enclosed, with a fused supply as shown, and provided with a pilot light in the form of a small neon indicator.

It consists of a full-wave rectifier assembly comprising four power silicon diodes in bridge formation, fed from a mains transformer. The output is roughly smoothed by at least 4,000 μ F and this forms the input to the regulator circuit. The voltage at the slider of VR2 is compared with the steady voltage across D5, which is a sharp-knee Zener diode, and the difference voltage is used to regulate the collector current of Tr3. This is amplified by Tr2, which acts as a current amplifier in the common-collector (or emitter-follower) configuration, and the amplifier current—which forms the base current to the series regulator transistor Tr1—maintains the voltage output at a figure determined by the position of the slider of VR2. The greater the current amplifier of the combination Tr2—Tr3, the more perfect the regulation. Since the regulating action also removes hum, it is worthwhile to select Tr2 and Tr3 for maximum gain at 100c/s, although samples taken at random give effective results.

Hum is further balanced out by the network which comprises a 3.9k Ω resistor and 4 μ F capacitor with the 405-line receiver the arrangement is correct as it stands in Fig. 14, but where higher currents than 1A have to be supplied it may be necessary to change over the positions of VR1 and the 330 Ω resistor in series with it. Balance is obtained by putting a 14 Ω resistor (made up with resistance wire) across the output terminals, attaching headphones across these terminals also, and rotating the spindle of VR1 for least hum with the output voltage adjusted to 12.4V by means of the slider of VR2.

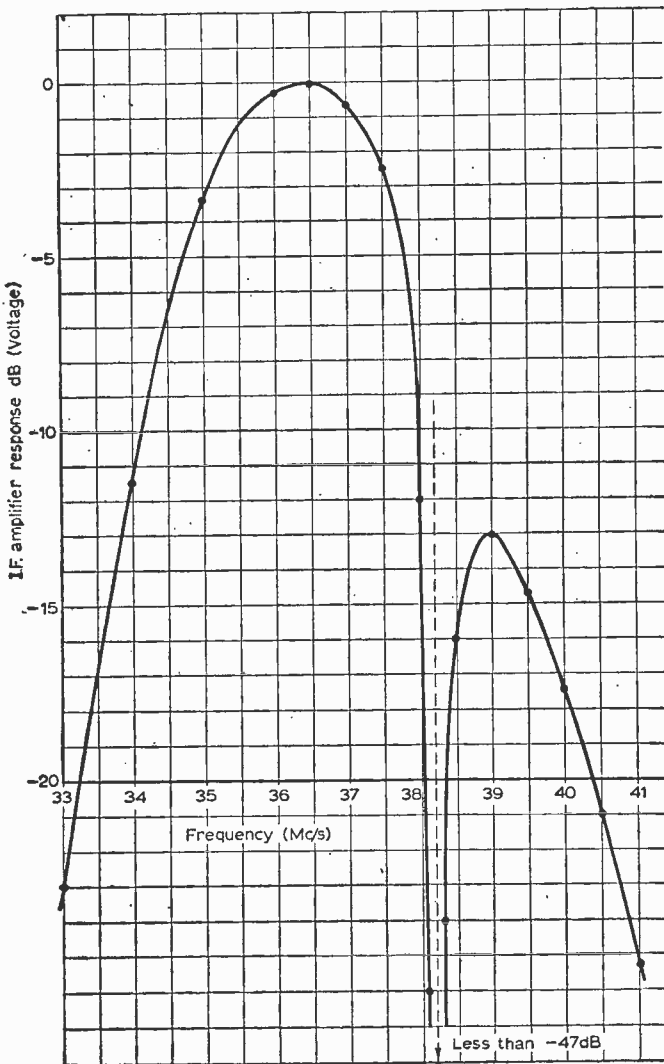


Fig. 13—The response curve of the vision i.f. amplifier.

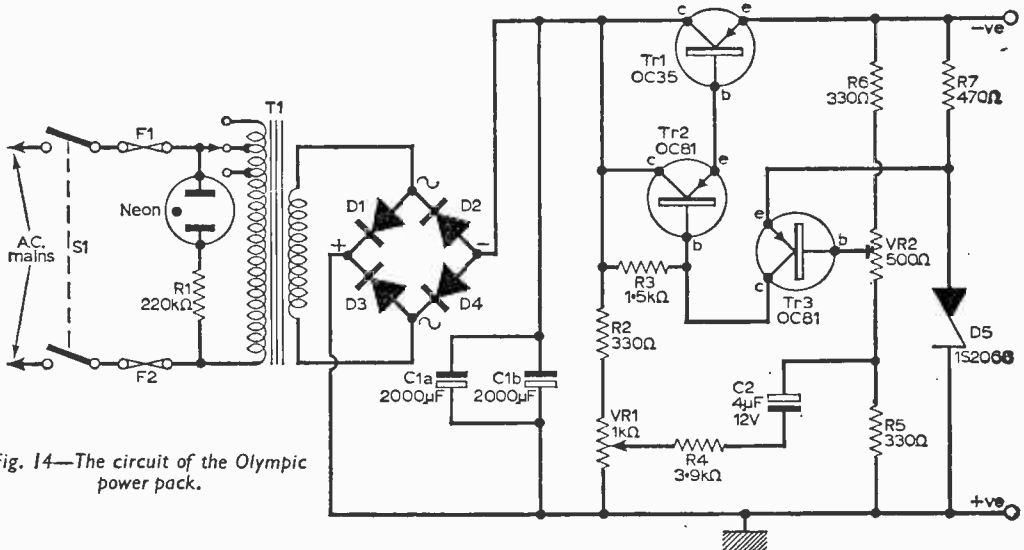


Fig. 14—The circuit of the Olympic power pack.

TABLE III Mains Transformer

Core

1¼ in. stack of No. 29 M.E.A. laminations Silcor 2, or equivalent No. 29.

Primary

1200 turns 32 s.w.g. enamelled copper wire in eleven layers interleaved 0.001 in. paper. Tap if desired at 200 turns and use 1000 turns for supply under 200V.

Secondary

80 turns 18 s.w.g. enamelled copper wire, in four layers, no interleaving.

Primary and secondary

Separated by two turns empire cloth or insulating tape in equivalent thickness.

Outer covering

Insulating tape. (The windings are at 5 turns/volt.)

A Volts Scale

It will be found advantageous to arrange VR2 to be operated by a pointer knob, and to place a volts scale behind it. The scale can be marked in volts, sub-divided into 0.2V units; this enables good setting accuracy.

The unit is immune to mains supply changes of 20%. It is worthwhile however to supply the mains transformer with a tap labelled 210V, when winding, so that if the supply voltage drops below this figure the tap can be changed. This enables the transistors to work under optimum conditions with low supply voltages. However, this refinement is by no means necessary unless the mains supply is normally under 200V.

The mains transformer specification is given in Table III.

It is probable that if the reader possesses a small acid accumulator, he will wish to use the mains unit to charge it from time to time. This can readily be done, but it is highly advisable to put a further rectifier diode, type 1S411 in series with the supply

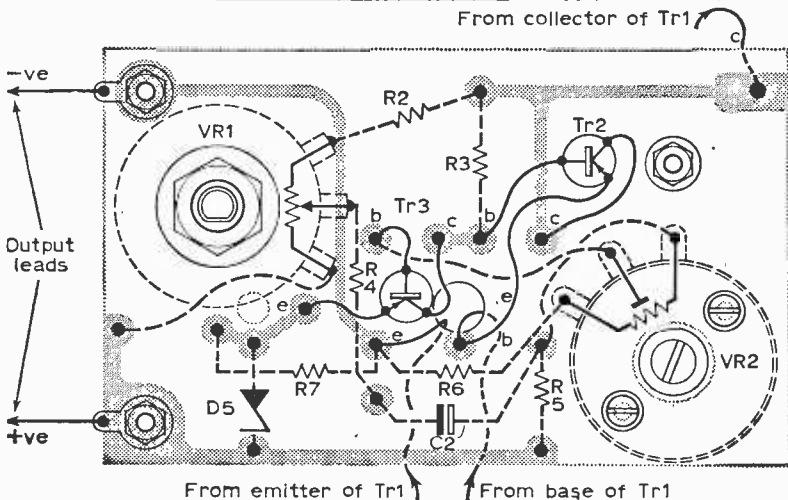
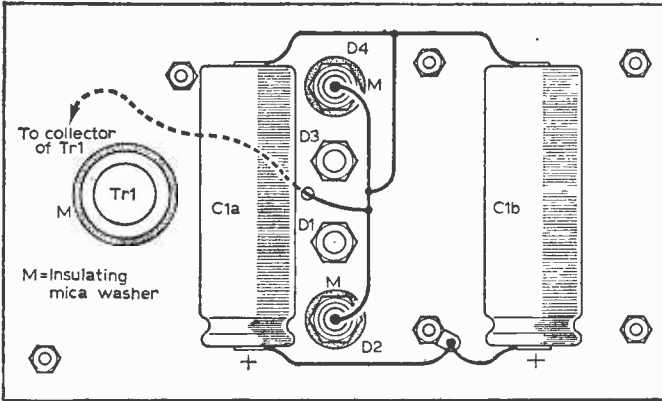


Fig. 15—The power pack printed circuit drawn full scale (copper parts shaded) and component connections.



and the accumulator. If the mains supply is accidentally switched off, there will then be no trouble. Otherwise, if the a.c. supply fails, there will be nothing to prevent the accumulator discharging through the regulator circuit and while the mains series regulator Tr1 may not mind this very much the amplifier transistors will pass relatively heavy current and may be damaged; also the accumulator will discharge rapidly.

Fig. 16—Components mounted on the underside of the power pack chassis.

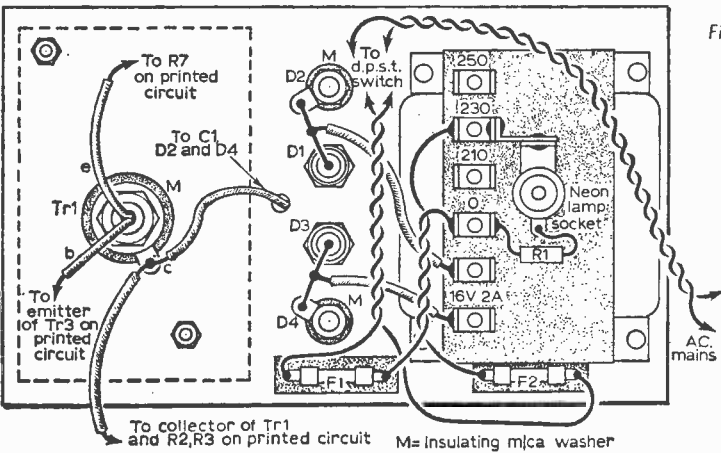


Fig. 17—Component layout above chassis and wiring details.

Checking

There is no setting-up to be done with this unit; all that is necessary is to check that the open-circuit voltage of the secondary is 16V r.m.s., or a little over, when the primary is connected to a source of 240V. Of the transistors, only the series regulator Tr1 needs a heat sink, and the chassis itself serves admirably in this capacity. It requires an insulating kit, as the collector is electrically attached to the

POWER PACK COMPONENTS LIST

Resistors:

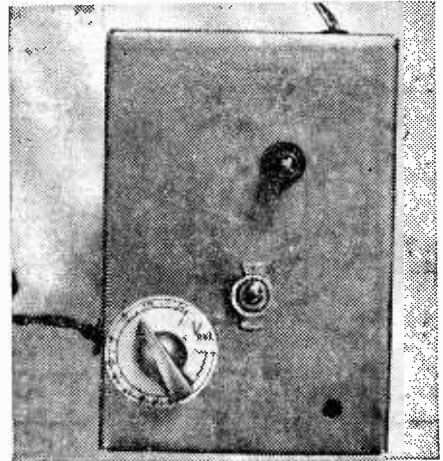
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|------------------|-----------------|
| R1 220k Ω | R5 330 Ω |
| R2 330 Ω | R6 330 Ω |
| R3 1.5k Ω | R7 470 Ω |
| R4 3.9k Ω | |

Capacitors:

- C1a 2000 μ F elec. 25V
- C1b 2000 μ F elec. 25V
- C2 4 μ F elec. 15V

Miscellaneous:

- Tr1 OC35 (Mullard) or any power transistor of 6A collector rating or higher (requires mica insulating washers)
- Tr2, Tr3 OC81 (Mullard) or 2G382 (Texas)
- D1, 2, 3, 4, IS411 (Texas) (D2 & D4 require mica insulating washers)
- D5 IS2068 (Texas)
- T1 200/250V primary, 16V 2A secondary
- Neon, miniature type (GEC)
- F1, 2 1A cartridge fuses



The appearance of the finished power pack.

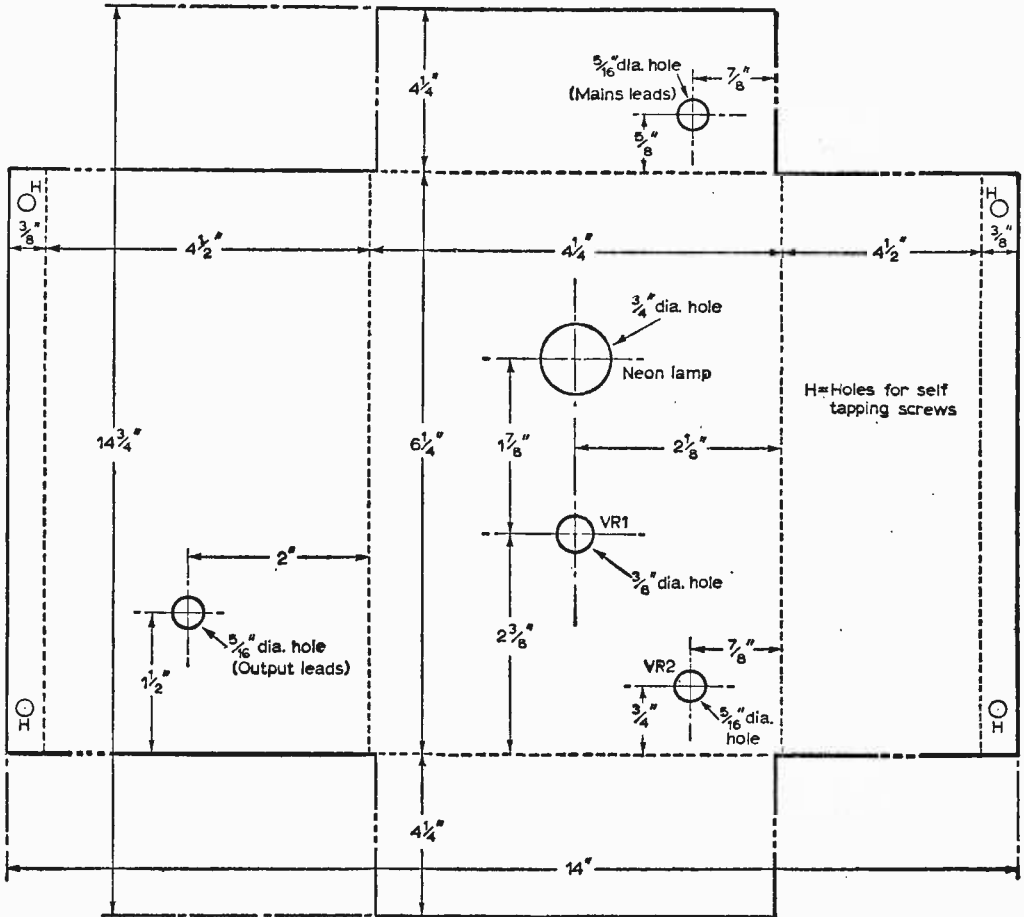


Fig. 18—Dimensions and drilling details for an aluminium case to cover the power pack.

casings. The amplifier transistors need no extra cooling, although the rectifier diodes all need a heat sink also. Again the chassis is suitable for this purpose. It will be seen from the circuit diagram that two of these diodes are connected direct to the chassis, but the remaining two require to be insulated from it with the usual mica washer and bushes for the holes. A light smear of silicone grease (available from Radiospares) is a good thing to add between the mica washers and the surfaces they separate, as it assists in the removal of unwanted heat.

Performance and Temperature

In use, the transformer rises a little in temperature, but not so much as to cause interference with the operation of the unit. The transformer has been designed to cope with the much heavier currents required with 625-line operation. Its temperature

will be found to rise much more when delivering the 2A needed in the latter circumstances, and it is therefore well worthwhile to mount the transformer on a heat-insulating platform above the chassis. The chassis and its cover should be well ventilated, and should be matt-painted on the outside to assist in removing heat. The rectifier diodes and Tr1 should be mounted at the opposite end of the chassis from the transformer. The two smoothing capacitors are quite large physically, and if the chassis is made 1 1/4 in. deep they can be put underneath it conveniently.

Integral or Separate

This mains unit is intended to be a separate bench-type supply, as it is fairly large. If desired, however, it can be accommodated in the receiver itself.

TO BE CONTINUED

A Test for ELECTROLYTICS

An instrument
for testing and
're-forming'
electrolytic
capacitors.

by J. B. Willmott

OF all the components used in radio and television receivers, the highest rate of failure seems to occur amongst electrolytic capacitors, and many constructors must have built equipment incorporating allegedly new (or perhaps not so new!) electrolytic capacitors, only to find that when their completed gear is first connected to the mains and switched on, either the reservoir capacitor begins to "steam and bubble" in an ominous manner, or a tell-tale odour of cooking begins to emerge from a decoupling capacitor somewhere in the circuit.

Electrolytic capacitors are extremely well made and robust these days, but it is inherent in their construction that, if left in use over a long period of years, they tend to "dry up" and the consequent loss of capacitance precludes them from doing their job; or, if left unused over long periods, either in actual equipment, or stored on the dealer's shelf, they deteriorate, and breakdown as soon as full working voltage is applied is probable.

The piece of apparatus about to be described fulfils the dual purpose of testing the condition of electrolytic capacitors, and also of "re-forming" those which have been stored or out of use for some time, before incorporating them in equipment.

Many electrolytic capacitors supplied by component dealers—especially those specialising in "ex Government stocks"—will have been stored for a long while (sometimes the date of manufacture is stencilled on the component) and it is most advisable that these should be tested before being put into use.

THE METHOD OF TESTING

Basically, the instrument provides means of applying a correctly polarised voltage, in gradually increasing steps (up to the rated working voltage of the component), this applied voltage being monitored by a voltmeter which can conveniently be the owner's tried and trusty friend, the multirange meter.

If there is severe internal leakage, or total breakdown of insulation, within the capacitor being tested, the meter will read either "zero" volts, or very much below the applied voltage figure appropriate to the setting of the range switch. If this happens, the component under test is best thrown into the rubbish box without more ado.

If, however, the rated working voltage is applied and the meter reading remains steady after two or three minutes, it can be assumed that the capacitor under test has no serious internal leakage.

A final check is made by quickly turning the

range switch back to the "TEST" position, at which point no polarising voltage is applied, but the meter remains connected across the component under test, and will now give some indication of its ability to "hold" a charge; the voltage will gradually leak away through the meter until a near zero reading is obtained.

Naturally, the time which this takes to occur depends on the rated capacity of the electrolytic under test, as well as on its actual condition. A capacitor of, say $2\mu\text{F}$, will discharge in a matter of 1 to 2 seconds, whilst a $32\mu\text{F}$ capacitor may well take 10 to 15 seconds, and $100\mu\text{F}$ considerably longer. With a little practice, the user will find that he can quickly judge the goodness or otherwise of components under test.

