Practical TELEVISION

APRIL 1965

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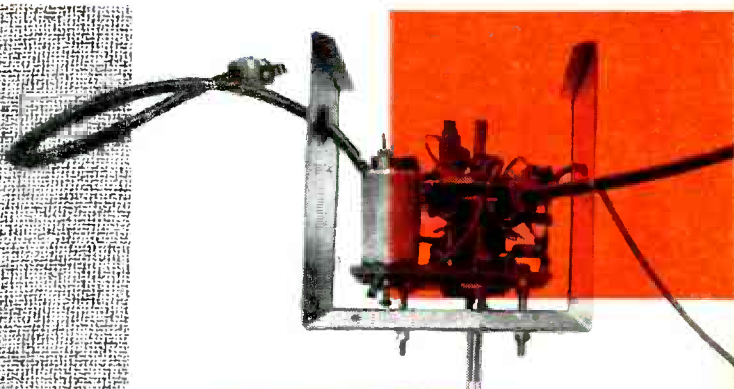
A NEW PT DESIGN



THE OLYMPIC II Transistor TV

Practical Television

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VOL. 15 No. 175

TELEVISION CONSTRUCTORS

MANY readers will remember the tremendous enthusiasm for television just after the war, when BBC transmissions were resumed from the old Alexandra Palace station. For many people, this was their first opportunity to see television and the chance to engage in such frivolous and non-utility activities was a very real realisation to a war-weary population that peace (of a sort) was a definite fact.

Despite the austerity of the immediate post-war years, many were better off financially than in pre-war days and were thus able to permit themselves the luxury of their own TV set.

But there also sprang up a vast army of home constructors and the kitchen tables of the nation rang to the activities of enthusiasts converting war surplus units into television sets. Thousands upon thousands of these green-eyed midgets must have been built and the demand for conversion literature was almost insatiable.

The cult prospered for some time, aided by those TV magnifying lenses which soon looked like flattened yellow goldfish bowls. Even when the novelty wore off, there was still a healthy interest in more "conventional" home built sets using 9- and 12-inch picture tubes.

But as straight sets gave way to superhets, as circuitry became more elegant and requirements more complex, the army of home constructors began to dwindle. Moreover it became as cheap to buy as to build. And the once energetic home constructors' movement remained in the doldrums for a decade.

The amateur TV enthusiast found his outlets in servicing, building test gear, in CCTV, etc. But once again there are signs that a new angle has presented itself to rekindle interest. This is no 1946 all over again, but the practicability of transistor TV circuitry is at once an opportunity and a challenge to the technical enthusiast.

THIS MONTH

OUR NEXT ISSUE DATED MAY WILL BE PUBLISHED ON APRIL 22nd

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.

TELETOPICS

TV AT THE IDEAL HOME EXHIBITION

TELEVISION has received much attention at this year's "Daily Mail" Ideal Home Exhibition now on at Olympia, with displays by the BBC, ITA and the independent programme companies and British Relay.

An unusual feature of the ITA stand is a demonstration of back-projection. Here, a television picture is projected on to the back of a semi-transparent screen which is open at the front to the public. For material, a closed-circuit TV system relays pictures of the crowd itself from a remote-controlled camera to the projector.

British Relay have a colour TV receiver on show and are featuring, among other things, their participation in the pay-television scheme to start in parts of London on an experimental basis this year.

A Face-lift for the Radio Show

IN 1965 the Earls Court Exhibition Hall is to see a successor to the National Television and Radio Show of previous years. This year the show has been organised by Industrial Trade Fairs Ltd., who have given it the new title "The '65 Show", or more formally, "The '65 international television radio recordplayer disc taperecorder stereo hi-fi and musical instrument show". For this year, for the first time ever, the organisers have abandoned the British-only policy and are inviting foreign participation in the show.

The dates of the show are August 25th to September 4th, and the doors will be opened to the public each day from 10 a.m. to 10 p.m., except Sunday. Only one day of the show this year—August 24th—will be for "trade only" visitors.

As the full title of the show indicates, its scope will extend to take in every form of sound and vision entertainment for the home. During the Show there will be two 405-line television transmissions for relay to the stands, as well as one 625-line demonstration channel.

The PTV Film Show – 1965

EVERY year, PRACTICAL WIRELESS and PRACTICAL TELEVISION invite their readers to attend a Film Show at the Caxton Hall, Westminster, London, where films and talks of technical interest are given for the audience of radio and television enthusiasts. This year's show was held on February 5th, and as usual attracted readers from all parts of the country.

The organisation of the show is in collaboration with Mullard Ltd., who supplied the films and the speaker for the evening, Mr. I. Nicholson. In the absence of the Editor, Mr. W. N. Stevens, the chair this year was taken by the Assistant Editor, Mr. L. E. Howes.

The show began with a film entitled "The Electromagnet Waves". This was followed by a short illustrated talk dealing with some recent cathode ray tube developments. After some refreshments, the audience returned to the Hall to hear a talk on "Current Topics and Present Trends". The evening ended with Mr. Nicholson replying to a number of questions put by members of the audience.

FREQUENCY CHANGES FOR SEVEN ITA TRANSMITTERS

DURING the course of 1965 the Independent Television Authority will bring into service seven new transmitters. The presence of these stations has made necessary slight alterations in the original offset of the frequency from the normal at some transmitters, in order to avoid co-channel interference. The effect of these changes in frequency on the tuning of television receivers, however, should be very small.

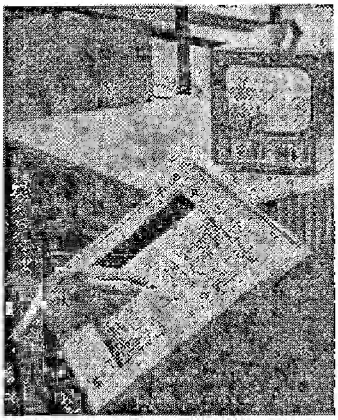
The changes were made during February to seven ITA stations: the other stations of the Authority's network will not be affected.

The new sound frequencies, in Mc/s, of the stations, followed by the new off-set in kc/s, are: Arfon 196·2575 (+7·5); Emley Moor 196·2575 (+7·5); St. Hilary 196·2305 (−19·5); Black Hill 196·2305 (−19·5); Presely 186·266875 (+16·875); Mendlesham 201·233125 (−16·875) and Durris 191·266875 (+16·875).

The new vision frequencies and offsets are as follows: Arfon 199·7575 (+7·5); Emley Moor 199·7575 (+7·5); St. Hilary no change; Black Hill no change; Presely 189·766875 (+16·875); Mendlesham 204·733125 (−16.875) and Durris 194·766875 (+16·875).

MORE CCTV TEACHING AIDS

AT the Closed-circuit Television Equipment for Teaching Purposes exhibition, held during February at the National Audio-visual Aids Centre, London, a display by EMI Electronics Ltd., demonstrated, among other things, an "electronic blackboard" and a control console at which pictures from four CCTV cameras can be inspected and selected for transmission to six monitors. The capabilities of the four-camera network include caption and blackboard scanning, televising live shots, and simple telecine for slide projection.



The "electronic blackboard" is shown in use above. A teacher using this equipment need not turn his back on his class to illustrate his lesson on a blackboard. By writing on the glass screen of the camera unit, a facsimile is produced simultaneously on the television monitor screens throughout his class.

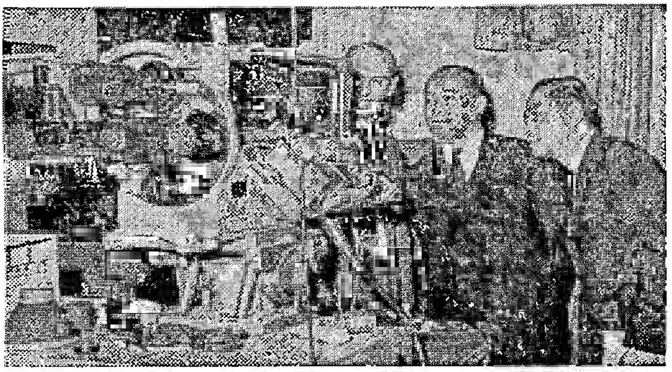
NEW "SEE-IN-THE-DARK" TUBE

A MAJOR development in image orthicon camera tube design that will make low-light-level television possible with equipment greatly reduced in size and weight, is announced by International General Electric Company of New York Ltd. These reductions have been achieved by the use of electrostatic beam deflection and focusing instead of magnetic, thereby eliminating the need for bulky yokes and alignment coils. (Previously the electrostatic principle had been employed only on vidicons which, however, do not pose the same technical problems as image orthicons.)

As a result, GE's new "see-in-the-dark" TV tube is one-fifth the size and one-twentieth the weight of a comparable magnetic image orthicon and requires only a thirtieth the power. Such equipment will be specially advantageous in space research where ambient lighting can be practically non-existent and round-the-clock weather surveillance from an orbiting satellite is one possibility. Another predicted use would involve the combination of the new tube with recently developed portable video tape recording equipment to provide a suitcase-sized remote television "studio".

The tube's "see-in-the-dark" properties are provided by a high-gain, thin film magnesium oxide target that has a sensitivity 10 to 20 times that of conventional glass targets.

Royal Visitors at Marconi's



During their recent UK tour, H.R.H. Prince Ratana Panya and H.H. Prince Sisoumang Sisaleumsak of Laos, visited the Marconi Company in Chelmsford. H.H. Prince Sisoumang Sisaleumsak, who is his country's Minister of Posts and Telecommunications, was able to see much of the latest communications equipment made by the Company, and in the photograph above he is seen examining a Marconi Mk IV television camera.

COLOUR TV AT FASHION SHOW

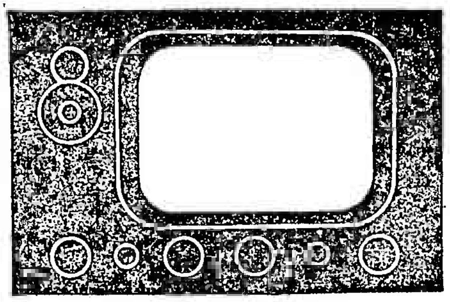
COLOUR television was used recently to add originality to a charity fashion show held in London at Celanese House, Hanover Square. As well as the standard parade of mannequins, the audience saw examples of the latest Paris and London collections, modelled in settings produced by using a new projection screen made by Rank, in conjunction with a Plumbicon colour studio TV camera developed by Philips.

This new screen—which has been developed by Rank's Audio Visual Division—is composed of millions of microscopic glass "lenses" with refracting surfaces, which pick up a projected picture at very low light intensity, and reflect it back at nearly a thousand times the brilliance. This brilliance was sufficient to overcome the effect of studio lighting, permitting the camera to photograph and relay pictures of mannequins in front of the screen to a number of Rank-Bush Murphy monitors, giving the audience "location" shots of the clothes.

New TV Relay Station

THE latest BBC television and v.h.f. sound relay station to be brought into service, is at Toward Point, Argyllshire. The new station serves the eastern half of the island of Bute and parts of the coastal areas of Renfrewshire and Ayrshire, including Rothesay, Largs, Wemyss Bay, Skelmorlie and Fairlie.

Transmission of BBC-1 television began during February on Channel 5 with vertical polarization.



THE OLYMPIC II Transistor TV

by D. R. Bowman

Part One The Tuner

THIS series of articles will describe in full detail the specification, construction, adjustment and performance of a fully-transistorised television receiver for the home constructor. Naturally, a certain amount of experience with both transistor and television receivers has to be assumed, but although not suitable as an exercise for the beginner, no difficulty should be found by one who has built a few transistor circuits and knows something about TV from the practical angle. A certain amount of theory will of course be mentioned, if only to interest those who will later on carry out a conversion on the circuit; the need for this will be explained also. The designer will be willing to make available to senior readers on request, the theoretical analysis of the design of the main units of the receiver.

The present design is for a straightforward 405-line Band I and Band III receiver, since most worthwhile entertainment is currently available only on the 405-line standards. Band V has not been neglected during the design procedure however, and the circuit is such that conversion to the 625-line standards can be done readily when circumstances make it desirable.

General Description

Fig. 1, which shows the block diagram of the 405-line receiver, indicates that in essence the circuit follows conventional lines. The tuner unit comprises a radio frequency amplifying stage consisting of a v.h.f. transistor operating in the common-base configuration, together with a similar transistor operating as a common-base oscillator. A further v.h.f. transistor acts as a frequency changer, again operating in the common-base mode, and the i.f. signals (38·15Mc/s sound, 34·65Mc/s vision) are taken from its collector circuit by means of a suitable transformer and passed to the i.f. amplifiers at the appropriate impedance level.

The sound i.f. amplifier consists of two slightly under-coupled transistor stages, somewhat over-neutralised in order to sharpen the selectivity and improve the sensitivity. This has been found to economise in one v.h.f. transistor at the expense of a little extra care in setting-up. The vision signal is completely eliminated in this i.f. amplifier; although on the low frequency side of the response curve the selectivity is not so high as on the high-frequency side, no trouble has been found from adjacent-channel vision.

The detector is the usual germanium diode, and between this and the high gain audio amplifier is interposed a noise-limiting device. Because of the low impedance levels which are inescapable with transistors in practical circuits, this is not so effective as in a similar valve circuit, but the difference in performance is not great and the effect of car ignition interference is not usually troublesome.

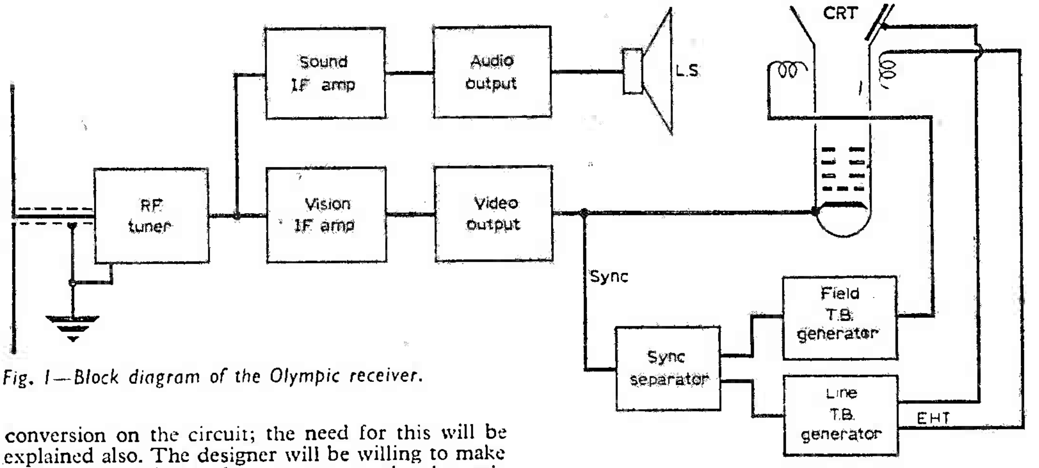


Fig. 1—Block diagram of the Olympic receiver.

The Olympic II transistor TV receiver

SPECIFICATION

Power Supplies

12V d.c. (accumulator for normal use with motorcar or in caravans, etc., or dry battery Ever Ready type TV1 in emergency).

190–250V a.c. (separate power unit for a.c. mains, for use as domestic TV). Interchangeable polarised power socket provides for quick change from domestic to mobile use.

No adjustment of transformer needed for a.c. mains unless supply voltage drops below 190V.

Power Unit

(For use with a.c. mains) fully stabilised.

Supply variable from 11 to 16 volts. Hum level less than 20 mV.

Current available 0–3A.

Power Consumption

9 watts on 405-line operation. On 625-line operation, consumption will be approx. 25 watts.

Standards

To receive 405-line transmissions on Bands I and III.

Capable of conversion to 625 line standards at relatively low cost at a later date.

Display

14in. picture tube, Mullard type M36–11W (electrostatic focus, electromagnetic deflection both line and frame, 90° deflection).

Tuner Unit

Six channel switch, with fine tuner (electronic or capacitive).

3-transistor circuit

I.F. outputs—Sound 38·15 Mc/s.
—Vision 34·65—37·65 Mc/s.

Noise figure 5dB or better.

Sound Receiver

Two i.f. stages, diode detection and noise limiting, audio pre-amplifier, driver and class AB push-pull output.

Audio output 1 watt (conservative estimate).

Distortion (total harmonic) 3% at 1 watt.

Speaker 3Ω.

Overall sensitivity 3μV at aerial socket for 50 mW output.

Vision Receiver

Three i.f. stages, diode detection, 2-stage video amplifier.

Overall sensitivity 10μV at aerial socket for 20V p-p at c.r.t. cathode.

Bandwidth 3 Mc/s.

Sound-channel rejector (main)—infinite—rejection bridged T circuit.

Time Base Generators

Field: Blocking oscillator, driver, output, with linearising circuits; choke coupled to scanning yoke. Direct locking. Linearity better than 8%.

Line: Blocking oscillator, driver, output switch (transistor). Direct coupled to scanning yoke, part of transistor current diverted to e.h.t. transformer. "Flywheel" sync. Linearity better than 5%.

Internally Generated Power Supplies

—75V for video amplifier.

+500V for tube supplies.

+14kV e.h.t.

Assembly

The prototype is in unit construction, for reasons of development. However, an integrated assembly, using the chassis for all heat sinks would save weight and space. Unit construction is however very flexible and permits of individual adaptation as required; it will also permit of more simple conversion to 625-line standards at a later date. Etched circuits are used widely in the prototype.

The audio amplifier consists of a pre-amplifier stage, followed by a 1W combination of driver and push-pull class AB output. The rating of 1W is a conservative one, and in practice 1½—2W is easily obtained; much depends here on the goodness of the heat-sink arrangements for the output transistors.

The vision amplifier comprises three transistor stages at intermediate frequency, followed by a pair of transistors working as a conventional video amplifier. The use of a high-voltage video output stage enables plenty of modulation drive to be available for the cathode-ray tube. The i.f. stages are preceded by a sound-trap giving only a small rejection notch at the sound intermediate frequency. The main sound-rejection is arranged to take place between the last two i.f. transistors, where an "infinite-rejection" circuit is interposed. The total rejection is nearly 50dB at the sound i.f., with sufficient rejection at the edge of the audio pass-band—over 42dB at ± 100kc/s about 38·15Mc/s. This eliminates sound-on-vision entirely, providing tuning is reasonably accurate, and the effect of the rejectors on the vision pass-band response is readily corrected by following a simple drill in adjusting the i.f. transformers.

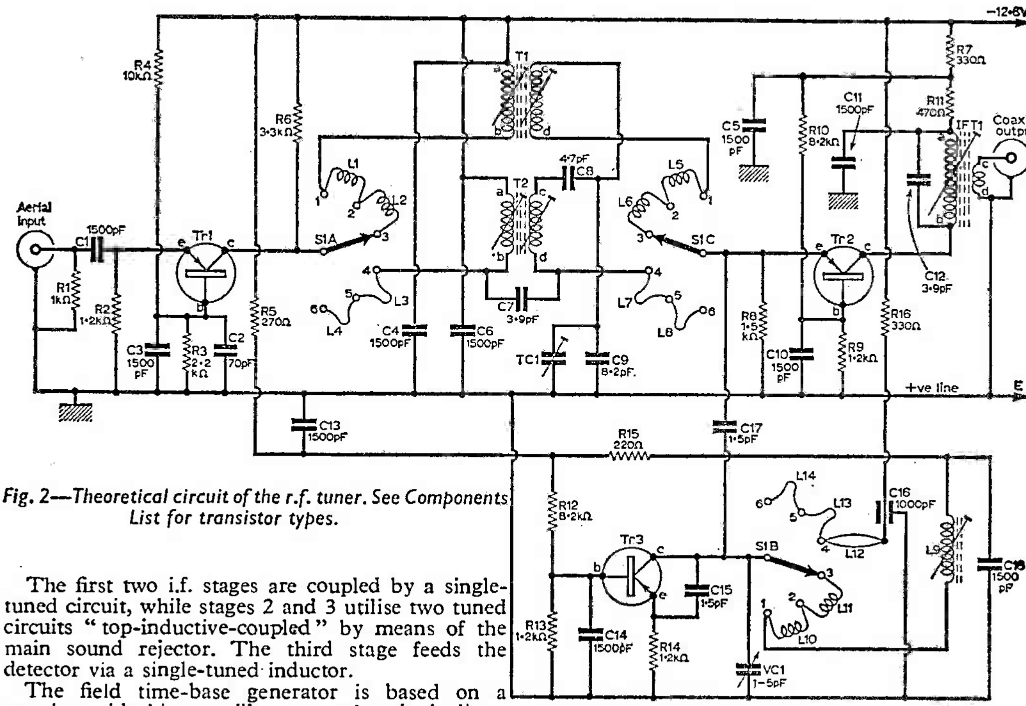


Fig. 2—Theoretical circuit of the r.f. tuner. See Components List for transistor types.

