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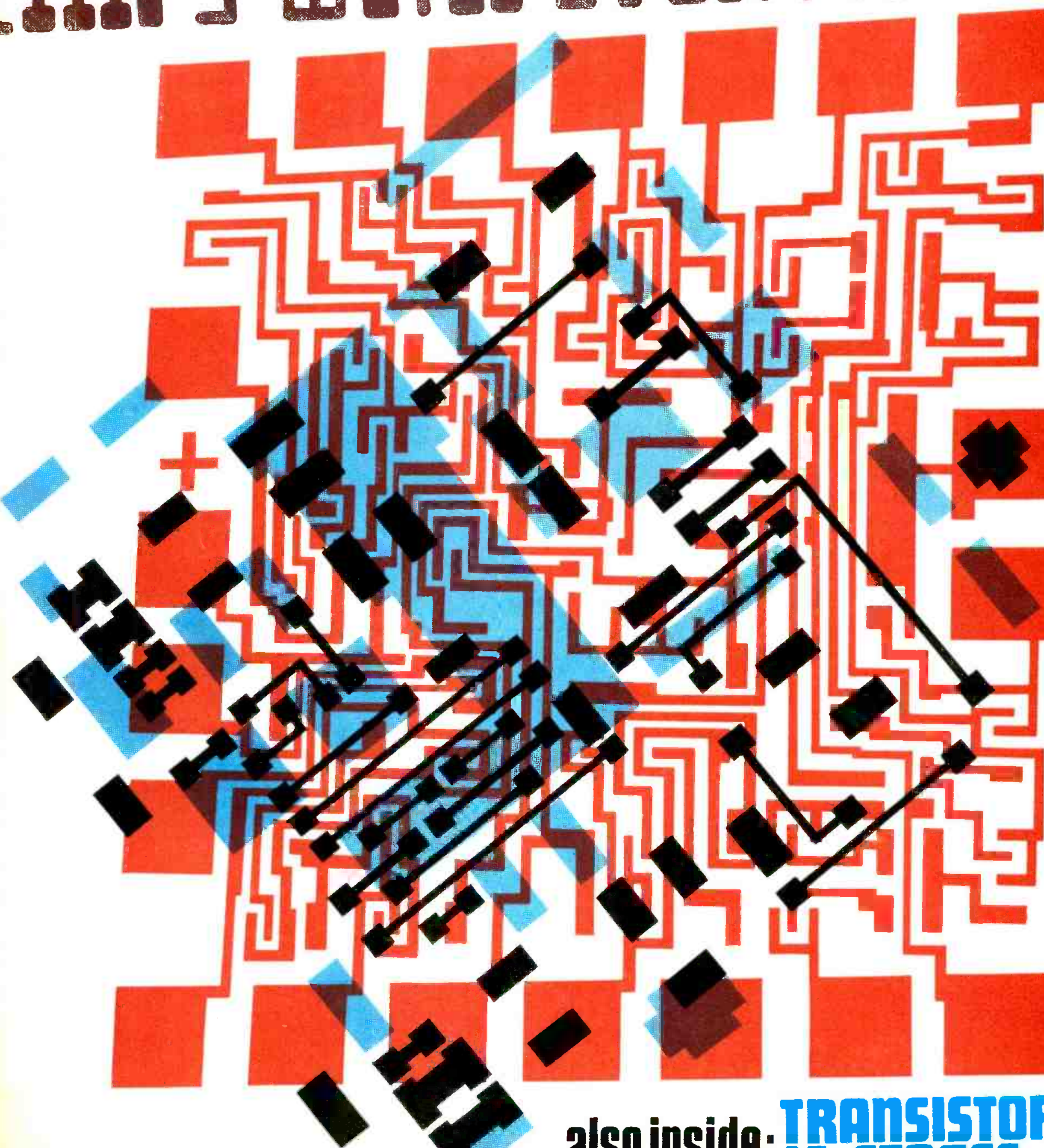

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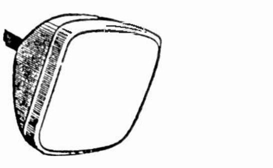

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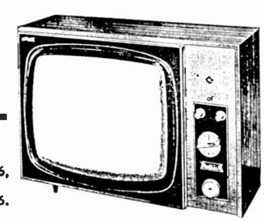

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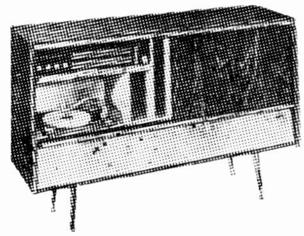

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PRACTICAL TELEVISION

VOL 19 No 12
ISSUE 228

SEPTEMBER 1969

COLOUR TV: THE GOVERNMENT'S RESPONSIBILITY

THE GOVERNMENT took the decision that we should enjoy colour TV, and rightly so in our view: the country that largely pioneered TV broadcasting could hardly stand aside and watch the rest of the world add colour to their TV services. The government also decided that the benefits of colour should be shared by BBC-1 and the ITV companies. These facts imply that the government has an obligation to ensure that the conditions are right for the healthy growth of colour TV.

Colour TV is an expensive business. The sets required are complex and sophisticated pieces of electronic equipment while the capital investment that the BBC and the ITV companies are having to undertake in installing the necessary colour studio and transmitting equipment is extensive and a severe burden to both.

So what do we find nearly two years after the start of colour TV transmissions and as we fast approach the commencement of BBC-1 and ITV colour? The BBC is hard up; the ITV companies' profits are falling sharply; while colour TV set sales continue to fall.

The key to the radical improvement in the situation that is needed is to get colour TV sets into people's homes. Colour TV will remain a sickly infant until sets can be produced in adequate runs and until the attendant licence fees and advertising revenue start coming in in worthwhile amounts. The conclusion is clear: the government must follow through from its original decisions; it must accept its responsibility and ensure that colour TV set sale and hiring conditions are such as to allow the healthy growth of colour TV in this country. The government of course would like to sidestep the issue by talking about its framework of priorities. But timing is vital: we either get colour TV going now or become an international sideshow with equipment supplied from you know where.

W. N. STEVENS, *Editor.*

THIS MONTH

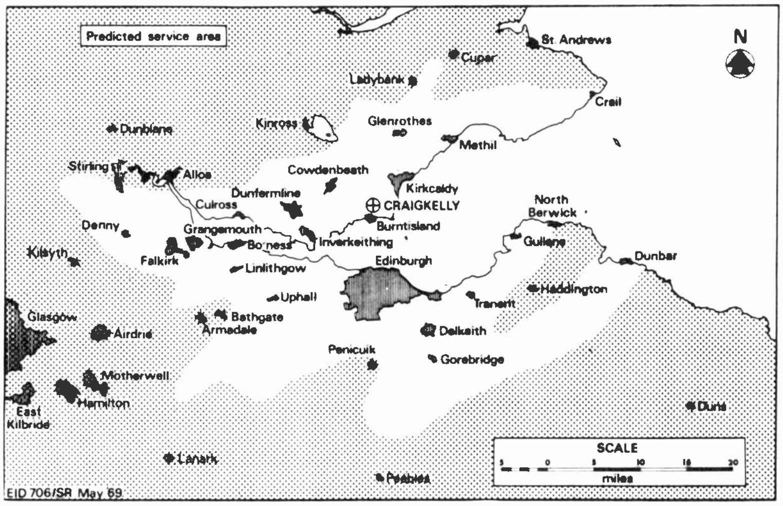
THE NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED SEPTEMBER 19

TELETOPICS

W. GERMANY TO START BAND VI TV TRANSMISSIONS

The German Federal Post Office intends to have in operation by 1971 ten transmitters broadcasting in Band VI, 11·7-12·7 GHz. It is estimated that with an output of 100W the transmitters will cover an area of 10-13 miles. Reception will be by means of a 24in. diameter metallized plastic parabolic aerial fitted with a converter to change the signal to a lower frequency for feeding into a standard commercial monochrome or colour receiver. A trial network of some 200 receiving units, some for communal use, will come into use along with the first transmitters. The transmitters will be used in densely populated areas to provide a local service and it is suggested that some of them will be reserved exclusively for such uses as educational TV.

CRAIGKELLY BBC-2 TELEVISION SERVICE



The above map indicates the approximate expected service area of the Craigkelly BBC-2 transmitter, which will transmit on Channel 27 using horizontal polarization and with a maximum vision e.r.p. of 100kW. Use a receiving aerial in group A. The other channels assigned to the station are 21, 24 and 31.

SQUEEZE HITS COLOUR TV

Although monochrome television receiver deliveries to the trade during the first four months of this year show a very slight increase over the same period for last year, colour television deliveries for January to April have dropped by almost half compared with 1968. This sober news comes from the Economic and Statistical Division of the British Radio Equipment Manufacturers' Association.

Monochrome delivery figures at 546,000 are 15,000 more than for the same months of 1968. But colour television receivers accounted for 28,000 compared with 44,000 for the first four months of last year, averaging only 7,000 a month so far this year. There were also substantial falls in radios, car radios and radiograms compared to 1968.

NEWS FROM THE BBC

The **Weymouth** BBC-1 relay station has now been brought into operation on Channel 1 with horizontal polarization. Aerials should be directed towards the relay station site at Church Knapp Allotments, Wyke Road.