Obviously, failure of the meter to record any voltage immediately after the switch is returned to position "TEST" indicates that the capacitor is "open circuited" and has not in fact absorbed any charge whilst undergoing the leakage test, and here again it is only suitable for throwing away.

When testing, it is advisable to increase the polarising voltage gradually by means of the range switch, allowing the meter to settle to a steady reading at each "step", before proceeding to the next higher voltage application. This will greatly assist the re-forming process to take place without danger of over-heating the component which would result if excessive leakage current were allowed to pass for any length of time.

THE INSTRUMENT

The theoretical circuit shown in Fig. 1, and the sketch of the suggested layout for the completed instrument, should make construction perfectly clear. Dimensions and physical layout are of no real importance, but it is suggested that the author's method, whereby the mains transformer, rectifier valve and reservoir capacitor are mounted on a small chassis, to which the aluminium front panel is bolted, is probably the simplest method of construction.

The range switch and on/off toggle switch are mounted on this panel, as are the insulated sockets for connection of the meter and capacitor test leads. The voltage divider resistors can be mounted directly across the tags of the 2-pole, 6-way range switch.

Actually only one pole of this switch is used, but a 2-pole 6-way is a standard, readily obtained component, and is therefore specified in the parts list.

It will be noted that the small "pre-amplifier"

* Made up of 10kΩ and 22kΩ in series

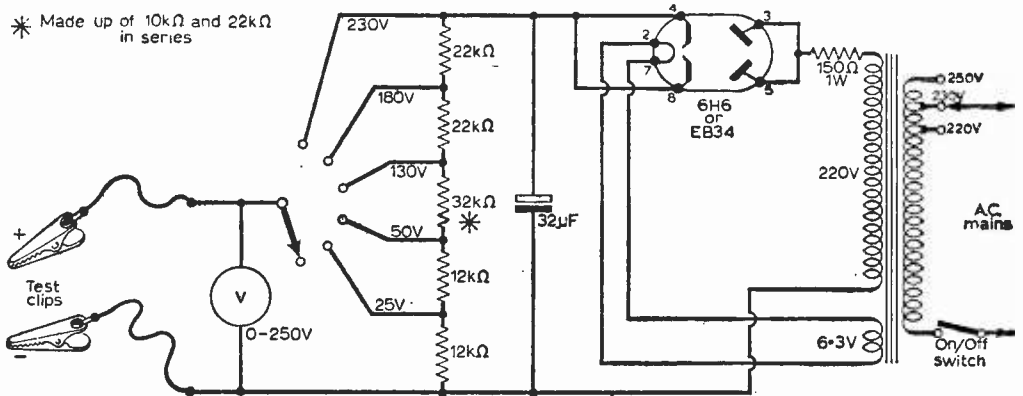


Fig. 1—The circuit of the capacitor test instrument.

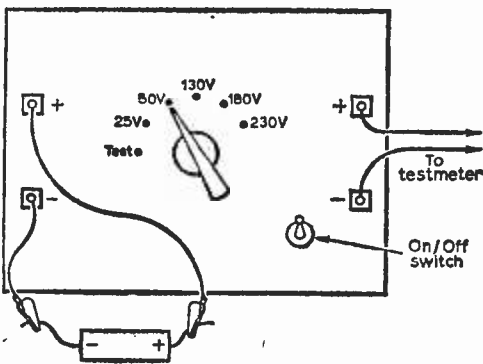


Fig. 2—This illustrates the layout of the front panel of the instrument and also the method of setting it up.

COMPONENTS LIST

- 1 Chassis (6 x 4 x 2½" suggested size)
- 1 Aluminium Panel, size to suit Chassis above
- 1 2-pole 6-way "Yaxley" type switch
- 1 on/off toggle switch
- 4 insulated sockets (2 red, 2 black)
- 4 plugs to suit above
- 1 Mains transformer, midget type. 220v. 45mA, 6.3v. 1A (Radio Component Specialists, Croydon)
- 1 Int. Octal valveholder
- 1 Valve 6H6 (or EB34)
- 1 32μF 350V capacitor
- 2 crocodile clips
- 1 mains lead and plug
- Nuts and bolts, solder tags, connecting wire, flexible leads for meter and test clips as required
- Resistors, ½ watt carbon, 5% (or better)**
- 2 @ 12kΩ 1 @ 10kΩ 3 @ 22kΩ
- Resistor, 1 watt carbon, 20%**
- 1 @ 150Ω

type of mains transformer specified only provides a maximum polarising voltage of about 230V, and some constructors may query the sufficiency of this to adequately test 350V or 450V working capacitors.

ASSESSMENT

In the author's estimation, if the component under test withstands the applied voltage of 230V for, say, 5 minutes, it is unlikely to break down on application of the full working voltage when put into service. If desired, it would of course be possible to substitute a mains transformer of higher voltage output, but this would necessitate re-appraisal of the value of the voltage divider resistor network, and substitution of the specified "rectifier" valve by a 6X5 or metal rectifier of suitable working voltage.

While on the subject of the rectifier, some constructors may view with surprise the use of a 6H6 (or EB34) valve in this position. Primarily intended as a diode for use at r.f. or i.f. frequencies, this

robust little valve (which is very cheaply obtainable on the surplus market) performs admirably under the low current conditions obtaining in this application. Note the inclusion of a 150Ω 1W surge limiting resistor between the high voltage end of the mains transformer secondary and the valve anodes.

A few final words of advice; always switch the instrument "off" before connecting or disconnecting the component under test, and make sure that it has discharged (i.e. meter reading fallen to zero or nearly zero with switch in "TEST" position), before disconnecting. Failure to observe this latter point can result in a nasty and unexpected shock if both crocodile clips are grasped simultaneously when unhooking the test component!

Also, don't forget to see that the multimeter is set to the correct range to read the test voltage which is being applied, and do not attempt to exceed the working voltage of a component being tested; 150V or more applied across a 25V capacitor produces quick (and sometimes spectacular) ruin.

DX-TV

A MONTHLY FEATURE
FOR DX ENTHUSIASTS

by Charles Rafarel

FOLLOWING on the list of European stations that are receivable in Band I, this month we are going to deal with Band III in a somewhat similar manner.

There is one important difference between Bands I and III, in that Band I reception is most likely to occur by Sporadic E propagation and only a small number will be available by means of tropospheric propagation.

In Band III, however, the converse will apply. In fact, for all intents and purposes, we can ignore the remote possibility of Sporadic E reception, since virtually all reception will be by tropospheric propagation. Very occasionally, Sporadic E reflection of Band III signals can occur under exceptional atmospheric conditions, but we should concentrate almost exclusively on tropospheric signals.

To obtain the best results from this type of signal it is essential that the receiving aerial is the most efficient possible, as the signals will be sharply directional and often low in strength. Multi-element high gain raise should be used.

The general remarks given last month in connection with Band I tropospheric reception will apply equally to Band III. If you get reception from one area in Europe look out for other stations in that general direction. But, as I have said many times before, always be on the look-out for DX stations from any area, and the best way to do this is to "scan" the Continental land area by rotation of the aerial array in conjunction with the progressive tuning throughout the band.

Band III Tropospheric Propagation

Channel	Station	Country	Notes
F5	Rennes Pern.	France	—
F5	Reims	France	—
F5	Strasbourg	France	—
F6	Metz	France	—
ID & IE	None	Italy	—
E5	Roermond	Holland	—
E5	Aalborg	Denmark	East England and E. Central Area
E5	Inselberg	E. Germany	—
d	Cork	Eire Rep.	625 lines negative
F7	Niort	France	—
E6	Koblenz	W. Germany	—
E6	Weinbeit	W. Germany	—
E6	Brocken	E. Germany	East and South England
E6	Smilde	Holland	East, South and Central England
E6	Västervik	Sweden	North East England only
R6 & R7	None	East Europe	—
B7	Dublin	Eire Rep.	405 Lines Positive
F8a	Lille	France	Good signal in many areas
F8a	Paris	France	—
F8	Brest	France	—
E7	Markelo	Holland	—
E7	Luxembourg	Luxembourg	819 lines positive
E7	Soenderjylland	Denmark	East and East Central England
F9	Bourges	France	—
IF & IG	None	Italy	—

Band III Tropospheric Propagation—cont.

Channel	Station	Country	Notes
R8	Katowice	Poland	Very rare East Central reception
E8	Wavre	Belgium	Now 625 pos. since 1.1.65
E8	Hanover	W. Germany	—
E8	Aalen	W. Germany	—
E8	Feldberg	W. Germany	—
E8	Aarhus	Denmark	E., N.E. and E. Central England
E8	Västerås	Sweden	East Central England
R9 & R10	None	East Europe	—
F10	Rouen Gde./ Couronne	France	—
IG & IH	None	Italy	—
E9	Langenberg	W. Germany	—
E9	Bergen	Norway	East Central England only
F11	Amiens	France	—
h	Dublin	Eire Rep.	625 negative
E10	Wavre	Belgium	625 lines positive
E10	Donnersberg	W. Germany	—
E10	Vestjylland	Denmark	East Central England only
F12	Cherbourg	France	—
F12	Le Mans	France	Vertical polarization
F12	Vannes	France	Rare "Floater" S. England only
R11 & R12	None	East Europe	—
j	None	Eire Rep.	625 Negative
E11 & E12	None	West Europe	—

Reception becomes increasingly difficult in Band III as the distance from the transmitter increases and it becomes virtually impossible in excess of 500 miles. This means that there will be a wide variation in the pattern of reception in the British Isles.

For example, those who like myself live in the South will find that the easiest reception is from France, then to a lesser extent Belgium, Holland, and certain areas of West Germany, and occasionally East Germany.

Those who live in East Anglia will find that the above countries are received rather better than in this area except that Stations in Western France will be less well received.

Further to the North East of the British Isles, France becomes much more difficult or impossible. The Belgium, Dutch and German stations remain available but more difficult to receive, and reception from Denmark, Norway and Sweden becomes

possible. Occasionally reception of Poland has been obtained.

Further north into Scotland, the Scandinavian stations will predominate in the DX log and other areas will become less easily receivable.

As one proceeds inland to the British Isles, Continental reception becomes increasingly difficult and in the North West, I am sorry to say, reception seems virtually impossible.

So with reference to the list below I would suggest that readers should take their own geographical location into consideration before assuming that they will be able to receive any of the stations listed.

The table lists some of the Continental Band III stations which have been received by myself and other P.T. readers. If other DX's have identified other transmitters not included, please let us have details.

Next month details of U.H.F. bands IV and V transmitters received here, also DX reception in Band II.

NEWS ITEMS

A sporadic E opening occurred on April 19th starting at about 1100 and continuing until 1700 with short breaks. Good signals were received from Grütén, West Germany, on channel E.2 with sound and vision and news bulletin at 1230, on my new Belgium Siera TV set now in use. At the same time, the TVE Spain check board pattern was received on channel E4, probably from Guadalcanal or Santiago. Also on Band I channel R1 there was a live East European programme, probably Czech in origin.

During the afternoon, from 1530 to 1700, the TVE Spain Madrid station on E2 gave good signals with an afternoon programme including a sports meeting from 1630 onwards.

The opening appears to have been fairly widespread, and Mr. R. Bunney of Romsey reports reception of what is believed to be the Yugoslav test card on channel E3, in addition to the above.

Let us hope that this comparatively early opening is a good omen for the coming season.

CATALOGUE RECEIVED

We have recently received the latest illustrated catalogue of Messrs. Henry's Radio Ltd. (303 Edgware Road, London, W.2). This latest edition which has been completely brought up to date to include many new lines, contains 90 pages detailing hundreds of components and may be obtained from Henry's for 2s. 6d. post paid.

A Do It Yourself Series

A VIEWER'S GUIDE TO TV SERVICING

by H. Peters

PART 4. COMPONENT CHECKS

THIS, the final article in the series, gives some hints and tips on the ways and means of checking various components suspected of being faulty. Depending upon how far you intend to go, the suggestions range from the primitive to the slightly technical.

Components fall into four main groups—valves, resistors, capacitors and inductors, and the methods of checking them are threefold: (1) Checking in circuit, (2) checking out of circuit and (3) substitution.

The most satisfactory of these methods is substitution and it is also the simplest. As my dentist would say: "If in doubt have it out". So that you need only refer to the part which is troubling you most, each of the four groups will be dealt with by the three methods in turn.

VALVES

Checks in Circuits

A mine of useful information can be obtained by carefully checking the voltages around the valve-holder while the set is running. The indications and their implications were dealt with in the second table in the previous article in this series and it is sufficient here to emphasise that what you find out relates just as much to the circuit around it as to the valve itself.

Signs of distress may be noted by the careful observer who looks for a uniform filament colour, absence of glowing electrodes and little flashes. A slight purple glow (sometimes on the move) is, however, quite normal in some output valves.

Checks Out of Circuit

These involve removing the valve and taking it to a shop with a valve tester, but as it is quite unlikely that the dealer will be able to stimulate on the tester the rigorous conditions under which the valve works in the set this form of checking is apt to be misleading.

If your set is over four years old most valve testers will condemn the majority of its valves as "low". Do not let this hurry you into buying replacements straight away. Consider first which stage the valves came from.

In the i.f. and sync separator stages a low valve will often give quite satisfactory service, but the stages where replacement will show a marked improvement are the r.f. amplifier, line oscillator and frame output stages.

You may have formed the impression that

checking the valve in or out of the circuit isn't going to get you very far and you are probably right.

Substitution

The only really effective way to check a valve is in a TV set. If you look around a chassis it is more than likely you will come across a number of valves of the same type. A systematic exchange of these may be all that is needed.

As an example it is quite likely that an ECL80 in a sync separator stage is as fresh as a daisy after four years in use. Try changing it over with the frame output ECL80 which has been driven hard all its life.

RESISTORS

Checks in Circuit

Due to parallel paths around the resistor under test formed by adjacent components, cold checks made on the ohms range of a multimeter cannot be relied upon. Carbon resistors betray their health by their appearance and, if they seem "cooked", replace them, since they usually change their value with heat, commonly going "low".

Pull at the lead-out wires with an insulated probe. They should not come away from the resistor.

Checks Out of Circuit

A measurement made with a modern multimeter on the ohms range should give a reading accurate enough for television work. There is no need to remove the resistor completely to do this. Simply unsolder and lift off one end wire and the resistor is as good as out of circuit.

Substitution

It is important to use the right type of resistor of adequate wattage. Most resistors are carbon composition types but some are "high stability" types. These are to be found in timebases and stages where low noise is required.

Wire-wound resistors are to be found where power dissipation is high and can be used to replace carbon types of the same value which have overheated in places like the line output stage screen feed.

A wire-wound resistor is, however, usually inductive and should not be used in r.f., i.f. or video stages, where a carbon resistor of higher wattage should be fitted if overheating due to poor design is suspected.

Standard Values

Carbon resistors come in sets of standard values. The basic values commonly found are based upon 1, 2.2, 3.3, 4.7, 6.8, 8.2 ohms and the range is extended by multiples of ten right up to 10MΩ.

For example, if a ½MΩ resistor is required the nearest standard value is 470,000Ω (yellow, mauve, yellow) and this is the value of resistor you would expect to see actually fitted in the set.

To cut your kit of spares down to a minimum the writer suggests you carry 15 ½W resistors as follows:

100Ω	1.0kΩ	10kΩ	100kΩ	1MΩ
220Ω	2.2kΩ	22kΩ	220kΩ	2.2MΩ
470Ω	4.7kΩ	47kΩ	470kΩ	4.7MΩ

By fitting these in series and parallel combinations almost any other value of resistor can be obtained. The permutations of the 100, 220 and 470Ω group are worked out here. For the rest simply add the appropriate number of noughts.

Approx. Value.	Made From.
56Ω	100, 220, 470Ω, all in parallel.
60Ω	100, 220Ω, in parallel.
80Ω	100, 470Ω, in parallel.
140Ω	220, 470Ω, in parallel.
320Ω	100, 220Ω, in series.
570Ω	100, 470Ω, in series.
690Ω	470, 220Ω, in series.
790Ω	100, 220, 470Ω, in series.

CAPACITORS

Checks in Circuit

The simplest check you can carry out in situ is to bridge a known good capacitor of similar value across the suspected one and note what difference (if any) you see. This will only give an indication of the capacity of the component and not of its leakage.

It is particularly useful when checking smoothing circuits, bias electrolytics and decoupling capacitors where the addition of a capacitor of similar value should not make any appreciable difference if the original component is performing satisfactorily.

For the benefit of "bare minimum" tool kit enthusiasts four capacitors will check most functions. A 0.001μF ceramic will be suitable for bridging across i.f. decouplers, a 0.1μF 1,000V paper can be substituted for anything from 0.02 to 0.25μF without causing disastrous distortion, a 50μF 350V electrolytic will check smoothing capacitors from 16 to 200μF by bridging and a 250μF 50V electrolytic will be a suitable substitute for bias capacitors from 50μF to 500μF.

Checks Out of Circuit

To do the job right involves using a bridge, which you probably haven't got. A multimeter with a sensitive ohms or Megohms range can, however, tell you quite a lot. As with resistors it is seldom necessary to remove the component completely, since lifting one end (the non-chassis end for preference) is sufficient.

Clip the negative probe of the meter (set to ohms x 100 or similar range) to the tethered end of the capacitor and touch the positive probe on the other end. The meter needle will kick forward and slowly move back to infinity if there is no leakage.

The time it takes to do this depends upon the sensitivity of the meter and the capacity of the component. A 0.1μF will take considerably less than a second. A 50μF electrolytic may take 10 to 15 seconds. A 0.001μF ceramic should barely move the pointer.

The final position at which the needle comes to rest will give you the leakage current, sometimes barely perceptible except with electrolytics, when a steady leakage current must be expected. Make sure that you keep your fingers on the insulated part of the probe when checking leakage.

Sticky fingers usually read about 50kΩ leakage and many a dozen capacitors have been rejected for leakage when all that the meter has been reading is the perspiration of the reader.

Substitution

When replacing electrolytics be sure to get the polarity right. An electrolytic fitted the wrong way round will work for a time and may even show a high capacitance, but it is liable to overheat and explode, scattering borax all over the works.

When two or more electrolytics share the same can there is a possibility that leakage can occur

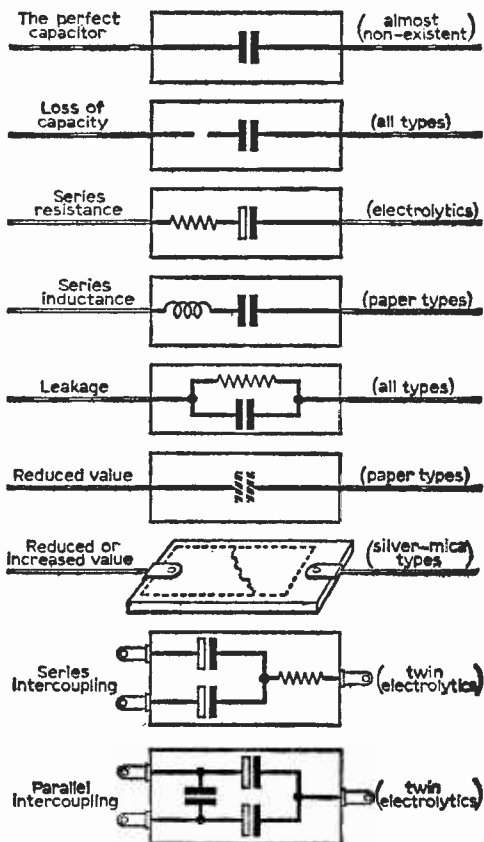


Fig. 4: Illustrating several of the causes and effects of imperfect capacitors.

between two sections, producing peculiar effects such as frame-on-sound or poor sync.