The first two i.f. stages are coupled by a single-tuned circuit, while stages 2 and 3 utilise two tuned circuits "top-inductive-coupled" by means of the main sound rejector. The third stage feeds the detector via a single-tuned inductor.

The field time-base generator is based on a transistor blocking oscillator, synchronised direct by the field sync pulses derived from an interlace device. The output transistor is choke-coupled to the high-resistance field-scan coils, and linearity correction is incorporated.

The line generator is similarly a blocking oscillator, which provides the output to a driver stage.

The input to the driver is adjusted by means of a very stable tuned circuit, which varies the "on-time" of the oscillator, while the output is used to operate the line-output stage as a current switch. Direct coupling to the low-inductance scan coils ensures high efficiency, although in order to obtain the high e.h.t. a small portion of the yoke current is diverted to a "line-output transformer". This transformer allows lower voltages of the correct polarity to be obtained for the first and focus anodes of the cathode-ray tube and for the video transistor, and for control of brightness.

Because of hole-storage effects it is not practicable to employ direct locking of the line oscillator, and this would in any case be inferior when conversion to 625-line standards is undertaken. Consequently a simple "flywheel" circuit is provided for line synchronisation, although more properly this should be thought of as a phase-correcting circuit.

The receiver uses a 14in. electrostatically focused tube operating at 14kV and giving a maximum light output of 100ft. lamberts—in fact this tube gives an exceptionally brilliant picture. This is a valuable feature, since the receiver is so light and robust that it can readily be transported in the boot of a car for use at picnics. Used in surroundings where ambient light is likely to be intense a good bright picture is a great advantage.

Sensitivity is very high on both Band I and Band III; the performance in this sense is well up to the standard of commercial valve receivers. The noise level at maximum sensitivity is especially low; when properly set up, the noise is about half that found with a double triode r.f. amplifier in modern valve tuners. Provision is made for the reception of six channels at the moment. Arrangements will it is hoped, be made with a manufacturer to provide a 13-channel switch of suitable design at a later date.

The weight of the receiver depends to some extent on the actual construction adopted. The tube itself weighs about 9lb., and the weight of the components and wiring about 5 or 6lb. If an 8½in. tube had been used it could have been a very small and light assembly, but most viewers would prefer a somewhat larger picture than this would give. However, it is a very portable instrument.

Power supplies have been thought out with some care. For most of its life it is likely to be used in the home as a mains receiver, and because of this a mains power supply has been designed for it. A 12V car accumulator will power it when used away from home, and if a small 12V accumulator is incorporated as an internal power supply, it will be independent—for an hour or two—of the power cuts with which "the economy" is threatened from time to time. Caravan dwellers without laid-on electricity will probably find that two car accumulators are the best means of providing power—one on charge while one is in use. The current taken is 800mA (0·8A), which represents a power consumption of about 10W.

COMPONENTS LIST

Resistors:

R1	1 kΩ	R9	1·2kΩ
R2	1·2kΩ	R10	8·2kΩ
R3	2·2kΩ	R11	470Ω
R4	10kΩ	R12	8·2kΩ
R5	270Ω	R13	1·2kΩ
R6	3·3kΩ	R14	1·2kΩ
R7	330Ω	R15	220Ω
R8	1·5kΩ	R16	330Ω

All 10% ¼W carbon.

Capacitors:

C1	1500pF tubular ceramic
C2	70pF silver mica
C3	1500pF tubular ceramic
C4	1500pF tubular ceramic
C5	1500pF tubular ceramic
C6	1500pF tubular ceramic
C7	3·9pF silver mica
C8	4·7pF silver mica
C9	8·2pF silver mica.
C10	1500pF tubular ceramic
C11	1500pF tubular ceramic
C12	3·9pF silver mica
C13	1500pF tubular ceramic
C14	1500pF tubular ceramic
C15	1·5pF tubular ceramic
C16	1000pF ceramic feed-through.
C17	1·5pF tubular ceramic
C18	1500pF tubular ceramic
TC1	1·5–5pF tubular ceramic trimmer
VC1	1–5pF air spaced variable fine tuning control, see text and Fig. 3 for alternative design)

All fixed capacitors ±20%.

Transistors:

Tr1 *Texas 2G102 or Philco 2N1742
Tr2 Texas 2G102 or Philco 2N1743
Tr3 Texas 2G102 or Philco 2N1743 or Mullard AF102

Mullard AF102 may be used in all three stages, with a slight reduction in gain.

Switches:

S1a/b/c 3-pole 6-way (on two 2-pole 6-way wafers, see text). Radiospares 'Maka-switch' assembly.

Inductors:

L1–L2–L5–L6, L9–L10–L11 } Band I coils
L3–L4–L7–L8, L12–L13–L14 } Band III coils
T1 Band I transformer
T2 Band III transformer
IFT1 1st i.f. transformer (tuned to 37·5Mc/s)

Miscellaneous:

PC1–PC2: Printed circuit board (copper clad laminate)—Bakelite Limited type DH74 or similar, two pieces, one is 3 x 2in. the other 3 x 3in.
0·3in. dia. polystyrene former (L9)—1
0·3in. dia. bakelite former 2¼in. in length (T1–T2)—2
Can assembly ¾ x ¾ x 1⅜in., with 0·3in. former (IFT1)—1
V.H.F. iron dust slugs (purple-coded)—4 (to fit L9, T1, and IFT1)
Brass slugs (OBA)—2 (T2)
Quantity of nuts and bolts and washers, 6BA brass; connecting wire etc.; 22 s.w.g. aluminium sheet (for the screening box); perforated zinc, pk screws.

* *Texas Instruments Ltd., Manton Lane, Bedford.*

Detailed Circuit Description

It will be noted that "unit construction" has been employed. This was not done as a deliberate policy, in spite of the advantages such assembly may have. In fact, each section of the receiver was conceived and designed separately, because new ground was being discovered in many respects, and it just turned out that way. It would have been perhaps better in some ways to have rebuilt the entire receiver into a specific form; but time would have been lost, and in addition flexibility would certainly have been impaired.

The prototype, as illustrated, therefore represents only one of a number of possible ways in which the sub-units may be assembled. It is true that certain layouts must be avoided—it would be very unwise, for example, to put the line-output stage farther from the cathode ray tube than the e.h.t. lead will reach without extension!—but these will be noted as the occasion arises. Apart from such considerations, the layout of the sub-assemblies is non-critical, and as a bench hook-up the most extraordinary positions have occurred without causing any trouble at all. There is no need at all to employ unit construction, and provided the screening is as specified the whole receiver can be mounted on a chassis in the conventional way. However, considerable advantages accrue from making a separate unit of the r.f. tuner, and as this is a relatively critical part of the receiver the constructor is recommended to follow the layout and assembly as given in this article.

The r.f. tuner circuit is given in Fig. 2, and as mentioned earlier, the common-base configuration is used for all the stages. Although the writer is aware that certain transistors now available would enable common-emitter working, the common-base arrangement has advantages in that neutralisation is not essential and cheaper transistors can be used. In any case, when the time arrives to convert to u.h.f., common-base operation will be essential.

The aerial is coupled directly into the emitter of the first (r.f.) transistor, Tr1, and this might be thought to represent a loss of match, liable to give rise to lack of sensitivity. In fact the loss is small if 75Ω cable and the appropriate aerial (plain dipole or the usual array having a 75Ω impedance) is used. The use of a pi-coupling network to match the aerial to the transistor input certainly gives a small reduction of noise, but this would require switching for other channels and itself represents a source of some loss of signal, it was thought better to simplify the circuit, and any loss is not noticeable in practice.

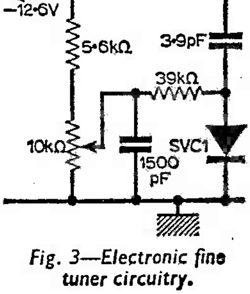


Fig. 3—Electronic fine tuner circuitry.

The input circuit is not untuned, as might be thought at first sight. The aerial is itself the first tuned circuit, and this implies that its "Q" must be low enough to give negligible attenuation at the edge of the band to which it is tuned. Consequently a "throw-out" aerial consisting of flex will give poorer resolution; the use of ¼in. tubing has been found however to give excellent results, and larger diameters can be used with advantage. The length should be accurate for the channel to which the receiver is tuned, and if portable operation is likely a very suitable type is a telescopic dipole,

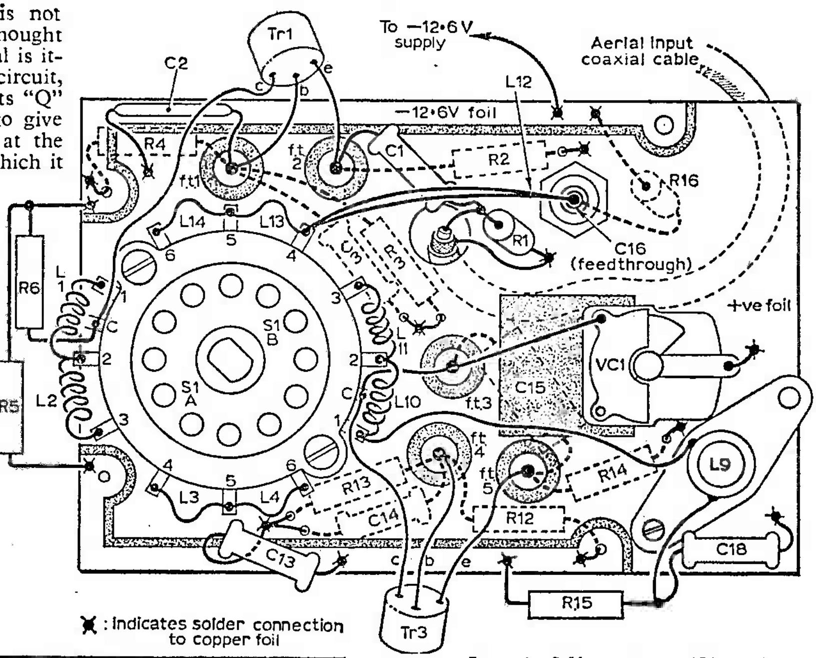


Fig. 4—PC1 wiring: 'ft' indicates anchor tag.

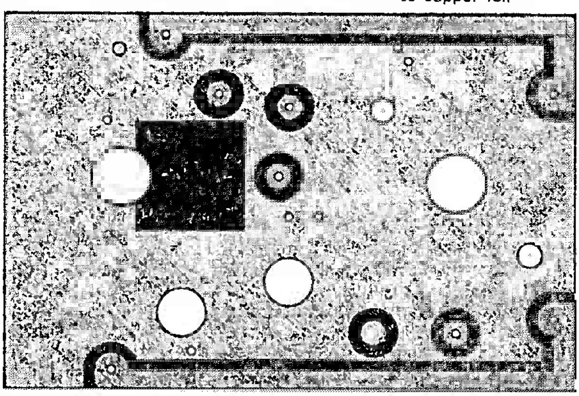
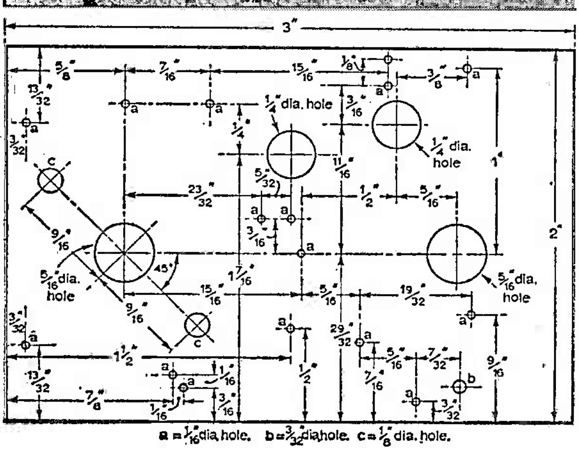


Fig. 5a—PC1 copper legend. Black parts etched away.



such as may be purchased from a number of manufacturers. Nevertheless, at a distance of 22 miles from the Mendlesham ITA transmitter a good picture was received on a small screwdriver plugged into the aerial socket, so it may be seen that one need not be too fussy after all. If the aerial is mismatched at the higher frequencies of Band III, however, it will be found that hand-capacitance effects may be noticeable, or that the tuning depends somewhat on the amount, and the position, of the coaxial lead. This clearly needs to be minimised, so it is worth while to take some trouble.

Although a self-oscillating mixer could be used it was considered better, for several reasons, to use a separate oscillator. The oscillator used is about the simplest possible, and works satisfactorily at all the frequencies of interest, without changing the feed-back capacitor (C15) between collector and emitter. The value of this capacitor is nominally 1·5pF, but is by no means critical. However, its value effects markedly the size of the Band II inductors, and it is best to use the specified value.

Tuned transformer coupling is used between r.f. and frequency changer stages, and the secondary of the inter-stage transformer is pi-coupled to the f.c. emitter to effect impedance—matching. This matching is accomplished by the combination C9

Fig. 5b—PC1 board drilling details. Both parts of Fig. 5 are drawn full scale.

and TC1, in conjunction with the input capacitance of Tr2, the f.c. transistor. C9 is effective on Band I, whilst on Band III, TC1 permits optimum results to be achieved. The inter-stage coupling gives a band-pass effect which improves selectivity without impairing bandwidth, but the matching needed is not critical and best results are obtained by adjusting TC1 on a Band III channel to obtain minimum noise. This cannot be done readily unless the output from the tuner can be fed into a suitable i.f. amplifier, and may be left until the receiver is complete.

Fine tuning on any channel is accomplished by VC1, a 1—5pF variable capacitor in the oscillator circuit, but a modification may be incorporated, which avoids the use of a variable capacitor and uses electronic tuning instead. This allows the use of a d.c. control, namely a potentiometer, and so enables remote tuning to be obtained if needed. The circuit is shown in Fig. 3. VC1 is removed, and point "X" in Fig. 3 is connected instead to the collector of the oscillator transistor Tr3 (pole contact S1b). The only extra connection is a lead from the −12·6V supply to the 5·6kΩ resistor. The Mullard SVC1 is a variable-capacitance diode, available through one's local dealer. Texas Instruments supply the 2G102 transistors direct to customers, on receipt of an order and delivery is normally from stock. Channel selection is by means of incremental inductances on both Band I and Band III. This requires some patience in setting-up, but a turret tuner is bulky and hard to come by. The alternative of separate switched coils is possible for Band I, but not so easy to arrange on Band III where the switch elements themselves form a major part of the tuning inductors. A choice of six channels is allowed by the nature of the switch specified; it is important to use this switch since it is small, electrically excellent and very stable in use. For portable use this may be an inconvenience, but a little juggling with the inductors for Band III can be resorted to if desired, and this can result in nearly all the channels being covered by the fine-tuning device.

The Band III "padding" inductors are merely short lengths of wire, and in the oscillator circuit, which operates at a higher frequency than the signal, L12 consists of two wires in parallel. The value of its inductance can be adjusted by varying the spacing between the "parallel" wires, and this is easily done by means of a perspex strip such as is used for trimming iron-dust transformer slugs.

Constructional Details

Etched-circuit construction is used in the tuner, and the two small circuit boards are of epoxy glass fibre laminate. This is electrically very stable and humidity changes have very little effect on its electrical characteristics. However, the cheaper E60 grade may be used if desired, as the DH74 is rather expensive. Bakelite Ltd. do not now supply direct to the public, but application for the laminate may be made to Anglo-American Vulcanised Fibre Co. Ltd., Cayton Works, Bath Street, London, E.C.1.

The two printed circuit boards will be referred to as PC1 and PC2 respectively. These may be marked out with resist direct[1], or a photographic method may be employed[2]. Since interconnections between the boards are necessary, certain components are best mounted before putting the assembly together, and a few notes on this may be of use to the constructor. The layout is arranged so that each circuit board is mounted on the switch itself, closely adjacent to the wafer concerned; the r.f. and oscillator stages are arranged on PC1 board which is farthest from the switch knob, while the frequency-changer goes on PC2 board which is nearest to the switch knob (see Fig. 8).

[1] *Feb. 1964 Practical Television.* [2] *July 1962 Practical Television*

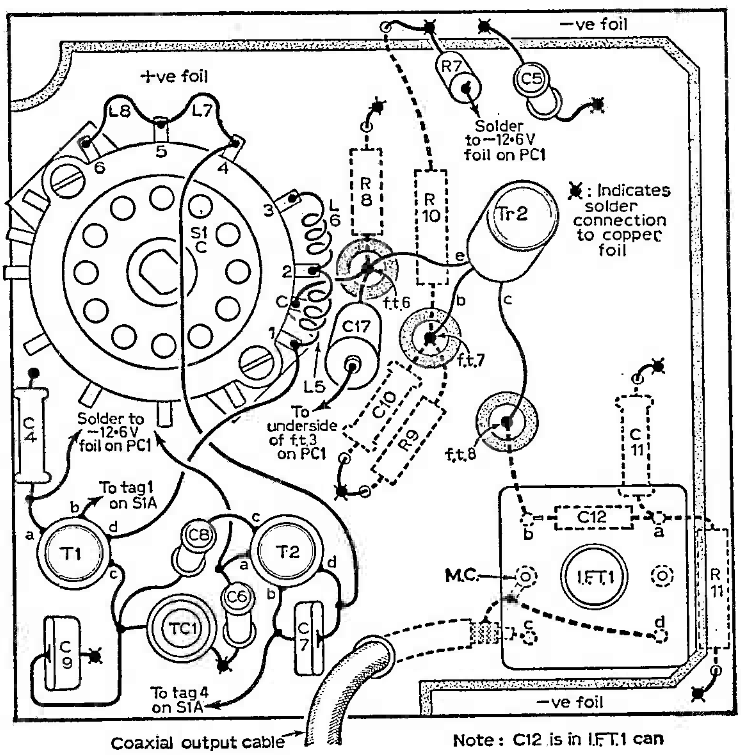


Fig. 6—PC2 wiring details.

The minimum amount of copper is etched away—sufficient to form anchor tags for the transistors and a rail for the "battery—minus" supply (−12·6V). The remainder then acts as screening between the stages. On the PC1 circuit board a square area is also cleared of copper so that the minimum capacitance of the variable capacitor VC1 (oscillator fine tuner) is as small as practicable.

When the boards have been etched and cleaned up they can be mounted together in a vice and drilled for the switch holes (Figs. 5b, 7b). The switch control hole is centred at $\frac{5}{8}$in. from the top edge of the board and $1\frac{1}{8}$in. from the right-hand side. The holes for the side struts are at 45° as shown and they are $1\frac{1}{8}$in. apart. If both boards are drilled at the same time there will later on, be no trouble about alignment. If the straightforward variable capacitance method of tuning the oscillator is used, the holes for this component should also be drilled in the same operation.

The larger larger circuit board (PC2) is next drilled to take the inter-stage transformers T1 and T2. For these, the prototype receiver uses the 0·3in. bakelite tubular former from one of the "long" canned assemblies which are retailed widely for coil-winding. The base is cut off so as to give the maximum possible length, and it will be found a simple matter to fix these into the holes now drilled for the $\frac{1}{4}$in. diameter portion of these formers.

The smaller circuit board (PC1) is next drilled to accept the Band I oscillator coil. This is a small polystyrene former of 0·3in. diameter, and may be cut from a "short can" assembly in the same way as previous. Finally, both boards are drilled with a $\frac{1}{16}$in. drill to take the leads of the small components. In the layout of the small components (the resistors and capacitors affording the correct d.c. supplies to the transistors) it is sufficient to take them to the nearest convenient point, both for B− supply and for earthing. The separate board design ensures the layout is non-critical in this respect. There are one or two critical points of layout, and these are detailed below.

The first r.f. transistor (Tr1) emitter is coupled directly into the aerial via a 1500pF capacitor C1, and any accumulation of static is prevented by affording a low-impedance d.c. path R1. The coaxial is taken along the underside of PC1 circuit board, through a hole, and the coaxial outer is soldered to the board close to this hole. The "inner" joins direct to C1 and R1; anchor tags are not provided for these components as this might impair the screening. Besides decoupling the base or Tr1 with the 1500pF capacitor C3, a further 70pF capacitor is soldered to the transistor base lead as close to the transistor case as possible. Only enough space to get in the point of sharp-nosed pliers—to use as a heat shunt—should be allowed; the soldering must be done quickly with a very hot iron, and the joint should be cooled with a wet finger forthwith. The earth end of C2 is then soldered to the board at the nearest convenient point. Keep all end wires of components as short as possible, i.e. C3 should be mounted as close as possible to the anchor tag ft1.