An order has been placed for building work on an extension to the **Blaen-plwyf** transmitting station in Cardiganshire to accommodate the u.h.f. transmitting equipment for BBC-2.

The BBC-2 TV service from **Caradon Hill** Cornwall started on July 5 on Channel 28 with horizontal polarization. The other channels assigned to this station are 22, 25 and 32. Use a receiving aerial belonging to group A.

The BBC-2 service from **Moel-y-Parc** Flintshire started on July 5 on Channel 45 with horizontal polarization. The other channels assigned to this station are 42, 49 and 52. Use a receiving aerial belonging to group E.

The BBC-1 and v.h.f. radio service from the BBC's new relay station to serve the **Isles of Scilly** started on July 14. BBC-1 is on Channel 3 with horizontal polarization, Radio 2 is on 88·8MHz, Radio 3 91MHz and Radio 4 93·2MHz. Aerials should be aligned with the station site about a mile and a half N.E. of Hugh Town St. Mary's.

ITA Llandrindod Wells Relay Station

The ITA Llandrindod Wells relay station was taken into service on July 1, relaying the Harlech TV programme for Wales on Channel 9, with horizontal polarization. The e.r.p. is 3kW and receiving aerials should be aligned in the direction of the transmitter at the BBC Rhiw Gwraidd site to the north-west of Llandrindod Wells.

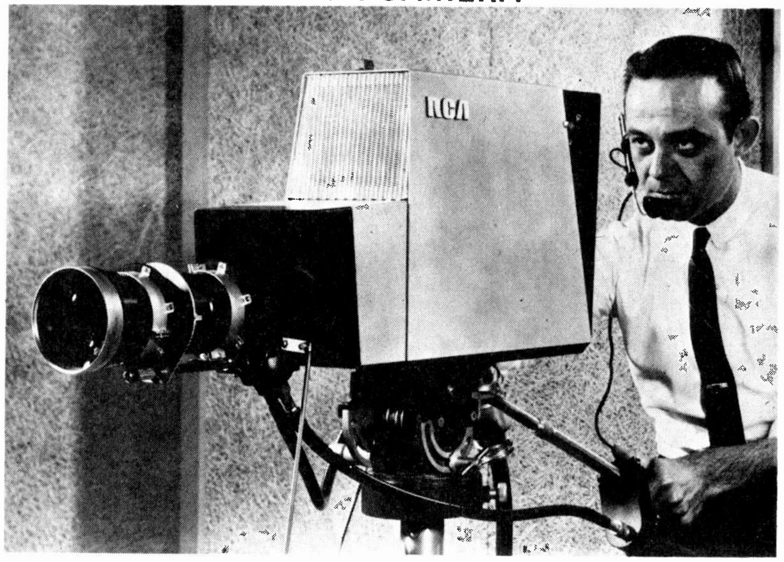
SHARPENING TV PICTURES

An application report on the use of line-period glass delay lines to improve the apparent vertical resolution of TV pictures has been released by Corning Electronics through Electrosil Ltd., Pallion, Sunderland, Co. Durham. The delay lines are used to compare three successive lines of video information: the previous line is compared to the following one and a correction signal obtained which is subtracted from the next line, the result being to sharpen the vertical edge response by making the dark areas darker and the light areas lighter. The system can be used for both colour and black-and-white systems.

INSTANT SYNC TV SYSTEM

A unique system of synchronising and phasing a television system to a studio film camera, the normal speed of which is 24 frames per second, has been announced by Century 21 Film Props. The system makes obsolete the need to use BP or photographic film inserts, offering advantages in setting-up time and in the quality of picture monitor displays. It comprises two television cameras, a source and destination routeing matrix, complete with "controlled interference patterns" as effects inputs. For normal framing and setting-up the system runs at 50Hz frame repetition rate, receiving positional pulse information from the film camera shutter (normally running at 24 f/sec). This is fed to an on-board converter in each camera which times and doubles the pulse rate to 48Hz which then automatically overrides the existing frame rate. The small unit is attached to the camera which requires no modification itself. Further details can be obtained from Century 21 Film Props Ltd., Bourne End, Bucks.

SINGLE TUBE COLOUR CAMERA



Our photograph above shows the first studio colour TV camera to use a single pickup tube. This is the RCA PK730, which was demonstrated at Montreux earlier this year. The single tube is used with a special colour-detecting optical filter and "innovative electronics". Output is to NTSC standards. The PK730 weighs only 45lb complete with electronic viewfinder and sells for less than £6,000. A companion non-viewfinder camera will be available at approximately £4,000.

ITA CONCRETE TOWER FOR EMLEY MOOR

The ITA has obtained planning permission for the construction of a new 1,080ft. 14,000 ton aerial support tower at its transmitter site at Emley Moor. To the 900ft. level the tower will be a self-supporting reinforced concrete structure. This is the first time that a high tapered concrete tower has been proposed in the UK to carry TV broadcasting aerials. The new structure when complete is expected to be the third highest of its type in the world: higher concrete TV towers have been built in Moscow and East Berlin. It is hoped that the new aerials will begin to come into operation before the end of 1970, and until then Yorkshire Television transmissions will continue to be radiated from the temporary 670ft. mast erected following the collapse of the Emley Moor mast on March 19.

Meanwhile the BBC have announced that they are seeking permission to erect a 700ft. mast to replace the 300ft. one erected to keep their u.h.f. service going shortly after the collapse. The BBC hopes that its 700ft. mast will be in oeration by the end of the year.

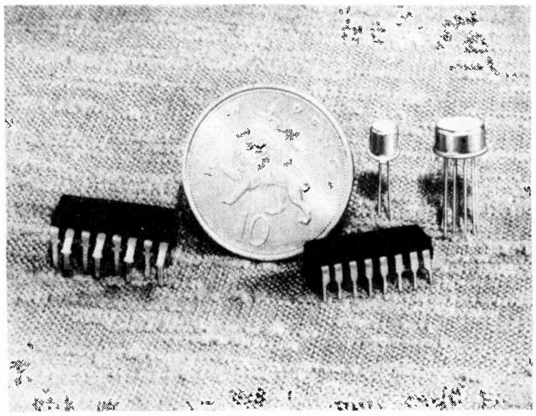
NEW SETS INCLUDE FIRST SINGLE-STANDARD MONOCHROME MODEL

The month brings the announcement of the first single-standard monochrome models. These, from **KB**, are the 20in. Model SV040 at £70 12s. and the 24in. Model SV140 at £81 6s. Dual-standard monochrome models from KB are the 20in. Model KV065 at £78 18s. and the 24in. Model KV165 at £89. All these models incorporate a Phillips four-button u.h.f. tuner unit. Also announced is the CK401, a single-standard 22in. colour model at £287 12s.

Six new models have been introduced by the British Radio Corporation. These are the **Ferguson** 20in. Model 3658 at £74 13s. and 24in. Model 3659 at £83 6s., the **Ultra** 24in. Model 6659 at £84 and the **HMV** 24in. Model 2659 at £83 6s. A new departure is the introduction of two 17in. portable models, the Ferguson Model 3661 and the Ultra Model 6661, both at £70 6s. These are fitted with the new Mazda square-corner flat-face 17in. tube and incorporate a telescopic aerial for v.h.f. reception and loop aerial for u.h.f. All these models are for dual-standard operation and are fitted with the Thorn 1400 chassis.

Dynatron have announced the price of their Copenhagen single-standard 22in. colour model first mentioned in our June issue. The recommended price is £299 with teak finish and £302 with walnut finish.

CHIPS WITH EVERYTHING



PART 1

E. J. HOARE

A REVOLUTION in the design of television receivers—both monochrome and colour—is just around the corner. In this article we shall gaze into a crystal ball dated 1975 to try to see what sort of receivers we shall then have and the implications for the television industry and its customers.

The term *chip* is a typical engineering colloquialism meaning *integrated circuit*. Until a short time ago they were used mostly in defence equipment where reliability and small space and weight were of the utmost importance and cost was no object. More recently as production increased and costs came down they have been used on a large scale by the computer boys. Now it is our turn, and the television industry is going to use them in a big way. Not all at once, of course, but in five years time the average receiver is going to be a very different animal from the one we know at present.

Evolution is a gradual process and afterwards one tends to look back and ask what all the fuss was about. Nevertheless when the time comes and we do have chips with everything it will be seen that the evolution was in fact a revolution and we shall have come to the end of one engineering road. Any further progress in TV reception will then have to come from a change of television system engineering and not from basic receiver design.

What are Chips?

Everyone is familiar by now with transistors—three-terminal devices which enable amplification to be achieved across minute junction areas carefully diffused into chips of silicon or germanium. Integrated circuits are produced by the same basic process but this is carried a stage further so that a number of transistors can be formed on the same chip of silicon having an area of only a few square made at the same time. Thus the equivalent of several groups of circuits, together with most of their associated components, can be formed on a chip of silicon having an area of only a few square millimetres. When this has been encapsulated for strength and protection you finish up with a device somewhat similar in size to a medium-power transistor but with a much larger number of connections—usually between ten and twenty, although occasionally more.