Alternatively a high resistance joint to chassis may give them some inter-coupling. When substituting in a multiple block disconnect the original component rather than bridge it by the new part.

Substituting decouplers in i.f. stages can be tricky too. Always use the same type of capacitor as previously fitted and put it in the same place, using the same chassis point. With modern high-gain valves the makers use all sorts of circuit ideas to get the most out of each stage.

Decouplers are frequently arranged to form one leg of a balanced bridge or to resonate at a frequency just above the i.f. in conjunction with the wiring. In such stages the fitting of, say, a 0.003 μ F in place of a 0.001 μ F will probably make things worse rather than better.

INDUCTORS

These are perhaps the trickiest of all components to check, mainly because every coil, choke or transformer is designed especially for the set it is in. When you come to think about it this is logical.

Valves, resistors and capacitors come, usually, in stock types and sizes "off the peg" as it were. Since their values are standard and fixed the only parts of a circuit that the designer can vary are his coils, which is why he does so.

The most frequent coil troubles in TV sets are in the line output and scancoil group. Blocking oscillator and sound output transformers have given some trouble, but nothing serious, and the writer very seldom has the need to change i.f. transformers.

A fair amount of trouble is encountered in tuner units but this usually turns out to be contacts rather than the coils themselves.

Checks in Situ

These depend on the nature of the inductance. Small chokes, blocking transformers, sound output transformers, etc., can be squeezed between the fingers whilst running (if practical). Nothing should happen. If it does you have trouble.

Checks Out of Circuit

You should really have a "Q" meter to find out all about your inductance, although even this instrument will not usually tell you how the thing behaves with the peak voltages found inside a TV.

Substitution—the Only Way Out

Do not despair readily, for provided you are only concerned with the problem "Is it dead or not?" you do not need to use the exact replacement in every case. Any blocking oscillator transformer known to be good can be used as a rough check for almost any other. Admittedly the timebase speed will invariably be wrong and you may have to try reversing one set of connections to produce oscillations, but at least you ought to obtain a scan of sorts.

A sound output or filament transformer can be used in place of a frame output transformer to give a reduced scan as a quick check.

Cramping top and bottom will result from mis-

match and unless you are lucky first time the picture may be upside down. To cure this reverse one set of windings.

Line Output Transformers

What, you will now be asking, about our old friend the line output transformer? This component is frequently blamed for faults in the surrounding circuit, so before substituting such an expensive item it pays to check the following: H.T. fuse to line output stage, screen feed resistor to line output valve, boost capacitor, scancoils, line drive and c.r.t.

A quick check on the boost capacitor, which usually shorts out, is to remove the top cap (cathode) of the efficiency diode. This will disconnect the h.t. from the anode of the line output valve unless the boost capacitor is shorted. Do not make this h.t. test with an expensive meter; a neon tester is cheaper and less likely to be ruined.

To test the scancoils disconnect the line feed wires from them and run the set again. If better results are obtained from the transformer (e.h.t. rectifier heater lights, line whistle sweetens, faint line appears up and down the screen) the scancoils are likely to be the faulty items.

Line drive can be checked at the grid of the line output valve with a voltmeter. At least -30V d.c. should be present if drive is satisfactory.

To eliminate the c.r.t. disconnect the e.h.t. lead. If this restores e.h.t. the c.r.t. is taking too much current and possibly has a displaced ion trap magnet. If after all this you still suspect the line output transformer and have another one known to be good, even though it is quite different, a quick check can be made by lifting the present leads from the top caps of the efficiency diode and line output valves and fitting the two leads from the test transformer (suitably extended) in their place.

If the e.h.t. rectifier heater in the test transformer lights up you can assume that your own line output transformer is the culprit. This test does not apply to timebases where the line output valve forms one half of the line scan multivibrator.

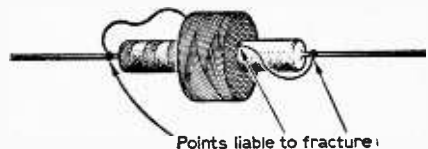


Fig. 5: The video choke. When fractures in the wires occur, as illustrated here, a streaky picture can result.

Video Chokes

A final word about a little inductance that frequently goes intermittent and gives symptoms of a streaky picture reminiscent of a heater-cathode c.r.t. These chokes are to be found all around the detector and video amplifier stages and comprise a few turns of wire wound round a resistor which is there to give a convenient support and some damping.

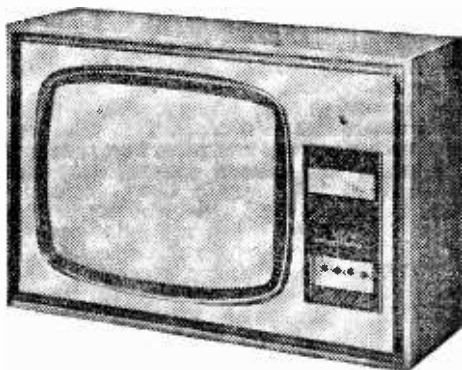
If the choke becomes open circuit a d.c. and low-frequency path is still made through the resistor, resulting in the aforementioned streaky picture. ■

TRADE NEWS • TRADE NEWS • TRADE NEWS • TRADE NEWS • TRADE NEWS

Shutterswitch TV

FROM Pye Ltd. comes a 19in. television receiver the model 35/UF, with shutterswitch tuning as featured on their 23in. set. The shutter, operating as a system switch slides up and down to expose the appropriate set of station controls. Four buttons are provided for u.h.f. and four for v.h.f.

The 35/UF has 15 valves, one silicon rectifier and seven semiconductors. The power supply is 200—250V a.c. or 230—250V d.c. The set features a two panel printed circuit chassis which swings out for easy servicing, flywheel sync, and high output video stage for extra contrast in a sunny room. The speaker is 5in. front-mounted and dimensions are 26½ x 13 x 19½ in. high. The finish is of afromosia vincer with Suwide tube surround. Price, including stand with magazine rack, is 75 guineas, including £11 7s. 1d. tax. *Pye Ltd., St. Andrews Road, Cambridge.*



The 35/UF 19in. "shutterswitch" receiver from Pye.

Oscilloscope Trolley

NOW available from Telequipment Ltd. is this oscilloscope trolley, type LHU, designed to handle the entire Telequipment range and suitable for most other current oscilloscope models as well as for many other instruments.

Dimensions are 31in. high, 17in. wide and 31½in. long, although the specification can be varied to customers' requirements. The trolley has two removable shelves and can carry a load of up to 300lb. Both frame and shelves are of 16s.w.g. mild steel and the unit is fitted with 4in. diameter swivel castors. The price is £15 6s. *Telequipment Ltd., 313 Chase Road, Southgate, London, N.14.*

Transistor Image Orthicon TV Camera

A NEW all-transistor television camera which uses a 4½in. image orthicon pick-up tube is announced by EMI Electronics Ltd.

Broadcast quality TV signals can be produced on 405, 525 and 625 line standards, and the change-over from one standard to another can be made at the flick of a switch on the control panel.

Camera type 206 can be fitted with a four-position turret to accommodate standard fixed-focus lenses or can be adapted for zoom lens operation. It has a built-in 7in. electronic viewfinder.

Transistor circuitry is used throughout and extensive use of plug-in printed circuit sub-units makes for easy accessibility and maintenance.

Two versions of the camera control unit are offered. It is available in a standard 19in. rack for studio use, or in a portable case for outside broadcasts. *EMI Electronics Limited, Hayes, Middlesex.*

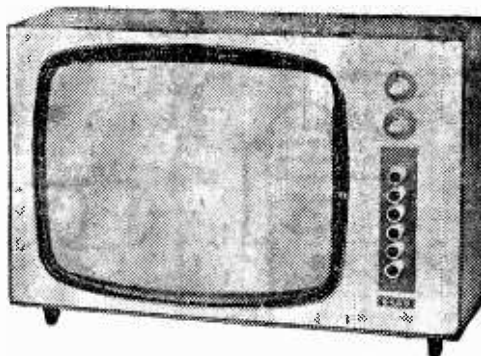
Ekco "Compact 16"

THE first Ekco transistorised television receiver has a new Mazda 16in. lightweight picture tube. Both sound and vision receiving circuits are fully solid-state right up to the demodulator stages.

A new feature of the receiver is the integrated v.h.f./u.h.f. tuner which gives the same high performance on 405 and 625-line systems without the need for a changeover switch. Described as "Lazy Switch" tuning, you simply press a button to choose BBC-1, BBC-2 or ITV and three spare buttons are provided to cater for any new programmes, either on v.h.f. or u.h.f., whenever they come.

The only controls on the front of the receiver, apart from six press buttons for programme selection, are volume/on/off and brightness. A preset contrast control at the back is supplemented by a separate preset control for contrast on 625-lines. There are also the usual preset controls.

The receiver measures 14in. high by 20½in. wide and the cabinet is only 7in. deep plus back cover. The price of the Ekco "Compact 16" Model T441 is 65 guineas. *Ekco Radio and Television Ltd., Southend-on-Sea, Essex.*



Transistorised TV from Ekco.

How to cure LINE SCAN RINGING

by G. K. Fairfield

MANY readers will have constructed their own line scanning circuits from designs given in the pages of this and other technical journals and have encountered difficulty in eliminating the effects of line scan resonance or "ringing" as it is commonly termed. This fault is also not unknown in professionally designed circuits and a cure may be sought for this in a commercial receiver which the reader has acquired.

Although the root cause lies in the mode of operation of the line scanning circuit the practical effects may be exhibited in many different ways and, in order to understand these, it is necessary to look closely into the way in which the line scanning circuit functions.

Operation of the Line Scan Circuit

A simplified version of a typical line scan circuit is shown in Fig. 1. Since each winding on the transformer is only imperfectly coupled inductively with its adjacent windings we can show this by means of "leakage" inductances external to the transformer and representing by their value the extent of this lack of coupling.

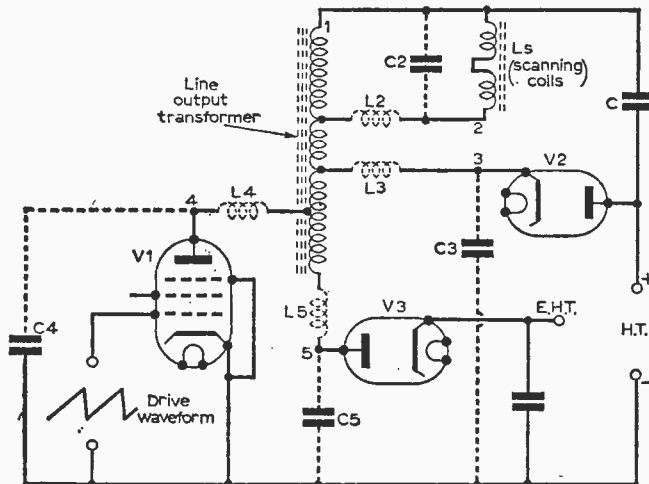


Fig. 1—A simplification of the line scan circuit, showing leakage inductance and stray capacitance.

These are shown dotted in Fig. 1 as well as the stray capacitances to earth of the windings and that across the scanning coils.

It is the resonance of these "external" components which gives rise to the ringing effects as we will see later.

Referring to Fig. 1, let us consider the sequence of operations commencing with the cathode ray tube spot in the screen centre—i.e., zero current through the scanning coils Ls.

V1, previously made non-conductive by means of a large negative bias applied to its grid, now commences to conduct. The potential at point 4 will now rapidly fall to the low "knee" potential for V1 and that of points 2 and 3 will fall in proportion to the transformer turns ratio. This ratio is so arranged that point 3 falls to a potential slightly in excess of V2 anode potential (the h.t. volts), in order to keep the valve non-conductive during this part of the cycle. The constant potential difference between terminals 1 and 2 will cause an increase of current in Ls and the spot will move from the centre to the right-hand side of the screen. This may be called the first part of the scanning period.

V1 is now cut-off by the negative-going excursion of the controlling grid potential, and with both V1 and V2 cut-off the oscillatory circuit formed by Ls and C2 becomes free to resonate at its natural resonant frequency (generally about 50kc/s for a 405-line receiver). During this oscillatory period the current in the magnetic system falls to zero, reverses in direction, and builds up to a maximum in the opposite sense so that the spot travels rapidly to the left-hand side of the screen. This is the fly-back period.

The potential at point 3 now reverses in polarity and V2 commences to conduct. This valve has a low impedance and will hold point 3 constant at the h.t. potential. The constant potential drop across terminals 1—2 will cause a linear decrease of current to take place in Ls, and with proper circuit design this will be of the same slope as the rise of current described earlier. This will cause the spot to complete the scanning cycle by travelling from the extreme left-hand side to the centre of the screen during the second half of the scanning period.

During the conduction period for V2 the boost storage capacitor C will be charged and its potential added to that of the h.t. supply for V1. This is an important feature enabling operation to be secured from a fairly low value of h.t. potential (180 to 200V).

Now the scanning circuit is capable of oscillation at several resonant frequencies simultaneously. The main magnetic flux around the circuit will resonate during the flyback period, at a frequency of about 50kc/s as previously described. Superimposed on this however, will be smaller oscillations of a much

higher frequency which are due to resonances between the leakage inductances and stray capacitances. These may modulate the constant potential required across Ls during the scanning period and so affect the scanning current through it.

The e.h.t. overwind in particular has a large number of turns, and as one of its requirements lies in having a small self-capacitance, it is usually constructed as a narrow wave-wound coil. Consequently its coupling to the other windings is poor, its leakage inductance large, and so giving rise to a large storage of energy in L5 during the flyback period. When V2 conducts during the second half of the scanning period it should hold the potential of terminal 3 constant to enable a linear rise of current to take place in coils Ls. However, the energy previously stored in L5 will cause oscillations to take place around the circuit C5, L5, L3 and V2, and an alternating voltage is developed across L3 which will have the effect of modulating the current in Ls.

Similarly when V1 anode current is cut-off at the commencement of the flyback period the stored energy in L4 will flow into C4 and cause oscillation between these two components. Oscillations between L3 and C3 are also possible in a similar manner when V2 is cut off. The leakage inductance L2 is not important as it forms part of the scanning coils resonant circuit, and will resonate with Ls and C2 at the main resonant frequency.

Fortunately, using the auto-transformer connection shown, leakage inductances L3 and L4 do not cause any noticeable effects since a high coupling factor can easily be achieved.

It is not, however, possible to do this with the e.h.t. overwind and this leakage inductance. L5, will be found responsible for almost all of the ringing experienced with the completed transformer design.

Transformer Modification

What can be done to suppress this resonance? Some form of damping is necessary, but this should ideally only be effective at the high frequency of leakage reactance resonance and not damp the transformer during the normal flyback oscillatory period.

One method is to reduce the Q factor of the overwind in such a way as not to damp the other windings coupled to it. This can be arranged by introducing distributed resistance into the winding. The desired effect can be achieved by stripping off the overwind from the transformer and replacing this by an exactly similar winding, but using resistance or Eureka wire instead of copper wire. If the gauge of this is selected to give the completed coil a resistance of 5 to 10Ω per turn then the Q factor can be reduced by a factor of 50 to 100, which is sufficient to reduce the ringing to negligible proportions.

With most designs a Eureka wire size of 44 or 46s.w.g. will prove satisfactory for this purpose. It has a higher tensile strength than the equivalent gauge of copper wire and will be no more difficult to handle than 40s.w.g. copper wire.

A second method which also involves modification of the transformer is to introduce a strip of ferromagnetic material between windings 1—4 and 4—5 in a somewhat similar manner to the electrostatic copper screen often used between primary and secondary of some main transformers (see

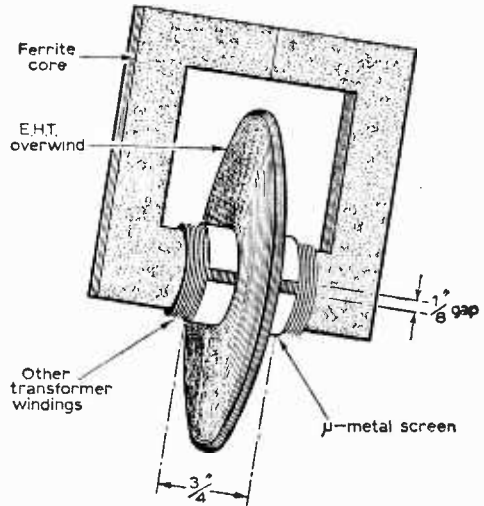


Fig. 2—The μ -metal screen shown here helps suppress overwind resonance.

Fig. 2) This screen should not form a complete turn of material as otherwise the shorted turn so formed will absorb a large amount of energy from the circuit. A gap of $\frac{1}{8}$ in. between the two ends may be allowed in order to prevent this.

Since the ferromagnetic strip will be situated within a strong magnetic field created by the current flowing in the windings, it will localise the flux near the strip and energy will be absorbed to enable the flux within the material to go through a hysteresis cycle of magnetisation.

The energy absorption will become quite as large as the frequency increases so that losses at the ringing frequencies of 200 to 600kc/s will be quite large compared with those at the fundamental flyback resonant frequency.

Suitable materials for the metal strip, which needs to be about 0.005in. thick, are Radiometal, Rhometal, Permalloy and Mumetal, of which the last is particularly effective.

Other Forms of Resonance

It may well be that the effects of overwind leakage resonance have already been taken care of in the design stage by using a "tuned transformer" technique (see my article in PRACTICAL TELEVISION for April 1964), or that either of the two methods suggested above have been successfully applied. Unfortunately this only means that the most objectionable form of ringing has been removed. Quite a number of other causes, including some odd secondary effects, may still be present but before dealing with these, mention must be made of the high frequency oscillations which are due to the presence of L4 in series with the V1 anode circuit shown in Fig. 1.

Output Valve Resonances

This leakage inductance can give rise to several objectionable forms of resonance. As shown in Fig. 3, it is possible for the potential at the anode of

V1 to become negative at the beginning of the scanning period, when the resonance of this leakage inductance is taken into account. This may give rise to high frequency oscillations, in one or two ways. The valve may behave as a Barkhausen oscillator. This type of v.h.f. oscillation is possible in a triode valve when operated with a positive grid and a negative anode potential. A second type is possible if the anode voltage of V1 is modulated in such a way that the knee of the 1aVa characteristic is passed. The anode current will then contain high order harmonics of the modulation frequency, especially when the anode potential reaches negative values as shown in Fig. 3. High order harmonics may also arise from the nature of the 1aVa characteristic for V1 at these low voltages. With certain tetrodes it is possible to have a region in this characteristic where the valve behaves as a negative resistance. Dvnatron oscillations will be set up with the tuned circuit L4, C4 representing the anode load, and as the 1aVa characteristic is far from linear over this region considerable harmonics may be produced.

All these forms of harmonic generation can produce frequencies which extend into the television bands. They may be picked up in the r.f. section of a television receiver and become evident as vertical lines towards the left-hand side of the screen.

This form of interference will, of course, be due to intensity modulation of the cathode-ray tube electron stream as distinct from the velocity modulation of the current flowing in the scanning coils previously described.

To deal with the Barkhausen oscillations small "beads" of ferroxcube can be obtained, which, when threaded through the wire leads to the anode terminal of the line output valve, will effectively suppress the oscillations. They have the effect of reducing the Q factor of the leakage inductance circuit to a value which does not allow the high frequency oscillations to be sustained.