Only two anchor tags are provided for Tr1. The collector lead is taken direct to the pole contact of

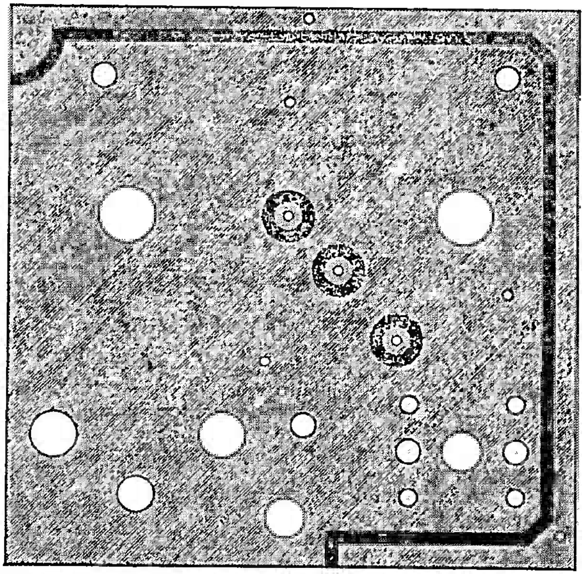
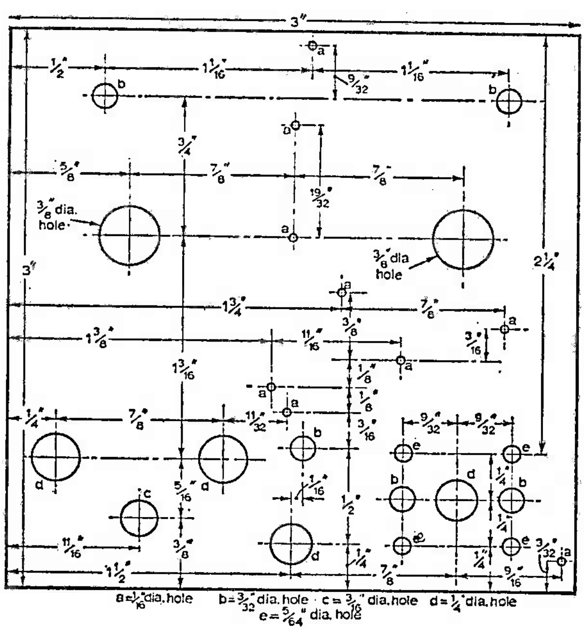


Fig. 7a (above)—PC2 copper legend. Black parts etched.
Fig. 7b (below)—PC2 drilling template. Both drawn full scale.



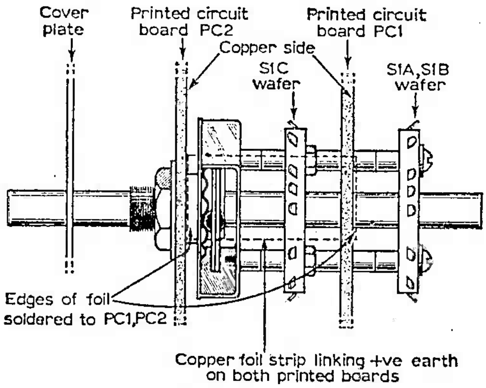


Fig. 8 (above)—Assembly details of the channel selector switch.

Fig. 9 (right)—Screening box for r.f. tuner. Cover to suit required in perforated zinc, which is held by pk screws.

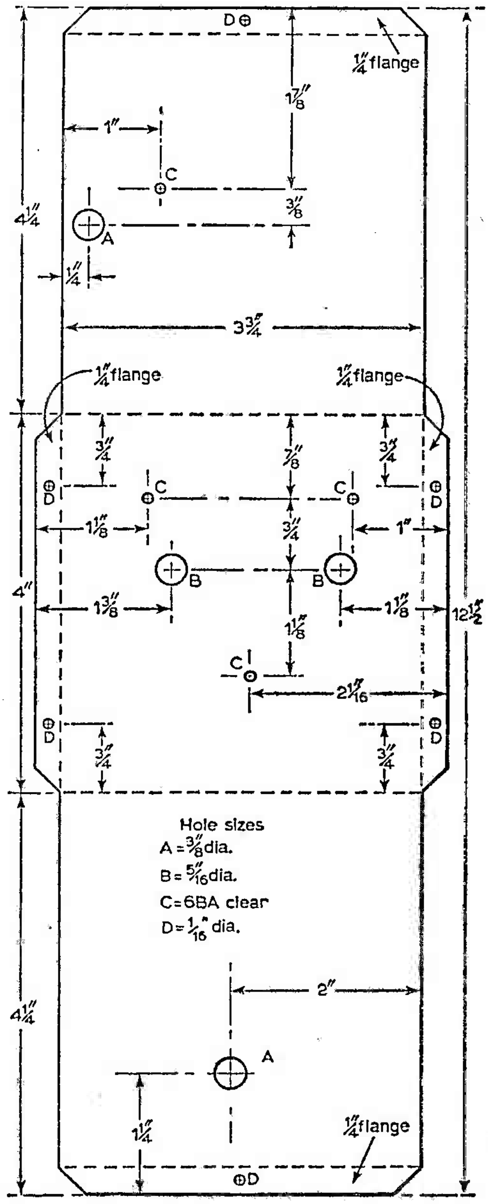
S1a. This minimises lead inductances and stray capacitances. It may be found an unnecessary precaution, but is advised.

The oscillator transistor (Tr3) collector lead is similarly taken direct to the pole contact of S1b but an anchor tag (ft2) is provided. This is not for the collector of Tr3, but for the variable capacitor VC1, and the capacitor C17 which couples the oscillator to Tr2, the frequency-changer. If electronic tuning is used, the 3·9pF series capacitor (see Fig. 3) is taken direct to the pole contact of S1b also.

The transformers T1 and T2 are so wound that the primary winding is just above PC1 circuit board and the secondary winding just below. This enables the B− contacts to be made at the edge of PC1 board, with the shortest leads to the switches.

It is not safe to rely upon the spacers and struts of the switch to give proper r.f. connection between the two boards. However it is very convenient for the switch to anchor the two boards mechanically together, and so when the switch has been mounted on PC2 circuit board, the first wafer is separated from the switch body by two $\frac{5}{32}$in. spacers and is clamped in position with 6BA nuts, with a washer. A single spacer $\frac{5}{32}$in., is then put on each strut, and then the upper circuit board. Two more $\frac{5}{32}$in. spacers are added to each strut, then the upper wafer, and finally this is clamped down with another nut. To enable this to be done conveniently it is suggested that the screw head is first cut off each bolt before assembly. The circuit boards will be separated by $1\frac{1}{4}$in., the wafer by $\frac{3}{4}$in. approximately, and the spindle need not be shortened; about $\frac{7}{8}$in. spindle stands proud (see Fig. 8.)

There is a certain amount of "radiation" from the line time base generator over a wide band of frequencies, and this can be picked up six feet or more from the receiver. The r.f. unit will normally be within this field, and so screening is necessary to avoid the appearance of three faint vertical strips on the picture. Also, the screening prevents hand capacitance effects and affords a means of mounting. A suitable box consists of three sides of aluminium



sheet with three sides of perforated zinc (which is much cheaper and easier to work); details for the marking-out of the sheet metal are given in Fig. 9. The tuner is fixed into the "box" by means of threaded rod, which also serves to mount the tuner in the cabinet when the time comes.

NEXT MONTH—PART TWO, COIL DATA AND I.F. VIDEO AND SOUND OUTPUT STAGES

A Do It Yourself Series

A VIEWER'S GUIDE TO TV SERVICING

by H. Peters

PART 2. NEON SCREWDRIVER TESTS

IF you read the first instalment of this series you will realise that it is not intended for the enthusiast with the shed full of bits and pieces, nor for the full or part time TV repair man.

These keen types will already have all the tools they need, and probably more, but for he whose interest in the back of his TV only begins when the front of it ceases to entertain, here are a few tips on the collection of a tool kit calculated to serve most purposes and not cost a fortune.

The Bare Minimum

If you have decided to limit the scope of your repairs to valve changing and simple replacements or repairs, practically all you need is a neon screwdriver. With this you will be able to check where mains is or is not and, with a bit of practice, where d.c. h.t. exists and whether the line scan stage is working or not.

The Happy Medium

Assuming that you are willing to take things a stage further the tool kit takes on a more practical form. As well as the neon, an ordinary screwdriver with ¼in. blade and another with a Phillips (cross) head are desirable. You can buy a combination tool with reversible heads, one of each. Pliers you probably own already and most households boast a pair of tweezers.

Side-cutting nippers are almost essential but a good, cheap substitute is a set of "Bib" strippers. These cost 3s. 6d. and will cut and strip almost any kind of wire you are likely to encounter. They also have a 4 and 6BA spanner stamped in the end.

Most of the nuts and bolts in television are 6BA, 4BA and 2BA, and since the middle size is the most popular and frequently encountered on the heads of self-tapping screws, a 4BA box spanner is desirable if not essential.

The rest of the tool kit is probably in the house already. Trimming tools are readily made from plastic knitting needles with their points broken off and filed to a blade. A size 12 fits most local oscillator cores in the tuner, and a size 10 fits most i.f. transformers.

Growing in popularity in the i.f. stages are hexagonal holed cores. These need a special plastic tool like an Allen key to adjust them and should not be attacked with a knitting needle; in fact, since they are quite a stable form of core, the sensible thing is to leave them severely alone unless you have a signal generator and manual to do the job correctly.

A 4BA trimming tool for adjusting the "beehive" capacitors found in rejector circuits can be made by forcing a hot 4BA nut up an empty ballpen case, removing it and allowing the case to cool to shape.

Brushes

Four brushes normally found in the home are often needed on the TV chassis. A 1in. paintbrush makes a good chassis dusting brush, a toothbrush is ideal for scrubbing tuner contacts, a suede brush (the type with brass bristles) will shine up dull surfaces on the chassis, tuner contacts, valve pins, etc.

A child's paintbrush is used for light lubrication of moving parts and cabinet retouching and, if held at the wrong end, will provide an insulated probe when checking wiring for intermittent connections.

Switch Cleaner

Several proprietary switch cleaning fluids are available to the trade only. All of them clean switch contacts very well but several of them also dissolve plastics. As a lot of switch contacts are mounted in plastic formers and have plastic knobs you will doubtless be relieved to discover that as a layman you cannot obtain any of these branded fluids.

From a very early age the writer has had it drummed into him "Never use grease or turps substitute on switch contacts" and, being of a curious disposition, decided to find out why. The result is that he has used the forbidden fluid for the last ten years with great success!

Its main virtue is that although it occasionally does not do much good it never does any harm to plastics or cabinets. The recipe is 1oz of Vaseline (MS4 silicone grease if you can get it) to one pint of turps substitute/white spirit. This takes two days to dissolve properly and is enough to last the large workshop six months.

For your own use a fingerful of Vaseline in an aspirin bottle of turps substitute will be all you need. You are then faced with the tricky problem of getting it out of the aspirin bottle into the set at the right place and in the right quantity.

Suitable implements for this purpose are an eye dropper or squeezable plastic bottle such as a lemon juice container. Better still, if you can get it, is a used disposable hypodermic syringe.

Volume controls usually have a small hole in the casing or a hollow rivet through which the fluid can be squirted. Do this with the set unplugged and, after rotating the knob a few times, give the set about 30 minutes for the fluid to evaporate before you switch it on again.

On turret tuners use a toothbrush to apply the fluid and finish off with a thin film of Vaseline if desired. On incremental tuners with rotary "Yaxley"-type switches and on TV f.m. slider switches, use very sparingly and do not let it soak into the paxolin of the switch wafer, or friction will make the switch heavy to operate.

Other uses for the switch cleaner are the dissolving of wax deposits on the chassis, the cleaning down of cabinets which have had too much wax polish applied. In an emergency it makes a good anti-static screen cleaner and can benefit squeaky castors and stiff automatic record changers.

Cabinet Retouching

Most cabinets are cellulose sprayed. Some are polyester varnish and these should be dealt with

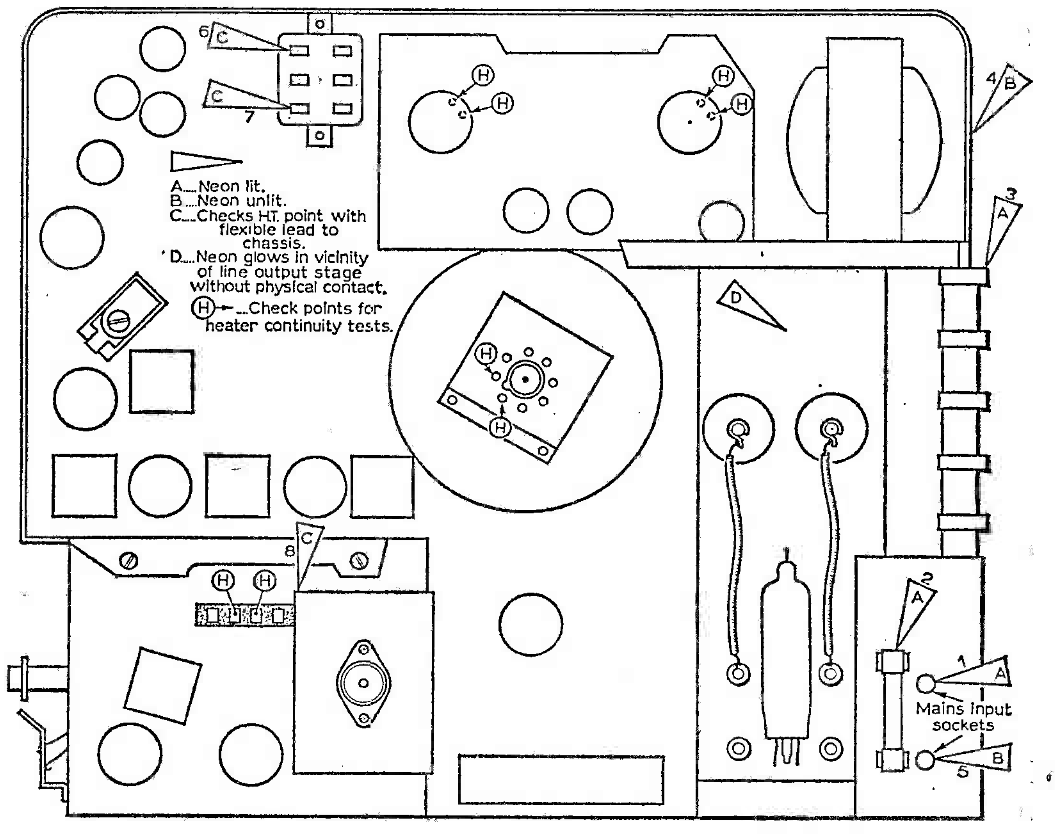


Fig. 3—A typical upright chassis, on which the following neon tests can be made.

Test with finger on neon.	Condition.
Lights at (1) but not at (5)	Mains polarity correct.
Lights at (5) but not at (1)	Mains polarity reversed.
Lights at (1) and (5)	Open circuit neutral mains lead.
Does not light at (1) and (5)	Open circuit live mains lead.
Lights at (1) but not at (2)	Blown fuse.
Lights at (1) and (2) but not at (3)	Faulty on/off switch.
Lights at (4) but not at (5)	Faulty on/off switch.
Lights on some terminals of mains resistor (3) but not on others	Faulty mains resistor.
Lights at (3) but no valves light	One valve open circuit.

To obtain an h.t. indication as at 6 and 7 on the sound output transistor or at 8 on the tuner input it is usually necessary to fit a flexible wire between the top of the neon and chassis. Most neon testers have a hole capable of accepting a wander plug at the top. Points marked H indicate useful test points where the heater chain is brought to the "surface" of the chassis.

by an expert. Fortunately they are not only in the minority but their lustre usually outlives the chassis they encase.

Small scratches on cellulose usually disappear if they are darkened slightly and a small amount of creosote on a wad of cotton wool is all that is normally needed to bring this about.

Avoid using creosote near the newer type of plastic knobs and if in doubt try applying it to a small square of the cabinet in an inconspicuous corner before moving on to the part which is always seen.

Very dull cellulose finishes may be revived to their original lustre by polishing with metal polish. Follow this up with an abrasive car polish and finish off with a wax furniture cream. Metal polish can also be used to reduce fine scratches on the Perspex type of screen implosion guard.

Do not use coarse rags for any of this work or matters may be worsened.

Equipment

The dividing line between tools and equipment is still a talking point in many workshops but for most of the work needed in simple servicing a soldering iron and a meter are the only two essentials.

For the enthusiast who wants to take the job more seriously the next two items to buy are an oscilloscope and a signal generator in that order. A number of suitable meter designs for the home constructor are constantly appearing in companion magazines and some are so cheap to make that the outlay involved is comparable to the purchase of a replacement line output valve.

The majority of readings on TV sets are made on the 250V d.c. range. The other popular ranges are the ohms ranges, especially one which reads Megohms accurately. Most service sheets give voltage readings taken by a 20,000Ω per volt meter such as the AVO 8, but if you are using a 10,000Ω per volt meter such as the Multiminor the difference is small enough to be ignored.

It is possible to use a meter of 1,000Ω per volt sensitivity without damaging the circuits but the voltages read will differ widely from those in the service sheet and a table of readings should be compiled while the set is still in good running order.

Nearly all voltage readings are given relative to chassis, so the negative test probe of the meter should have a crocodile clip (in desperation use a paper clip) as its termination. The positive probe should be as sharply pointed as possible, especially if you are measuring on a printed circuit which is varnished over.

An empty ballpen case with a stiff brass insert filed to a point makes an ideal probe. You can if you like attach the lead-out wire to the metal part of the refill and this way you will get a probe which will not only read but write!

Unhappily this state of affairs does not last long with the author. The first spark he draws on a current measurement usually welds the ball to the socket and on one occasion he was horrified to see the ball actually leave the pen and fly into the gap of a loudspeaker magnet.

On the subject of soldering irons, much is a case of individual preference but for most purposes a small mains instrument such as the 25W Henley Solon is all that is needed. Gas-heated irons are rather too bulky for modern chassis wiring.

The only objection to the small iron is that it will not make a good joint on the metal chassis itself. Usually it is possible when replacing a component to leave enough of its original lead-out wire protruding from the chassis to solder the end of the replacement upon.

The next part of the series will give a few hints and tips on the most frequent offenders in TV sets with particular emphasis on how to check components without spending a fortune on test equipment.

—continued next month

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

WE start this month with some details of European TV stations that can and have been received in Band I in the British Isles. First of all a few explanatory notes.

(1) The "Tropospheric" list is very much dependent on the geographical location of the receiver both in respect of the distance from the required transmitter and the nature of the intervening terrain.

If, for example, you are in the North of England or Scotland and the distance to Caen, France, is over 500 miles it is extremely unlikely that you will receive it even under the most favourable propagation conditions because the distance is too great.

You may also have difficulties if much nearer when there is an obstruction in the form of rising ground or high buildings in the direct line between you and the transmitter.

The tropospheric reception of a distant station in one direction does not mean that reception of another is possible in a different direction at approximately the same distance even if the intervening terrain is similar in both directions. This is because the atmospheric conditions often cause fairly sharply defined "ducting" paths to appear in a certain direction only.

Indications of good reception in a certain direction, however, should encourage us to try for reception from other stations in that general area. For example, if reception from Ruiselede, Belgium (E2), is good, then it is worth while looking for Lopik, Holland, on E4, although the difference in frequency between E2 and E4 may mean that the signals E4 are not refracted so well and E4 is not receivable from Holland.

In spite of the above remarks, which are intended for guidance only, try for reception of any possible station at any time as tropospheric reception is very fickle and does not necessarily always obey the rules and occasionally, under very abnormal conditions, very abnormal reception is possible.

Tropospheric reception is usually best during periods of "settled" weather, particularly when there is a sharp drop in temperature in still air as in the evening during summer and autumn and, above all, during fog.

(2) Sporadic E reception is, as its name implies, even less predictable and the best period of the year is usually May to September, but reception is possible throughout the year, although winter openings are somewhat rare. Unsettled, thundery weather is often an indication of possible Sporadic E reception, but there is no hard and fast rule, so keep your eyes open and keep trying!