The circuits replaced by a typical chip might have about 40-50 conventional components comprising transistors, resistors, capacitors, diodes, etc. The chip itself however has to be supplied with decoupled d.c. potentials, and there will be a number of separate components coupling inputs and outputs together with auxiliary feeds such as pulses, and also components which cannot be laid down on the chip itself. Obviously if you need an electrolytic capacitor or a coil in the circuit you cannot expect to build it into a minute chip or silicon, and so it has to be connected externally. A typical chip will probably have about 5-10 discrete components associated with it, although this figure can clearly vary a great deal. Thus the use of a chip enables conventional circuitry to be condensed to better than a fifth of its normal size and physical complexity.

Practical Limitations

Now before everyone starts to visualise monochrome receiver circuitry in matchboxes and colour receivers in cigarette cartons, we had better sketch in a few of the limitations at the present state of the art. First comes power dissipation. Existing chips normally run at less than ½ watt, so a field output stage for example has to use conventional power transistors or valves. Next comes voltage. The transistors laid down on a chip cannot handle more than about 20 volts and so are not suitable for video output stages let alone line output circuits. The third limitation in the context of a television receiver is frequency. It is tempting to think of a single chip providing all the i.f. gain, but just imagine for a moment the difficulties of designing 80dB of amplification at 39·5MHz across a chip of about 2 square millimetres! The feedback problems appear insuperable.

So at present we can think in terms of small-signal, low-frequency circuits in chip form, with i.f.s and

Our heading photograph shows four Mullard integrated circuits for use in television receivers, from left to right the TAA470 RGB matrix, the TAA700 central signal processor in quad-in-line encapsulation, the TAA550 voltage reference source and the TAA570 intercarrier sound i.f. amplifier and detector. Further details were given in Teletopics, July 1969. These devices will soon be appearing in television receivers.

power and high-voltage stages using conventional components. This is interesting, even impressive, but it is a bit of a hotchpotch and the advantages are not sufficiently obvious to cause more than a mild stir in the industry. The real fun only becomes apparent when you begin to look ahead.

Advantages of Chips

We have already discussed space. Three chips and a few odds and ends are the equivalent of a complete medium-sized printed board as we know it at present. Think how many resistors, capacitors, diodes, soldered joints and pieces of copper print will be saved, and how this will improve reliability. Futhermore if the reliability of a chip is comparable to that of a single transistor, as we confidently expect, then we are in for a further improvement due to the reduction in the number of active devices.

Another advantage is consistency. Chips have to be made and tested to extremely high standards and due to their inherent characteristics it is safe to say that if their design is right there will be very little difference between one chip and another of the same type. This will not only give rise to better performance but will also make it easier to diagnose whether a fault is present and if so where.

Effects on Performance

Performance will also benefit from other considerations. When designing a chip you are free, within certain overall limitations, to add a few extra transistors and diodes at virtually no extra cost. Thus if you want to add an extra sync clipper, or an emitter-follower or two, or a keyed black-level clamp, go ahead. The performance can be improved with hardly any penalty. Even the added complexity will make very little difference to the reliability. Of course you must not overdo it because otherwise the chip area, power dissipation, and the number of loads increases to a point where you run into difficulties. The chip has to be designed within the overall framework of these limitations. Furthermore they have to be designed to a very high standard. The equivalent of connecting up a handful of components and getting a reasonable performance simply will not do. Only the best is good enough, and a chip that has reached the mass production stage can be expected to perform better than its equivalent in conventional components.

The problems of heat are made a bit easier too. The odd few watts saved by using a few chips are not very important. However if the circuitry is condensed into a much smaller space the designer has greater freedom to place components where he likes, so it is easier to keep heat-producing circuits, such as line output stages and h.t. smoothing, well separated from other items. This is one of those intangible factors that lead to a better overall design but cannot easily be written into a specification. All one can say is that in this way the life and reliability of the aparatus should be improved considerably.

Reliability and Durability

If you think of a PAL decoder for example, comprising three or four chips and a handful of components all on a small board in a cool air stream at the bottom of the cabinet, it is clear that old standards of reliability and durability are out of date. When there are only a few conventional components involved it is easier to ensure even higher standards of quality. Why shouldn't such a decoder last for twenty years? It probably will. The limiting factor will not be the reliability of the receiver so much as social pressures for change. People will buy a new TV set just because they fancy a new one, or perhaps because technology has improved and they can have bigger, brighter pictures in slimmer cabinets.

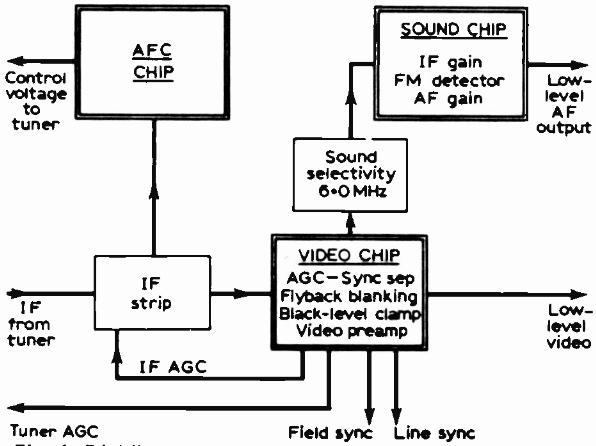


Fig. 1: Dividing up the circuit into three chipfuls. But how do we add a fourth—see Fig. 2.

These are the obvious, performance, advantages to be gained by using chips. There are all sorts of others, some of them of more interest to the industry than to its customers, but we will discuss these later. Of disadvantages there seems to be only one of any importance. This is the hazard of having too many eggs in one basket, or rather electronic black box. However by the time this issue becomes a real one it will, paradoxically, be an asset and not a liability, as we shall see.

Designing Chips

The process of designing chips can be divided into three stages. First you must decide exactly what functions the chip is to perform and what the inputs and outputs are going to be. The next stage is to design the elecronic circuits that will perform these functions to the desired standards of performance, and which are fully compatible with chip techniques. And finally these circuits have to be laid out in a plane pattern of pn junctions, conductors, resistive tracks and leadouts, rather like the pattern on a printed circuit board, so that an experimental chip can be manufactured. This is a complex and highly specialised art.

Of course these three stages are interdependent. The functions that you allot to a chip depend upon a number of factors such as the total power dissipation, chip area and the number of leadouts you are permitted. This is determined by the state of chip technology. Looking outwards instead of inwards you must divide up the receiver functions in the most logical way possible so that each chip has the minimum number of connections, the maximum amount of circuitry permitted, and joins up with its neighbours as harmoniously as possible.

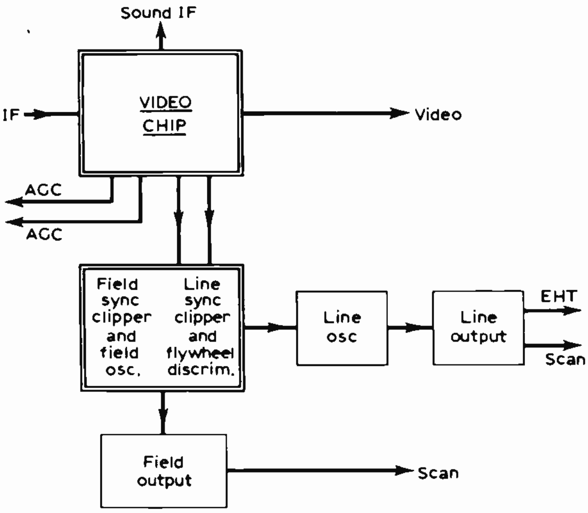


Fig. 2: An unsatisfactory way of adding a fourth chip to the arrangement shown in Fig. 1.

It is rather easy for example to plan a chip that does a lot of work in a beautiful, logical way. Everything dovetails together just as you would wish. Then when you come to divide up the other circuits you find that it is impossible to group them together into chipfuls (to coin a phrase) without having too many leadouts or forcing into an unsuitable marriage partners who are basically antagonistic (such as line and field oscillators). It can all be very frustrating. Figure 1 shows a hypothetical quandary. It is a mixture of triumph and despair. The three chips do their jobs very nicely except, perhaps, that the a.f.c. chip barely replaces enough circuitry to be economic at present day prices. This illustrates one of our problems. The intercarrier sound chip is a nice entity and gets full marks. The video chip sweeps up a number of functions and is a tidy chipful. But if we want to introduce some more chips into the game what do we do? A possible grouping is to put the line and field oscillators on a single chip, but this is dangerous practice to say the least. There is simply no adequate answer which gives an economic and technically satisfactory solution. One might try the arrangement shown in Fig. 2 but the chances are that line sync pulses would get into the field oscillator and affect the interlace, and in any case the cost of the extra chip would probably be higher than that of the conventional circuits it replaced.