The other forms of negative resistance oscillation may be avoided by including a resistance, at least

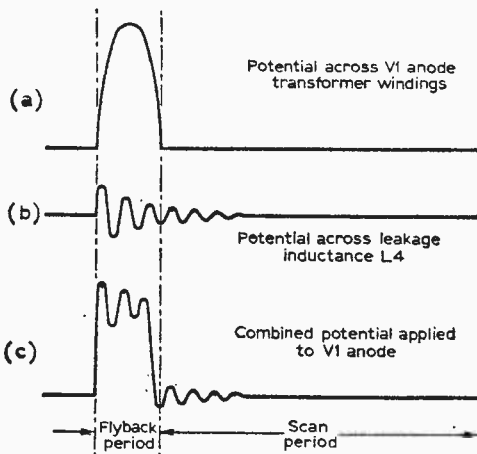


Fig. 3—Voltage waveforms in the line output anode circuit.

equal in value to the negative slope of the 1aVa characteristic, in series with the valve anode. A value of about 100Ω will generally be satisfactory.

Scanning Coil Resonances

When the various sources of ringing due to the line scan transformer have been located and either removed or minimised, some velocity modulation of the scan may remain and can be attributed to resonance within the line scanning coils. This form of ringing occurs on the extreme left-hand side of the screen at a frequency of the order of 300-800kc/s and may be removed by tuning one of the scanning coils as shown in Fig 6 and 7. The resonance is due to an unbalance in the natural resonance frequency of the two halves of the scan coil with their stray capacitance. The added



Fig. 4—The effect on the horizontal pictures lines caused by velocity modulation of the frame scanning current waveform.

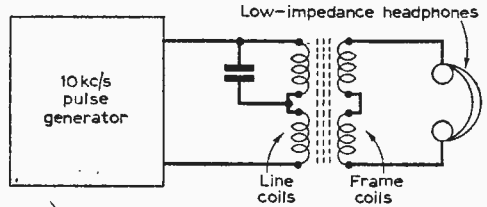


Fig. 5—A method of null adjustment for minimum coupling between line and frame coils.

capacitance is adjusted until the resonant frequencies of the two halves of the circuit are identical and no variation of potential appears across the complete coils due to this cause. In view of the high potential pulse appearing across the scanning coils during the flyback period the capacitor will have to be able to withstand a peak potential of up to 2kV. A capacitance trimmer, having ceramic dielectric, and a range of 3 to 30pF will be suitable.

It is also possible to have a resonance of the frame scanning coils when these are inductively coupled to the line coils. The pulse appearing across the line coils at the end of the scanning period will shock excite the frame coils at their natural resonant frequency and velocity modulation of the frame scanning waveform appears. This takes the form of a "wavyness" of the horizontal picture lines at the left-hand side of the screen as shown in Fig. 4. To reduce this effect the coupling between the line and frame coils may be reduced by orientating the pair of frame coils relative to the line ones, until a minimum voltage is induced in the former from a 10kc/s pulse generator connected across the line coils (see Fig. 5.)

This may not always be possible, however, or completely effective, as capacitive coupling will

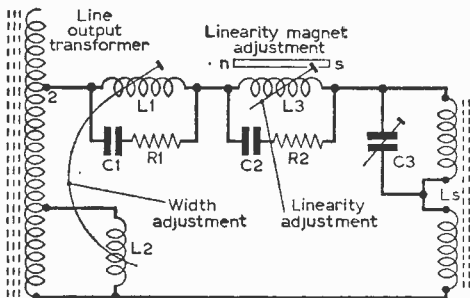


Fig. 6—Width and linearity controls added to scanning coil circuit.

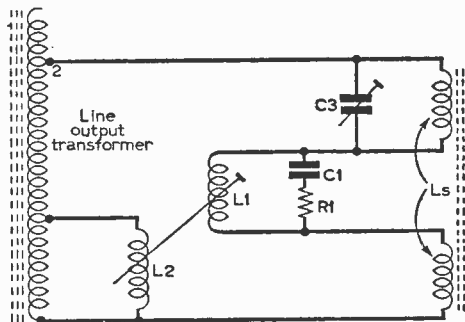


Fig. 7—Alternative position for series width coil.

exist between the pairs of coils. An alternative remedy is to damp the individual frame coils with a resistor of the order of $1,000\Omega$ so as to increase the decrement of this resonant circuit and so reduce the amplitude of oscillating potential developed across it. It is necessary to damp each frame coil individually, as a common resistor across the pair of frame coils will leave the leakage inductance relatively undamped.

Width and Linearity Coil Resonances

From the remarks previously made regarding leakage reactances it will be clear that any inductive elements added to the circuit will be shock excited into resonance with their stray and self-capacitance. Thus the coils incorporated in the complete receiver to provide control over picture width, L1 and L2 in Fig. 6, and linearity, L3, can give rise to resonances at the commencement of the scan.

To reduce this shock excitation of L1 and L3, a damping resistor may be connected across the coils. Usually however, the value of resistor required will be such that an appreciable amount of energy will be dissipated within it.

A better arrangement is to shunt L1 and L3 by

a series combination of C1R1 and C2R2 as shown in Fig. 6. We can make this combination non-resonant if the relationship $L=C.R^2$ can be maintained. Of course, since L1 and L3 are both made variable new values of R1 and R2 are required for each setting of the width and linearity controls. As the ringing is usually most objectionable at the maximum inductance setting for L1 and L3 it is sufficient to adjust R1 and R2 for this conduction. In a practical case C1 and C2 can be made about 300 pF and R1 and R2 included as a potentiometer of $20\text{ k}\Omega$. When the optimum value has been secured it may be replaced by a fixed $\frac{1}{2}\text{ W}$ resistor.

Although an added inductive element may be made non-resonant in this way it can behave as a capacitance at certain frequencies of the order of 500 kc/s . This capacitance in series with leakage inductance L2 (shown in Fig. 1) can form a tuned circuit having this order of resonant frequency. A solution to this problem is to place the coil, together with its associated damping circuit between the two halves of the scanning coil as shown in Fig. 7. The transformer leakage inductance is now no longer directly associated with the circuit L1, C1, R1 and this source of ringing removed.

In the June

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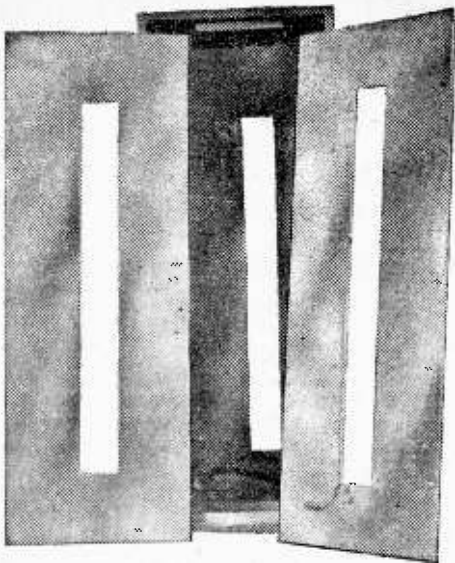
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vertical and others with the rods horizontal. If we turn the aerial through 90° so that the rods are horizontal in a reception area where the signal is vertically polarised, the signal picked up by the aerial will fall considerably, almost to zero in some cases.

The polarisation of the wave is determined by the direction of the *electric* component or lines of flux. Thus, if the electric component is vertical, as implied in Fig. 1, then the wave is vertically polarised. By the same token, therefore, a wave with a horizontal electric component is said to be horizontally polarised.

This polarisation business is helpful to the developers of a large scale, compact television system, for it means that television channels can be shared by two stations by using vertical polarisation for one and horizontal polarisation for the other. In this way maximum discrimination between the two, shared-channel, transmissions is achieved, though, of course, it is still highly necessary to ensure that the two (or more) shared-channel stations are as far as possible away from each other for maximum freedom of co-channel interference.

ALL electromagnetic waves have two components, the electric and the magnetic. Such waves are propagated through space because the components vary sinusoidally from instant to instant. It can be considered that the electric component is sustained because of the changing magnetic component and that the magnetic component is sustained because of the changing electric component.

Electromagnetic radiation is effectively leakage of such energy from an oscillatory circuit, and tuned oscillatory circuits of special design, like transmitting aerials, encourage leakage of this nature and hence the emission of electromagnetic or, as they are usually called, radio waves.

What are Radio Waves?

Radio waves travel with the speed of light and in such a way that the electric and magnetic fields are at right-angles to each other and also at right-angles to the direction of travel. The energy of the wave is divided equally between the electric and the magnetic components.

The diagram in Fig. 1 shows the front view of a radio wave. This is on a plane which is parallel to the mutually perpendicular lines of the electric and magnetic components, or "fluxes" as they are sometimes called, and it is referred to as the "wave front".

As mentioned, the travel of the wave is always at right-angles to the wave front, but its direction of travel—forward or back—is governed by the relative directions of the flux lines of the electric and magnetic components.

If the direction of either flux lines is reversed, so also is the direction of travel of the wave. But if the direction of both flux lines is reversed, then the direction of travel of the wave remains the same.

Wave Polarisation

A radio wave is said to be "polarised". We already know something about this by television aerials—some are erected with the element rods

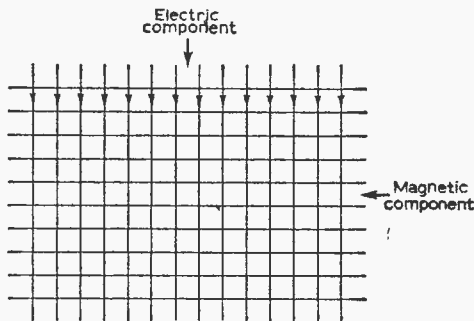


Fig. 1—Representation of a signal wave front. The signal is polarised in the direction of the electric field, shown vertically here.

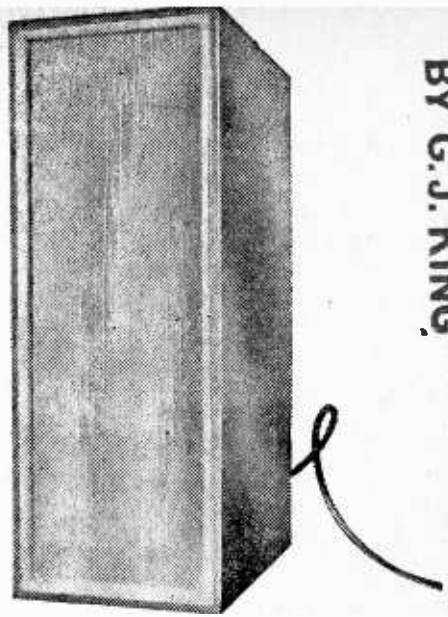
Doing the Twist

During a wave's travel through space its polarisation can twist. This can ruin both the co-channel interference protection aspect and the general reception. Unfortunately such twisting of the wave front may not be consistent, and it can be affected by tropospheric and weather conditions. Where there is a consistent twist of polarisation, though, the reception can often be improved by quite a large amount simply by tilting the aerial itself so that the rods line up to the electric component.

This would be a simple matter if the wave front could be made visible, but in practice the aerial has to be tilted either side of vertical or horizontal by a few degrees while checking the signal strength on a signal strength meter or on the set itself, aiming

DOT AERIAL

BY G. J. KING



for the best reading or reception.

Twist of polarisation is causing a bit of trouble on the u.h.f. channels, even relatively local to the transmitter. The problem is that the sound and vision waves are not twisting by the same amount. This gives the unfortunate condition that if the aerial is carefully tilted to match, say, the polarisation of the sound wave the vision wave is then out of polarisation, resulting in good sound and poor pictures, and vice versa. In severe cases of this effect two aerials may represent a (clumsy) solution, one for vision and the other for sound.

While on the subject of polarisation, it is worth noting that the polarisation need not be arranged to be either truly vertical or horizontal. Any intermediate angle is possible. Indeed, it is also possible to arrange for circular polarisation. This could represent a solution to the selective twisting of polarisation between the sound and vision waves.

Finally by way of introduction, radio waves vary in intensity with the frequency of the current which is producing them. They thus swing alternatively positive and negative, as a sine wave. The distance occupied by one complete cycle is equal to the velocity of the wave divided by the frequency of the complete cycles emitted. This is called the "wavelength".

All this preamble may seem far removed from slot aerials. It is not really, for when we experiment with u.h.f. slots curious things can happen, and it is as well to know why.

From what has already been said, it will be appreciated that an ordinary type of aerial system is in some way related to the electric component of the radio wave. This is because optimum response occurs only when the rods of the aerial are lined up with the electric component. An ordinary dipole does, in fact, use the electric component of the radio

wave, and energy is abstracted from waves passing the aerial because the electromagnetic flux of the waves cutting across the aerial induce a voltage that varies in time in exactly the same way as the signal current in varying in the transmitting aerial. The voltage induced into the receiving aerial is called "signal voltage", and its strength is governed by the intensity of the passing waves and by the directivity and gain of the aerial system.

For maximum energy to be abstracted from passing waves, the aerial must be tuned. That is, its overall length must be equal to a half wavelength of the signal or a multiple of complete half wavelengths. In television, the half-wave aerial is used almost exclusively. In practice, because the velocity of the wave is slightly reduced by the presence of the aerial in space, the length of the aerial is about 95 per cent of the length of the signal's half wavelength.

Dipole Aerial

This aerial or rod is usually cut in the middle to form two half sections and connection is then made to the feeder at each section at the middle, as shown in Fig. 2. The current in the aerial is at a minimum at each end and at a maximum at the centre, while the voltage is at a minimum at the centre and at a maximum at each end, as shown in Fig. 3.

Maximum signal current signifies minimum resistance or impedance, which means that the impedance of a tuned half-wave dipole is minimum at the centre and maximum at each end. The impedances are in the order of 70Ω and 3,000Ω respectively. Signal can be got out of the aerial, then, simply by coupling a feeder as shown in Fig. 2, and maximum signal transfer results when the impedance of the feeder equals the impedance at the centre of the dipole.

If the aerial is longer or shorter than a complete half wavelength or multiple of half wavelengths, signal pickup is impaired and the impedance at the centre of the aerial rises. These things result in the signal being reflected and cancelled. In other words, the aerial is off tune and mis-matched.

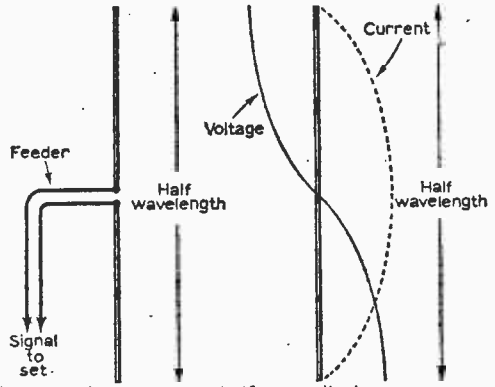


Fig. 2 (left)—A typical half-wave dipole.
Fig. 3 (right)—Current and voltage distribution in half-wave aerial.

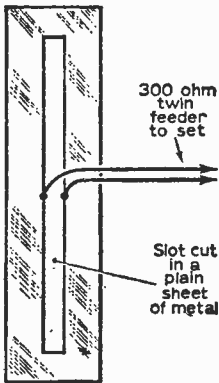


Fig. 4—The basic slot aerial.

dipole itself, the centre impedance of the dipole falls and it is restored to a value to match the feeder by matching devices or by folding the dipole. A fold causes the centre impedance to rise about four times.

The Use of the Slot

Now, by utilising the magnetic field of the radio wave a kind of mirror image of all the things that have so far been discussed results. Firstly, how can the magnetic component be utilised? What we do in this case is to use a slot or slit in a plain sheet of metal as the dipole and, if we want to, use similar slots for the parasitic elements. These slots are effectively the equivalent of the metal rods of an ordinary aerial.

Since slots respond to the magnetic component of the radio wave instead of to the electric component they must be lined up to the magnetic flux of the wave. Thus a vertical slot is used with a horizontally polarised signal and a horizontal slot with a vertically polarised signal. This means that a vertical slot is needed for the reception of the u.h.f. BBC-2 signals, since so far these are horizontally polarised.

Fig. 4 shows a basic slot and one way in which it can be connected to the feeder. It will be seen that connection to the feeder conductors is made either side of the slot at the centre. This mode of connection requires the use of a balanced feeder, such as twin-feeder, as distinct from coaxial cable. Moreover, the impedance at this point of a slot is in the order of 300Ω , so that optimum signal transfer is possible only by the use of 300Ω balanced feeder. This is singularly inconvenient since all British sets have facilities for $70/80\Omega$ unbalanced (coaxial) aerial inputs on both v.h.f. and u.h.f. tuners.

There are various ways of unbalancing the slot and facilitating a match to 75Ω coaxial cable. One way is to fold the slot. This decreases the impedance, which is the opposite to what happens

The signal induced in the dipole proper can be reinforced by means of a parasitic element ("reflector") being placed behind it or by means of a similar rod ("director") being placed in front of it. The reflector is about 5% longer than the dipole and the director about 5% shorter, though this is not a definite rule.

When such parasitic elements are added which, incidentally, need not be in electrical connection with the

when an ordinary dipole is folded. Another way is to effectively fold two slots of different widths. Almost any impedance value can be obtained by these means.

The slot can be fed from an unbalanced, coaxial feeder by means of a probe suspended along one half the length of the slot connected to the inner conductor of the feeder with the braid or outer conductor electrically bonded along the corresponding side of the slot.

Novel Slot Design

Still another way is shown in Fig. 5. Here a rod is arranged along the whole length of the slot but displaced slightly from centre. The inner conductor of the coaxial cable is connected to the centre of this rod while the outer conductor or braid is bound, by means of tinned copper wire threaded through holes, closely to the edge of the slot, as

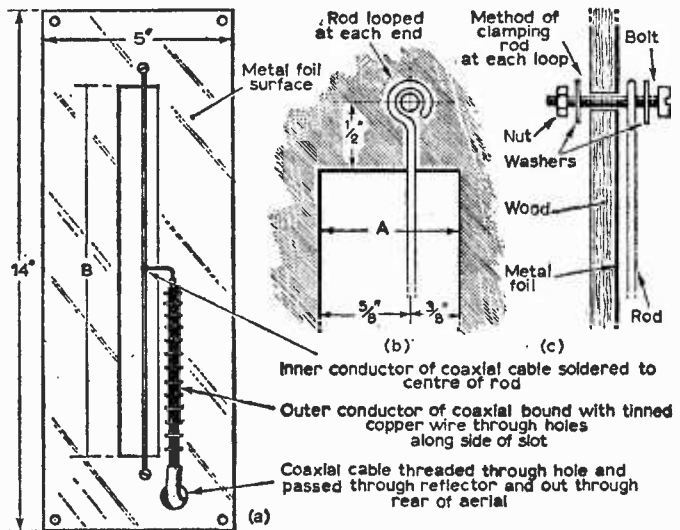


Fig. 5—A practical slot for unbalanced feeding and impedance correction: (a) physical arrangement, (b) the loading rod placement in the slot and (c) method of fitting and loading rod.

shown. The coaxial is then threaded through a hole at the bottom of the slot structure.

This, in fact, forms the slot structure of an experimental u.h.f. slot-aerial designed for mounting on top or near the television set. The slot is first cut into a piece of three-ply wood with a fret-saw, and then one side of the wood and the edges of the slot are metallised by cementing on a thin layer of metal foil of the nature of that manufactured for domestic use and coming under a trade name such as "Mirap".