Like tropospheric reception, an opening often means that reception of more than one station in a certain direction is possible, but here the general direction is less sharply defined and other directions of reception are more likely to be possible than is the case with tropospheric reception.

Sporadic E signals are very prone to changes in "skip" distance in a certain direction. For example, when reception from the East is available and (say) U.S.S.R. is being received on channel R1 we often find a "fadeout" of this signal means its replacement by (say) a Polish station. This in turn can vanish, only to be replaced by a Czech station.

As the skip distance progressively decreases, the nearer transmitters begin to appear in turn, but at times it is possible to have simultaneous reception from stations at different distances.

"Floaters"

Simultaneous reception of two or more stations gives us a rather curious effect on our screen—we see our original stationary locked image with a second, third or even fourth picture in motion across it; this picture is usually complete (i.e. line/frame locked) but travelling across the screen horizontally at varying speeds.

For want of a better word we call these moving images "floaters" and they are of considerable use to us as they enable us to receive more stations per channel than would be the case if they were not present. Test cards, for example, can show a different card from another country floating on the first card received or we may see a duplicate of the first card as a "floater". This indicates a second station in the same country as the first card.

Next month we will publish a full list of Band I stations, giving channel, country and notes for each.

READERS' REPORTS

N. Crisp (Hadleigh, near Ipswich) has been doing well with his converted Regentone Ten/8 set and has already, in his first season of DX-TV, logged Italy, Spain, Sweden, Belgium, France, Portugal, Norway, Czechoslovakia, Finland, USSR, West Germany and possibly Austria as well, which is an excellent start.

Ian Beckett (Twyford, near Buckingham) has submitted a most impressive log of u.h.f. DX-TV, but we are going to hold over the details for an article in the near future on u.h.f. DX possibilities.

U.H.F. Caen Mt. Pincon is reported by Ian Beckett as being operational on channel 25 and he also reports another ORTF French station on channel 28 and from aerial direction this appears to be Rouen.

UNDERNEATH

THE DIPOLE

THE television industry is devoted to the study of statistics. On the programme side it is hypnotised by the glamorous vital statistics of TAM ratings or Audience Research assessments. On the TV equipment manufacturers' side, they analyse the sales figures of domestic receiving sets and also the relative values of technical performance stylisation, cabinet finish and ease of operation.

What the Public Want?

It is sad to relate that from the buyer's point of view, technical performance is a bad second in appeal compared with appearance of a television set, whether it is on hire or purchased. The housewife (who usually has the last word!) alas, is more impressed with what a set looks like as a piece of furniture than how the picture looks or sounds. In an interesting lecture before the British Kinematograph Sound and Television Society, Mr. E. G. M. Alkin of the BBC related some of the answers received to a questionnaire to viewers. In reply to the simple question *"Does the sound come from the front or the side of your set?"* came the decisive answer: *"Yes!"* from a large number of participants. No wonder the designers of sets have to study the housewives' choice in contemporary trends and designs of curtains, wallpapers and carpets! The sound technicians in studios also have to remember the muffling effect that curtains have on side-facing loudspeakers, which has to be counteracted by pre-emphasis on sibilants to make speech reasonably intelligible on sets with poor sound.

The public gets what it wants at the lowest possible hire or purchase price, and it is high time that it was educated to look for the best technical performance, even if a set costs a little more. After all, one hopes to look at the picture and hear the sound, and, while doing so, forget the set's appearance. There are growing numbers of TV sets which now achieve most of these objectives; a few of them even have really good loudspeakers. The odd few pounds extra is money well spent. **For a few extra pounds you can buy yourself a colour television set in America or Japan — not here, just yet.**

Colour TV Statistics in USA

The price of colour television sets in USA has come down to \$350 (which is equivalent to about £125) for a twenty one inch table model set. Considering the complications of the three colour system, compatible also for black-and-white, this seems remarkably cheap and has been achieved by mass production of five million sets in 1964 and an estimated fifteen million by 1968. In 1964, the sales of colour television sets amounted to 35·7% of the American market, with black-and-white console sets 18·1% and black-and-white table and portable models 46·2%. The number of television stations equipped for colour transmissions rose to over three hundred. The reliability of colour television transmitters and receivers has improved rapidly during the last three years and the joke is over about the colour television maintenance men becoming lodgers in the households of the proud owners of these sets. Millions of dollars have been spent in the development of the American NTSC colour system in both USA and Japan, and the annual losses of ten years are now becoming profits. Meanwhile, technical committees in Europe are still debating merits of SECAM (French) and PAL (German) systems as alternative standards.

Colour Films for TV

The European engineers have tended to attach great importance to live or videotaped colour television as a source of programme material. The Americans have followed their black-and-white policy for staged programmes, of which about 80% are produced on motion picture film, both for interiors and exteriors. The breath of fresh air and the wide open spaces are important ingredients for success. The same applies to fluidity in film-editing which is impossible with VTR. This accounts for the astonishing fact that Hollywood now employs more people on film production than in the palmiest days of the cinema. Some of the largest studios in California are devoting 75% of their activities to films for television (both colour and black-and-white) and a few of the smaller ones are completely occupied with TV films. Currently, there are over a hundred film units in USA occupied with TV film series, documentaries and commercials. This compares with about six TV film series being made in British film studios by traditional methods, which are of excellent quality but expensive and comparatively slow in production. **The daily output of film making in British film studios is two minutes twenty-eight seconds per day for feature cinema films and about six minutes per day of films for television must be compared with the thirty minutes per day per stage achieved in British television studios, which are probably the most advanced in the world in this particular field.**

The Next Move?

It is generally conceded that the development of u.h.f. transmissions in England has been a flop. BBC-2 has been making a gallant effort at great cost and with very limited success. The excellent quality pictures on 625 lines on the monitors at BBC's Television Centre Studios are rarely seen on switchable receivers unless their aerials are well sited and close to the transmitters. The 50-field flicker is noticeable when the brilliance is turned up. The information contained in 625 lines on 50 cycles is virtually the same as on 525 lines at 60 cycles (as in USA) from which there is a complete absence of flicker and less eye fatigue. Have we made yet another mistake in policy? Will millions of pounds go down the drain to pay for hundreds of u.h.f. TV relay transmitters? Will viewer licence fees increase, possibly by £2, to subsidise the u.h.f. white elephant. Will the television receivers in Britain become complicated patch-ups of u.h.f. and v.h.f. frequencies for black-and-white and colour, plus switch-backs for negative or positive modulation for vision plus frequency or amplitude modulation for sound? All these complications present set designers with problems of circuit instability and continue the retreat from the quality obtainable on the d.c. restoration domestic receivers of years ago.

Colour Supplements for British TV?

Colour has caught the fancy of the public with their holiday snaps and movies, huge colour transparency pictures in room decor, 70mm cinema films of superb quality, colour supplements in the Sunday papers and colour advertising in daily papers. The time will not be distant when colour supplements will appear in British television programmes, not to mention colour commercials on the ITA. It is an expensive step in progress, too expensive to fritter away in its transient appearance on live television transmission or to be restricted to 405- (or 625-) line standards which are not exportable to other countries. The Americans are going ahead fast. Let us hope that the British television industry doesn't continue to dither about in a modern version to Vienna Congress Dances or fiddle about while Rome is burning, with endless discussions under the old P.A.L.'s act!

Many problems lie ahead. The magnificent studios at BBC's Television Centre and the ITV's London and regional centres are probably the best in the world. But the techniques and technical facilities required for colour TV are still to be developed. **Time flies, and if we want to take our place in the world market, it may be later than we think.**

At any rate, this is the opinion of your commentator.

Iconos

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30 YEARS BACK

THE BIG news in April 1935 was the forming of the Television Advisory Committee, following the recommendation of the Television Committee that a public high definition TV service should be started. One definite fact was known: that the service would be "transmitted on ultra short-wave lengths in the neighbourhood of 7 metres". Various sites for the first station, to cover the London area, were under consideration.

The BBC had already appointed the first Television Director—Mr. Gerald Cock, who had previously been a director of outside broadcasts. And Wolsey Television Ltd., announced that they would be marketing "a suitable receiver for both the vision and sound channels" at a price of £25—£30.

The main prestige article in this issue was "Television: Old and New" written by no less than John Logie Baird, who said, among other things: "The experiences to be gained from the 30-line transmissions will, however, prove of immense value to the amateur and help him to master the technique of high-definition reception when public broadcasting commences."

Other articles included "Television in Germany" (they were then operating an experimental 180-line system three nights a week), "Television in Natural Colours", "Optical Units for Disc Receivers", and "A Deep-sea Television Camera". There was still material on mechanical scanning but a full page was given over to an illustration of the "inside of a cathode-ray vision receiver".

Three news items evoke ironic or topical notes. We read that speculation was rife as to whether advertising would be allowed on TV. It was mentioned that "permission given in the BBC's licence to accept certain types of sponsored programmes should be applied also to the television service". It is interesting to speculate how this would have affected the future of both TV and Radio in this country if BBC had, in fact, gone commercial!

The matter of TV v. Cinema came up again. We quote: "But just as broadcasting has never succeeded in ousting the theatre and music hall . . . so I think it extremely unlikely that the television screen in the home will eclipse the cinema screen." Later; speaking of viewers, "(they) may not wish to have their eyes glued to a screen for two or three hours at a stretch . . ." Oh, dear!

Finally a voice in the wilderness, complaining that "in its present stage of development (television) is not universal". He goes on to stress that systems in various countries differed and this made reception from one system to another very difficult, or impossible. He refers to a German engineer claiming to have perfected a scheme to enable television receivers to be adjusted irrespective of the transmitting standards employed at the broadcasting station. If this genius is still around, he would be welcomed with open arms at the moment by the EBU!

PART 3 — TIMEBASE CIRCUITS

The Elements of Closed Circuit TV

BY G. J. KING

SO far in this series we have dealt with the camera tube and last month with the video amplifier. We have seen how the camera tube produces small amplitude electrical impulses corresponding to a breakdown of the scene focused upon its faceplate and how the video amplifier steps up these weak signals and corrects them so that, along with the synchronising pulses, they can be applied to the video input of a monitor receiver.

The camera video amplifier is usually designed to produce a video signal amplitude in the order of 1V peak. This is a composite signal including the sync pulses.

We shall now consider how the sync pulses are created and how they are added to the amplified vision signal, after which we shall see how the composite signal can be easily modulated upon an r.f. carrier wave.

The sync pulses in the type of equipment under discussion are derived from the line and field timebases in the camera channel. These timebases are necessary here to deflect the camera electron beam over the photo-conductive layer of the target.

It will be recalled from Part 1 that the electron beam in the picture tube has to be deflected in absolute step with the beam in the camera tube. This is where the sync pulses play their part. At the finish of each line and field scan in the camera channel, sync pulses are produced by the timebases. After shaping these are sent along with the picture information to the monitor set.

At the monitor the sync pulses are separated from the picture signal in the usual manner and they are then used to initiate the line and field flybacks. This action ensures that both the line and field scans start off in the picture tube at exactly the same time as they start off in the camera tube and that the beams are deflected in step over the scans.

Interlace Systems

At this stage it should be noted that a synchronising system that fails to provide a constant interlace is usually adopted in the popular type of closed-circuit television system. The interlace is said to be of the "random type". This implies that the lines of one field fail consistently to fall between the lines of a subsequent field. The interlace tends to vary at random between the "perfect" and "line pairing".

In practice this is of little consequence and a closed-circuit system using the random interlace technique is capable of providing very good pictures.

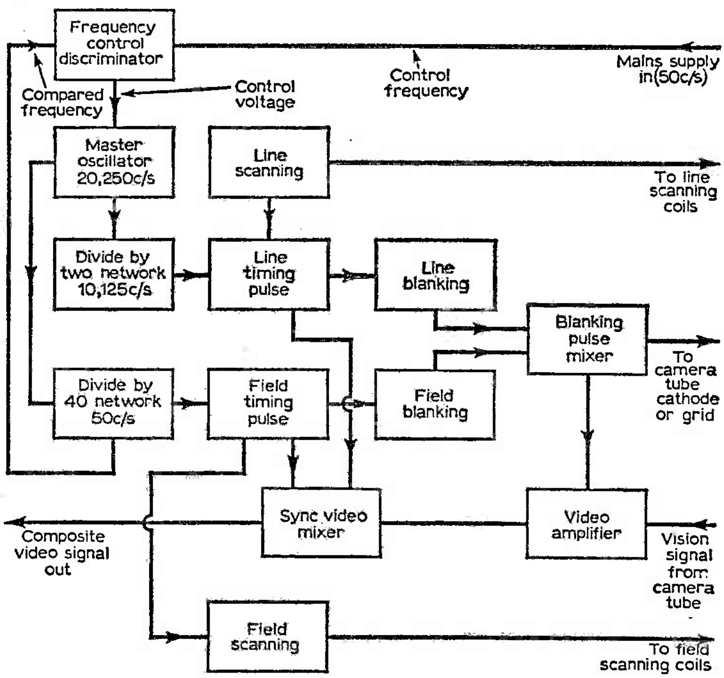


Fig. 11—Block diagram of closed-circuit television system adopting full interlace. A master oscillator controls both the line and field scanning, blanking and sync signals. This is controlled by a discriminator circuit which receives samples of the field signals and the mains power signals. Should the frequency of these signals tend to differ a control voltage is produced which adjusts the frequency of the master oscillator so that the field frequency corresponds exactly to the mains frequency. This avoids the ripple due to asynchronous working. That is, when the field frequency differs a few cycles from the mains.

Random interlace is used in inexpensive systems because it is far less complicated than a system employing full interlace. Pictures of the BBC and ITA, of course, are fully interlaced. This means that a complete television picture is produced of *two* fields (or frames). On 405-line pictures each field comprises 202½ lines and on 625-line pictures 312½ lines. The lines of the two fields are interlaced to give a complete picture of the full number of lines. In practice not all the lines are used to carry picture information because some of them occur during the blacked-out period between fields and are not seen.

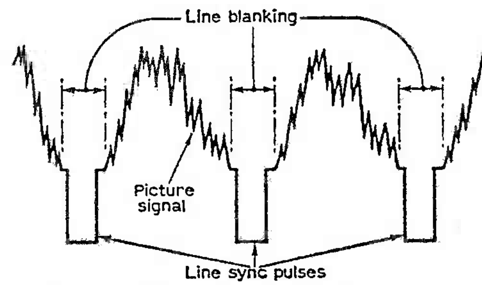


Fig. 12—Illustrating a line blanking period.

British Systems

On all British systems the field timebase operates at 50c/s and is often locked to the frequency of the power supply system. This then means that a picture field occurs every fiftieth of a second and that a complete picture happens every twenty-fifth of a second. On 405-line systems the line timebase operates at 10,125c/s and at 15,625c/s on 625-line systems. The line timebase repetition frequency is discovered by multiplying half the number of lines by the field repetition frequency.

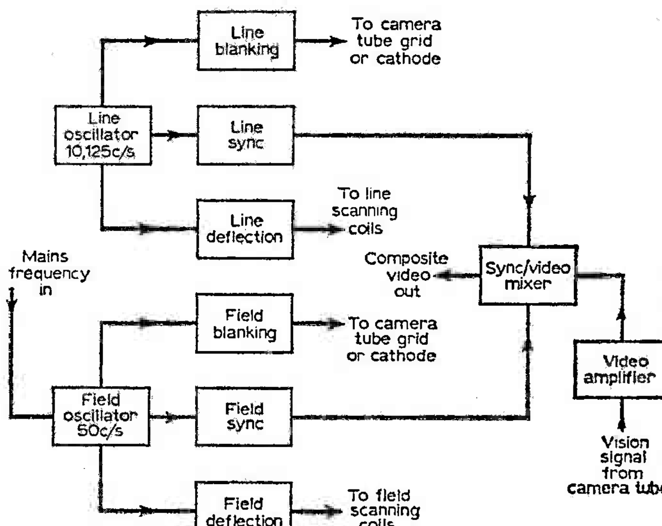


Fig. 13—Block diagram of a random interlace closed-circuit TV system. The line oscillator is free-running while the field is derived from the mains supply at 50c/s.

Full Interlace

The other complex stages of a camera system employing full interlace is shown in Fig. 11. The line and field timing or sync pulses are derived from a controlled master oscillator which, on 405-line systems, operates at a frequency of 20,250c/s.

Thus by the use of a circuit which divides this frequency by 40 a 50c/s timing pulse is produced for the field circuits, and by the use of a circuit which divides the master oscillator frequency by two a 10,125c/s timing pulse is produced for the line circuits.

Mains Locking

Locking to the mains frequency is often accomplished by a discriminator network. This compares the generated field frequency with the supply mains frequency. Any difference in frequency produces a control voltage which is used to correct the frequency of the master oscillator.

In the system depicted in Fig. 11 the line pulses operate the line timebase and the field pulses operate the field timebase for deflection of the camera tube scanning beam. Various "blanking" networks are also utilised to blank off the camera tube electron beam during the flyback periods between successive line and field scans.

Fig. 12 gives an illustration of line blanking during the line flyback when the line sync pulse is added.

Random Interlace

The far less complicated random interlace arrangement is shown in block form in Fig. 13. Here we have a free-running 10,125c/s oscillator (for 405-line systems) to provide line deflection, line sync and line blanking and a 50c/s oscillator locked to the mains supply frequency to provide field deflection, field sync and field blanking.

It will be seen that there is no definite relationship between the line and field scanning frequencies. The payment for this simplification is the lines of the picture dancing in and out of interlace, but this need not be disturbing as already intimated.

Simple Field Timebase

Fig. 14 shows a basic random interlace field timebase circuit. This is probably the simplest transistor circuit that there is of this kind. There is no actual field oscillator. Instead signals at 50c/s mains frequency (picked up from a winding on the

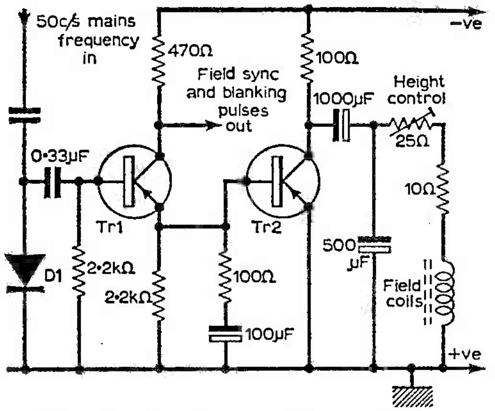


Fig. 14—Simple field timebase operated from 50c/s mains supply.

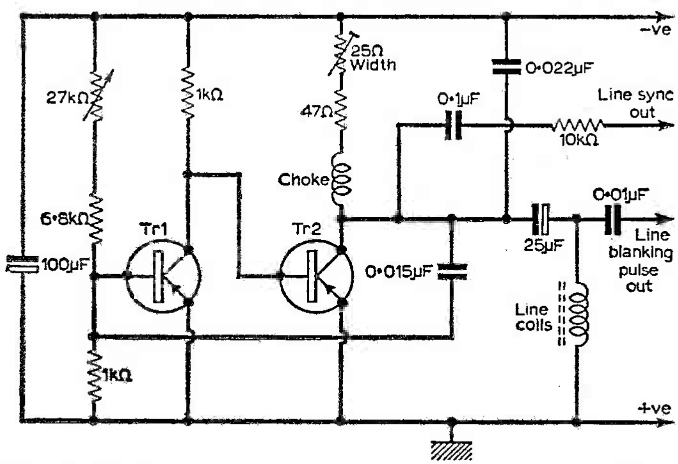


Fig. 15—Simple line timebase circuit using a free-running oscillator.

mains transformer) are applied to the base of Tr1. These signals are rectified by the diode D1 and amplified by Tr1. The signals resulting at the collector are used for field sync and blanking purposes.

The signals at the emitter of the transistor are fed to the base of Tr2, this transistor being the field amplifier proper. The collector feeds the field scanning coils from a capacitive potential-divider, which corrects the waveform, through the height control and a 10Ω limiting resistor. Further waveform correction is provided by the 100Ω resistor and the 100μF electrolytic capacitor in Tr2 base circuit.

This is a very straightforward circuit with virtually nothing to go wrong and represents an ideal experimental network for the enthusiast. A control of field linearity can be provided by replacing the 100Ω resistor in Tr2 base with a 250Ω preset.

Simple Line Timebase

An equally simple line timebase circuit is shown in Fig. 15. Here the collector of Tr2 is fed back to the base of Tr1, via the 0·015μF capacitor, to form a self-oscillating circuit. The repetition frequency is governed by the feedback capacitor mentioned and by the setting of the 27kΩ potentiometer in Tr1 base circuit.