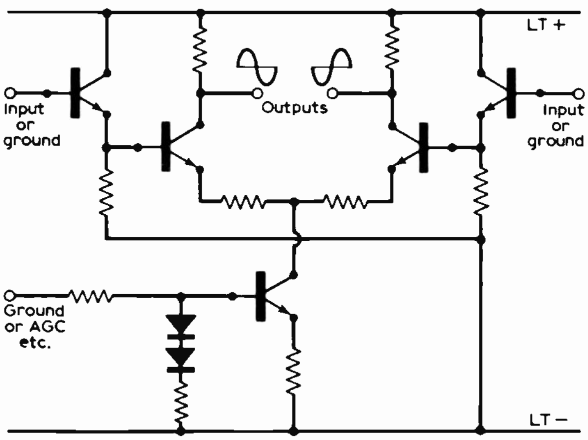


Fig. 3: Differential amplifiers are basic building bricks in modern electronics. This example has high-impedance emitter-follower inputs.

So much for planning and specification. The actual circuit design, apart from needing a totally different approach to that used for conventional circuitry, has to face the basic problem of keeping to a minimum the number of connections that have to be made to each chip. It is obvious that designing 10-20 connections to a single chip of a few square millimetres and then mass-producing it in hundreds of thousands is no mean task. The connections not only have to be electrically good but must also stand up to the stresses involved in the encapsulation process and to the handling and dip soldering they receive afterwards. This is the expensive part of the manufacturing process, and costs can be reduced by having fewer connections. So careful specification and ingenuity in circuit design are at a premium.

The process of designing the various masks used when diffusing the different constituent parts of the chip is a very complicated matter involving all sorts of dimensional requirements in terms of clearances, conductor widths, junction areas, and so on. They are peculiar to each manufacturer and a vital part of his technology. It is a subject that you either describe in full or leave well alone, but it would be inappropriate to discuss it further here.

Chip Circuitry

The art of designing circuitry for production in chip form is a rather specialised one. To begin with it needs a very different mental approach because ordinary circuit techniques based on the use of conventional components have to be discarded almost in their entirety. Chips have to perform the same *functions*, but these must be achieved in a different way.

Certain limitations are inherent in the physics and physical structure of chips. Any ordinary values of capacitance are out — literally — because of the excessive amount of chip area they would require. Thus capacitors must be connected externally, and since it is necessary to economise in the number of connections as much as possible d.c. coupling between stages is used almost exclusively. This brings us up against the difficulty of designing stable high-gain d.c. amplifiers, and so here is another problem. Temperature compensation must receive careful attention and becomes a routine though difficult part of the design process.

High values of resistance also take up too much space and so have to be avoided. Indeed it is desirable to reduce the number of resistors to a minimum because it is much more economical to lay down transistors and diodes. All this means that ordinary circuit techniques must be turned upside down since in chip technology active devices such as diodes and transistors are cheaper to produce than passive components such as resistors and capacitors. Hence our comment about the different mental approach needed.

Chips have two performance characteristics which are of great importance in deciding what kind of

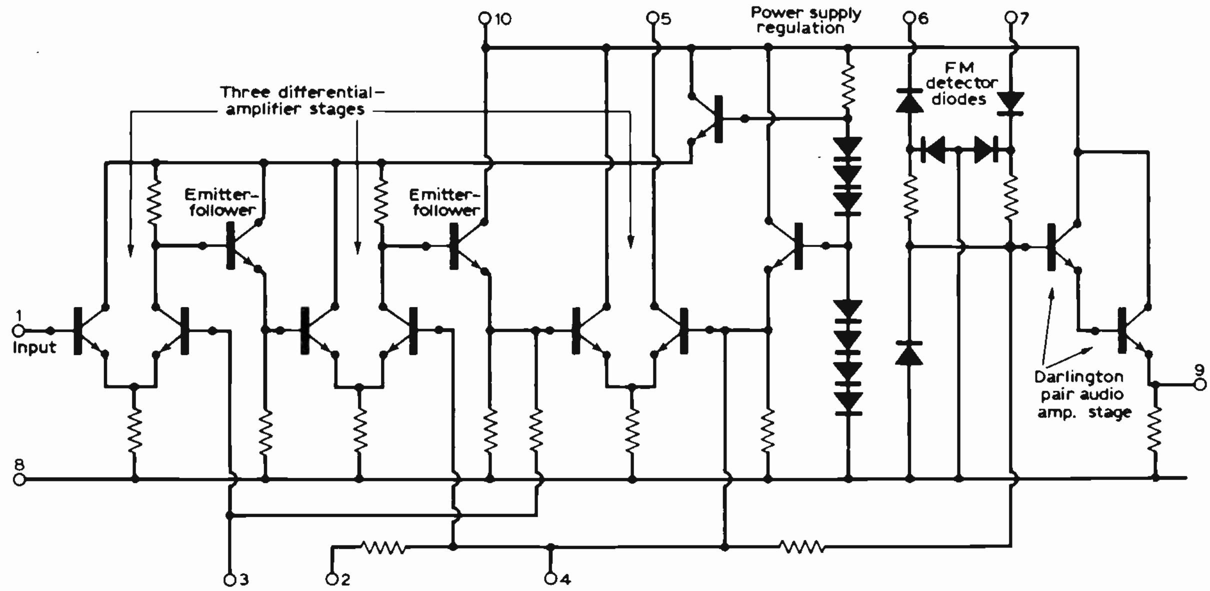


Fig. 4: The internal circuitry of the 10-pin RCA CA3013 intercarrier sound i.f. amplifier, discriminator and low-level a.f. stage integrated circuit. It comprises twelve transistors, twelve diodes and fifteen resistors.

circuitry to use. In the first place it is difficult to achieve an accurate value of resistance, and the spread in production—variation in values within a production batch—will be quite large. On the other hand since all the constituent items are being diffused at the same time all the transistors and diodes will have closely matched characteristics and resistance *ratios* will be nearly constant.

The Differential Amplifier

The various factors which we have just outlined have led to the adoption of an almost universal "building brick" used in nearly all chips. This is the *differential amplifier*, and a typical example is shown in Fig. 3 complete with stabilisation and temperature compensation. The advantages of this circuit are its flexibility of application, absence of decoupling capacitors, small number of resistors, its dependence on resistance ratios rather than absolute values, the use of low-value resistances and the inherent balance between the inputs. Two or more stages can be connected in cascade to provide the required gain or to carry out a series of different operations. Here are some of its possible applications: amplification from d.c. to v.h.f.; amplitude modulation; synchronous detection; limiting; frequency multiplication; gain control.

Differential amplifiers are of course often used in conventional circuitry, but the high cost of valves and transistors has precluded their use in domestic equipment. The advent of chips however will enable their special qualities to be used to provide better performance even in everyday equipment. Facilities such as noise limiting and the cancellation of impulse interference can become commonplace features in television receivers.

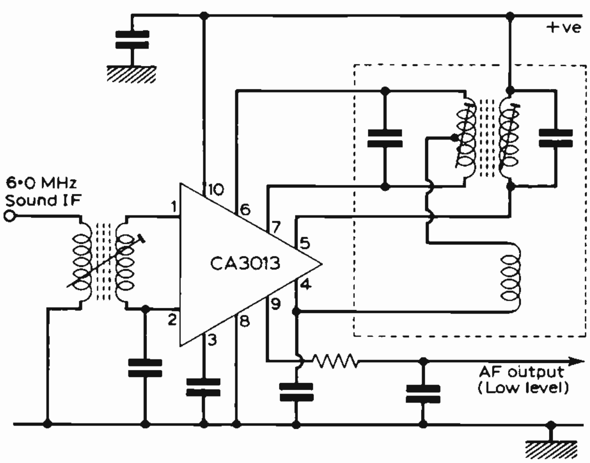


Fig. 5: The external circuitry required for the CA3013 consists of an input selectivity coil, a ratio detector transformer, five capacitors and a resistor. The circuit then replaces the entire intercarrier sound channel from the vision detector to the audio output stage.

A Chip for TV Receivers

By way of illustration Fig. 4 shows the circuit diagram of the RCA CA3013 chip given in one of their excellent handbooks. Although this chip is not a particularly large one it provides sound i.f. amplification, noise limiting, f.m. detection and low-level audio amplification suitable for the intercarrier stages of a monochrome or colour receiver. Ignoring the input coupling and selectivity coil, which would be needed anyway, it requires only six external components, and an f.m. discriminator coil assembly.

The circuitry consists of three simple differential amplifier stages in cascade coupled by two emitter-followers fed from a built-in regulated power supply. The f.m. detector requires an external tuned phase-shift transformer, and a Darlington pair provides a low-level audio output.

Next month we will take a look at the likely trends in the use of chips in television receivers and the effects of this on our trade.

TO BE CONTINUED

TRANSISTORS IN TIMEBASES

PART 2 LINE OUTPUT STAGES

H. W. HELLYER

IN this part we shall take a look at the use of transistors in the line output stage but before doing so it would be as well to consider the basic valved line output stage in order to get clear at the start what the basic requirements are. In this way we can note the particular problems in the design of the line output stage, considering the inevitable losses and the sources of main current drain. The main virtue of transistors lies in their low power consumption, lack of heat generation, and small size, making the portable receiver an obvious excuse for using them.

BASIC REQUIREMENTS

In the line timebase the cathode-ray tube is the chief determining factor. The deflection power required depends on its size and design. The e.h.t. is set by its characteristics, and the beam power—or more accurately the beam current—regulates the design of the video stage and imposes limits on the h.t. that is to be used. The circuit of the line timebase will have to fit into this framework of fairly close parameters to maintain an order of efficiency of some 80 per cent and to reduce to a minimum any drain on the h.t. supply.