The overall dimensions of the slot structure are given at (a) in Fig. 5, while (b) and (c) reveal how the rod is attached at each end of the slot, the amount of displacement from the centre of the slot and other relevant dimensions which are self explanatory. The rod itself is best made of a stretched length of 18s.w.g. tinned copper wire. The loops at either end are then clamped under

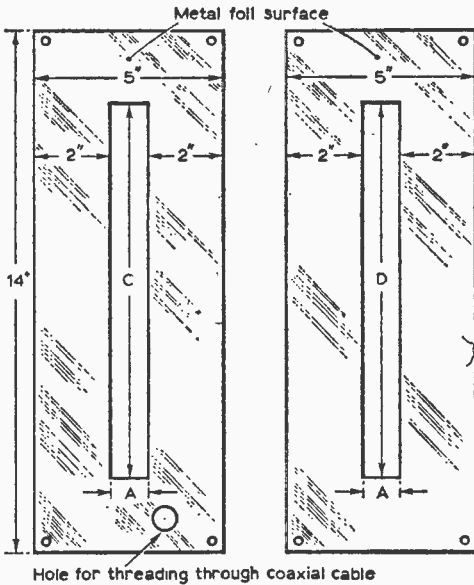


Fig. 6 (left)—The reflector slot assembly for the experimental aerial, and Fig. 7 (right)—the director slot.

washers by the use of a 6BA nut and bolt. So much, then, for the aerial proper, the slot dimensions of which are given in Table 1 along with the dimensions of the parasitic elements for Channels 33 and 40 (e.g., BBC-2, London and Birmingham).

The aerial system is built into a wooden box to look rather like a miniature bass reflex loudspeaker cabinet. Figs. 6 and 7 show the appearance of the reflector and director assemblies respectively. These, again, are made from ply-wood with the slots being cut out first with a fret-saw and one side of each assembly and the edges of the slots being covered with metal foil, as the aerial assembly. Note the hole at the bottom of the reflector assembly to allow the feeder cable to be passed out of the aerial.

Fig. 8 shows a side view through the aerial cabinet which can be made either from five-ply wood or similar thickness hard wood. Wood fillets are positioned along the inside top and bottom of the cabinet to secure by small wood screws at each

TABLE I

Channel	Dimension (inches)						Station
	A	B	C	D	E	F	
33	1	10.6	11.25	10.15	2.65	5.3	London
40	1	9	9.45	8.55	2.25	4.5	Sutton Coldfield

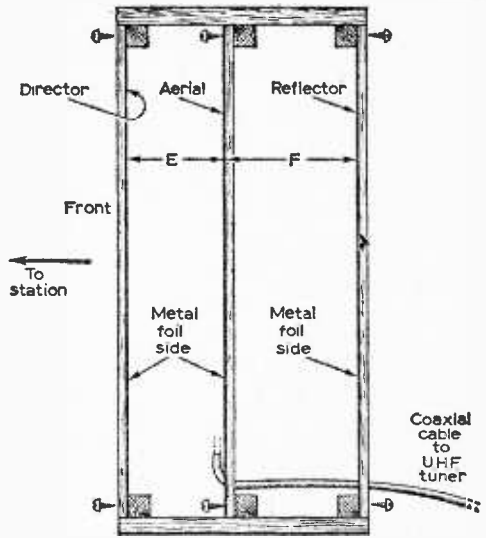


Fig. 8—The arrangement of the assemblies inside the cabinet.

corner the director, aerial and reflector assemblies. The assembly spacing dimensions are also given in this diagram to tie up with Table 1.

A somewhat different view of the completed aerial is shown in Fig. 9. Here the drawing is processed as though the cabinet were transparent to reveal the manner in which the assemblies are

continued on page 416

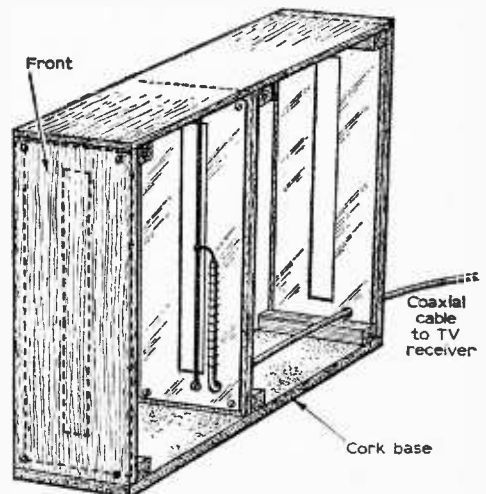


Fig. 9—The final arrangement of the finished aerial.

WHAT is the ideal length of time to be allocated to a television play? How long is a piece of string? Both questions seem at first to be equally unanswerable whether they are being considered by producers of the BBC, of ITV or of the makers of films who supply series for the expanding world of the market for staged television films.

At one time the BBC leaned towards the formidable 90-minute length with no breaks for refreshments (or advertising). The early ITV programme contractors shaped their staged production for a fixed 54 minutes time (allowing for commercials) whether the results were "live" or on film—and this was in the days before videotape was a practical proposition.

In the course of time 26 or 27 minutes was a more popular duration and has become more or less standard on ITV for "series" programmes whether home-made or imported from USA.

Dr. Finlay's Casebook

Fifty minutes' duration has been regularly achieved in *Dr. Finlay's Casebook*, for which Gerard Glaister is the producer and a number of individual directors—Bill Hays, Moyra Armstrong, Prudence Fitzgerald and Bill Slater—have made their individual contributions.

The growing popularity of this series may be partly due to hypochondriasis on the part of viewers in respect of medical subjects but more likely attributable to its high professional standard in scripting, direction, acting and technical values—all of which come under the jurisdiction of the producer. Mr. Glaister has found (with precision) the length of the piece of string and, in this case, it is neither too long nor too short.

In my personal opinion the all-round professionalism apparent in this series has seldom been surpassed so far as the story values, casting, acting and timing are concerned. The last-mentioned item—timing—is becoming of major importance and this concerns the performances of the actors, the director, the vision mixer and sound balancer which all contribute and add up to the 50 minutes'

UNDER NEATH



THE DIPOLE

duration of each highly entertaining episode. As for the technical qualities I am always surprised to see that the photographic values are so good, bearing in mind the fact that this series has been tele-recorded to 35mm film (and 16mm film) rather than being videotaped.

The Walrus and the Carpenter

Give the public what they want but leave them wanting more! is a saying of music-hall performers which dates back to Joe Miller's gag book of 1882. It still holds good in show business generally and is more than ever a maxim for television producers and directors.

The Walrus and the Carpenter, a 25-minute series, is another piece of scripting virtuosity which is made to measure and beautifully tailored by James Gilbert,

with character comedy of give-and-take by Hugh Griffiths and Felix Aylmer respectively as Mr. Luther Flannery and Mr. Gascoigne Quilt. The slight but well-balanced story-line is sustained by many well-lit close-ups of these superb actors which are videotaped each week at Television Centre in one day after off-stage rehearsals and exterior scenes are photographed on film.

This is the kind of professional staged TV production which leads the world. It was probably Granada who made the first nation-wide impression in character TV series with *Coronation Street*, a programme which seems to be a permanent fitting and fixture for family viewing after several years—and still going strongly!

Relay Stations

Over 40 years have passed by since the time when the first eight main transmitting stations of the BBC started broadcasting sound programmes with transmitters in the centres of London, Birmingham, Cardiff, Newcastle, Manchester, Glasgow, Aberdeen and Bournemouth. Their 1.5kW transmitters served limited areas around each centre so far as crystal sets were concerned, which amounted to about half the total number of licensed listeners—plus many who were unlicensed.

In the interests of other important cities unable to receive the signals satisfactorily from these transmitters 200W relay stations were set up in Sheffield, Plymouth, Edinburgh, Liverpool, Leeds, Bradford, Hull, Nottingham, Dundee, Stoke-on-Trent and Swansea.

The precedent has been followed in these days of television with BBC relay stations in centres which suffer from poor reception on u.h.f. and will multiply by the dozen in the effort to provide reasonable signals on u.h.f. of the BBC-2 programme.

These TV relay stations are sometimes called satellites, slave stations or translators, some of them of very small power and unattended; but all of them will help to serve the "shadow" areas.

The ITA is now faced in many regions with almost overpowering competition from the new BBC relay transmitters in these black spots and a start is being made with a number of similar satellite transmitters in various regions which will increase the number of homes satisfactorily served.

The ITA is following up with a few relay transmitters which will give increased viewership in the Grampian, Border, Anglia and TWW regions, the last mentioned also providing separate channels for special interests of the Welsh-speaking parts of this area. But the BBC has made by far the most progress with such relay transmitters, spurred on by the need to provide more outlets for BBC-2 in all parts of the country. ITA should follow up with more slave or satellite stations, call them what they like, for other regions.

Satire Strikes Again

Two hundred years ago satire was a regular feature in newspapers, magazines and the theatre. The theatrical political sketches of Fielding so flayed the people he did not like, by reproducing what he considered were their weaknesses, mannerisms and follies, that Sir Robert Walpole went backstage at the Little Theatre, Haymarket, and thrashed an actor with his own hands! He followed up this physical protest by piloting in Parliament the Licensing Act which put all plays under control as they are today.

Films are subject to censorship by the British Board of Film Censors, a voluntary body created by that industry, which grants "U", "A" and "X" certificates for different categories of subjects and rejects those which are considered undesirable. The rules it applied at one time were closely followed but there are now no British Standards Institution censorship specifications with which to fly a kite.

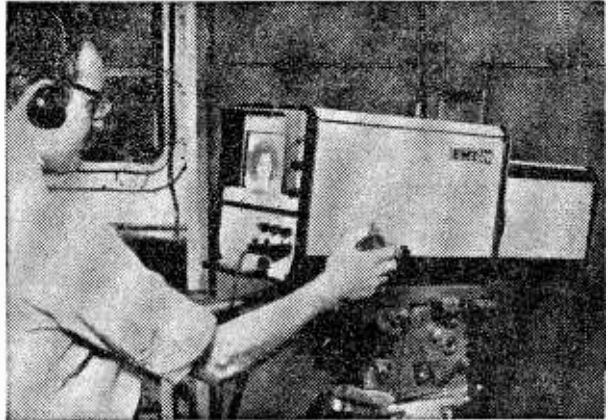
Television in Britain has no such rules and very little guidance in the standards of horror, pornography, satire and good taste which "U", "A" and "X" would convey in advance to unwary viewers. In

this respect the ITA has shown itself to have a far greater sense of responsibility than the BBC, which has continued to allow disgraceful exhibitions of bad taste and political and religious attacks in its programmes.

Years ago a film company promoted an advertising campaign for one of its films with a slogan "Come and see the man you'll love to hate!" Perhaps this is the BBC's policy, too. The executives, producers and directors behind some of these satirical programmes must take the blame and not leave the

loft complete but requiring a makeshift stage, tabs and orchestra pit for ballet and musical shows (other than concerts) and which lacked the usual grid for flying scenery and lighting. Modifications had to be made for acoustic improvements and provision of a film projection room and screen.

In this electronic age it is surprising that no provision was made for built-in facilities for television cameras and associated sound outlets in any of the civic theatres. I would have thought that, even if the installation of



Here is a new all-transistor TV camera made by EMI Electronics Ltd. Weighing only 40 lb., the camera uses a "Plumbicon" pick-up tube and incorporates an electronic viewfinder which can be seen in this photograph.

actors and participants to take the thrashing they all of them deserve which would have been so soundly administered by Sir Robert Walpole!

Civic Theatres

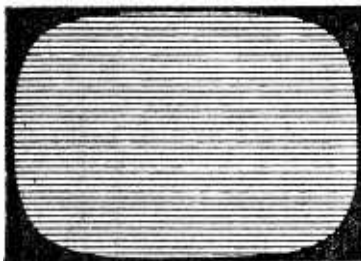
The recent conference on civic theatres organised by the Association of Municipal Corporations revealed differences of opinion by artistic and technical experts. The all-purpose auditorium suitable for straight plays, musicals, dances and bingo—favoured by some corporations—is not proving very satisfactory.

Theatre-in-the-round and the abandonment of the proscenium was admitted by others to be less successful than had been hoped. London's Festival Hall was quoted as an example of a well-designed concert hall with organ

electronic aids was not carried out when such theatres were built during the past five or six years, it would have been comparatively simple to plan cable ducts and space for control rooms, etc., when they were initially constructed.

The theatres of the future, in my opinion, should be designed for the future—including facilities suitable for all the wonderful electronic devices necessary for shows for television, filming or the public performances with raked floors for stall seats, orchestra lifts to convert proscenium stages into apron stages, built-in electrical stage revolvers and modern dimmer controlled lighting.

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Servicing TELEVISION Receivers

No. 114: Ekco T381, TC383 and Ferranti T1058 series

by L. Lawry-Johns

A LARGE number of receivers in the Ekco, Ferranti and Dynatron range have similar features and the notes here given may be applied to a goodly number of these, using a little prudence as component values may differ from those given in our diagrams.

The actual models dealt with have facilities for f.m. radio reception and have 19 inch tubes and a hinged chassis. Most service work can be carried out by loosening the two screws marked "A" in the upper supports.

The chassis then hinges down allowing both sides to be worked on. Quite apart from this the left side panel can be swung open when screw "B" is released.

point is in the 11 o'clock position. Then insert a slender blade between the cabinet and the top of the knob to depress a spring loaded key fully. The knob can then be pulled off.

Conversely, when replacing, depress the key and push the knob on to the spindle, slightly rotating until the key clicks into the spindle groove.

Complete Chassis Removal

Remove the channel selector as above then lay the cabinet face downward. Unscrew the feet on table models or legs of the console version. In the table model the feet brackets are secured by four self tapping screws, two at the front, two at

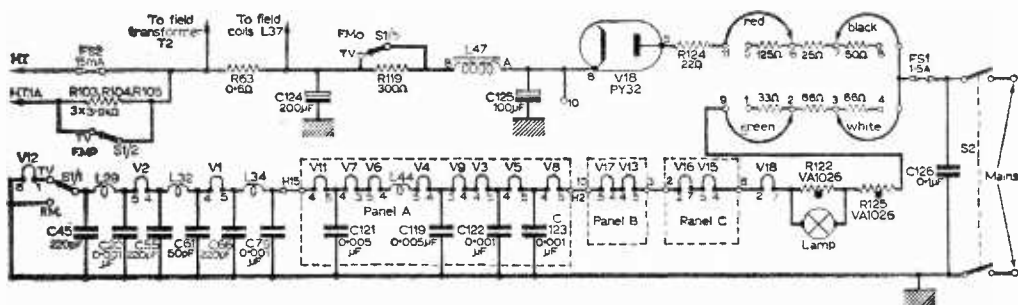


Fig. 1: Power supply and heater chain arrangement.

The removal of the front window is also a simple matter. Using a small screwdriver, prise out the styling strips above and below the screen to expose the four 4BA screws. Remove these when the window and front surround can be withdrawn.

Most readers seem to have found the above out for themselves but become rather frustrated when attempting to remove the channel selector knob. It cannot be directly pulled off and there is no grub screw or clip.

The knob should be rotated so that the u.h.f.

the rear. When these are removed, the whole assembly, base cover and cover rail can be lifted off.

The console has two 2BA screws at the front and one at the rear. Remove the two wing nuts securing the control panel to the front of the cabinet, it is then free to be withdrawn with the chassis.

Remove the four bottom screws and one through a bracket at the top centre of the chassis. Unclip the loudspeaker leads. The chassis can then be lifted clear of the cabinet.

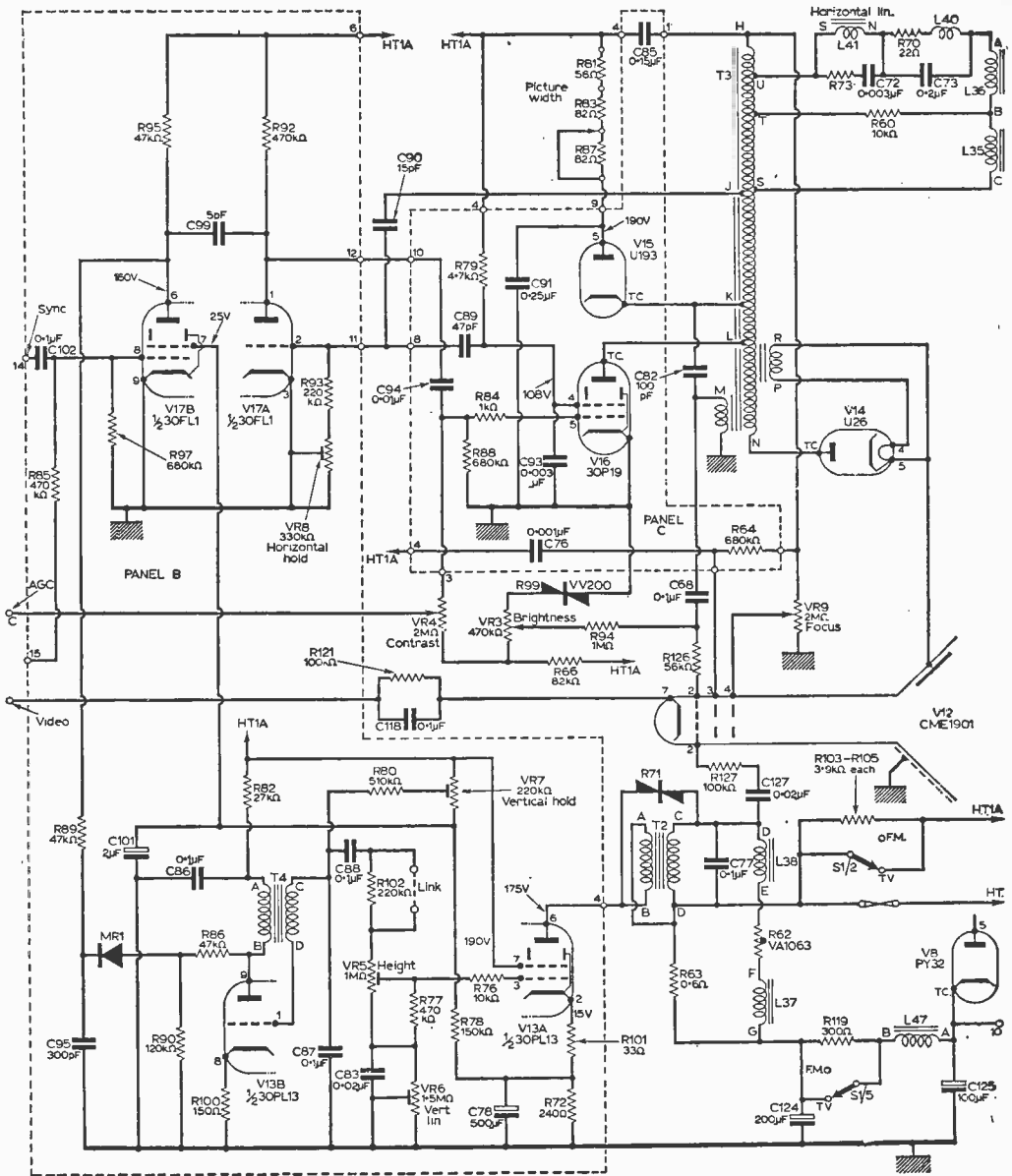


Fig. 2: The timebase and c.r.t. circuits.

Changing the Tube

With the chassis removed as above, arrange a soft clean surface and lay face downward, ensuring that there is nothing on the surface which can scratch the front of the tube.

Remove the tube base socket, slacken the screw securing the magnet and deflection assembly to the tube neck. Take off the parts separately noting the order and position as they come off.