The collector of Tr2 is loaded by a choke and resistor combination, the resistors controlling the line scan amplitude and the choke acting as a corrective coupling to the line scanning coils. Further waveform correction for a linear line scan is given by the 0·022μF capacitor on Tr2 collector.

Line Blanking

Line blanking is provided simply by feeding a pulse from Tr2 collector to the control grid (or modulator as it is often called) of the camera tube. This pulse kills the camera output during the line period and thus gives the blanking effect as shown in Fig. 12. Line sync is extracted also from the collector of Tr2, the waveform here being corrected by the capacitor-resistor coupling.

This signal, along with a suitable field sync signal from the field timebase, is applied to the sync/video mixer as we shall see.

Field Pulse Shaping and Blanking

Fig. 16 shows a field pulse shaping circuit. Here the signal at the collector of Tr1 in Fig. 14 is applied to the base of the transistor. The shaped field sync pulse is fed to the same network which receives the line sync pulses coming from the collector circuit of Tr2 in Fig. 15.

A ratio of the signal at the collector of the transistor in Fig. 16 is used as the field blanking pulse. This is fed to the control grid of the camera tube, through a coupling capacitor, along with the line blanking pulses.

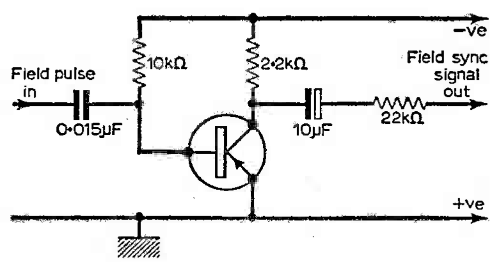


Fig. 16—Field pulse shaping circuit.

In Fig. 17 is shown the circuit of the video/sync mixer. This is very straightforward, the transistor being arranged in the common-collector mode (emitter-follower). Both the vision signals from the video amplifier and the sync signals from the timebases, via the pulse shaping networks, are applied to the base of the transistor and the composite video signal being extracted at low impedance from the emitter.

Such a signal would be suitable for feeding into the control grid circuit of a video amplifier in any television receiver, assuming matching line standards, of course. Closed-circuit television enthusiasts often acquire old domestic-type television receivers which they then adapt to work as monitors. It is usually necessary simply to disconnect the feed from the vision detector to the video amplifier valve in the set, ensuring that the grid is not left floating above chassis, and then apply the composite video signal from the output of the camera channel to the grid circuit in place of the signal normally applied from the detector.

Very good results are attainable by this means and such a set-up with the camera channel exposed allows the effect of adjustments in the camera circuits to be seen and with the knowledge that, at least, the monitor is of commercial origin. This provides a standard on which the camera channel can be based.

R.F. Output

Fig. 18 reveals a circuit which allows the composite video signal to be modulated on to a carrier wave of a frequency corresponding to a Band I television channel. The camera channel output can then be connected direct to the aerial socket of any receiver of corresponding line standards and the set adjusted to the selected channel number to secure normal working conditions.

This technique has the great advantage that any domestic set can be used as a monitor without internal modifications and that any number of monitor receivers can be established on a standard amplified distribution network. Usually, however, the r.f. output is of sufficient level to work up to about three monitor sets without amplification provided they are connected to the common cable through a matching or "star" network.

In Fig. 18 Tr1 is the final transistor in the video amplifier channel, while Tr2 is the r.f. oscillator transistor. The transistor is made to oscillate by the 10pF coupling between the collector and emitter and the oscillatory frequency is tuned by L1 and the parallel 30pF trimmer. The 22kΩ resistor here provides a degree of damping.

The modulation process is basic. The OA81 diode is used as the modulator (any non-linear device is suitable for this function) and to this is applied the r.f. signal from Tr2 collector and the vision signal from Tr1 collector. This causes the amplitude of the carrier wave to vary in sympathy with the picture signal. The diode also gives d.c. restoration and a datum to the signal.

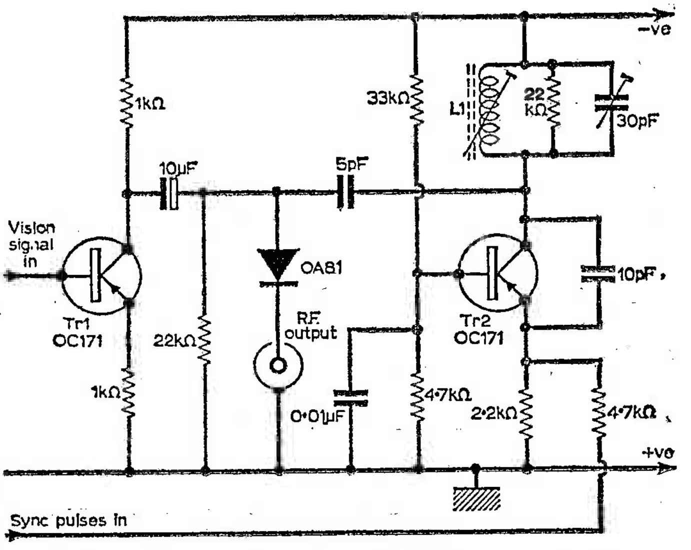


Fig. 18—Showing how an r.f. oscillator, tuned to correspond to a Band I channel, is modulated by the picture signal and the sync pulses. The former is applied together with the r.f. signal to a modulator diode while the latter are applied to the emitter of the oscillator.

The sync signals may also be fed into the diode but in the circuit shown these are taken actually into the oscillator at the emitter through the 4·7kΩ resistor.

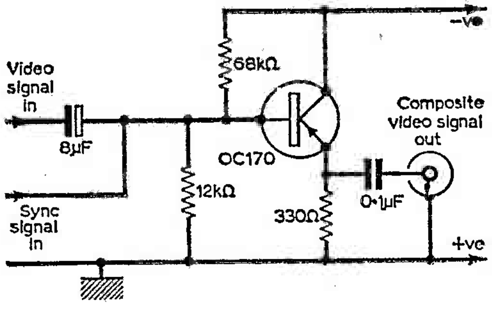
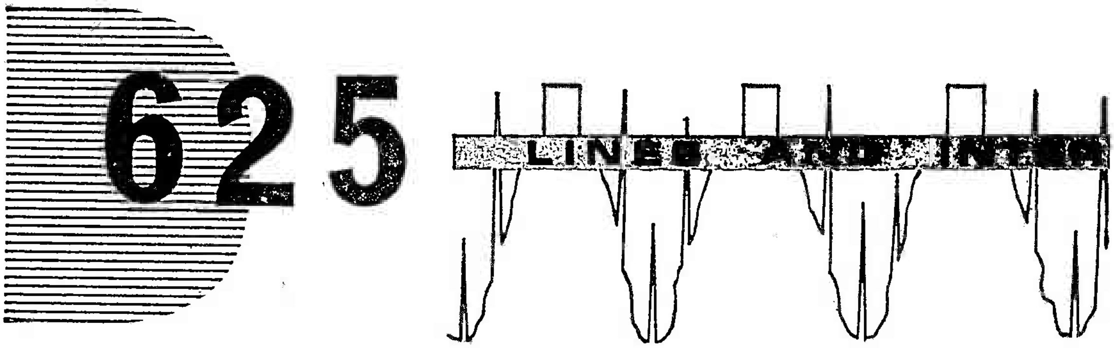


Fig. 17—Video-sync mixing circuit.

Next Month

Next month we shall deal in the final article with adjustments to closed-circuit television systems and also give some information regarding the addition of sound to the vision.

PART 4 NEXT MONTH



IMPULSIVE interference is the most common to television these days. This results from all kinds of electrical appliances and devices which tend to spark when switched or operated. A very powerful source of impulsive interference is the ignition system of a motor-car.

Brush-type electric motors of the kind employed in some domestic appliances is another potent source. Thermostats and switches also give rise to interference of this nature.

Without going too deeply into technicalities, impulsive interference is a burst of electromagnetic radiation lasting only a fraction of a second. There may be a series of such bursts, of course, thereby giving prolonged interference effects.

The amount of instantaneous power radiated during a single burst is considerable but fortunately the average power is small owing to the short time period of the burst.

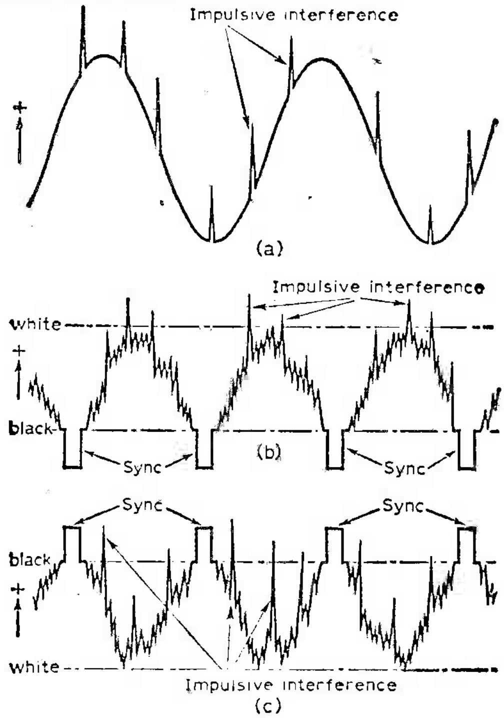


Fig. F—Impulsive interference on demodulated waveforms. At (a) on an audio signal, at (b) on a positive-going vision signal and at (c) on a negative-going vision signal.

TRANSITORY NATURE

The interference thus takes the form of large amplitude pulses with very sharply rising leading and trailing edges. The transitory nature of the pulses evokes a damped oscillation within any receiving equipment that the pulses enter.

In a television set, for instance, the pulses cause the tuned circuits effectively to "ring". The resulting damped oscillation sends a modulated burst of signal through the set which is demodulated by the sound and vision detectors and which can then disturb the sound and vision reception in a manner that is very well known.

It is interesting to note that the bandwidth of the tuned circuits through which the interference pulses pass governs the pulse time at the detector. The pulse duration, in fact, is related to the reciprocal of the bandwidth. Thus the greater the bandwidth the narrower the pulses.

The relatively wide vision channel bandwidth minimises the pulse duration and to some extent facilitates suppression of the pulses prior to the picture tube without detracting too greatly from the picture quality. The smaller sound channel bandwidth, on the other hand, makes suppression at the set just that little more difficult.

Impulsive interference appears on demodulated waveforms as shown in Fig. 1. Here we see at (a), (b) and (c) impulsive interference on sound and on 405 and 625 vision waveforms respectively. Waveform (b) shows positive modulation and waveform (c) negative modulation. The interference is common to all the waveforms in that it rises in a positive direction.

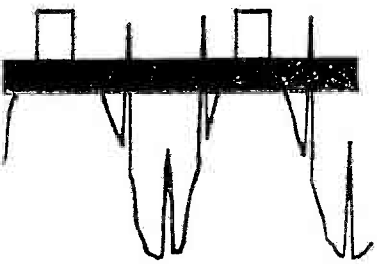
INTERFERENCE LIMITING

The best suppression, of course, is at source, so that the interference never arises on the signal waveforms. The only other palliative is to clip the interference at the set. Limiters are used on both sound and vision for this purpose as is well known.

The sound limiter is caused to conduct or go open-circuit (depending upon its design) on pulses of interference and thus either short-circuits or blocks the pulses prior to the audio amplifier. In that way the audio signal is let through while the interference is suppressed.

Similarly, on the positive modulation of the 405-line standard either the positive-going pulses are clipped before peak white or they are neutralised by the application of negative-going pulses at exactly the same time as the positive-going pulses occur.

The latter gives the well-known "black spotter" suppression effect where, instead of the interference



K. ROYAL

manifesting as white spots on the picture, it shows as grey or pinpoints of black.

On positive vision modulation (waveform (b)) it is seen that the pulses rise in the same direction as the picture modulation. To the receiver video circuits, therefore, the interference "looks" like picture signal of short duration, peak white nature. Hence the reason why the pulses are displayed as spots of white on the screen. The sync pulses, it will be seen, are here completely unaffected by the interference.

Now let us look at the negative picture modulation of the 625-line standard in waveform (c). Here the interference pulses rise in the direction of the sync pulses, away from peak white picture. The result on the screen, therefore, is opposite to that on 405 lines. That is, grey or black spots of interference arise.

This is useful, since the effect is precisely that produced by the vision interference limiter on a 405-line receiver. Thus, on 625 lines a vision interference limiter is not required.

Unfortunately, however, this is not the end of the story since the sync pulses are a part of it. In spite of the interference pulses rising towards black, they also rise towards the sync pulses, an effect which is not too helpful from the field and line synchronising aspects.

LESS U.H.F. INTERFERENCE

Just how greatly impulsive interference detracts from the synchronising performance of a receiver on 625 lines depends on the design of the sync circuits and on just how much impulsive interference is received by the set.

From the latter point of view, it is well worth remembering that impulsive interference is less troublesome on 625 lines as compared with 405 lines, since the interference response on the ultra high-frequency channels used for the 625-line standard is considerably less than that on the very high-frequency channels used for the 405-line standard.

Nevertheless, main road u.h.f. viewing can incite sync troubles, especially from the field timebase aspect.

At this stage it should be mentioned that the majority of dual-standard receivers embody a system of flywheel-controlled synchronising in the line timebase. This system adopts a free running oscillator and a discriminator circuit which compares the phase and frequency of the line timebase signal and the line sync pulses.

Should there be a tendency for the timebase signal to fall out of step with the line sync pulses a control voltage is produced by the discriminator which is fed through a long time-constant circuit to the line oscillator, thereby correcting its drifting tendency and pulling the oscillator back into step with the sync pulses. A block diagram of this system is given in Fig. 2.

There are various designs of flywheel-controlled line synchronising systems, the circuits of which are outside the scope of this article. Some arrange for the control voltage to correct the frequency of the line oscillator direct, while in others the control voltage operates a variable reactance device which in turn controls the frequency of a sine wave oscillator feeding the line output stage, via a pulse-shaping network. Such circuits have been detailed in past issues of PRACTICAL TELEVISION.

The chief attribute of flywheel-controlled line synchronising is that the line oscillator or generator, being buffered, in effect, from the line sync pulses, is unaffected by interference or noise which may be present on the pulses.

Noise or interference in a direct synchronising system can cause random firing of the line oscillator or generator, an effect which gives ragged edges to the vertical parts of a picture.

FLYWHEEL EFFECT

Since it is a voltage, as distinct from pulses, which controls the frequency of the line oscillator in flywheel circuits, noise on the pulses is not particularly troublesome, as will be appreciated. Moreover, the Flywheel effect given by the long time-

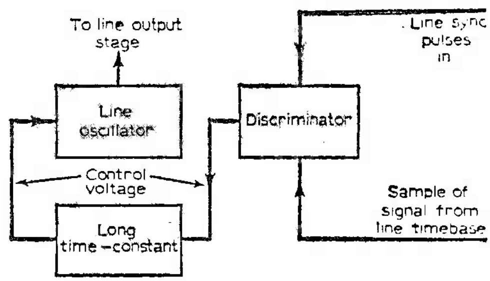


Fig. 2—A block diagram of a flywheel-controlled line sync system.

constant circuit between the discriminator and the oscillator irons out any fast variation of control voltage which may result from noise or interference on the sync pulses applied to the discriminator.

This feature also holds the oscillator at the correct frequency for a brief period should for some reason or other the line sync pulses be very badly distorted or fail altogether.

Early 405-line-only sets of the fringe area type featured flywheel-controlled line sync quite extensively. As improvements occurred in signal strength and interference suppression throughout the country, however, the system was dropped by the majority of makers in favour of direct line sync.

Owing to the very real possibility of disturbances to the line sync by interference on 625 lines, flywheel-controlled line sync is again returning to the domestic scene and it is now found in the majority

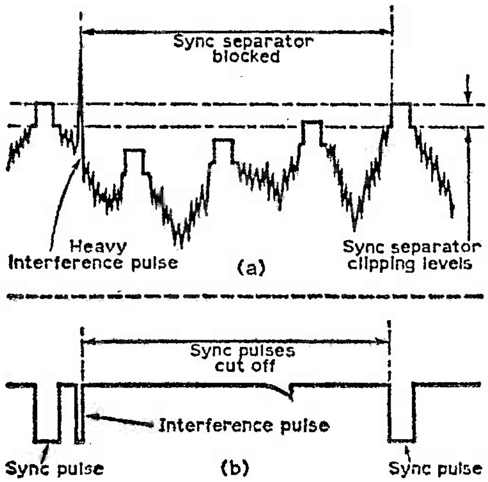


Fig. 3—Blocking at the sync separator due to impulsive interference at the control grid of the sync separator valve.

Unfortunately it is not easily possible to employ a similar arrangement in the field timebase.

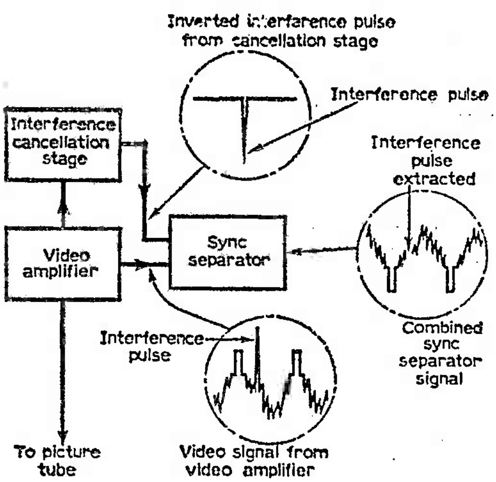
That the field timebase oscillator is likely to be as greatly affected by noise pulses as the line timebase is made clear by the waveform in Fig. 1(c). Let us see exactly what happens in this respect.

If it is supposed that a high amplitude interference pulse occurs on the video waveform, it is obvious that this will also occur at the control grid of the sync separator valve, even though the interference pulse is not actually superimposed upon the sync pulse. One can understand, therefore, why the sync separator could mistake a pulse of interference on 625 lines for a line sync pulse.

Applied to the sync separator control grid, therefore, might well be a pulse of interference rising in exactly the same direction as the sync pulses, but of far greater amplitude than these. This interference pulse will tend to push the sync separator into deeper grid current than the sync pulses.

Thus, the capacitor connected to the grid of the sync separator will develop an abnormally high charge—greater than that produced by an ordinary sync pulse. The effect is that the sync separator "blocks".

This means that it becomes inactive to ordinary sync pulses for the period of time that it takes for the abnormally high capacitor charge to leak away through the grid resistor. Subsequent sync pulses



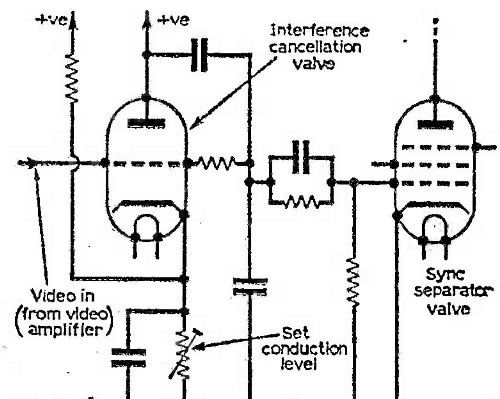


Fig. 4a (left)—Interference cancellation block diagram and; b (right)—the basic circuit. This is fully described in the text.

of dual-standard sets, either on both standards or switched in only on the 625-line standard, depending upon the make, type and the design of the receiver.

The ragged vertical effect is also emphasised on the 625-line standard resulting from random noise on the line sync pulses due to the higher line scanning speed and the greater energy of the scan. So much, then, for the line synchronising, but what of the field?

FIELD EFFECTS

In practice it is the field synchronising which appears to be more affected on the 625-line standard than the line synchronising, the latter now being stabilised by flywheel-controlled line sync.

are, therefore, not registered in the anode circuit of the sync separator valve. That is, not until the grid capacitor is sufficiently discharged.

Now, we have seen that a flywheel-controlled line oscillator can continue undisturbed for a brief period without line sync pulses, but not so the field oscillator. This must receive strong, noise-free field sync pulses to initiate the field scan and to ensure good interlace performance.