Thus to see where the limits lie and where the losses occur let us first take a conventional valved line output and efficiency diode stage and study the valve and current waveforms (see Figs. 1 and 2).

If the inductances in the circuit were perfect there would be minimal losses: the scan field would first grow in the scan coils and then, collapsing, generate current in the coils via the boost circuit. But in this imperfect world there will be losses in the deflection coils due to the heating effect (I^2R losses) and the windings and core of the output transformer will likewise suffer. We saw in Part 1 that timebase transistors act as switching devices but that these "switches" are never quite perfect. There is always some "slope", some finite resistance between the on and the off states. This means that transistors can never act fast enough to eliminate heat losses, although in the past couple of years some really impressive design figures have been coming in from the colour television laboratories.

NON-LINEARITY

A point that may be overlooked is the necessity to correct for circuit non-linearity. The build-up of the line scan is non-linear, mainly because of resistive losses in the scan coils; and correction circuits themselves cause losses. Components have to be made to fairly wide tolerances to allow for the lumped differences in scan circuits, and the practice is to design for rather more power than the circuit demands, then to adjust to obtain the correct scan. So it will be asked of transistors to be capable of doing a little more than they have to do—which is no bad thing.

HT DRAIN

The h.t. drain may be quite serious when power supplies are designed with portability in mind. The boost voltage is more important than with many valve circuits, where quite drastic boost losses can be tolerated before the blooming picture, unstable field timebases and sometimes jittery sound proclaim the fault even to the unobservant. The a.f.c., a.g.c. and other regulating systems must also be designed with a view to least losses as well as most efficient control. All these factors restrict the choice of transistors and prescribe general circuit design.

VALVE CIRCUIT

In a valved line output stage circuit the energy put into the scan coils when the field collapses at the end of the scanning stroke is recovered by the efficiency diode and used to charge the boost capacitor, adding to the h.t. supply for the line output stage (and other parts of the receiver). This technique is not always followed with transistor designs

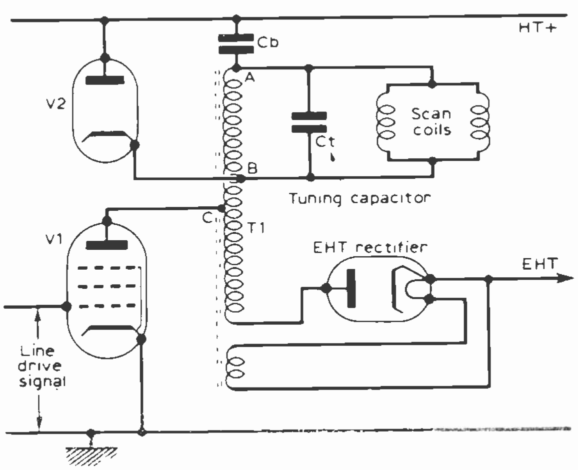


Fig. 1: Basic valve line output stage. V1 line output valve, V2 boost diode, Cb boost reservoir capacitor.

however where a variation of the principle may be found. We shall see by considering the basic circuit shown in Fig. 1 that the h.t. voltage is only a small part of the stage operating voltage, and the prime requirement of a linear increase in flux through the scan coils is achieved by virtually clamping each end of the coils to a fixed voltage, resulting in a linear rise in current provided the circuit is mainly inductive.

The pentode (Fig. 1) line output valve V1 obtains its h.t. from a tapping on the line output transformer T1 whose h.t. feed is not direct from the h.t. line but via the boost diode V2. The top end of the transformer is connected to the h.t. line by the boost capacitor Cb. Across the secondary winding of the line output transformer we find the scan coils, with a tuning capacitor Ct. The lower part (on our drawing) of T1 is an overwind that steps up the signal applied to the e.h.t. rectifier (i.e. the flyback pulse).

When the h.t. voltage is first applied to the circuit current flows to charge the boost capacitor, the path being Cb, A, B, C, V1 and chassis return line, so we have a large voltage difference between A and C and current begins to build up in the deflection coils. The four waveforms shown in Fig. 2 are drawn to a time scale of a single scan on the horizontal axis with the corresponding voltages and currents drawn on the vertical axes.

WAVEFORMS

For ease of description we will assume that the scan commences at point F. At the end of the scan the current through the scan coils has built up to a high value and when the line output valve is switched off by the applied drive to the grid this large current falls rapidly and the field around the coils collapses. The transformer opposes the

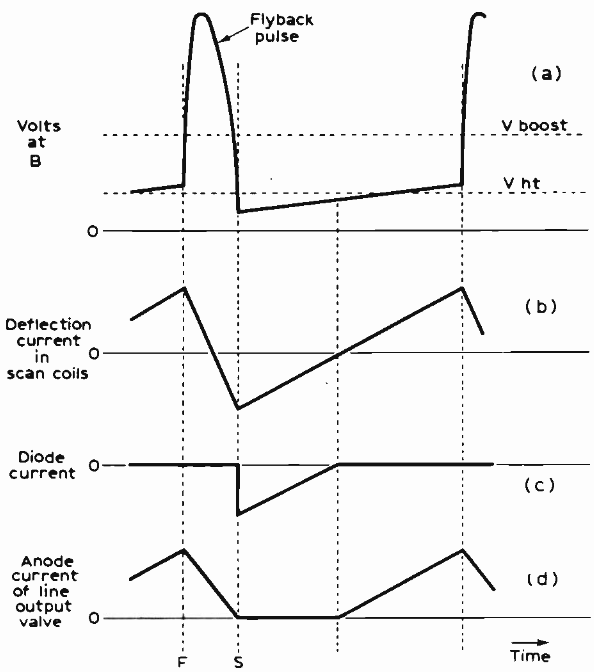


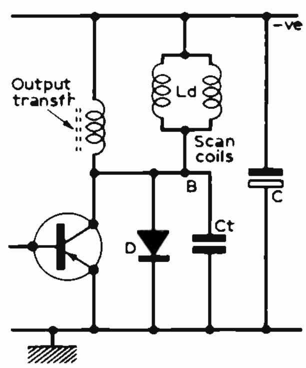
Fig. 2: Voltage and current waveforms in a valve line output stage such as that shown in Fig. 1.

change and as there is no direct return path the charge is applied to Ct, discharging into the scan coils again until a half-cycle (at the resonant frequency of the circuit) is completed. This is the flyback period when the current in the scan coils and so the flux that acts upon the tracing beam in the cathode-ray tube reverses. In Fig. 2(b) this is shown from F to S and can be seen to match on the time scale the large flyback pulse, traced from the voltage at point B. When the voltage at B has fallen to the h.t. value, current from the scan coils flows into the efficiency diode (V2) part of the circuit and back through the boost capacitor. There is a virtually constant charge across Cb and the low forward resistance of the diode causes a nearly constant voltage across the deflection coils. Fig. 2(c) and (d) show the valve currents to clarify the sequence of operation.

BASIC TRANSISTOR CIRCUIT

In the transistorised line timebase a different form of energy recovery takes place. Figure 3 shows a rudimentary circuit that we can use as an example. The efficiency diode D is connected in reverse polarity to the conduction polarity of the transistor. The line output transformer is here a single winding to simplify description. Switching on by applying the drive signal to the transistor effectively connects the collector of the transistor to the chassis (since the transistor has little resistance in the "on" or saturated state) and current increases linearly through the scan coils Ld which in our simplified diagram are shown connected across the transformer.

Fig. 3: Basic transistor line output circuit. The boost diode D is connected in reverse polarity to the transistor — the arrowhead in its symbol points in the opposite direction to the emitter arrowhead of the transistor. On the positive overswing following the flyback pulse D conducts, its current constituting the first part of the forward stroke.



At the end of the scan the transistor is switched off by the drive waveform and the current generated by the collapsing scan coil field flows around the circuit Ld, Ct and C, the supply decoupling capacitor. During the half sinewave flyback pulse the voltage on the collector of the transistor goes very negative, as shown in Fig. 4(a). When it returns to zero the resonances in the circuit tend to drive it positive but the clamping action of the diode, now conducting heavily, effectively clamps the end of the scan coils to chassis potential. This limiting action causes the supply capacitor C to recharge and in this way we obtain the necessary energy recovery. The voltage at B is at chassis potential so as we can see from Fig. 4(b), (c) and (d) a linear scan current can again build up.