Remove the extrusion from under the deflection coils. Remove the e.h.t. clip from the side of the tube and loosen off the bolts at each side of the front assembly. The chassis, deflection coils and cradle is then lifted off leaving the tube on its own.

When reassembling, there are several points to watch. The plastic strip must be properly fitted under the front strap and the spring clip must

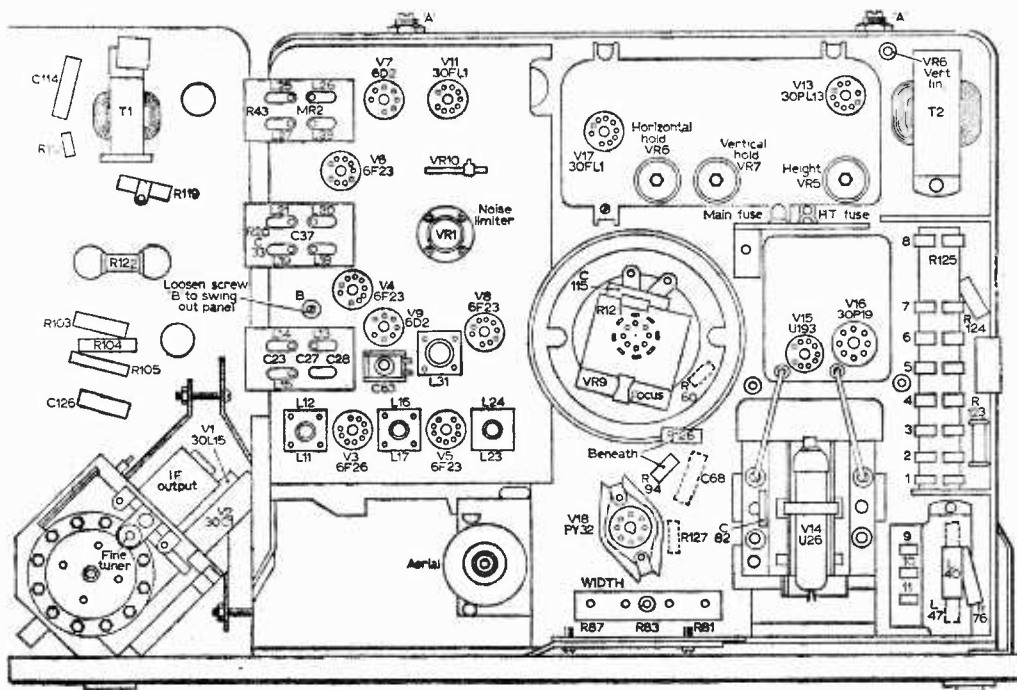


Fig. 3: A rear view of the Ferranti T1058 chassis, showing the layout of the major components.

make good contact with the outer conductive surface of the tube.

The thin wedge is used to centre the coils correctly on the tube neck. The coils must be snug up to the flare of the tube and the magnet assembly should be pushed well up to the coils before clamping.

The pegs on the assembly must correctly locate in the grooves in the deflection assembly and the P.V.C. strip must be fitted under the clamp. The whole assembly should rotate when the clamp screw is loose so that the picture can be straightened in the mask during final testing.

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INDOOR SLOT AERIAL —continued from page 411

fitted inside. Note the way in which the feeder from the aerial assembly is fed out through the rear reflector assembly.

It will be seen that the front and rear of the cabinet are, in fact, formed by the director and reflector assemblies themselves. The cabinet proper can be painted, stained, veneered or polished or covered with one of the p.v.c. colourful materials so as to give it an attractive appearance when stood on top or near the television set.

The front and rear slot assemblies can also be covered with a plastic or cloth fabric, while the bottom can be covered with a thin layer of cork to prevent the aerial sliding upon or scratching a polished surface, such as the top of a television set cabinet.

Table Lamp as well

The exact overall dimensions of the aerial will depend on the channel number and on the kind of

wood used for the cabinet. But they should not be much greater than 15in. high by 6in. wide and 8in. deep. This is quite a useful size, and as a final touch a bulbholder and lampshade can be fitted to the top of the cabinet so as to serve the dual functions of aerial and television viewing lamp. Should this idea be taken up care should be taken to avoid the mains flex from falling in front of the slots.

It has not been possible to perform precise measurements of gain and directivity on the aerial, as these are extremely difficult to undertake at u.h.f. Nevertheless, there is no reason why the aerial should not have a performance comparable to the best set-top u.h.f. aerial and of possible greater directivity, which can be a blessing on BBC-2 in some locations for getting rid of ghosts. The aerial is novel and presents scope for experiment.

The author is currently engaged in working on other designs for u.h.f. aerials, including an integrated slot/amplifier design, details of which it is hoped to publish from time to time in these pages.

The CATHODE RAY TUBE and its CIRCUITS

by J. McCarthy

THIS article sets out to describe the many uses to which the cathode ray tube is utilised in present-day circuitry. The main classifications of use are in television receivers and oscilloscopes. Circuits of oscilloscopes will be described, and deviations from this will be added afterwards.

The Cathode Ray Tube

Forgetting the focus and deflection units, the c.r.t. may be regarded as an ordinary triode valve with slight modifications. A diagram of a typical electrode structure is given in Fig. 1. The main differences are in the anode and in the grid. In a valve, the grid consists of a fine wire mesh which

surrounds the cathode—in a c.r.t., the grid is a cylinder, with a small hole at the end, surrounding the cathode. The anode in a c.r.t. can be of one or two forms—the screen itself may be the anode, or the anode may be of similar form to the grid. In this case, the electron beam overshoots the anode and strikes the screen.

Now for the deflection units: As is well known, an electron beam has a negative charge. It will therefore be repelled by a negative plate, and attracted by a positive plate (similar poles repel, dissimilar poles attract). Two pairs of plates are disposed around the electron beam, and by these the electron beam can be deflected. See Fig. 2. In television tubes, electromagnet deflection is usually employed. The disposition of the coils is roughly as shown in Fig. 3. Coil (a) for example, produces a magnetic field, coil (c), in series with it, is wound so as to produce an opposing field. One of these fields will attract the beam, whilst the other will repel it. The coils (b) and (d) similarly.

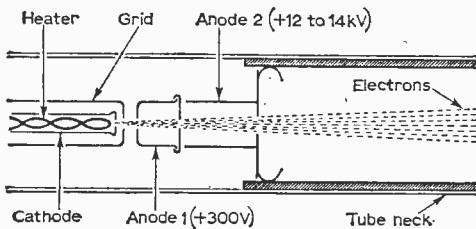


Fig. 1—The electron gun assembly of a tetrode picture tube

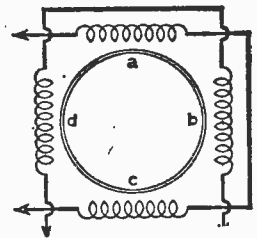
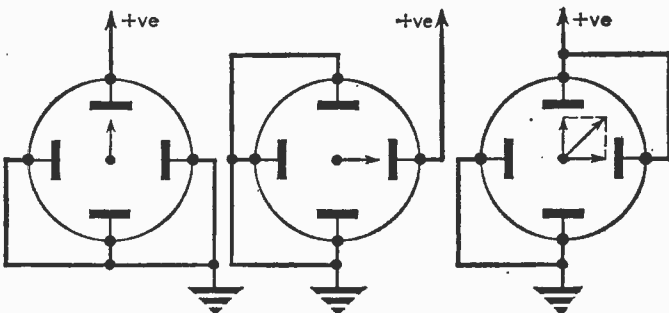


Fig. 3—The way in which the four coils are mounted round the tube neck.

Fig. 2—These diagrams serve to indicate the effect on an electron beam of positively and negatively charged deflection plates.

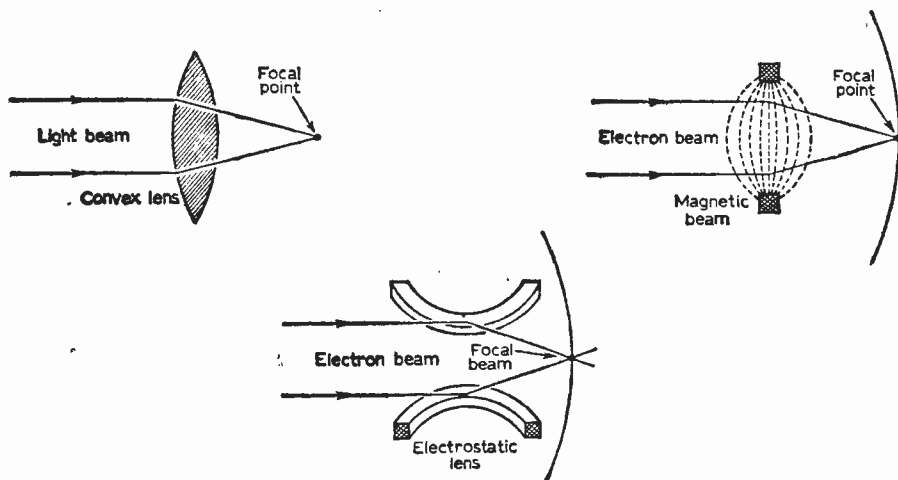


Fig. 4—Here the action of a convex lens on a light beam is illustrated. Next it is shown how electrostatic 'lens' have a similar effect on an electron beam, and also how the same result is achieved with a permanent magnet.

Next, the focus arrangements — a hollow cylinder, usually at about a quarter of the anode potential w.r.t. cathode, is situated around the electron beam between the anode and the grid. There is now a potential difference between the focus electrode and the anode. Electrostatic lines of force are thus developed between them. These lines of force act in a very similar way to an optical lens, and are in fact sometimes called an electron lens. Fig. 4 gives the action of a convex lens on a light beam, and the action of an equivalent electron lens on an electron beam. Sometimes a permanent ring-magnet is used for focussing—this has a similar effect, using magnetic lines of force as the lens; this is also shown in Fig. 4.

The Screen

The last item of importance is the fluorescent screen. Certain chemicals glow when struck by electrons. This property is known as fluorescence. The characteristic green glow of an oscilloscope is produced by zinc sulphide in combination with a copper activator (the activator is the substance which produces the colouration). Blue, for photo-

graphic purposes, is produced by zinc sulphide and silver, whilst a yellow colour is caused by a combination of zinc sulphide, cadmium, and copper. The white coloured screen used in television tubes is produced by a combination of the yellow and blue fluorescent substances.

The after-glow is produced by a phosphorescent substance—a substance which gives out light after it has been struck by light. Usually the after-glow is the same colour as the initial glow, although a few c.r.t.'s are made with a blue initial glow, and a yellow after-glow. There is a third screen "parameter"—the length of the after-glow. These are vaguely classified as short, medium and long, the last of which may be of several minutes duration. There are five combinations of glow, after-glow and persistence for c.r.t.'s manufactured in the U.K. These are given in Table I.

TABLE I

Glow	After-glow	Persistence	Uses
Green	Green	Medium	Oscillography
Blue	Blue	Medium	Photography
Yellow	Yellow	Long	—
Blue	Yellow	Very Long	—
Red	Red	Very Long	Radar
White	White	Very Short	Television

Extra High Tension Supply (E.H.T.)

To produce a bright glow on a tube's screen it is necessary to produce a high beam velocity which in turn requires a high potential between anode and cathode. Oscilloscopes require voltage normally below 2000V whereas TV tubes often require voltages in excess of 4000V.

The e.h.t. supply of an oscilloscope is very different to that of a TV—the e.h.t. supply

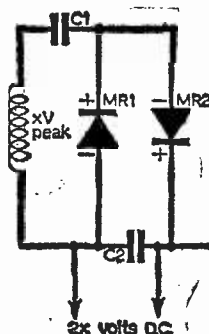


Fig. 5—This is a voltage doubler circuit which could be used to supply e.h.t. for an oscilloscope.

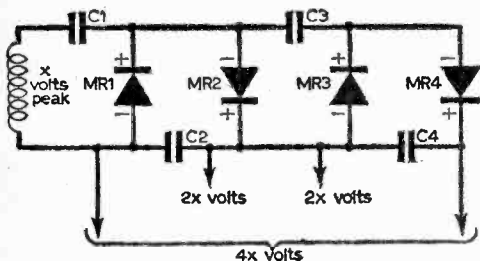


Fig. 6—A voltage quadrupler—a development of the voltage doubler circuit of Fig. 5.

of an oscilloscope is usually produced by rectifying the voltage generated by a transformer connected to the mains supply. For rectification, a single diode, or a voltage multiplier circuit is used. The former is well-known, but the operation of latter circuits may be a little mystifying. A voltage doubler is shown in Fig. 5, the operation of which is as follows:

Assume MR1 is conducting, C1 charges up to the peak value of the a.c. voltage applied. When MR2 conducts, the flow of current through C1 is reversed and it discharges. The voltage across C2 is now equal to the voltage across C1 plus the peak voltage supplied by the transformer which is almost equal to twice the peak input voltage—clearly the voltage has been doubled.

If an identical circuit comprising C3, C4, MR3 and MR4 (Fig. 6) are connected in parallel with the first circuit, and its output applied in series to the output of the first circuit, a voltage almost equal to four times the peak input voltage is generated. This process of adding circuits can be extended as many times as is necessary.

In TV circuits, a different means is used. The line time-base oscillator, which will be described shortly, is used to provide a high a.c. voltage by using an auto-transformer. The output from this is rectified, usually by a valve, and is applied to the c.r.t. The advantage of this system is mainly the smoothing required; with a ripple of 50 c/s, a greater value reservoir capacitor is required than when a ripple at the high frequency of the line oscillator is present—and at several kV, a large capacitor is massive! In practice, a valve of about 0.001 μ F is all that is required. The basic diagram of a typical TV e.h.t. circuit is given in Fig. 7.

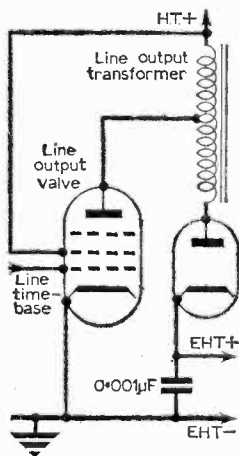


Fig. 7—A typical e.h.t. circuit for a TV receiver.

TO BE CONTINUED

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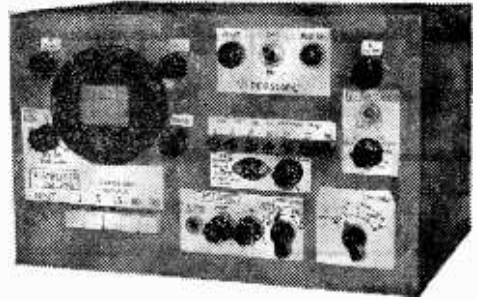
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VIDEOSCOPE

MODIFICATIONS

Improvements to this
P.T. oscilloscope design



by
**Martin L.
Michaelis, M.A.**

CONTINUED FROM PAGE 376 OF THE MAY ISSUE

EXPERIMENTS showed that the question of incorporating a flyback blanking amplifier according to Fig. 2 (page 373 last month) is a borderline case for the DG7-32/01. Using the original "straight-through" blanking circuit without an amplifier, as published for the VCR139A, blanking action was equally satisfactory with the DG7/32/01 up to the levels of trace brightness previously also obtainable with the VCR139A.

If the brilliance is then turned up to the much higher levels which the DG7-32/01 is capable of, the flyback re-appears and blanking is therewith incomplete.

The more advanced amplifier circuit of Fig. 5, for which a detailed layout diagram is given in Fig. 6, was the result of efforts to devise further functions which such an amplifier could also assume within the *Videoscope*, to justify its inclusion more definitely. An oscilloscope is immediately rendered more useful if a third parameter can be displayed in the form of beam intensity modulation at the control grid, in addition to the X and Y deflection signals.

Flyback blanking is one form of beam intensity modulation, and thus it seemed reasonable to undertake experiments to make the amplifier of more general application while also catering for optimum flyback blanking during normal oscilloscope work.

The design of Fig. 5 was developed with due regard to the principal requirements for intensity modulation in a general-purpose TV oscilloscope. These are largely twofold. Firstly, when using the oscilloscope in conjunction with a wobulator for TV receiver alignment, it is useful to inject frequency markers by way of intensity modulation.

Secondly, intensity modulation is required to display a TV picture in the conventional manner. The latter function dictated the design bandwidth of about 1Mc/s for the amplifier of Fig. 5 (this is sufficient for obtaining a clear TV picture on such a small screen).

Design Principles

For general applications an input socket for an external intensity modulation signal and a suitable gain control (VR9 and SK12) were provided on the front panel. These had to be at very low impedance, to permit connection to the amplifier sub-chassis via screened cable. Twin screened cable is better than two separate screened cables, since the self

capacitance between the two cores then acts in a frequency-response correcting sense.

The transistor Tr1 is the simplest and most convenient matching device. It operates as emitter follower, transforming the high-impedance flyback blanking pulses arriving from the junction of R51/R52/D5 (main chassis) to the required low impedance level. These low-impedance pulses may be taken off at SK12 if required, this constituting a most useful output signal of the *Videoscope*.

The output is an asymmetrical square wave at SK12 whose negative part coincides with each timebase flyback and whose positive part coincides with each timebase run. Apart from uses as a general-purpose audio pulse signal generator, this output can be used to trigger or slave-drive all manner of ancillary units such as double-beam switches, wobulators, etc.

The low-impedance flyback pulses from Tr1 are also applied across the track of VR9 and any desired portion of their amplitude can be taken off at the slider and applied to the actual intensity modulation amplifier V10 which is basically similar to Fig. 2. The flyback blanking can therefore be set to optimum with VR9 at all times.

Correct procedure is to turn VR9 to zero, set desired trace brilliance and lock the waveform being observed, and then to advance VR9 until the flyback trace has just disappeared. Since D8 (Fig. 3) restores the d.c. component of the amplified blanking waveform such that the positive level is clamped to the potential at the slider of the brilliance control VR8, the intensity modulation control VR9 has no effect whatsoever upon the brilliance of the timebase trace, influencing the flyback alone.