INTERFERENCE CANCELLATION

Fig. 3 shows the blocking effect at the sync separator and reveals clearly that some artifice must be adopted to avoid this so as to retain good field synchronising under conditions of impulsive interference. A method in current use employs a so-

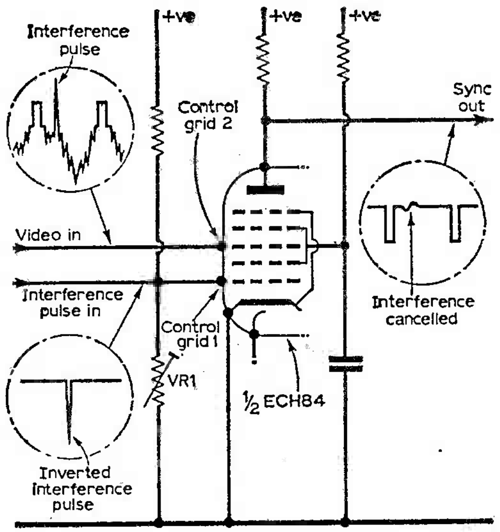


Fig. 5—Noise-gated sync separator circuit, using the Mullard ECH84 triode-heptode valve. The heptode is shown here. The triode is employed elsewhere in the receiver.

called interference cancellation circuit.

Here the output of the video amplifier valve is passed to the control grid of an interference cancellation valve as well as being passed to the control grid of the sync separator valve and the picture tube.

Now, the interference cancellation valve is adjusted to be non-conducting during normal picture signal and conducting on pulses of interference. The output of this valve is applied in parallel with the video signal at the control grid of the sync separator valve. Under zero interference conditions, therefore, the interference cancellation valve has no effect on the operation of the circuit at all.

During a pulse of interference, however, the valve conducts, and due to its phase reversal effect it passes on to the grid of the sync separator an inverted version of that same pulse. Thus, the sync separator receives two interference pulses, that direct from the video amplifier and the inverted one via the interference cancellation valve.

These two pulses of opposing phase cancel each other out at the grid of the sync separator valve, and prevent the valve from blocking in the manner already described. A block diagram of this system is shown in Fig. 4 at (a) and the basic circuit at (b).

NOISE GATED SEPARATOR

A somewhat different arrangement has been evolved by Mullard Limited. This employs a heptode valve (Mullard ECH84) as the sync separator in a so-called "noise-gated" configuration. The basic circuit is shown in Fig. 5. The operation of the circuit is quite staightforward and is given below.

Video signal from the video amplifier valve is applied to control grid 2 of the heptode section of the valve in the ordinary way. In order to get the valve working, however, control grid 1 needs to be

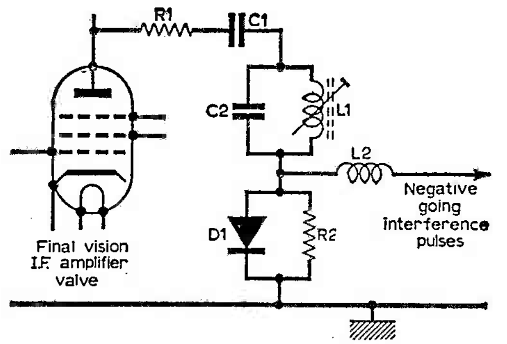


Fig. 6—A simple noise detector for operating the noise-gated sync separator stage.

positively biased to a small extent. This is achieved by the preset VR1.

To control grid 1 is also applied any interference pulses which may occur on the demodulated video signal. These pulses are derived from a noise detector and they are negative-going in opposition to the polarity of the interference pulses which occur on the video signal at control grid 2.

Now, under conditions of zero interference, the sync separator works in the conventional manner. On the occurrence of a large amplitude interference pulse, however, control grid 1 is pulled heavily negative just at the time when control grid 2 would be entering its blocking period.

The valve is now, of course, prevented from blocking since it is pulled out of conduction by the negative pulse on control grid 1. Only a very small disturbance then occurs on the pulse chain in the anode circuit, which is insufficient to impair the synchronising.

The circuit in practice may differ from its basic configuration since it might incorporate dodges which are designed to keep the gating action constant over the full range of contrast control. The triode section of the ECH84 may serve either as a pulse clipper or even as the noise detector. A simple noise detector circuit, not using the triode, is shown in Fig. 6

A NOISE DETECTOR

Here the noise detector is a germanium diode. Signal from the anode of the final vision i.f. amplifier valve is coupled to this diode through C1 and the tuned circuit L1-C2.

This tuned circuit discriminates between the sync pulses and the noise pulses, having in mind that the signal components of the sync pulses are concentrated into a relatively narrow channel of about 1Mc/s width while the interference pulses comprise signal components from very low to very high frequencies.

The tuned circuit is adjusted for minimum low frequency signal at the noise detector output, an action which deletes the sync pulses and brings forth only the interference pulses. These are then fed through the filter choke L2 to control grid 1 of the heptode. Resistor R2 is simply the diode load.

The foregoing, therefore, has shown how impulsive interference, although less responsive on the u.h.f. channels, relative to the v.h.f. channels, can upset both the line and field synchronising of 625-line pictures, and how these troubles can be overcome and, indeed, are overcome in contemporary dual-standard receivers.

Before concluding this article there are two more points of interest worth considering relative to the 625-line standard.

ASYNCHRONOUS EFFECTS

One concerns the asynchronous working of the 625-line system. On 405 lines the field timebase frequency is locked to the 50c/s mains frequency. On 625 lines there is no such locking and the field frequency differs a little from that of the mains supply. Thus, there can occur a very low-frequency beat effect between the field frequency and the mains frequency.

Normally, this is not noticeable. However, should the power supply smoothing in the receiver be below standard or faulty, then this beat effect will show up. It is displayed as a slow ripple up the picture.

If the h.t. filtering to the vision or timebase circuits is impaired, it is possible for the field synchronising to be disturbed due to hum beats, even though the ripple on the picture may barely be noticeable. The effect then is that at intervals the picture triggers one frame, and no matter how carefully the field lock control is adjusted the effect persists.

The trouble is proved by switching the set to the 405-line standard when the field lock will remain consistent and solid. The solution lies in replacing the defective filter or smoothing capacitor or the valve with a heater/cathode leak.

SIGNAL POLARISATION EFFECTS

The other point concerns the polarisation of the u.h.f. signals. From transmitters so far in action the signals are horizontally polarised. This means that the receiving aerial has to be horizontally disposed to pick up the best signal. That is, so far as theory goes.

In practice, it has been discovered that the plane of polarisation of the u.h.f. signals tends to twist, even over relatively short distances, particularly in heavily built-up areas.

Indeed, the twist in polarisation is sometimes not consistent on both the vision and sound signals. This can mean that the sound signal is of considerably different level from the vision signal at the end of the aerial downlead after the aerial has been orientated for the best vision signal. In some cases, it is possible for the sound signal to be so far below the strength of the vision signal that it is impossible to get the sound and vision together at the same point on the u.h.f. tuner.

The effect is that if the tuner is adjusted for maximum sound the vision is poor while tuning for maximum vision gives poor or zero sound!

To overcome this trouble a compromise aerial setting may be required between the vertical and horizontal planes, depending upon just how far the polarisation has twisted on sound or vision relative to vision or sound. It should also be borne in mind, however, this similar trouble can also be caused by a generally weak u.h.f. signal and by misalignment of the 625-line i.f. stages. ■

Servicing TELEVISION Receivers

No. 112: Beethoven B106/1 and Raymond F105/1

by L. Lawry-Johns

WE receive many enquiries for information on these receivers and it would appear that many readers have been using them for some years without knowing the maker or model number!

To this end we would point out that these particular models are simplified versions of the B106 and F105, which are not the subject of this article, also that the Beethoven B208 used the same chassis as the Emerson E704, already covered in this series.

The B106/1 and F105/1 may be found as table model or as floor-standing models with legs. The controls are situated at the side, the chassis is vertical and the tuner unit, etc., is mounted on a carriage which slides inward when the fixing screws are slackened to facilitate chassis removal.

Separate sensitivity controls for Band I and

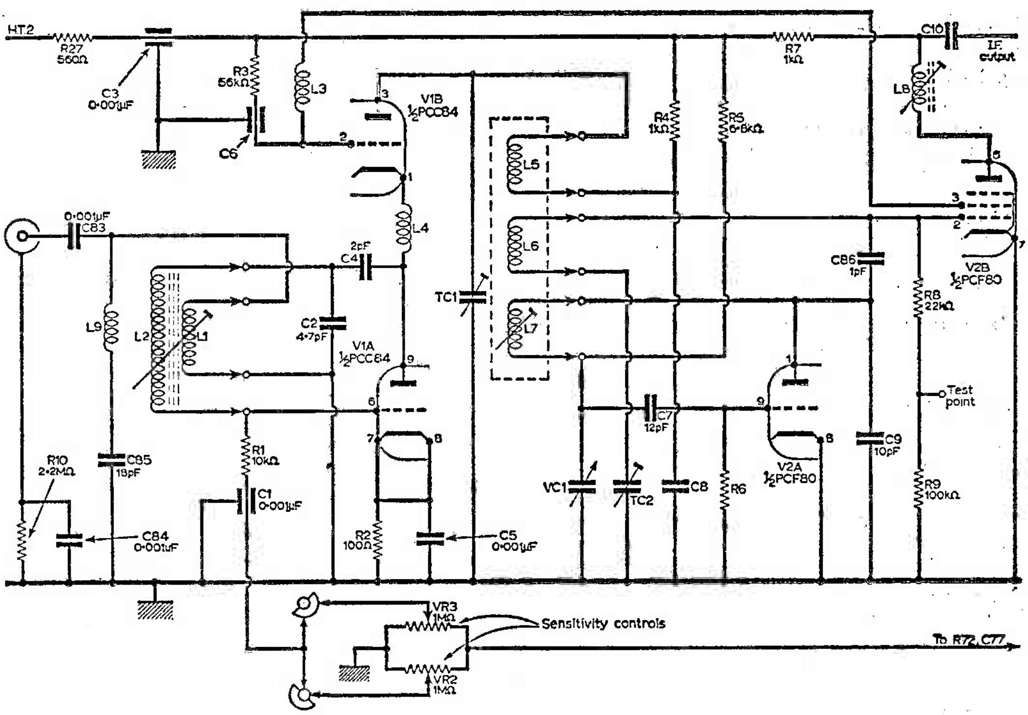


Fig. 1—Circuit of the Brayhead tuner unit and the sensitivity controls.

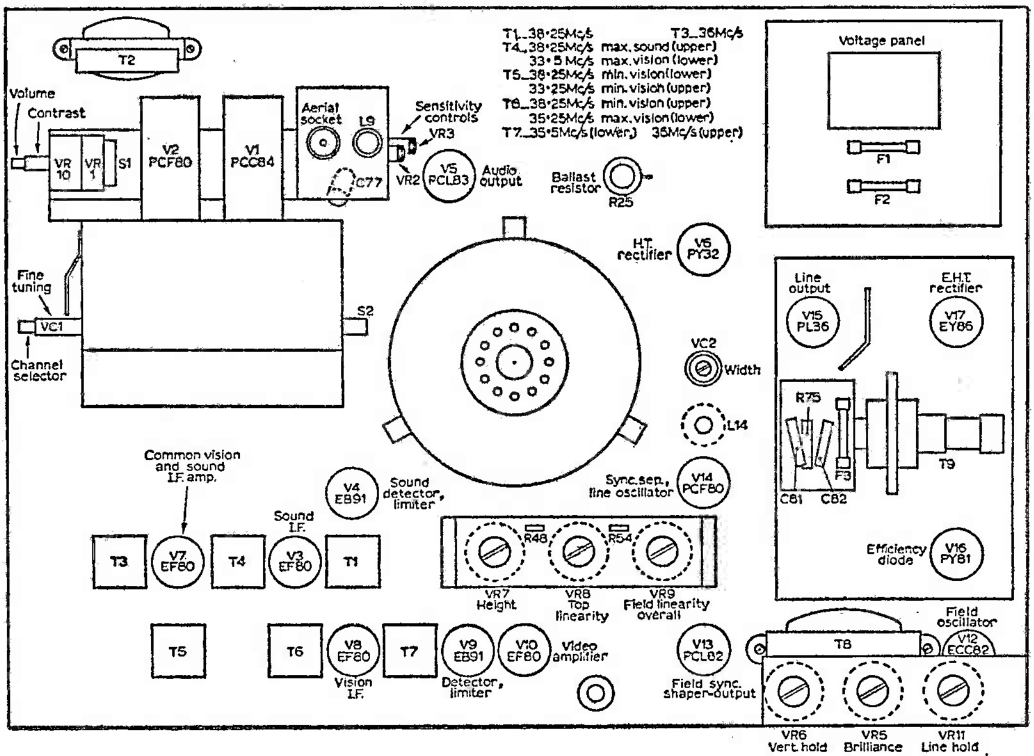


Fig. 2—A view of the chassis from the rear showing the major components. Alignment figures are given on this diagram for the i.f. transformers.

Band III are provided which feed a negative standing bias to the PCC84 control grid from the line output stage, the cathode being fixed biased.

With this circuit no a.g.c. is applied to the tuner and in areas of high signal strength it is essential to set the controls VR2 and VR3 correctly to avoid cross-modulation sound on vision—vision buzz on sound, etc. A.G.C. is only applied to the common i.f. stage V7.

The tube used is a Mullard electrostatically focused AW43-80. Attention is drawn to the fact that the brilliance is varied by applying the control voltage to the cathode; there is no direct coupling to the video amplifier and the grid is returned to chassis via the field output for blanking purposes.

We mention this so that tube base voltage tests will not be confusing. The grid is at chassis potential and the control variation is to be read at pin 11 (cathode). Boost line voltage is applied to the first anode at pin 10 and focus potential is selected by plug and socket for application to pin 6.

These are the only particular points to be borne in mind. The basic circuit is extremely simple and the faults which may be encountered are easily diagnosed and speedily rectified.

Common Faults

The h.t. rectifier valve is a PY32. The faults to be expected with this valve are as follows:

Low Emission

Small picture lacking both width and height, poor picture definition and e.h.t. regulation, eventually becoming weak or no sound and no vision as the voltage drops more severely.

Gassed

Blue glow in valve envelope, extended warming-up period with the voltage gradually creeping up, leading to delayed sound and much longer delayed picture, which appears small, to slowly improve over perhaps an hour.

Blown Fuses

Internal arcing inside electrode structure. Use a PY33 rectifier for replacement.

The fuses may only fail when the line timebase comes into operation, preceded by the PY32 heater lighting brightly. In this event change the PY81.

This fault occurs when the PY81 heater/cathode insulation breaks down, when the line flyback voltage builds up to the critical level. The fuse F3 does not always blow.

After trouble has been experienced with the h.t. supply it is as well to check the 47Ω surge resistors to pins 3 and 5 of the PY32 valve base.

Sound

The PCL83 (V5) can be responsible for various defects ranging from complete absence of sound, intermittent sound which comes on with a loud crack, distorted sound with perhaps overheating and damage to R20, or perhaps only weak sound.

An internal short in the PCL83 can produce severe overheating in R21, overloading of the h.t. supply with copious quantities of smoke heralding more serious damage and consequent extensive repairs to the dropper, surge resistors, PY32, R21, R20 and the original culprit, the PCL83.

The fault of intermittent sound can often be definitely located by lightly tapping the valve.

CONTINUED NEXT MONTH

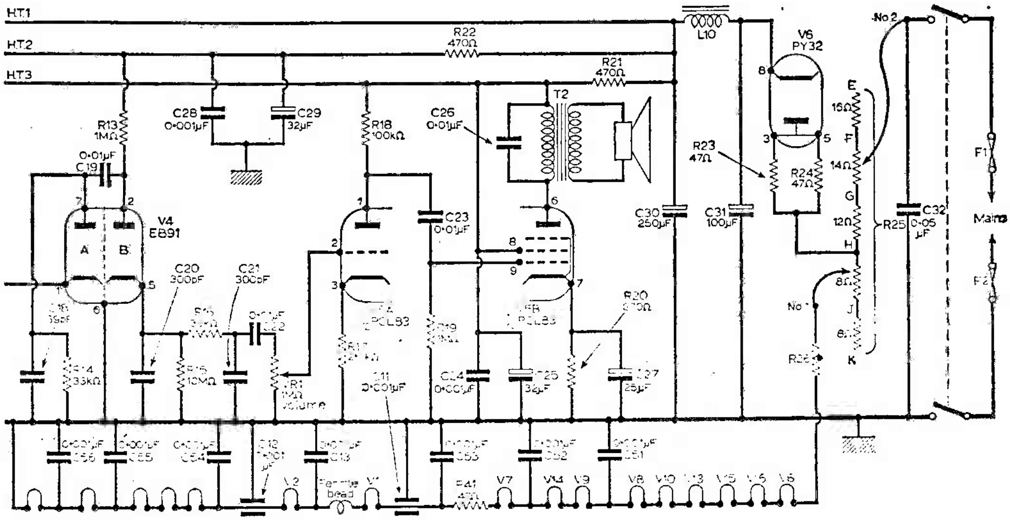


Fig. 3—The audio output stage and power supply network.

colour
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colour

NTSC

The Industry's Choice

ntsc
secam
pal
ntsc
secam
pal

WITH colour TV once again the subject of renewed discussion, and with (we hope) a decision on the standards to be adopted by Europe and/or Britain imminent, a comprehensive report on the UK-favoured NTSC system has been prepared by BREMA*. Since the subject of colour TV touches closely on the activities and interest of most readers of *Practical Television* we are reporting extensively from this document.

The Basic Set-up

From July to November, 1964, BREMA organised a series of home viewing tests using UK-made NTSC colour TV receivers. The tests were designed to assess, under normal domestic viewing conditions and for non-technical viewers who had no connection with the TV industry or programmes, the *controllability* of NTSC receivers. Information was also gathered on *picture quality* and *reliability*.

Transmissions were from the BBC Crystal Palace station, channel 33 u.h.f., and contained a mixture of camera pictures, films, slides and captions; each session lasted approximately one hour. A complete monitoring record of all transmissions was maintained at a site about two miles from the transmitter.

Questionnaires were provided to obtain information on controllability and picture quality, including that of the monochrome picture produced on the colour receiver, in order to check whether poor grey or misconvergence influenced the assessment of the colour picture. The installing engineers also gave assessments of picture quality and other information on viewing conditions.

Controllability

The results from 127 sites show that the *tuning* of the receivers was remarkably stable on u.h.f., as were the *colour intensity* (saturation) and *hue* controls. The results show that NTSC receivers do *not* require repeated adjustment.

TABLE I

Receiver Control	Number of Adjustments						
	0	1	2	3	4	5	6
Tuning...	73%	21%	4%	2%	0	0	0
Colour Intensity	44%	29%	14%	6%	3%	3%	1%
Hue	45%	30%	13%	5%	3%	3%	1%

This table gives the percentages of viewing sessions in which the stated number of adjustments were made to each of three controls.

Table 1 gives a summary of the total adjustments to these controls for all reasons and indicates that there was a strong tendency for the operator to make either no adjustment or very few adjustments.

Results show that 48% of all control adjustments were made at the *start* of the colour programme, 28% were occasioned by a "programme change" and 24% were for other reasons. The adjustment of the controls, assessed from 499 replies, was found to be better than "easy". Using a six-point scale (1=very easy, 2=easy, 3=fairly easy, 4=rather difficult, 5=difficult, 6=very difficult) the mean rating was:

Tuning	1·43
Colour intensity	1·82
Hue	1·86

Picture Quality

The quality of colour pictures, based on 1,149 replies representing 1,600 man-hours viewing, was better than "good". Using a six-point scale (1=excellent, 2=good, 3=fairly good, 4=rather good, 5=poor, 6=very poor) the mean rating was 1·75.

The quality of film clearly affected viewers' judgment of consistency, while variations between receiver types and of transmission quality had no statistically significant effect. Of the main sample 78% said that the colour picture quality was consistent throughout the programmes. In a sub-sample of 108 replies 21 viewers said that picture quality was not consistent but nevertheless gave a mean quality rating of 1·86.

The impairment of the monochrome picture, due to a colour cast, for 920 replies had a rating of 1·84 on a six point scale (1=imperceptible, 2=just perceptible, 3=definitely perceptible but not disturbing, etc.).

Conclusions

BREMA conclude that after field tests with more than 40 NTSC colour TV receivers installed in 127 homes of members of the general public under normal domestic viewing conditions have shown that:

(a) The tuning, colour intensity and hue controls are easy to adjust. Initial adjustment took place in about half of the viewing sessions; repeated readjustments were not necessary.

(b) Picture quality, using normal receiver controls, was good.

(c) Reliability was most satisfactory. Few service calls were necessary and these were of a trivial nature.

* *BREMA—British Radio Equipment Manufacturers' Association.*

THE BREMA CASE FOR NTSC

THE television receiver industry in the UK has given much consideration to the choice of a system of colour TV and has based its assessments on answers to these fundamental questions:

(1) Is the NTSC system one which will give good quality reliable pictures (both on colour and monochrome) on receivers operated by unskilled viewers?