This is all very fine in principle: in practice there are other circuit considerations, limitations on components, and losses to take into account. An

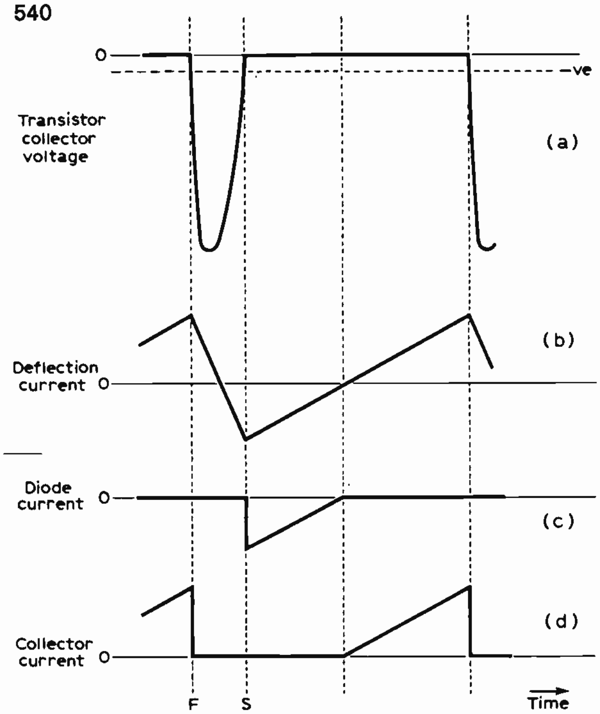


Fig. 4: Waveforms of the circuit shown in Fig. 3.

example would be the boost voltage, which, ideally, should be as high as we can make it—several times above the h.t. value. The higher we can make this boost voltage the lower the current we draw and the greater the circuit efficiency. But insulation problems cause some limitation and external current drains cause yet more limitations.

SUPPLY POTENTIAL

In the circuit we have just considered the h.t. of the receiver is actually the boost potential, in contrast with the valved circuit previously discussed. The transformer was shown as a single coil for ease of explanation but we must now take into account the fact that the c.r.t. final anode voltage is dependent on boost potential so that again an overwound transformer is required. There are also considerations of flyback ratio (the ratio of the flyback to the scanning times) and pulse shape, as we shall see. But first we must remember that the h.t. of a transistorised receiver may well be limited by the type of supply.

Many of these receivers are portable, designed to be run on an input voltage of around 12V to enable them to be operated from a car battery. The fact that many are also mains-operated makes no difference, for in these the power supply circuits simply transform down the mains supply voltage and rectify it to obtain a similar low d.c. supply voltage. In these some derivation of the Blumlein circuit shown in Fig. 5 will be employed, but where h.t. rails are at a higher potential we may well see variations of circuit that look something like conventional valve designs, with boost volts derived in the same way.

Other considerations are the line synchronisation, which can affect the flyback ratio, becoming smaller

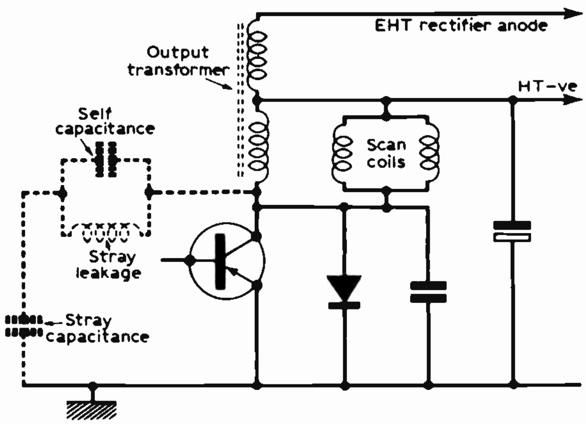


Fig. 5: Blumlein line output circuit, used for current saving An overwinding on the output transformer feeds the e.h.t. rectifier.

when the speed is on the low side, causing higher peak collector volts and changes of beam current which will significantly alter the peak collector voltage.

FLYBACK RATIO

We have twice mentioned flyback ratio and the importance of this factor must next be considered. The peak collector voltage is a determining limit in the choice and use of transistors. Flyback ratio has a direct effect on this limit. In early types of valved receivers quite small flyback ratios could be tolerated. But later sets have larger scanning angles and the e.h.t. is much higher: flyback ratios of more than 16 per cent are normal. Hand-in-hand with this goes the actual shape of the flyback pulse. A square-topped pulse gives the largest pulse area for the least peak height—and pulse height is directly tied to peak collector (or anode) voltage.

This flattening of the pulse-top to achieve a rectangular shape is achieved in modern sets by third-harmonic tuning. The peculiarity, as far as transistor operation is concerned, is that the shape of the pulse can be drastically affected by the transistor's turn-off time, delaying the flyback commencement and reducing the initial slope of the pulse. This increases dissipation in the line output transistor but has other advantages that outweigh this drawback. These are principally connected with the synchronisation and will be considered later.

The flyback ratio with transistor circuits needs to be high, as much as 23 per cent. This also means that direct synchronisation cannot be used so flywheel sync is the order of the day. And to prevent display of video information during the retrace with a high flyback ratio, flyback blanking is essential.

DRIVE CURRENT

An additional circuit required in transistorised line timebases is the drive section. Enough current to keep the line output transistor fully conducting must be injected into its base when it is switched on. Correct scanning action depends on the transistor then being turned off by the drive waveform at the end of the scan in order to generate the flyback pulse when current circulates through the tuned part of the circuit. When the half-cycle previously described

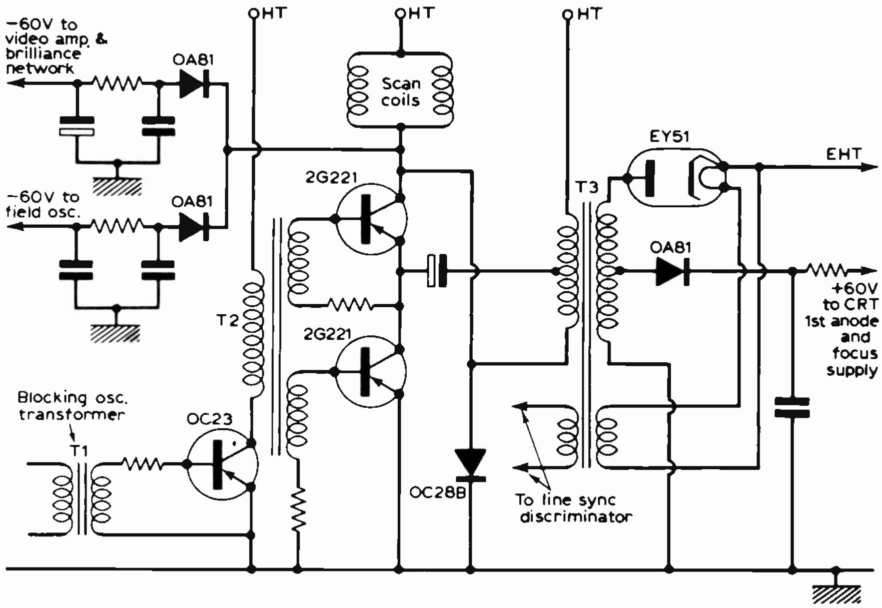


Fig. 6: One of the earliest transistorised line output stages, used in the Pye Model TT1. The driver transistor is fed from a tertiary winding on the line blocking oscillator transformer. Two series-connected 2G221 power transistors share the flyback voltage pulse developed in the inductance of the deflection coils. The output stage is directly connected to the coils, the primary winding of the output transformer acting as a shunt for the d.c. component of the deflection current. An overwinding on the transformer feeds the EY51 e.h.t. rectifier and an OA 81 rectifier providing the 14 in. C14/13A tube first anode and focus potentials.

ends and current flows in the diode the scan starts (see Fig. 4). But the drive current at the end of the scan when collector current is at maximum is vital to the operation, and the most rapid switch-off that can be obtained will depend on the driver circuit as much as the preceding generator circuits. A large transient current spike is needed: this is where the main difference in transistor circuits lies, and where the greatest stumbling block may occur. We have to think in terms of currents where previously we were concerned with voltages.

DRIVER STAGE

The driver stage is usually transformer-coupled to the base of the output stage. The waveform of the voltage then delivered may be more square than sawtooth, and speed-up circuits that have already been discussed (see Part 1) will be found. The driver transistor gives the switch-on edge (inverted pulse providing the switch-off edge) for the output stage, and its stored energy gives the drive current during the scan.

PYE TT1 CIRCUIT

Examples of the combination of driver and output stages can be seen in Figs. 6, 7 and 8 where the very different configurations can nevertheless be broken down to the basic constituents we have discussed. The first of this trio, Fig. 6, is the earliest example, the line output section of the Pye TT1 mains-battery portable. Appearing in May 1961 (although this is a 1964 version of the circuit) this receiver suffered mainly from the then existing limitations of transistor design. The output power was obtained by the use of two transistors in series.

Following a fairly straightforward oscillator stage the driver (OC23) is coupled from a tertiary winding on the blocking oscillator transformer T1 and itself feeds into a split-secondary transformer from which the bases of the two 2G221 output transistors are fed. The output pair operate in series, sharing the flyback pulse. The line output transformer (T3) primary winding acts as a shunt for the d.c. component of the deflection current and the output transistors are connected directly to the deflector coils. An OC28B is used as efficiency diode and we can see that this circuit is almost a replica of the Blumlein example in Fig. 5. There are some pecularities in minor respects, principally associated with the oscillator and flywheel circuits, and these will be discussed in a later article.