Two stages of amplification are used in Fig. 2 and in V10 of Fig. 5 in order to preserve the same output polarity as required. In Fig. 5 the first stage of V10 operates at insignificant gain (anode and

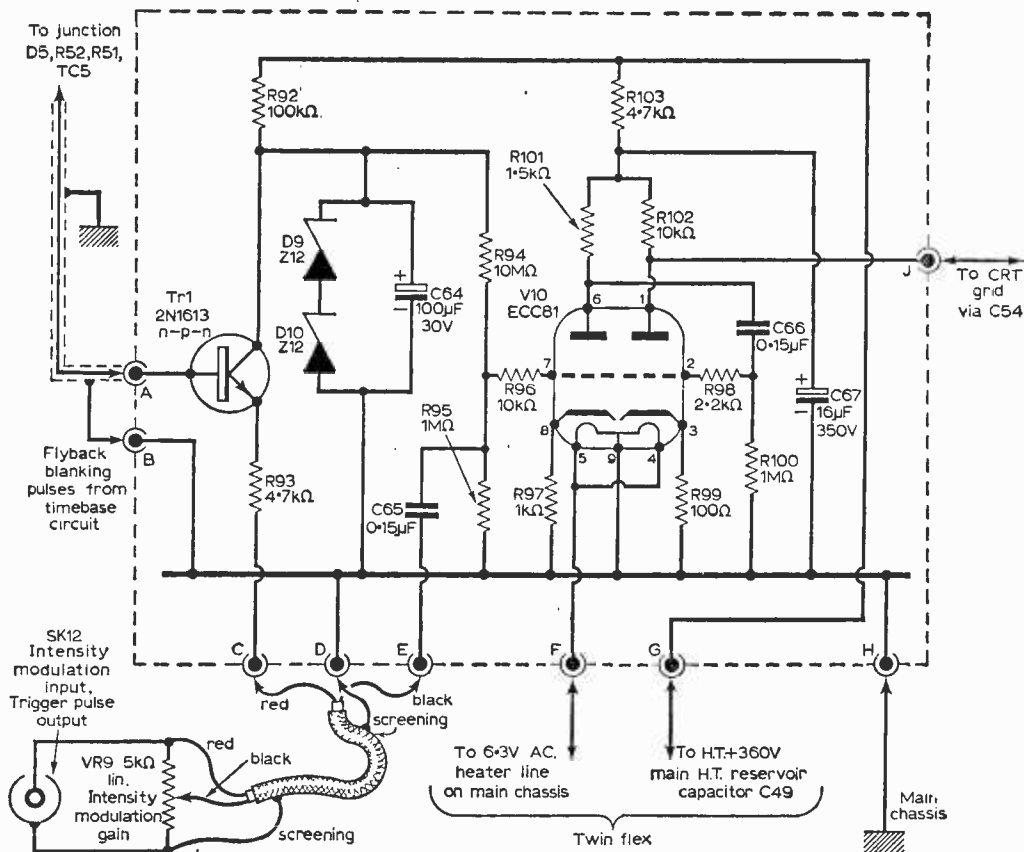


Fig. 5—An advanced flyback blanking amplifier with manual control of blanking, level, also suitable for general purpose intensity modulation (third signal display parameter) and video amplification for TV picture display on the Videoscope.

cathode loads about equal), to avoid loss of bandwidth at the relatively higher impedance grid pin 7 due to the Miller effect (R96, 10kΩ, required to prevent parasitics on video transients).

The net impedance at grid (pin 2) of the second stage is much lower, so that the Miller effect due to the higher anode load and higher gain is here insignificant and bandwidth is maintained.

The value of R101 should be selected such that a standard 1V video signal applied to SK12 will just modulate the c.r.t. grid fully when VR9 is turned about two-thirds up. R93 should thereafter be selected such that flyback blanking is just complete at the highest trace brilliance setting usable when VR9 is turned fully up and nothing is connected to SK12. The component values shown in Fig. 5 satisfied these conditions in the prototype.

D9 and D10 are two small 12V Zener diodes to establish the positive collector voltage of 24V for Tr1 (n-p-n transistor). R92 and C64 give the necessary voltage drop from the h.t. line and the essential very high degree of smoothing, since the same derived 24V supply is used to set the operating point at V10 grid pin 7 via R94.

Both stages of V10 operate strictly linear in Class A, but Tr1 operates in Class B, being cut-off in the absence of a base signal (during flybacks) and keyed-on during the timebase runs (positive output pulse for duration of timebase run at SK12).

Any other small silicon n-p-n transistor (not germanium and not p-n-p type!) with a voltage rating of 30V or more and a current gain of at least thirty may be substituted for Tr1, regardless of make.

Television Picture Display

The following remarks apply to the display of a television picture on the Videoscope fitted with a DG7-32/01 tube, picked up by any CCTV-camera operating with an EMI 10667 vidicon tube (or direct equivalent), which is the most common camera tube at present to be found in amateur CCTV equipment.

The Videoscope fitted with a DG7-32/01 operating in the circuit of Fig. 3 and fitted with the intensity modulation amplifier shown in Fig. 5 is eminently suitable for displaying a small TV picture from such cameras for setting-up purposes and "viewfinding", in addition to normal oscillo-

scope work on the CCTV equipment. The connections for TV picture display under these conditions are as follows:—

- 1 Connect the *Videoscope* "Y-amplifier" input in parallel with the vidicon field scan coil, without using the probe. Depress the "25 V/cm" coarse gain key, when correct frame amplitude will be found about midway on the fine control of Y-amplifier gain.
- 2 Connect the *Videoscope* "External-Sync" input in parallel with the vidicon line scan coil, switch X-function switch to "external sync" and set timebase coarse speed to fastest range. Correct line lock for both 405 and 605 lines will then come within the fine control range.
- 3 Connect the video monitor output signal (standard 1V pp positive video signal) from the CCTV camera to the new intensity modulation input socket SK12 on the *Videoscope* and advance the gain control VR9 as required.

Picture quality is surprisingly good, considering the circumstances. Individual scale divisions on a 2in. moving coil meter televised via the vidicon camera in this manner were clearly visible and the pointer reading could be read-off accurately. Line lock was extremely secure even when the sync level control was advanced only about quarter-track.

Neither 405 nor 625 lines can be resolved individually, so that the image is continuous without line structure. The general appearance is that of the type of snapshot customary from the cheaper type of box-camera and thus is fully adequate for setting-up and viewfinding.

Variations of Procedure

If the cable from the vidicon field scan coil is unplugged from the Y amplifier and the video cable is transferred from the intensity modulation input to the Y-amplifier input, the display on the c.r.t. screen immediately reverts to the normal line-video oscillogram without changing the settings of any controls.

It is thus possible to change back and forth in a couple of seconds between the two most important CCTV monitoring settings of picture display on the one hand and line-video oscillogram on the other hand. The resolution of the latter is excellent with the DG7-32/01.

With the same 2in. moving coil meter being televised, movement of the thin pointer was seen as a sharp pulse riding across the video oscillogram and with a little practice it was possible to "read-off the pointer indication" with reasonable accuracy that way too!

The video oscillogram is most useful in studying correct adjustment of beam and target controls for the vidicon, particularly in relation to illumination and required lens-stop. It also permits correct adjustment of sync to vision ratio. All these adjustments are less clear on a picture display, which then serves the principal purpose of "view-finding" once the camera controls are set correctly.

A second variation of procedure is dictated when a picture display is desired under conditions of high ambient illumination. The cable from the vidicon line scan coil can be unplugged from the "external sync" input of the *Videoscope* and

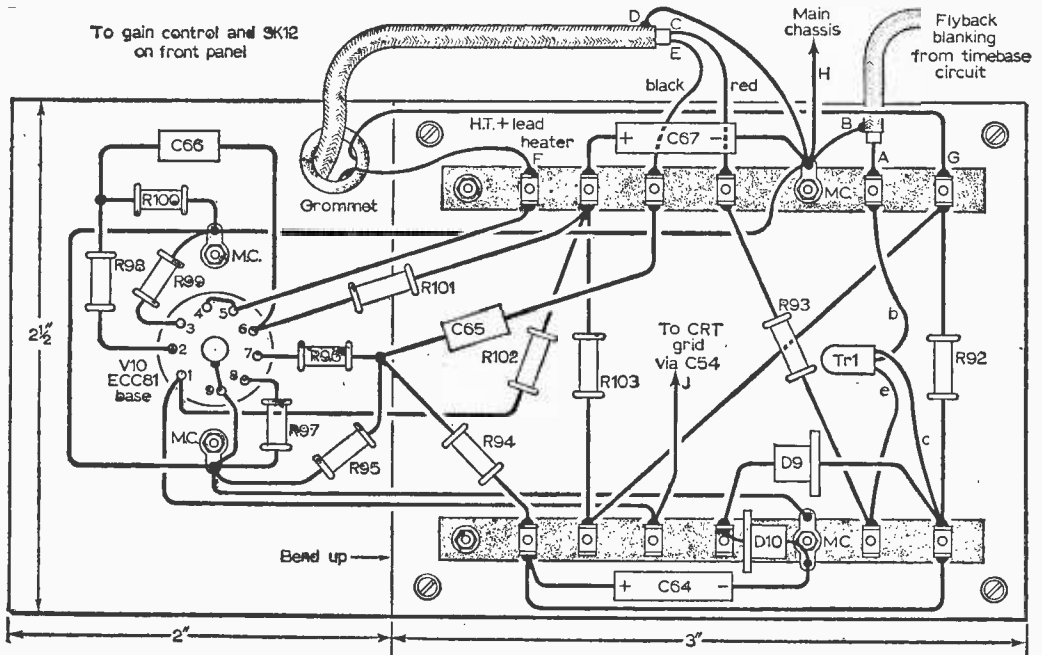


Fig. 6—Constructional details for advanced flyback blanking and intensity modulation amplifier. This sub-assembly may conveniently be screwed to the base of the cabinet at the centre rear of the main chassis.

plugged into the "external X signal" input, switching the X-function over to mute the *Videoscope* timebase and operate the X-amplifier off an external signal.

The line scan signal for the vidicon is almost a pure square wave with a tiny sawtooth component. The latter is amplified-up by the *Videoscope* X-amplifier to give a small line scan on the DG7-32/01, the entire picture then being pushed to the right on account of the large squarewave component. The latter can be cancelled with the X-shift control. After suitable reduction of the Y-gain, any desired degree of reduction of picture size can be achieved by suitable setting of X-gain, with corresponding increase of brightness. In this manner an intensely brilliant picture about half an inch in diameter can be produced with sufficient clarity for general "viewfinding" in aiming the CCTV camera in a strongly lit room.

It is not possible to increase the picture diagonal above about three-quarters of an inch in this arrangement, since line scan becomes grossly non-linear thereafter due to overloading of the X-amplifier on account of the large squarewave component of the vidicon line scan waveform. but the whole point of this setting is to get unlimitedly *small* pictures for conditions of high ambient illumination.

If the maximum picture size (2in. diagonal) is required, the first setting described, with the vidicon line scan merely used to synchronise the internal timebase is essential. Linearity of both line and field is then excellent.

Black Level

The reference level of a television video waveform is given by the sync pulses, so that correct black level clamping is ideally given by a positive d.c. restorer diode. This is exactly the opposite requirement to flyback blanking at the grid of the

c.r.t. during oscilloscope display, which needs a negative d.c. restorer (D8, Fig. 3).

If D8 in Fig. 3 is reversed, to constitute the positive d.c. restorer for TV picture display, the functions of brilliance and flyback blanking controls become strange and unwieldy during oscilloscopy. The brilliance control then has to be set to a threshold value and actual trace brilliance adjusted with the blanking control, which is most confusing.

Thus it is essential to maintain the polarity of D8 as shown in Fig. 3, since only then do brilliance and blanking controls operate correctly and independently during oscilloscopy. If D8 were to be omitted altogether, the settings of brilliance and blanking would both no longer be independent of timebase speed.

D8 *must* therefore be of incorrect polarity for TV picture black level clamping and consequently clamps the picture highlights, at whatever level they may lie, to the brilliance level selected at the slider of the brilliance control VR8. Thus the picture gets weaker and brighter as VR9 is backed off, instead of weaker and darker as is more familiar with normal TV receivers when contrast is reduced.

However, this is not confusing and therefore is not considered as being a disadvantage. After all, oscilloscopy is the primary function of the *Videoscope* and not high-quality TV picture display. Indeed, settings of the brilliance and intensity modulation controls were found with both polarities of D8 giving identical picture display qualities.

Other Oscilloscopes

There is in principle no objection to using a circuit such as the one shown in Fig. 5 for TV picture display on any other suitable oscilloscope. The only requirements are sufficient beam intensity without undue loss of focus and accessibility of the c.r.t. grid. The facilities of external sync input for the built-in timebase and a Y-amplifier will be found on all oscilloscopes. ■



(From "Practical Television", June '35)

AT this point in time the title of the magazine is changed to *Practical Television and Short-Wave Review* to cater for the growing interest in short-wave listening. Among the special articles are notes on bandspreading, description of a three-valve short-wave superhet, a list of s.w. broadcasting stations and a page of short-wave notes, one of which suggests that it is quite fun to identify motor-cars by the noise their ignition systems make on receivers!

High-definition TV gets closer (240-line transmissions are anticipated from the BBC five months hence). The site—Alexandra Palace—is announced. The Government grant to the BBC is increased to

just over £2,000,000, of which the princely sum of £50,000 is intended for television. We also hear that the BBC has blessed the word "televiever" as opposed to "looker" and other hideous suggestions like "scanner" and "gazer"!

On the Continent the German high-definition service has been operative for "several weeks" on an experimental basis. A television room is opened in the Berlin main post office and a nation-wide system of 25 stations is planned. Mid-July is mentioned as a possible time for opening the French TV service. Even so, a P.T. issue runs an article on how to adapt a 30-line receiver to pick up the French 60-line transmissions on 175m—DX-TV is born!

In the USA the RCA company agrees to spend £200,000 "to establish television on a firm commercial basis". New stations are planned to supplement the experimental transmitter which had been running for several years in New York.

Back home we learn that at the Olympia Radio Exhibition television will be shown by the Radio Manufacturers' Association but not by individual manufacturers. A suggestion for a separate Television Exhibition was mooted. The imminence of public TV has had no effect on the sales of radio receivers.



LETTERS TO THE EDITOR

INDIVIDUAL RELAY SYSTEMS FOR LOW SIGNAL AREAS

SIR,—I have read with great interest articles on microvolt amplification and coaxial relay systems which have been published in *PRACTICAL TELEVISION* from time to time.

These posed for me the question "what can the layman do to improve his reception in fringe and badly screened areas?"

I have just completed a personal coaxial relay system, at low cost, with almost perfect results at a distance of 75 miles from the transmitter at Kirk O' Shotts in Central Scotland, a few details of which may be of some practical help to other readers.

My idea was sparked off by Mr. Gordon King's articles on signal/noise ratios and I calculated that I could manage a run of some 400 yards with low-loss cable before I lost all the gain from my amplifier. I did, in fact, go 330 yards and I am pleased to say that the result is near perfection.

The cost has not been excessive for the good results obtained. The amplifier cost around £11 with the power pack, and the cable bought in bulk can be had at reasonable costs, the whole installation costing well under £20.

I may add that if the potential "relay" project is in doubt owing to lack of knowledge as to where a signal would be likely to be available, it would be a good investment to hire, beg or borrow the use of a signal meter. In my case, however, this was not necessary as I knew that a neighbour just over the ridge received a perfect picture.—A. W. GRAHAM (Lochgilphhead, Argyll).

COLOUR CONVERTOR

SIR,—I would like to tell you about my Colour Convertor, the plans of which cost about \$2 from the USA.

It is a ten valve unit with motor-driven colour wheel and only five wires to the TV set; they are (1) earth, (2) frame pulse, (3) line pulse, (4) chroma (at the crystal detector), (5) colour out (to c.r.t. grid). The unit picks out the chroma from the BBC 625 colour, it is amplified and detected, the burst triggers a crystal, the colour is switched by a three-valve gate and fed to the c.r.t. as a field sequential system.

I have been using the convertor since last summer and I am able to say that the results are better than my shadow mark c.r.t. The only thing against it is the size of the wheel, which is twice the diameter of the c.r.t.—R. I. BLANEY (Billericay, Essex).

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.

The Editor does not necessarily agree with the opinions expressed by his correspondents.

SLAP HAPPY

SIR,—I have a Pam 808 television receiver, and the only picture I could get was too harsh and too bright. Any movement of the brightness or contrast controls immediately resulted in the picture being replaced with a wicker basket effect.

I could not trace the cause of this fault so I gave the set a really heavy slap which seems to have cleared up all the trouble.—R. B. MONET (Thorn-ton Heath, Surrey).

Vision channel instability would cause the wicker basket effect. A poor soldered connection, a valve not seating properly or an intermittent-contact screen in the i.f. channel could be responsible. Such trouble may clear temporarily on subjecting the set to sharp vibration.—Editor.

MAINS DROPPER SECTIONS

SIR,—Re Mr. Icely's letter published in the March issue of *Practical Television* on mains dropper sections from Radiospares. These are very good but I would like to point out that Radiospares will at present only supply to the trade and it is not all that easy to obtain sections to the value one may require. I have had the experience of using four units to make up a given value but there are two points here to consider—space and price. Four at 2s. 6d. each when one of the proper value would cost only 2s. 6d.—H. WILDASH (Manchester 22).

TEST CASE AND PROBLEMS

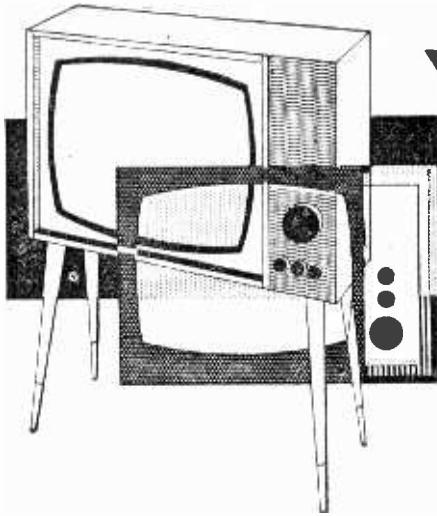
SIR,—Contrary to Mr. Palmer (Letters to the Editor, March, 1965) I do criticise the "Test Case" and "Problems Solved" features.

Articles like these obviously encourage the "layman" to tamper with his receiver to try and save a few shillings (which is nearly always a false economy).

I would urge you to spare a thought for the engineer who has to sort out the mess which so often results.—A. J. LITTLEWOOD (Coventry).

COLOUR INSTEAD?

SIR,—When colour television is so far advanced in the U.S.A. and Japan why does Great Britain still lag behind? In the early days of television we were in the forefront of development, but we have gradually dropped behind. I think that instead of 625 lines, many people who are not really struck with BBC-2 would prefer to see colour TV developed.—R. SMITH (Winchmore Hill, Middlesex).



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 428 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

RGD T600

I have renewed the line output transformer on this set after losing the picture, and hearing no whistle or drawing any spark from it. After renewing the transformer I obtained a whistle but not very clear, so I renewed PY81, PL81, PCF80 line osc. EB91 and had the PY32 tested, but the fault still persisted.—E. Cossey (Dagenham, Essex).

We suggest that you check the 0.1 μ F boost line capacitor, C49.

Ensure that the EY51 is not shorted internally. Check h.t. and 100 μ F electrolytic (reservoir) if low.

PHILCO

This receiver has the picture collapsed to a quarter-inch horizontal line. The sound is perfect most of the time, but occasionally it comes on very loud. The valves have been checked by substitution without results.—D. Hockman (S. Croydon).

The trouble lies in the frame output stage, and if the PCL82 output valve is in order, you should check the scancoils and output transformer. If a meter is available this is no problem, and you can test the scancoils for continuity (and for low resistance continuity) by disconnecting at the 5-way connector.

The secondary of the transformer can be tested in the same way. The primary is easily tested by noting whether there is a voltage at the anode of the pentode section of the PCL82. Screen grid voltage should also be checked.

If neither is present, look for the 6.8k Ω resistor that provides h.t. to the frame stages. This component lies between the PCL92 base and the connector plug base. One end goes to the fifth tag from the rear of the central tag strip, the other to the electrolytic capacitor nearby. This could have burned out, and is quite a common fault.

ALBA T324

There is a blank space of about 1in. at the top of the picture, and if the height control is altered, the test card picture goes the shape of a pear.

I have changed by substitution PCF80 sync separator, frame output ECC83 and frame time-base ECC83; also resistors from the height control, but this has made no difference.—N. Covell (Morecambe, Lancashire).

The frame output valve of this receiver is a PL82, situated near the front of the chassis, and this should first be changed for the fault you describe.

A lack of scan at the top of the picture indicates that the feedback circuit is incorrect—this is if the raster is correctly set. The fault is most unusual. You should check the 0.02 μ F capacitor in series with the vertical form preset.

BUSH T36C

When first switched on, this set produces a good picture on BBC, but after a few minutes the picture fades and diagonal white lines appear. The picture then alternates from good to bad at regular intervals.