(2) Is there any other system which, under the same conditions, gives results sufficiently superior to NTSC to justify the departure from an established system? The only serious contenders to NTSC are the latest version of SECAM (known as SECAM 3) and PAL.

As a result of its investigations, the industry, represented by BREMA, is firmly of the opinion that of the three systems under consideration, NTSC is the most suitable for a public broadcasting service.

At the meeting of CCIR Study Group XI Sub-Group on Colour Television held in London in February 1964, it was evident that, although the UK receiver industry was unanimously convinced of the superiority of NTSC (and indeed this was the preference expressed as the official UK view), further documentary evidence would be desirable, in spite of the fact that the NTSC system had been operating successfully in the USA (and, more recently, in Japan) for many years.

There had been suggestions that the public could not operate these receivers easily and that the absence of the Hue and Colour Intensity (saturation) controls in a SECAM receiver was a point in its favour. BREMA therefore decided to conduct its own large-scale trials which have established that this suggestion is a fallacy. The differing types of NTSC receivers produced by a number of UK manufacturers were stable and easy to handle, and under normal home-viewing conditions it was found desirable to have Hue and Colour Intensity controls. These trials have fully confirmed the BREMA preference for NTSC.

Colour Picture Quality

NTSC, with a wideband I circuit, has the highest horizontal colour definition potential, while the vertical colour resolution is greater than the other systems (twice that of SECAM) and is not subject to spurious horizontal beat patterns. NTSC has, therefore the highest potentiality for good colour pictures, and NTSC receivers are fully capable of reproducing high standard colour transmissions.

Compatibility

NTSC gives the best results on monochrome receivers since it has the lowest colour sub-carrier visibility and an absence of spurious patterns on moving pictures, which can be troublesome on both the other systems. In the UK over two million 405/625-line receivers are already in service, and these have sufficient resolution of fine detail to make compatability important; this situation also applies in many other countries. A simple notch filter is possible in future designs of receivers with NTSC (and PAL) to remove all traces of the sub-

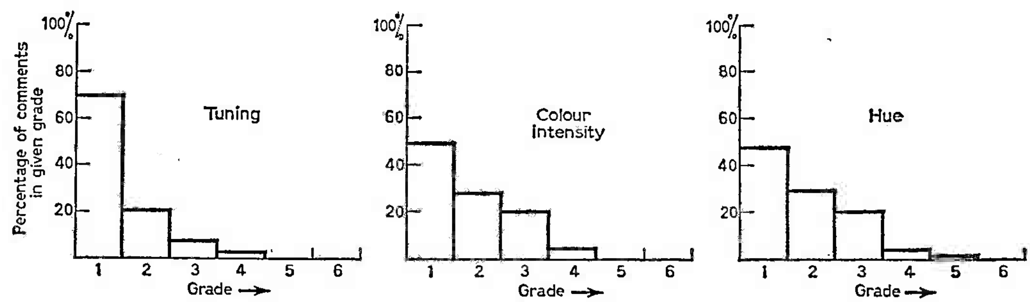

Fig. 1—These graphs illustrate by percentage. comments from set users on the ease of adjustment of certain contro'

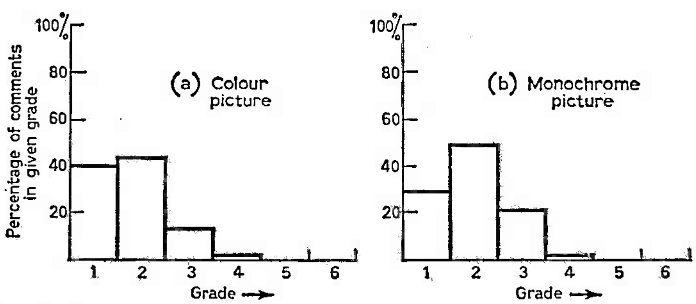

Fig. 2—Comment percentages for (a) colour picture quality and (b) impairment of the monochrome picture due to 'colour cast'.

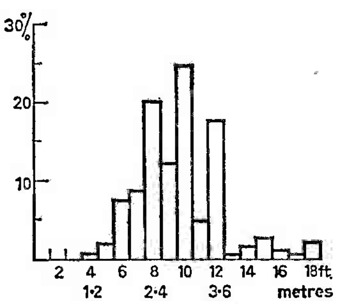

Fig. 3—Distribution of viewing distances (average picture height 1ft. 3in.)

BACKGROUND OF COLOUR ACTIVITY BY U.K. MANUFACTURERS

1954: BBC commenced testing NTSC system on Channel 1, 405-lines.

1955: Tests of compatibility of NTSC with satisfactory results.

1956: Fifteen British-made NTSC receivers assembled by BREMA for over-the-air demonstrations to CCIR study group who also saw other NTSC equipment staged by the BBC and the radio industry.

1956/7: Tests carried out in conjunction with BBC on NTSC colour reception in the home. Receivers satisfactory but not advanced enough for general marketing.

1957/60: General development work on NTSC and, later, SECAM receivers.

1960: Following the TAC Report (colour TV should be introduced only on standards ultimately adopted for monochrome TV), research activities slackened off.

1962: The decision to adopt 625-line system rekindled interest. The EBU established colour TV group to recommend a common colour TV system for Europe. Demonstrations organised showing NTSC, PAL and SECAM systems, to study all aspects. BBC commenced first experimental NTSC colour transmissions on channel 44, 625-lines; manufacturers resumed development. All three systems thoroughly examined.

1963: BBC field trials on channels 34 and 44 allowing simultaneous comparisons to be made between the three systems.

1964: BREMA home viewing tests.

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carrier but SECAM requires a filter which is more complex and is then not completely effective.

Controllability

The recent BREMA Home Viewing Tests have proved that the controls on an NTSC receiver are stable and easy to handle, even by unskilled viewers; although it is perfectly satisfactory to have separate Tuning, Colour Intensity and Hue controls the NTSC system is flexible and all these controls can be made automatic if desired.

The Tuning control (a problem with all systems on u.h.f.) is probably the most important of these, and can be simplified by the employment of automatic frequency control, either with or without push-button channel selection.

The Colour Intensity control can be automatic with NTSC, but is very useful in correcting for differing ambient lighting conditions and for the preferences of individual viewers; SECAM is unsatisfactory in this respect since the normal absence of an intensity control prevents adjustment to cope both with these conditions, and also an incorrect balance between the luminance and chrominance signals which occurs with SECAM in areas of poor signal strength if the limiter becomes ineffective; an intensity control is now often fitted to SECAM receivers.

The Hue control (also normally available with NTSC but not with SECAM) enables the viewer to adjust the picture to his personal preference and to compensate for different tints of ambient lighting or small changes of colour which may occur at the programme source. This is easily made an automatic control if desired, while the use of an optional automatic/manual circuit in an NTSC receiver enables the viewer to obtain the correct hue and then make adjustments to suit his personal preferences.

Stability and Lack of Complication

The NTSC system is in practice non-critical in terms of i.f. response for both the luminance and chrominance channels; the use of a suppressed colour sub-carrier ensures accuracy and stability of white balance. NTSC receivers are less complicated than those for other systems because:—

(i) There is no recognition signal requiring additional circuitry and to be prone to interference.

(ii) They require no h.f. de-emphasis ("anti-cloche") circuit.

(iii) There is no f.m. discriminator to be carefully aligned for perfect balance.

(iv) There is no limiter circuit.

(v) There is no delay line.

These considerations simplify alignment in production and make servicing easier. Experience shows that the highest reliability factor is always associated with the simplest circuits.

Weak Signal Reception

Due either to the attempt to receive a signal in an area not yet properly covered by the u.h.f. service or to the use of inefficient receiving aerial installation it has been found that some receivers have to work under exceptionally poor reception conditions. It is therefore essential that the receiver circuits should not fail to operate under such conditions, and that a very low signal/background "noise" ratio should not cause a disproportionate degredation of the picture. Experience shows that the NTSC receiver gives the best results under these conditions.

Cost of Receivers

Estimates of the costs of the latest SECAM receivers show little difference from the known cost of NTSC receivers, but the new SECAM techniques involve simplifications of circuitry which have so far given disappointing results. The cost of a PAL receiver is significantly more expensive than an NTSC receiver. The question of royalties payable on patents has not been taken into account, but must be higher for SECAM and PAL than for NTSC.

Experience of Systems

The NTSC system is the only one which has been tested operationally by the radiation of a colour television service over many years. As a result it is established that it is a practical system and all the difficulties of its operation are known; neither of the other two contenders have yet been fully tested on a countrywide service basis, which may well bring further problems to light. There is a wealth of background engineering and operational experience already available in the USA and Japan on the NTSC system, but little or no operational experience of SECAM and PAL has been obtained.

Future Potentialities

THE NTSC offers the greatest scope for improved definition of colour pictures and good compatible performance on monochrome receivers. It is also the most suitable system for use with single-gun tubes should these become available.

System Standardisation

The remarkable developments in the field of long-distance communications will undoubtedly result in an increase of inter-continental exchange of programmes. The USA, Japan and Canada are already committed to the NTSC system and the adoption of the same basic system in Europe would undoubtedly facilitate programme exchange.

Conclusions

BREMA concludes unanimously that the answers to the questions posed in the introduction are:

(i) The NTSC does give good quality reliable pictures on receivers which are easy to manufacture and which give a consistent and stable performance over a long period.

(ii) Neither the SECAM nor the PAL systems give results superior to NTSC; both systems have inferior compatibility performance and the SECAM colour picture is also inferior to NTSC.

These factors clearly indicate why the preference of the UK television receiver manufacturing industry is for the NTSC system.

GPO VIEWPOINT

ACCORDING to the GPO, the main reasons underlying the UK's preference for NTSC are:

(a) NTSC has been in service in the USA for over 10 years and a considerable background of technical know-how has been built up. PAL and SECAM are comparatively recent developments.

(b) It is believed that the cost of a SECAM receiver can only be brought down to the same level as an NTSC receiver by sacrificing performance and stability to an unacceptable degree. The cost of a PAL receiver is likely to be higher than that of an NTSC receiver.

(c) The monochrome picture received by millions of viewers who will not have colour sets is expected to be appreciably better with NTSC.

(d) The adoption of NTSC in the UK would facilitate the interchange of programmes with other countries using NTSC, e.g. USA.

THE CRITICAL DATE

A MEETING of the Colour Television Sub-group of Study Group XI of the CCIR opens in Vienna on March 24th in an endeavour to reach agreement on a common transmission system for colour TV in Europe.

Some further notes on the

PRACTICAL TELEVISION CCTV CAMERA

CIRCUITS FOR IMPROVED PICTURE QUALITY

by E. McLaughlin

CONTINUED FROM PAGE 251 OF THE MARCH ISSUE

BECAUSE of operating conditions discussed last month, the controls which permit correct adjustment of the field output stage are necessarily as follows:

(a) A means of setting the d.c. operating point accurately to Class A. This had to be added by splitting the junction of R22, R23, R24 and inserting a 50kΩ 1in. preset potentiometer as shown in Fig. 4a (last month). This was easily accommodated on the tagstrips above the field output transformer, in addition to the previously existing components situated there, together with the field shift components already discussed earlier in this article.

(b) A means of adjusting the drive voltage amplitude at the grid to achieve Class A1 operating conditions. This control was already present, in the form of VR3.

(c) A means of varying the applied h.t. voltage (h.t.+A yellow, Fig. 4a) in order to change the current amplitude of the Class A1 mutual characteristic of the valve until this corresponds to correct field scan amplitude (9mm on the vidicon target). This means that R3 in Fig. 15 on page 176 of PRACTICAL TELEVISION, January 1964, will have to be chosen judiciously or be made variable. As a matter of fact the published value of 25kΩ did not have to be changed in the prototype, since it led to a correct mutual characteristic with the power supply circuits used. Constructors using slightly different power supply components may need to modify this resistor. Use of a smaller value, say 10kΩ 2W, and a 180V Zener diode shunted across C7 (same Fig. 15), will stabilise the field output valve h.t. voltage. This may prove beneficial in areas with large mains voltage fluctuations and will also make behaviour independent of the exact nature of power supply components.

Adjustments

Assuming completely displaced controls, the following procedure is recommended for adjusting the field output stage. Set the field amplitude control (VR3, Fig. 4b) to midway and lock a focused picture on the receiver. Adjust the new field scan linearity control (Fig. 4a) towards higher negative bias (slider towards R23) until the top and bottom of the displayed picture cease to expand equally and the top begins to distort. The negative peaks of the waveform at the grid are then just running round the bottom bend near cut-off and the intense white band at the top of the picture will have weakened in proportion.

Black flyback lines will appear at the bottom of the picture since the bias will be too high and drive too small at this stage. Now increase drive (VR3 slider towards R29 in Fig. 4b) until the black flyback lines have just disappeared at the bottom of the picture. The increased drive will now be too great in relation to the bias, so that much of the grid waveform is below cut-off and the top of the picture on the receiver is grossly expanded. Therefore, as the next step, reduce bias on the new field scan linearity control (slider towards R24) until the field geometry is correct again and the intense white band at the top of the picture just starts to reappear. Thereafter reduce drive by turning VR3 slider towards R31 until the black flyback lines at the bottom of the picture just do not reappear. One cycle of adjustments is therewith complete.

The same cycle of adjustments, commencing with increasing the bias on the field scan linearity control until the top of the picture just begins to expand, should be repeated as often as necessary until the correct settings have been reached, i.e. black flyback lines at bottom of picture and white band at top both absent and field geometry linear on receiver display.

Now adjust the new vertical shift control. If the top and bottom of the display picture is shaded off anyway, once the operating point adjustments as above have been completed, i.e. if the frame mask is in the picture, then much of the scanned raster on the vidicon target is behind the mask at both top and bottom, so that the scan amplitude on the vidicon target is clearly too great for the prevailing Class A1 drive. This means that the h.t. voltage is too high and must be reduced by increasing the value of R3 as already described. If, on the other hand, neither the top nor the bottom edge of the vidicon mask is in the picture in the centralised setting of the vertical shift control and wide adjustment is necessary to bring the respective mask edges into the picture, then the field scan amplitude on the vidicon target is clearly too small under the Class A1 drive conditions; the extremities of the mask are not reached by the raster. These conditions mean that the h.t. voltage is too low and must be increased by reducing the value of R3 in the "h.t.+A yellow" feed line.

The sequence of drive and operating point must be repeated after every h.t. voltage adjustment, and these two adjustments must be repeated alternately, until absolute optimum settings are achieved. The controls should then be sealed with a spot of lacquer and the setting of the frame amplitude control VR3 on the front panel clearly marked. Small mains voltage fluctuations can be compensated and deliberate field geometry distortion for "special effects" is possible with VR3.

Once all the factors discussed in the foregoing sections have been clearly understood and appropriate adjustments carefully carried out the field linearity and picture quality will be excellent. Very slight residual "flash" at the extreme top of the field (intense white band, then very narrow indeed) after the best possible adjustments have been made according to the above described procedure can be cured by judicious adjustment to the value of R25 (Fig. 4b) to match the current rise to the bottom bend of the field output valve characteristic. The component numbers in Fig. 4 coincide with the original publication, to avoid any confusion.

Vidicon Grid Blanking D.C. Restoration

The diode shown across R38 in Fig. 4b proved to be a useful addition in the course of experiments to remove the black flyback lines at the bottom of the picture. This diode d.c. restores the vidicon grid waveform to the beam current control voltage selected on VR5, such that the waveform is entirely negative-going from this level. This gives a more definite and quicker cut-off action on the leading edge of the field blanking pulse, so that less grid current delay of the vidicon beam return is required in the field output stage.

Receiver Lock Stability

All adjustments and operational questions so far discussed in this article refer to display of pictures via the modulated r.f. output of the camera control unit and aerial terminals of an ordinary domestic TV receiver. A further point which received attention in the course of these experiments concerned picture lock and rigidity on the receiver in relation to factors originating in the camera control unit.

Line hold was always excellent right from the start and, apart from a few minor points mentioned in the original publications, this question received no further attention here. However, line rigidity gave some trouble under a number of conditions. This manifested itself as wavy verticals dependent upon picture contrast and content. Such symptoms are due to an incorrect black level in relation to sync pulse and peak white levels, so that the receiver sync separator circuit passes some picture content into the sync circuits in addition to the pure sync pulses. The exact moment of firing of the timebases will then depend upon the picture content at the start of each line, leading to vertical wiggles in sympathy with picture content. Such faults in receivers on BBC or ITA transmissions, which may be assumed to conform to standard specifications, are due to incorrect adjustment of the voltage gating level in the sync separator circuit, or due to a signal of incorrect total amplitude reaching the sync separator circuit on account of a fault in the r.f. and i.f. a.g.c. circuits or simply insufficient signal strength at the aerial in fringe areas. In the present case, with our CCTV equipment, the sync-to-picture-content ratio may be incorrect as it arrives at the receiver, even though the sync separator is set correctly. The effect is the same: vision will enter the sync circuits if the sync pulses are too small.

Modulation Characteristic

Correct vision-to-sync ratio at V6 (Fig. 4b) in relation to standards does not necessarily give best results because of possible non-linearities of the modulation characteristic in the CCTV tuner (Fig. 16, page 177, PRACTICAL TELEVISION, January, 1964) which can compress the sync pulses and favour the picture content. It may thus be necessary to assure greater sync pulse amplitude at V6 cathode. For this purpose R80, formerly 18Ω, has been replaced by a 50Ω preset potentiometer which should be adjusted to the minimum resistance value, preventing wavy verticals on the receiver display.

It is, of course, essential to keep the excess sync pulse amplitude at R80 to the smallest possible level by adjusting the modulator and tuner in the manner already described in the original publication. Otherwise a non-standard signal will appear at the video output, P7, leading to trouble on some video circuit monitor units.

The most important factor in the CCTV tuner is its neutralisation with the help of TC3. Neutralisation is not primarily introduced for reasons of stability; the circuit is perfectly stable without any form of neutralisation. The neutralisation is intended to cancel any r.f. signal which bypasses the modulated p.a. stage, reaching the output socket straight from the oscillator section without being modulated. On BBC standard 405-line systems such unmodulated "swamping" signals will seriously compress sync pulses in relation to picture content, because they represent a rather high residual carrier ampltiude at the output socket which cannot be reduced, however intense the modulation drive. The effects are less serious on CCIR standard 625-line systems where sync pulses represent peak carrier amplitude. Unmodulated carrier swamping components due to poor neutralisation of the p.a. also compress the sync pulses in the modulation envelope slightly, but not to the same extent as those video waveform components near minimum carrier level, which give the picture highlight details. Poor p.a. neutralisation on a 625-line CCIR version of the equipment will consequently flatten picture highlight contrasts, but lead to only slight sync troubles.

Adjustment of R80 should consequently be made in conjunction with adjustment of the neutralising trimmer TC3, striving to find a setting of TC3 for which the resistance setting of R80 can be reduced as closely as possible to 18Ω without loss of picture lock and picture rigidity on the receiver.

Field Jitter

The simplified arrangement of the sync mixer, V12 in Fig. 4b of this article, injects *either* a field pulse *or* a line pulse into V6 in the video amplifier at any time. In other words, line pulses are absent during field pulses, in contrast to the standard waveform in which the field pulses are chopped at twice the line frequency. This means that the line timebase can "run wild" during field flyback, the extent to which it has got out of step at the end of the field pulse depending upon the quality of the "flywheel" or "memory" circuits in the receiver line sync arrangements. We are, of course, speaking purely of the *receiver* line timebase circuit here. Most modern receivers are extremely good in this respect, which explains why line sync may be interrupted during field flyback of our CCTV equipment without noticeable effects on the receiver beyond very slight jitter for the first very few lines at the top of the picture. Slight increase of receiver field height will move these lines off the top of the screen without noticeable loss of picture.

Flywheel Sync

Receivers with flywheel sync are undesirable in this respect. Flywheel sync derives the line timebase waveform from any form of oscillator which is pulse-synchronised in the same manner as in the very earliest receivers where the sync pulses from the sync separators were simply amplified and applied to the line oscillator directly. The only difference in the classical flywheel sync circuit found in moderately old receiver models is that the amplified sync pulses from the sync separator are used to "pull" a sinewave circuit (often just a tuned circuit tuned to approximately the line frequency) into step, the sync pulses used for locking the actual line timebase oscillator then being derived from the ringing waveform of this tuned circuit. If *isolated* line sync pulses are missing in the received signal, the sinewave tuned circuit can easily "flywheel on" and continue to provide the line oscillator with good sync. Similarly, isolated pulses of interference cannot fire the line timebase at the wrong moments, since the flywheel action of the sinewave circuits cannot change its tactics so rapidly. The absence of *regular blocks* of line sync pulses during all field flyback pulses can, however, cause a classical flywheel sync circuit to get seriously out of step. It cannot tide over the loss of so many input pulses in one batch. Total instability may also occur and complete line tear-up over the entire picture, i.e. line lock will then not be possible for any part of the picture. In such cases direct straight-through line sync, as in the earliest receivers, would be better. It would lead to a complete jumble over anything up to the top sixth of the picture whilst the line timebase is getting into step again after a field flyback, but the rest of the field would have excellent line lock.