PHILIPS T-VETTE

Quite different in detail but similar in principle is the circuit of the Philips T-Vette shown in simplified form in Fig. 7. This is a later circuit released in 1966 and we can already see the effect of the availability of a heavy-duty line output transistor (AU103) particularly in the simplification of the driver section. The driver transistor Tr1 conducts when the line output transistor is cut-off, using the "non-simultaneous mode" (well, it figures!); its collector current is limited by the network R1, C1 across the primary of the coupling transformer. It is essential for this type of circuit that the oscillator and the driver transistor conduct together, and the balance of the transformer between these two stages is vital for stable operation.

The efficiency diode is again shunt-connected and the flyback time is controlled by the capacitor C2 (82kpF) across it. The line output transformer operates in the constant flyback-ratio mode and the correct third-harmonic tuning for 405- and 625-line operation is ensured by switching the tapping. The deflection coils are fed from different sections of the line output transformer windings selected by the system switching. There is a fair amount of complication in this switching which has been omitted in our simplified diagram. Transistors are vulnerable to switching transients and precautions that would not be met in valved receivers will be found: here we have a break-before-make switch (S1) in the power feed to the stage to protect the transistor on system change. Additional windings and diodes give

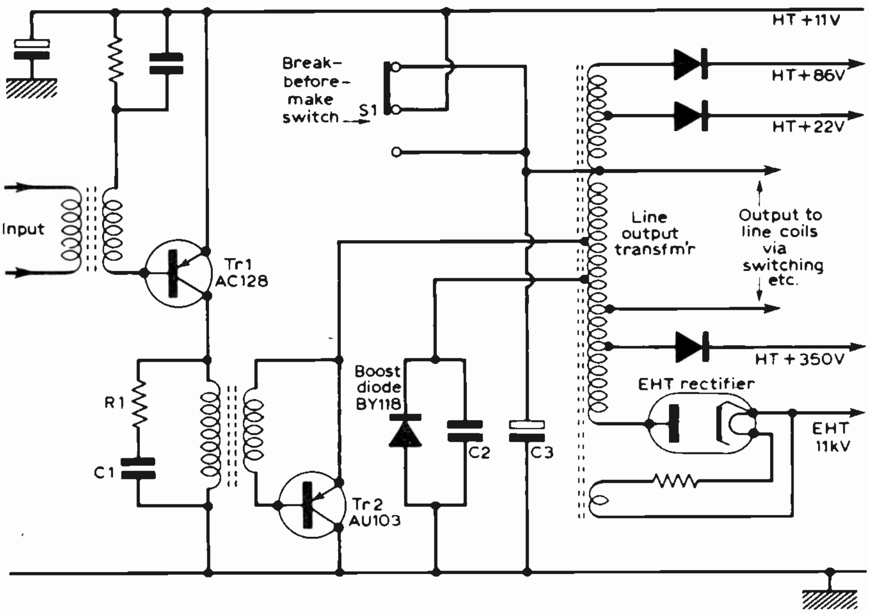
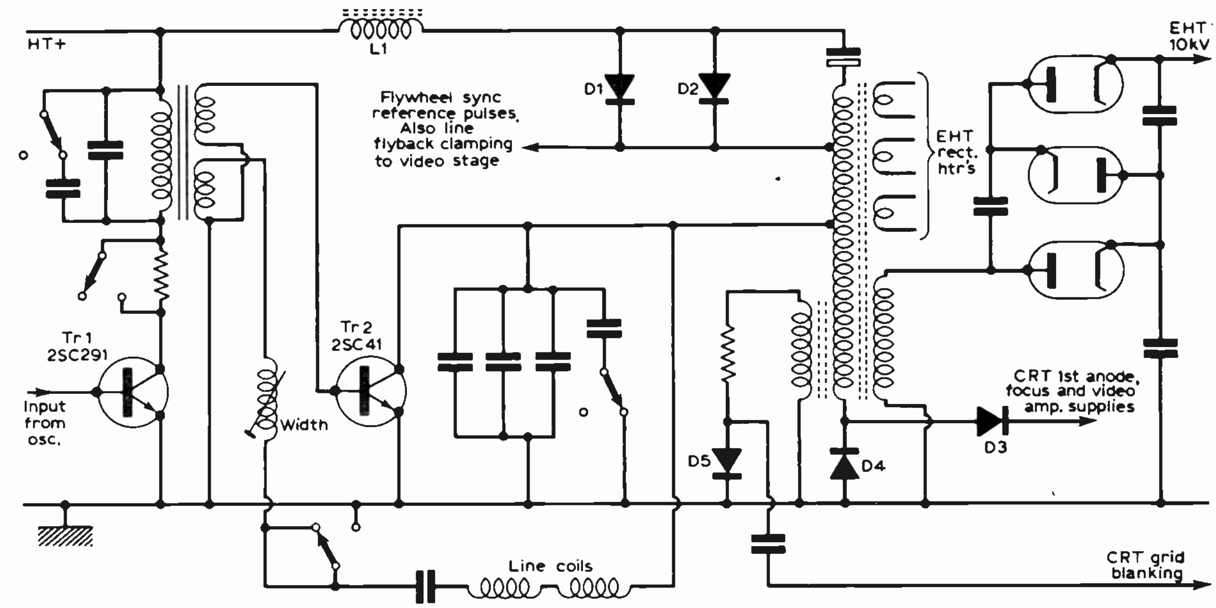


Fig. 7: The line output circuit used in the Philips 11 in. mains/battery portable T-Vette model. This uses a sinewave line oscillator transformer coupled to the line driver transistor, the windings being arranged so that the oscillator and driver conduct together. When the driver is conducting the line output transistor is cut off, and vice versa. The line output stage operates in the constant flyback ratio mode with C2 controlling the flyback time. To avoid transients which could damage the output transistor during 405-625 system changeover, the supply is via a break-before-make switch. Here again several supplies are obtained from the stage to feed other sections of the receiver.

Fig. 8 (below): The driver and line output stage used in the Sony Model TV306UB.



us the 350V, 86V and 22V supply lines for the c.r.t. first anode potential and other parts of the receiver.

SONY TV306UB CIRCUIT

A rather different situation exists in Fig. 8. This is the line output stage used in the Sony Model TV306UB, a 9in. portable receiver that employs a conventional blocking oscillator but has the driver stage fed from the collector load of the oscillator and, via a split transformer, a hard-run 2SC41 line output transistor. The diodes and capacitors across this circuit can be confusing. The capacitors are for tuning, with the final one switched out for 625-line operation. Diodes D1 and D2 form a fairly conventional efficiency diode circuit; D3, an HFSD1Z provides a supply for the c.r.t. first anode and focus circuits and also for the video amplifier; D4 damps the circuit to prevent line output transformer ringing; and D5 is concerned with the c.r.t grid flyback blanking. The e.h.t. is obtained from a tripler circuit, approximately 10kV being needed for the 230DB4 9in. c.r.t.

Fault-finding in this circuit—until one learns to pounce on the vulnerable diodes—can be tedious. It is shortened by noting whether the choke L1 in the supply line warms, a clue to a short-circuited output transistor, but equally caused by any of the components across the circuit developing a fault. D1 and D2 have subsequently been replaced by a single DG1NR, having given trouble previously. The resistance across the line output transistor should not be less than 20Ω. When breakdowns occur symptoms are not on display so that fault-finding is very much a logical process.

SERIES TO BE CONTINUED

DX TV

CHARLES RAFAREL

A MONTHLY FEATURE FOR DX ENTHUSIASTS

ANOTHER pretty good SpE month, though not quite so good as last month. However, we are still very much in the opening stages of this year's SpE season and I am sure that things will develop very nicely in the coming weeks. What has been most noticeable during the current period has been the very good openings to Norway, Sweden and the USSR, with Spain, Italy and Yugoslavia a little behind them, and the relative absence of short skip to Czechoslovakia, Hungary and Poland this time.

Also there has been a fairly pronounced pattern in the reception. The openings to the East and and North East have been early in the mornings, starting with the USSR and turning through Sweden and Norway, with a lull about midday except for the continuing counter-clockwise rotation producing Iceland on occasion (at last!). The South and South-West stations have come in generally in the late afternoon and early evenings, which seems to confirm the theory that skip direction had progressively moved round.

The Trops, too, showed some promise at times. There were even minor openings during the main SpE ones, which is unusual.