When switched to ITV, the picture is much weaker with a dark border, the diagonal lines appear and there is continual "flashing".—D. W. Harrison (Whitley Bay, Northumberland).

The symptoms indicate a loss of signal, which may be due to a PCC84 valve losing emission. Under these circumstances, the raster would still be controllable by the brilliance control, and fairly bright when turned up fully.

Alternatively, if the border at the sides is also evident, if to a smaller extent, on band 1, the h.t. may be low. As this happens when hot, suspect either or both of the PY82 rectifiers.

If the brilliance control will not darken the raster sufficiently, you may have a faulty MW43-69 tube.

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AW59-90		CRM173		C17AF	C21SM	SE14/70		7405A	
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AW53-88		CRM212		C17FM	C23-7A			7501A	
AW53-80		CME141		C17GM	C23-7A			7502A	
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PYE V14

There are a number of faults on this set. The picture folds up at the bottom although the width is OK. Sometimes the picture rolls and it takes a long time to get adjusted, and when the channels are changed, after a good picture on one station, the set has to be switched off for a short time in order to get a picture on the other station.—H. J. Bunn (Wednesbury, Staffordshire).

The faults you describe all appear to be of different origin. Picture folding is normally due to a defective PL82 frame output valve, and picture rolling to slow heating ECC82 just in front of the PL82. Your other symptoms suggest trouble in the line oscillator circuit, which is associated with the ECL80 valve just behind the black box.

FERGUSON 146T

There is a very bright one-inch line right across the centre of the screen. Volume is not affected.—W. Avery (Dartford, Kent).

The only part of the circuit which requires attention is the field (frame) timebase. Check the right side ECL80 and the PCF80 on the rear left centre. Check associated voltages if necessary.

PHILIPS 1768U

Increase the brightness control above a certain minimum and the line hold fails. Decrease brightness and the line hold is all right: this is without any adjustment to the line hold control.

I have replaced several valves but still the fault persists.—J F Grindley (Oswestry, Shropshire).

Check the 2.7k Ω screen feed resistor of the PL36, and the 1M Ω anode load of the triode section of the ECL80 line oscillator.

It is possible that some boost loss is caused by the focus potentiometer, which is a 2M Ω slider preset. Disconnect to prove.

A modification that reduces this fault, common to this range of models, is to feed the line oscillator from the main h.t. instead of the boost line. The above-mentioned 1M Ω resistor must be disconnected, and reconnected to a nearby h.t. point. It may be necessary to alter values slightly to allow for the voltage difference.

ULTRA V17—60

The sound is perfect, there is no raster and the e.h.t. whistle is weak. The U26 has been renewed, but this made no difference. I removed the fly-lead from the centre position of the 3-position paxolin panel next to the l.o.t., and the e.h.t. sprang to life and the raster became visible, but only $\frac{2}{3}$ width, leaving the other $\frac{1}{3}$ blank.—H. Dalby (Wakefield).

There are two possibilities. Most likely is that the boost capacitor 0.1 μ F, or its focus smoothing filter of 1M Ω and another of 0.1 μ F is faulty. A leak in the boost capacitor would give the symptoms you describe.

Another possibility is that the 270pF capacitor across the section of the line output transformer which feeds the deflection coils has short-circuited. This capacitor may have been increased to 350pF in later production runs, but should always be

replaced with a pulse ceramic component of 1,000V rating, or preferably a 12kV component. You can disconnect the component to test, leaving the tapping in place on the tag strip. This should give you a full raster but with lack of linearity at the right.

MURPHY V230

The picture on this set is cramped on the left side. On a blank raster, two distinct vertical white lines can be seen at the extreme left of the screen.—J. A. Shaw (Northwich, Cheshire).

The usual cause of your trouble is a faulty 20P4 line output valve. Check also that the U801 h.t. rectifier is efficient.

EKCO T221

Width is lacking on the left side of the screen by about $\frac{1}{4}$ in. I have replaced the 20P4 line output transformer but this has made no difference.

Both picture and sound are otherwise perfect and when no signal is applied there is a full raster.—W. G. Morrow (Belfast, Northern Ireland).

This trouble could be due to low h.t. caused by a faulty metal h.t. rectifier. Check also that the line linearity choke has not slipped down to short to chassis, and that the line output transformer appears to be efficient. If this latter component is defective its casing will appear burnt or buckled.

R.G.D. 590

After this set has been working normally for about an hour the sound drops suddenly.—G. Richards (Glamorgan, South Wales).

Check the 0.001 μ F capacitor decoupling pin 8 of V10 EF80 and the components associated with the MR4 (OA81) noise limiter: R83, C64, C66 etc. Disturbing these items may produce the effect, and it may well be that proper soldering is all that is required.

BUSH TV115R

There is no e.h.t. I have changed the EY86 and PY800, also had the PL36 checked. The h.t. line was low voltage, and drawing 400mA. I corrected this by changing the 300/200/100 smoothing capacitor using a 300/100/100 and a separate 100 μ F. The line whistle is present when the horizontal hold is rotated but the e.h.t. rectifier remains unlit.—T. Cartwright (Liverpool 9).

Check the 0.01 μ F line coupling capacitor from pin 1 of the ECC82 (C104). Also check the 2.2k Ω resistor to pin 4 of the PL36 and boost line 8 μ F (two in series) capacitors.

K.B. FV40H

Smoke began to issue from this set, and on closer inspection it appeared to be coming from a capacitor situated immediately behind the voltage selector.—R. S. Hall (Stanley, Co. Durham).

The capacitor immediately behind the voltage selector is a 0.05 μ F 500V component. This is in the field sync circuit and is hardly to be found smoking.

There is, however, a resistor further back, 4.7k Ω 2W which overheats when V5 6AL5 develops a heater/cathode short.

HMV 1840

When first switched on, the sound is normal but then the set goes silent almost immediately. If left, the sound reappears after about 15-20 minutes and then remains normal.

The sound can sometimes be restored by a process of switching on and off until it finally remains.—G White (Doncaster, Yorkshire).

The fault described is invariably due to a faulty EBF80 (ZD152 or WD709) or to a capacitor associated with pin 1. The valve is on the right side, second from rear.

MURPHY V250

There is a noise like a motor running on both channels and the sound is poor. There is also a horizontal line present.—P. Smith (London, E.7.).

The symptoms you describe suggest a faulty bias decoupling capacitor on the ECL80 sound output valve. This is a 100 μ F electrolytic held in a clamp adjacent to the valve.

PYE AT17

When this set is switched on, I cannot get the line hold to register one clear picture, even when I have turned the knob as far as it will go. All I get is three or four pictures a time.—A. J. Madeira (London, S.W.1).

Replacing the PCF80 line oscillator valve, which is at the back of the set near the mains resistor usually provides a cure to your trouble. It may be necessary at the same time to re-adjust the preset line hold capacitor just beneath the valve and accessible via a small hole in the chassis back.

QUERIES COUPON

This coupon is available until JUNE 24th, 1965, and must accompany all Queries sent in accordance with the notice on page 425.

PRACTICAL TELEVISION, JUNE, 1965

TEST CASE -31

Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions, but are based on actual practical faults.

? *Test Case 24 and its solution (November and December, 1964) revealed that impaired field lock on dual standard sets operating on 625 lines can be caused by a high level of residual mains hum in the timebase and vision sections of the receiver.*

As a consequence a viewer experiencing such trouble took steps to reduce the hum voltage by replacing a low value electrolytic capacitor and by improving the efficiency of the smoothing. He still found, however, that the field lock was below the efficiency of that on the 405-line standard, and noted particularly that the lock appeared to be affected by interference bursts, the location being on a main traffic road.

What is the most likely cause of the trouble in the case of this viewer and what steps could he have taken, if any, to minimise the effect?

The answer to this will be found in next month's PRACTICAL TELEVISION, along with another Test Case.

SOLUTION TO TEST CASE 30

(Page 380, last month)

In some BBC-2 reception areas, even those reasonably close to a transmitter, it is being discovered that a curious effect exists whereby the vision and sound signals are not picked up by the u.h.f. aerial at their correct relative levels. Sometimes the sound signal is much stronger than the vision signal and vice versa.

There is no direct v.h.f. equivalent of this effect, the nearest being so-called "selective fading" at receiving sites well removed from a v.h.f. station. Here it is sometimes found that the vision signal strength will rise while the sound signal strength falls, and vice versa. This in the main is caused by polarisation variation between the vision and sound signals. However, this has never been found to be consistently troublesome within the service area.

Polarisation also seems to have a bearing on the u.h.f. service area aspect of the trouble, for experimentation has shown that the signals can be brought into some degree of reasonable strength balance by shifting the polarisation of the aerial a little. This exercise, however, calls for the use of a u.h.f. signal strength meter which will tune both the vision and sound signals separately. Tilting the array from the true horizontal by a few degrees can help matters, bearing in mind that so far the u.h.f. signals are horizontally polarised.

It seems that the u.h.f. signals have their polarisation twisted by factors of general propagation and by reflective objects much more easily than the v.h.f. signals, and that the polarisation twist differs with frequency, as would be expected, of course.

The solution here, then, is to find a compromise polarisation for the aerial which provides the optimum balance between the sound and vision signals, bearing in mind that this may well result in an overall fall in signal strength, relative to sound or vision.

It seems likely that the aerial makers will eventually help with a solution to this problem. There is also one school of thought which favours circular polarisation as a means of alleviating such troubles.

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1R5	4/1	6F23	9/6	12A08	8/1-	35Z4GT	4/6	DY87	7/6	ECL82	6/6	EM81	7/1-	N37	10/6	PL500	15/6	U37	29/1-	UL84	5/6	OC25	12/1-		
1R7	3/3	6F24	10/6	12A17	5/1-	35Z5GT	5/9	E80F	24/1-	ECL85	8/9	EM84	6/9	N78	26/1-	PM4	9/3	U45	15/6	UM4	15/10	OC26	8/1-		
1T4	2/3	6F74	4/6	12A18	10/9	35B5	6/6	E83F	24/1-	ECL86	8/1-	EM85	8/9	N108	26/2	PM4	9/1	U76	4/6	UM34	16/10	OC28	23/1-		
2D21	5/-	6K7G	1/3	12A76	4/6	60V5	6/6	E88CC	10/1-	EF22	6/6	EM87	7/6	P2	10/1-	PV31	6/9	U91	9/6	UM80	8/3	OC29	29/6		
2N2	3/1-	6K8G	3/3	12A76	5/9	50L6GT	6/3	E106F	10/6	EF26	3/3	EN31	10/1-	PAB08	20/1-	PV32	8/9	U91	9/6	UM80	11/1-	OC30	9/6		
3A5	6/9	6K8GTM8/6		12A76	5/9	72	6/6	E150	16/6	EF37A	7/1-	EV51	5/6	P61	2/6	PV33	3/3	U92	12/3	UM	11/6	OC31	21/6		
3Q4GT	6/9	6K25	24/1-	12A8V	5/6	55A2	6/6	E18C80	5/9	EF40	8/9	EV51	7/6	PC86	10/6	PV80	4/9	U301	11/1-	UY1N	13/6	OC41	8/1-		
3B4	4/6	6L1	10/1-	12B5E	4/9	60A3	6/6	E1F42	7/9	EF41	6/6	EV53	9/3	PC88	9/6	PV81	5/-	U404	6/1-	UY21	7/6	OC44	8/1-		
3V4	5/-	6L6GT	7/3	12B7H	6/1-	60A4V	6/6	E1R34	1/1-	EF42	3/9	EV84	9/6	PC95	6/9	PV82	4/9	U401	15/1-	UY41	5/1-	OC46	4/9		
6Y4GY	8/6	6L7GT	5/6	12K35	10/1-	90K1	6/6	E1B41	4/9	EF50	2/6	EV86	5/6	PC97	6/9	PV83	5/6	U420	6/6	UY85	4/9	OC65	22/6		
6Y4G	4/8	6L18	10/1	19A93	7/3	90K1	42/1-	E1B11	2/3	EF80	4/1-	EV88	8/9	PC98A	5/6	PV88	7/3	U420	6/1-	VP4	14/6	OC66	25/1-		
6Y4G	4/9	6F28	11/6	19B11	6/1-	90V5	42/1-	E1B23	6/1-	EF83	9/6	EV81	6/1-	PC98B	6/9	PV80	5/9	U421	6/6	VP4	14/6	OC66	25/1-		
6Z5	6/6	6Q7G	4/1-	20F2	11/6	186BT	34/11	E1B41	5/9	EF86	6/6	EZ41	6/3	PC98B	8/6	PZ30	9/6	U421	6/6	VP4	14/6	OC66	25/1-		
2Z6G	7/6	6R7G	5/3	20L11	12/6	866A	12/6	E1B40	5/9	EF89	4/1-	EZ80	3/9	PC98B10/6		QV047	7/1-	U421	6/6	VP4	14/6	OC66	25/1-		
6A5	5/9	6S17GT	5/3	20P1	12/6	5763	7/6	E1B83	7/3	EF91	3/1-	EZ81	4/3	PC98B	6/6	R10	15/1-	U421	6/6	VP4	14/6	OC66	25/1-		
6A7	3/1-	6S2T	5/3	20P2	12/6	5763	7/6	E1B83	7/3	EF91	3/1-	EZ81	4/3	PC98B	6/6	R10	15/1-	U421	6/6	VP4	14/6	OC66	25/1-		
6A7	5/9	6U4GT	8/6	20P	12/3	ACORPEN	4/9	E1B21	10/5	EF85	4/9	EZ33	10/1	PC98A	8/6	R18	9/6	U421	10/9	X66	7/3	OC76	8/6		
6A95	5/9	6V6G	3/8	20P5	12/3	AZ31	6/6	E1C53	12/6	EF87	10/1	EZ37	14/6	PC98B	8/9	R19	6/9	U422	6/3	X78	20/6	OC77	12/1-		
6A7	8/9	6X4	3/9	25L6	4/9	AZ41	6/6	E1C70	4/9	EF98	9/9	HABC80	9/3	PCF801	10/6	RP41	2/1-	UC84	8/1-	X79	27/6	OC78	9/6		
6A7	5/9	6X6GT	6/3	30Z4G	8/6	B36	4/9	E1C92	6/6	EF183	7/3	HL41DD		PCF802	10/6	RP41	2/1-	UC85	8/6	X83	5/1-	OC79	8/6		
6A7	6/6	6Y20L2	6/1-	25Z0GT	8/1-	CL33	11/6	ECC41	7/1	EF184	7/9	ECC41	7/1	PCF805	8/9	RP45	2/7	UCF80	9/6	Z86	7/6	OC81D	1/6		
6B4G	4/6	7B6	15/6	27L1	23/3	CV31	8/9	ECC40	7/1	EF804	20/5	HL42DD		PCF806	17/6	T41	9/1	UCB21	8/1-	Z86	7/6	OC81D	1/6		
6B6	4/3	7C57	9/6	30C13	9/3	D1AF6	6/6	ECC81	3/6	EH90	9/6		12/6	PCL82	6/6	TH41	10/1-	UCB42	8/1-	Z86	7/6	OC81D	1/6		
6B6	5/3	7E5	8/1-	30C18	8/9	D1D41	10/6	ECC82	5/6	EK32	5/9	HN309	26/1-	PCL83	6/6	TH23	6/9	UCR81	8/1-	AF102	27/6	OC84	8/1-		
6B6	5/6	7G6	6/9	30F5	7/3	DP96	15/1-	ECC83	4/6	EL33	6/6	HVR2	3/3	PCL84	7/6	TH66F	11/6	UCR82	7/3	AF114	11/1-	OC170	8/6		
6B7A	7/6	7E7	12/6	30F11	9/3	DP96	6/1-	ECC84	5/6	EL34	9/9	HVR2A	3/9	PCL85	8/6	U1214	7/6	UF41	6/9	AF116	10/1-	OCPT1	5/6		
6B8	8/3	7E7	12/6	30F13	9/6	DP97	10/1-	ECC85	5/6	EL36	8/9	KT36	28/1	PEN45	7/1-	U16	15/1-	UF42	4/9	AF117	5/6	MAT100	7/6		
6BR8	8/1-	7Y4	5/1-	30P4	12/1-	D11101	25/1-	ECC88	9/9	EL41	7/1-	KT36	28/1	PEN45	7/1-	U18/20	6/6	UF80	6/3	AF127	9/6	MAT101	8/6		
6B8	7/6	8V6	9/6	30P12	7/6	D110716/11		ECC91	3/1-	EL42	7/9	KT41	6/6	PEN45	7/1-	U22	5/9	UF85	6/9	AO70	3/1-	MAT120	7/6		
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6C3	10/9	10C2	12/1-	30P11	9/3	DL96	8/6	ECC90	7/3	EL83	6/9	KT61	6/6	PEN48	4/1-	U35	8/6	UF86	9/9	AO73	3/1-	MAT121	8/6		
6D6G	15/1-	10F1	16/1	30P13	10/6	DL96	18/1-	ECC92	6/6	EL84	4/6	KT63	3/6	PEN33	10/3										
6C86	5/-	10D13	9/3	30P14	11/3	DL72	15/1-	ECC96	11/6	EL85	7/6	KT66	12/3	PFI300	20/6										
								ECC91	9/1-	EL86	7/3	KT88	28/1-	PL83	9/1-										
								ECC93	6/1-	EL91	2/6	KTW61	4/9	PL86	9/1-										
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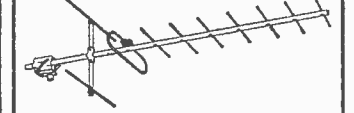
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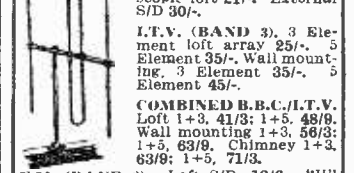
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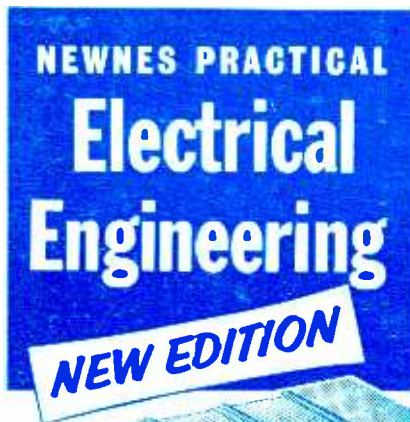
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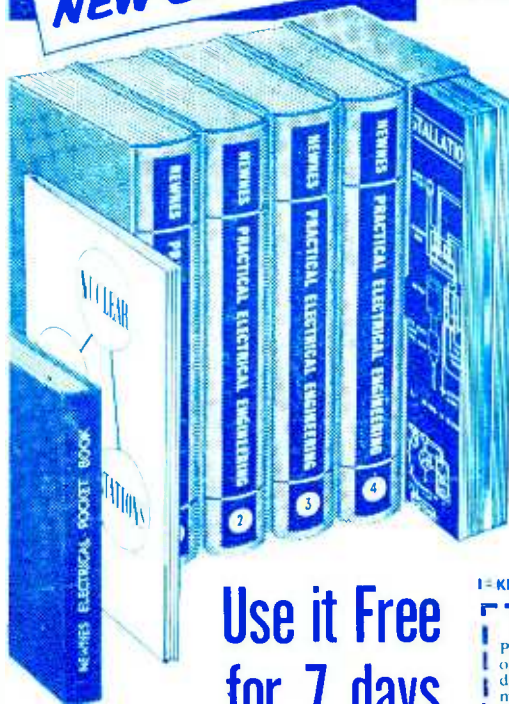
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