Discriminator with Memory Rectifier Circuit

Modern television receivers now almost universally employ a line sync circuit of the discriminator type with a memory rectifier circuit. This arrangement has all the advantages of the classical flywheel sync circuits but none of their disadvantages. Although the vulnerability to impulsive interference is in fact a little poorer, so that good receivers have to employ additional noise-inversion amplifiers with the output applied to a further blanking grid in the multi-electrode sync separator valve, the stability in the face of missing line sync pulses in the incoming signal is enormous. When properly adjusted the author's receiver will maintain line lock if all line pulses are missed on whole picture frames at a time. Interruptions during field flyback are therefore trivial in relation thereto!

It is theoretically not very difficult to modify our CCTV camera control unit so as to chop the field sync pulses at line frequency (double line frequency is here required only if interlace is used, which is only possible anyway if the line and field frequencies are phase and frequency locked to each other); several relatively simple solutions occur to us. But we have so far considered such modifications to be unnecessary because most modern receivers employ discriminator line sync and readers would be better advised to convert their receivers to this form of line sync rather than modify the CCTV equipment, since this would bring the second advantage of improved reception on BBC and ITA transmissions.

Fig. 6 sketches the principle of a discriminator line sync circuit in a television receiver; examples of full circuit details may be traced in trade circuits with the help of this block diagram. A discriminator compares the train of line sync pulses arriving from the sync separator on the one hand and the train of line scan flyback pulses from a small extra winding fitted on the line output transformer. The line oscillator is *always* a sinewave oscillator in this arrangement, followed by suitable shaping circuits between its output and the line output stage. A reactance valve circuit is in parallel with the tuned circuit of the line sinewave oscillator and reflects a virtual capacitance or inductance in parallel with that tuned circuit, changing its resonant frequency accordingly, in proportion to the d.c. bias voltage applied to the grid of this reactance valve circuit. A reactance valve circuit is simply an otherwise ordinary amplifier stage with feedback from the anode to the grid in such a manner that the feedback signal is shifted through 90° in its phase. A d.c. voltage change at the grid of the reactance valve will thus control the line timebase frequency. This d.c. voltage change is the output signal of the discriminator already mentioned.

When the incoming line sync pulses and the line flyback pulses from the line output transformer still differ greatly in frequency, the discriminator simply operates as a beat frequency generator between the two frequencies. The beat frequency is rectified by the discriminator diodes and gradually builds up a d.c. control voltage across their load resistors in such a sense as to change the line timebase oscillator frequency (when applied to the reactance valve grid) to coincide with the mean frequency of the incoming line sync pulses. As soon as this has been achieved, i.e. *all* narrow line sync pulses from the sync separator ride somewhere on the widened and shaped line flyback pulses at the discriminator, the latter ceases to give a beat frequency output and reverts to giving a continuous train of output pulses at line frequency, the amplitude *and polarity* thereof depending upon the *phase* error of the line timebase in relation to the mean intervals of the incoming line sync pulses. The rectifier diodes in the discriminator circuit rectify and smooth these phasing pulses, leading to continuous fine correction of the line timebase phasing, by changing the standing d.c. voltage across the load resistor and smoothing capacitor by small appropriate amounts.

It is this standing d.c. voltage at the output of the discriminator which controls the line timebase frequency at the grid of the reactance valve. If the incoming train of line sync pulses from the sync separator should be interrupted suddenly, the discriminator ceases to deliver correction pulses. However, the d.c. output exists for some time, because the grid circuit of the reactance valve is of high impedance and back discharge through the discriminator diodes, especially if valves and not semiconductor diodes are used, is not possible. The line timebase of the receiver thus "remembers" the correct line timebase frequency for considerable periods in the absence of continued line sync input, without any need for over-critical adjustments.

The sensitivity to strong impulsive interference is due to the fact that any interference pulses which happen by chance to lie close to the proper line sync pulse, and which consequently also ride on the shaped line flyback pulse at the discriminator, lead to spurious additional output pulses causing unwanted changes in the d.c. control voltage. However, the effects are never those of single lines tearing out, as in the earliest receivers with straight-through sync. The memory charging time constant is made sufficiently long to ride over many lines so that isolated interference pulses remain without effect. In the face of severe impulsive interference on most lines the picture verticals wobble without loss of line hold as such. This coarser effect is avoided in the better receivers by suppressing interference of sufficient strength to otherwise cause it, using auxiliary circuitry in the sync separators.

Conclusions

The purpose of this article is twofold. Firstly, to explain the importance of correct operation of the field output stage in our CCTV camera design. Secondly, to help readers to understand some basic facts about line timebase synchronisation in modern and older television receivers, showing that those employing discriminator and memory circuit line sync (which includes most modern models) are best suited for use with our CCTV equipment. It is probably better to replace or modify older receivers rather than go to the trouble and expense of undertaking more drastic modifications of our CCTV circuit design. ■

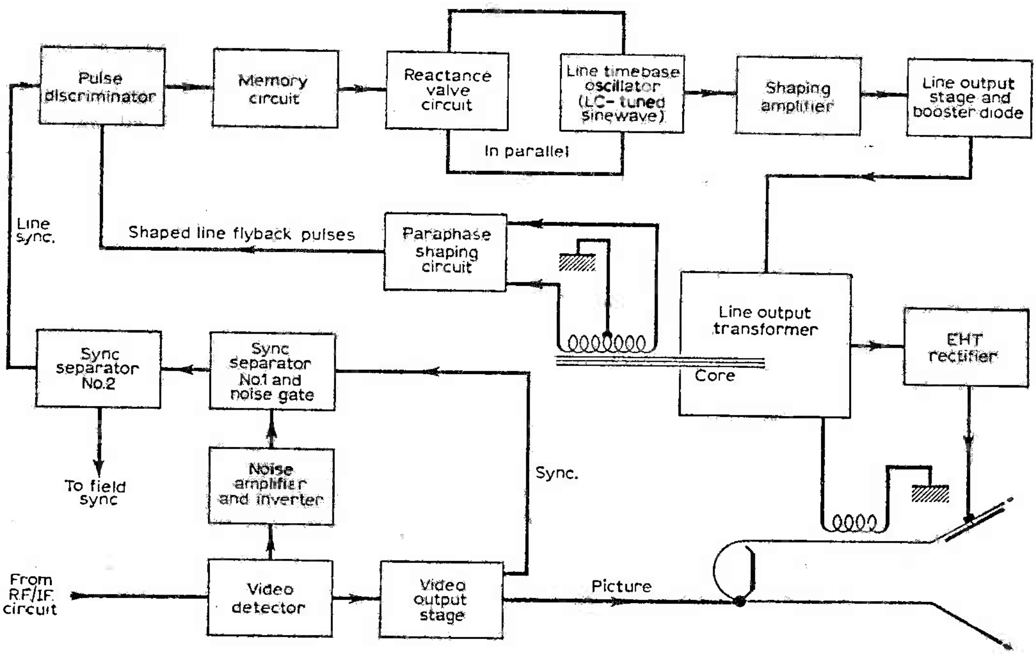


Fig. 6—Circuit principle of the line timebase chain in modern television receivers.

LETTERS TO THE EDITOR

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.

625-LINE SIGNAL GENERATOR

SIR,—I purchased a Wayne-Kerr signal generator, model CT53, recently which was advertised for about £18 and found that it was a beautifully built instrument and very stable. It occurred to me that it could be modified for the 625-line system for alignment of the new TV receivers.

I think that this modification would make a really valuable article in *Practical Television* for those wanting a laboratory built generator at a modest price and I am sure that some of your readers would be sufficiently skilled to undertake this interesting experiment. — W. H. ROPER (Chelmsford, Essex).

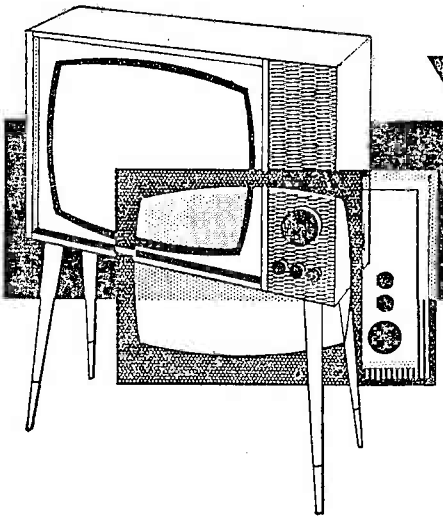
[*We should be interested to hear from other readers who may have undertaken modification of the above unit or who have built their own BBC-2 alignment equipment.*—Editor.]

TEST CASE

[*With reference to the letter in the March issue of* PRACTICAL TELEVISION *on the subject of Test Case. Due to the small number of letters we have received in favour of printing the answer in the same issue as the question, we are continuing to carry on with the present style.*—Editor.]

BBC-2 POLICIES

SIR,—Further to your February leader, and to the letter from L. Leggatt, I too am somewhat perplexed at the strange mental processes at work in BBC-2. The best programmes have been *very* good, but a curious pattern seems to have set in. First, the Great War series, then the Danny Kaye Show, now the Likely Lads. All great successes on BBC-2. And all transferred to BBC-1. The only conclusion that can be drawn is that whenever a good series emerges on BBC-2 it is transferred to the old channel. Is BBC-2 becoming an experimental channel to find good material for BBC-1? Do the BBC *really* want to get, and retain, viewers to BBC-2?—S. MILTON (Woodford Bridge, Essex).



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. 332 must be attached to all Queries, and a stamped and addressed envelope must be enclosed

FERGUSON 306T

The fault on this set is intermittent, but recently the horizontal hold always has to be at a minimum position.

The picture breaks up horizontally and a noise seems to come from the line output transformer.

When the broken picture exists, advancement of the contrast or brightness controls causes the picture to black out completely.—N. V. Cope (Letchworth, Hertfordshire).

Suspect increase in value of the 2·7MΩ resistor connected to the centre tag of the line hold control Alteration in value of this component puts the locking point outside the range or at the extreme end of the line hold control, thereby encouraging picture breakup.

McMICHAEL MP17

After this set has been on for a few hours, the bottom of the picture creeps up and leaves a $1\frac{1}{2}$in. gap. I have tried replacing the ECL80 frame output valve but this has no effect.—J. Pratt (Croydon, Surrey).

The frame output valve is a PCL82 and you should check this valve, its bias 330Ω resistor and the 0·01μF and 0·02μF linearity capacitors.

BUSH T67

The volume control in this set is very noisy. I have inserted a 0·1μF capacitor between the slider of the control and the grid of the triode section of PCL82 with a 1MΩ grid back to chassis. The trouble still persists even when a complete replacement control is fitted.—S. A. Scott (Woodside, Aberdeen).

The PCL83 itself is usually responsible for the fault described. Try a new PCL83 and change the 0·1μF capacitor to 0·01μF or 0·02μF.

BANNER BT117

The picture is perfect but the sound is extremely low even when the volume is turned right up. I have changed the volume control, EF80, ECL80 and EBF80 valves.—W. A. Hall (Chesterfield, 8).

Weak sound could be caused by a fault anywhere in the sound i.f. channel, sound detector, sound interference limiter and audio stages. However, have the alignment of the sound i.f. channel checked, for this sometimes drifts. Check the value of the resistor to the anode of the sound interference limiter diode. A rise in value would reduce sound and introduce distortion. Check voltages generally in the sound channel.

MASTERADIO TG7T

This set was working well, but failed after a few flashes on the screen. Now there is no vision but the sound is normal and no e.h.t. is obtainable.

The line output transformer is new and I have checked all capacitors, resistances and wiring of this part of the circuit including the timebases. There is no spark at the c.r.t. anode, the EY51 does not light up, but I can hear the line timebase whistle. H.T. is 180V, but although the valve 11 (efficiency diode) anode is 180V, the cathode which should be 400V is only 200V. Also, valve 15a anode which should be 275V is only 160V and the cathode only $5\frac{1}{2}$V positive.—P. A. Wilson (Walthamstow, London, E.17).

If you have checked the 0·25μF boost capacitor (by removing it and fitting another) note the effect of disconnecting the line deflection coils and check the 10kΩ 1W resistor to pin 8 of the 50CD6G.

We are presuming that you have changed the line timebase valves.

FERRANTI 21K6

A fault seems to have developed in the h.t. section. I switch on the set and the picture comes on full width, full height and brilliant. Then, after 2 or 3 minutes, the PL81 gets hotter and hotter, the picture shrinks and dies away.—S. E. Potts (Stockport, Cheshire).

You should check the 3·3kΩ resistor to the screen grid of the PL81.

There should be 160V on this electrode under normal circumstances. Measure when the raster first appears, and note whether this voltage tends to rise as the PL81 overheats. If so, change the resistor, using a 3 or 5W wirewound component for safety.

FERGUSON FLIGHT 546T

When switched on, the picture is 60% good, but after being on for about an hour the sound gets less and less with increasing distortion.

When switched off for an hour or more, then switched on again, it is back to about 60% quality again. The picture remains fair but has a greyish look, and the contrast control makes no difference at all.—H. Clark (Mansfield, Nottinghamshire).

It seems as though the trouble lies in the tuner. Progressive deterioration in emission of one of the valves is a possibility. This can be proved by substitution. This would then affect both sound and contrast control.

STELLA ST1049A

I have converted this set and the reception is quite good on all channels. After a few minutes on 625-lines only, the picture quality begins to float and after about an hour all sync is lost.—H. H. Phelps (Birmingham, 22A).

This fault is caused either by valve trouble in the sync separator stage or a change in characteristics of the video amplifier valve. This may show up only on 625-lines owing to the different conditions of operation on that standard, relative to 405-lines, of these two stages. Check the valves by substitution if possible.

FERGUSON 705T

The picture is perfect, but there is a " howling " on the sound. The smoothing cans have all been changed but this has made no difference.

This howling cannot be controlled by the volume control, only a slight pitch alteration, also if C102 is uprooted, the howling stops.—J. G. Jones (Glamorgan, South Wales).

The trouble appears to be due to the grid of V12B not being properly returned to chassis via R133 and ensure that the chassis connection is well bonded and is not floating above chassis with R127.

FERGUSON 998T

There is a dark band on the left hand side of the screen, and this band tends to get wider. The picture otherwise is clear and bright.

The width adjustment seems to have no effect whatsoever.—S. Fawees (Bridgwater, Somerset).

We would advise you to check C63. This is a 0·001μF capacitor associated with the width tappings.

Also check the 0·01μF decoupling pin 6 of the c.r.t.; junction of the 220kΩ boost line feed resistor.

INVICTA 5370

This set has lost both sound and vision. There is a raster present. I have had valves PCC84 and PCF80 checked and they are OK. The set also seems to be lacking in picture width.—J. Cadman (Sheffield, 8).

The most likely cause of both faults on your receiver is a low h.t. voltage caused by weakness of the metal rectifier. This particular type is prone to rapid deterioration when overheated. It is mounted on the rear of the set, near the mains dropping resistor.

You could substitute with a silicon diode, such as the BY100, but should add a 21Ω 5W resistor in series to allow for the extra h.t. available due to the improved efficiency of the silicon diode.

The h.t. should correctly be 215V, measured at the h.t. end of the smoothing choke.

PHILIPS 21TG106U

A bright line appears right across the screen. On turning down the brilliance, the picture can be seen very faintly and after a few hours it comes on perfectly.

The Line output transformer, PCL82 and ECL80 have been replaced, but this fault still persists.—A. Jary (Hackney, London, E.8).

A horizontal line denotes a failure in the field (frame) timebase and it is difficult therefore to see why you considered it prudent to replace the line output transformer.

We would suggest that you check the PCL82 bias resistor to pin 2 (330Ω 1W) and the boost line feed to the height control. If this latter voltage is low, note the effect of disconnecting the focus control from chassis.

ULTRA VT9—17

The picture is present while the brightness control is at minimum. When the control is advanced, the picture blows up and disappears to the left. At this point a blue light appears in the U25 valve. When switched off, the bright spot on the screen drops to the bottom of the screen as it fades.—A. D. Arthur (Lerwick, Shetland).

It would appear that the ion trap magnet on the rear neck of the tube is not correctly set for maximum brilliance. If the trouble persists when the magnet is properly set, change the U25.

COSSOR 948

The reception from BBC is good, but on ITV there are horizontal lines which cannot be adjusted. Sometimes, but only for a few seconds, these lines disappear.—W. York (Trowbridge, Wiltshire).

We advise you to try replacing the PCC84 r.f. amplifier in the tuner. Check also that the ITA coils are satisfactory, and if necessary clean their contacts with a solution of Vaseline in turps substitute.

FERRANTI T1023

This set takes an unusually long time to warm up before a picture appears. Several times during the evening's viewing the picture "blow up," goes out of focus and disappears. It reappears a second or two later.

When operating the contrast or brilliance controls to bring the picture in better, it acts in exactly the same way (blowing up etc.).

On a few occasions the picture blanks out for a second or two and a zig-zag line appears down the centre of the tube, the picture then reappears. The sound remains normal all the time the vision fault occurs.—T. A. Smith (Yorkshire).

We would advise you to check the PY32 rectifier. Replace this with a PY33 if it is slow to warm up to operating emission. Replace the U26 e.h.t. rectifier lower right side and tap the 30P4 and U191 valves with an insulated tool to ascertain which causes the intermittant loss of line scan.

INVICTA 137

The raster is there, but it collapses when adjusting the line hold control. This trouble is intermittant. The PL81, PY81 and EY86 are new.—R. Patel (London, N.W.2).

If the line collapses only when the line hold control is adjusted, we feel that there must either be a fault in the control itself, or a bad soldered joint on one of its tags.

QUERIES COUPON

This coupon is available until April 22nd, 1965, and must accompany all Queries sent in accordance with the notice on page 329.

PRACTICAL TELEVISION, APRIL, 1965

TEST CASE -29

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.

? *On a Stella model 8314 brought in by an experimenter it was found that vertical parts of the picture appeared distinctly bent to the right at the top of the screen. The receiver was otherwise perfectly all right on both sound and vision, though the picture was not excessively bright, but this was put down to reduced picture tube emission.*

The line lock was perfect and tests made in the sync separator stage, line sync feed circuits and in the video amplifier failed to reveal the cause of the symptom. Valves were changed and voltages were checked and everything seemed normal.

What could have been causing the bent verticals and what factor did the experimenter overlook when making his tests?

See next month's PRACTICAL TELEVISION for the solution to this problem and for a new Test Case item.

SOLUTION TO TEST CASE 28
(Page 283, last month)

The usual cause of progressively increasing contrast is the development of a positive voltage somewhere on the vision a.g.c. line which tends to neutralise the negative a.g.c. voltage. Most models feature a "clamp diode" on the a.g.c. line whose purpose is, in fact, to prevent the line from going positive. However, it will not prevent the line from going to zero volts with a consequent rise in gain of the vision channel (i.e. because there is no negative control bias, only the standing bias due to the cathode resistors of the controlled valves).

Moreover, "hold-off" resistors are used in the a.g.c. circuit for filtering and so on and it may happen that one of these acts as a "load" to a positive fault voltage on the a.g.c. line. A positive voltage can get on to the line due to three main causes: (i) Breakdown of the insulation of the a.g.c. feed circuit to a circuit carrying a positive potential; (ii) fault in a controlled valve resulting in the reflection of a positive voltage on the control grid (this is a common cause and each controlled valve should be checked by substitution in turn to prove it); and (iii) breakdown of the insulation of a coupling capacitor between an anode circuit and the control grid circuit of a subsequent valve (this often happens on the tuner-to-i.f. amplifier coupling capacitor, resulting in a small positive leakage current to reach the a.g.c. line).

When the symptom is progressive, as in Test Case 28, a valve is the most likely cause, though causes (i) and (iii) have also been known to produce exactly the same symptom. A check with a high-resistance voltmeter should be made at each controlled valve control grid and any sign of a positive voltage should lead to detailed examination of the grid circuit and valve.

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