Here is the log for the period 1/6/69 to 30/6/69:

1/6/69 USSR R1 and R2, Czechoslovakia R1 and R2, W. Germany E4, Spain E2, E3 and E4, Sweden E2, E3 and E4, Norway E2, E3 and E4.
2/6/69 USSR R1, Poland R1 and R2, Portugal E2 and E3, W. Germany E2, Spain E2.
3/6/69 Czechoslovakia R1, Poland R1 and R2, W. Germany E2 and E4, Spain E2.
4/6/69 USSR R1, Poland R1, Austria E2a, W. Germany E4, Sweden E2, Norway E4, Iceland E4, Yugoslavia E4, Portugal E3.
6/6/69 Czechoslovakia R1, USSR R1, Sweden E4, Norway E4, W. Germany E4.
7/6/69 Norway E2, E3 and E4, Sweden E2, E3 and E4.
8/6/69 USSR R1, Sweden E2, E3 and E4.
9/6/69 Sweden E2, Italy IB.
10/6/69 Czechoslovakia R1, USSR R1, Poland R1 and R2.
11/6/69 W. Germany E4, Norway E4.
12/6/69 W. Germany E3, Austria E4, Yugoslavia E4, Italy IA.
13/6/69 Sweden E2 and E4, Norway E2 and E4.
14/6/69 Poland R1, Italy IA.
15/6/69 Poland R1, Sweden E2 and E3.
16/6/69 Austria E2a, Hungary R1, Yugoslavia E4.
17/6/69 USSR R1, Czechoslovakia R1, Spain E2, E3 and E4.
18/6/69 Czechoslovakia R1, Poland R1, W. Germany E3, Italy IA, Spain E2, E3 and E4.
19/6/69 Sweden E2, E3 and E4, Norway E2, E3 and E4, Iceland E4, France F4 and Corsica F4.
20/6/69 USSR R1, Sweden E4.
21/6/69 USSR R1, Sweden E2 and E4, Norway E2 and E3.
22/6/69 Sweden E2.
24/6/69 USSR R1.
25/6/69 USSR R1, Sweden E2, Iceland E4, Italy IA and IB, Poland R1.
26/6/69 USSR R1, Sweden E2, Norway E4.
27/6/69 USSR R1, W. Germany E4, Sweden E2, Spain E3.
28/6/69 USSR R1, Sweden E4.
29/6/69 Sweden E2 and E3.
30/6/69 Norway E2 and E3.

My own main news is the reception of Iceland E4 on 4th, 19th and 25th. It was an excellent long-duration signal on the 19th. The "build-up" was via Sweden and Norway, in that order, and the times 13.30 to 15.00. There seems to be no doubt of the origin of the test card which could only be received with the aerial to the North West. Earlier reception of "bursts" of this card at 08.30 were of W. German origin and the aerial had to be pointed Eastwards. In any case, allowing for the two-hour time difference for Iceland it would seem unlikely that they would be on the air at 06.30. Roger Bunney sent me a photo of his earlier reception: he and I differ a little in the details of the card, his version showing no grid whereas there was a small white grid on mine, so it may well be that there are two versions.

The second notable incident was also on the 19th. The first indication of it was sound interference by French speech on the local B3 channel and a check showed that Carcassonne F4 was roaring in, the best that I have ever seen it. But even more remarkable was a second image displaced about ½in. vertically: this was Ajaccio Corsica, a new one for me. I hope other DXers spotted it too.

Rumania has been one of the "missing" ones for many of us over the past twelve months and now thanks to Roy Sheppard of Amman, Jordan, we have an explanation. On June 20th he saw a programme followed by a clock and a TVR Rumanian caption, this in turn being followed by the EBU (black rectangle) card. So Rumania is using this card: we have had reports of it on Ch.R2 and now we know what it is. Further, Roger Bunney reports reception of Bucharest R2 with the "new" card as shown in Data Panel No. 15. Also rather a mystery, test card G with no other lettering on occasions seen on R2. Could this be Rumania as well or perhaps even Bulgaria?

We have a list of predicted Meteor showers for the coming months:

Orionids Oct. 15-25 peaking 20-21st.

Taurids Oct. 26-Nov. 16 peaking 1-7th Nov.

—continued on page 551

SERVICE NOTEBOOK

G. R. WILDING

Inadequate Height

INSUFFICIENT height which remains sensibly constant with no pronounced tendency to bad linearity or bottom foldover and with the field output valve running at normal temperature is most often due to reduced voltage at the anode of the triode timebase generator. Timebase generators are extremely sensitive to voltage variations and in most designs this feature is made use of by including a high-value potentiometer connected as a rheostat in series with the anode load resistor to vary the vertical amplitude.

The h.t. supply to the generator valve is nowadays always taken from the boost h.t. rail instead of the normal h.t. rail to improve scan linearity, and due to the high-resistance feed the height will always reduce drastically when the triode anode voltage is being measured, even with a meter of high internal resistance. Due also to the h.t. feed being via a high resistance any readings may well prove to be below those stated in the service manual, and for greatest accuracy it is best to use the meter on the highest range compatible with a reasonable needle deflection.

However if the voltage appears low on testing along the supply feed from the boost h.t. rail you will invariably find a high-value limiting resistor, and on shunting it with an equivalent usually more than ample height will be restored. Such resistors after some years of service gradually develop an increased resistance resulting in the anode voltage being too low even with the height control at maximum.

Another cause of inadequate height, or more truly impaired linearity at the bottom of the raster giving the effect of reduced amplitude, is loss of capacitance in the electrolytic capacitor shunting the cathode resistor of the field output pentode. As always the simple and sure test is to temporarily connect a replacement across the suspect and note results.

Most field generator circuits today have their output stabilised with a v.d.r. to compensate for variations in mains supply voltage, etc. Should this component develop a reduced resistance it could also cause impaired height. If at all suspect the best procedure is simply to disconnect the v.d.r. and note how much the height increases. If it increases only fractionally the v.d.r. can be assumed to be normal, but if there is a very dramatic increase to much more than the required amplitude the component is most probably defective. These components however prove very reliable in practice and the possibility of their failure should only be considered when more conventional components have been ruled out.

As the anode voltage to the triode generator is obtained from the boost rail, height will automatically suffer should this voltage be low. Naturally reduced boost-rail voltage will also reduce scan width and e.h.t., but as field timebase generators respond so much to even small voltage variations reduced boost voltage is often first made evident by an inability to obtain full height. A quite common cause of reduced boost-rail voltage is a slight interelectrode leak in the c.r.t. from the first anode or the focus electrode to an earthed point, since both these electrodes may be fed from the boost rail. Though small the resulting additional drain can be quite sufficient to produce the defect.

Such interelectrode leakage usually results in an inability to fully black-out the screen so that the picture seems as if the brilliance is set too high. Occasionally some slight improvement can be effected by feeding the leaky tube electrode via an additional feed resistor to reduce the applied potential, but as in most cases this defect only develops in ageing tubes the only remedy is tube replacement.

Line drift

WHEN line drift occurs soon after switching on the almost certain cause is a faulty valve in the line generator circuit. We say faulty valve in the generator circuit rather than a faulty generator valve since commonly in modern receivers two valves are employed in a multivibrator arrangement and a defect in either can cause the trouble.

We emphasise this point because we recently came across a modern Ekco T433 in which the line hold control had constantly to be reset. The owner had replaced the PCL84, the triode section being labelled horizontal oscillator in the service manual, and also various vital components associated with it but without removing the fault. However the cause was the PL36 line output pentode for the owner was unaware that it formed part of the line generator circuit as well as providing line output.

Most line output pentodes are driven by a double-triode or triode-pentode multivibrator, but when in doubt about whether or not the output valve forms part of the generator circuit look for a small-value capacitor linking the line output transformer or pentode screen with the grid of the complementary valve. In this instance, as in many other Ekco and Ferranti receivers, feedback is from the pentode screen to the PCL84 triode grid via a 150pF capacitor and from a tapping on the line output transformer via a series-connected 270kΩ resistor and 12pF capacitor.

As a quick practical test, set the line hold control to just establish lock and then replace the valve. If the line hold must then be readjusted the line output valve also functions as one half of a multivibrator pair.

Half-size Picture

WE HAD an older 17in. Philips model with a picture just about half size in the centre of the screen. Usually coincident lack of width and height is due to low h.t. and our first move was to try a new PY33 rectifier although we were rather doubtful if it would be effective this time as low-emission h.t. rectifiers generally take a longer time than usual to give any output and the warm-up period of this set was little if any longer than usual. There was negligible improvement and as hum level was normal with no trace of a screen hum bar we discounted the possibility of a reduced value reservoir capacitor.

We next replaced the PL81, for a low-emission line output valve will also reduce the boost rail voltage from which the field oscillator supply is tapped. There was again negligible improvement. We then tried a new PY81 and obtained full width but with only a slight increase in height.

There are two ECL80s in the field circuit but replacing them both did little more than change the field hold position. Although height was reduced so much vertical linearity was quite good and as expected shunting replacements across the cathode decoupling electrolytics produced no improvement.

As we had no service manual to hand to give the correct oscillator anode voltage—always very susceptible to reduced h.t.—we followed the wiring and found that the anode was supplied from the boost h.t. rail via the height control and a 1.2MΩ resistor. On measuring this we found it to be nearly 3.4MΩ and when replaced height was fully restored. When confronted with inadequate height but fair linearity not curable by valve replacement, always check the oscillator anode voltage first.

Contact-cooled Rectifiers

WE CAME across an old Pye Continental model the other day that had blown its fuses. On removing the back the first thing apparent was that the surge limiter sections on the dropper were completely burnt out. Tests then showed that there was no h.t. short-circuit present but there still remained a negligible resistance reading from the a.c. feed point of the h.t. rectifier to chassis. Most of these models have a contact-cooled rectifier bolted to the side of the deep metal chassis, and on inspection we found that the anode tag was just touching the metal casing. The surge limiters therefore had virtually been connected across the mains. During assembly the tag had been placed very close to the casing—no more than a twentieth of an inch away—and had remained so for about 10 years. However, slight thermal expansion had occurred to earth the anode tag.

On test the rectifier as expected showed a high forward resistance so we replaced it with a BY100, fitted appropriate surge limiters, and found on test that we had a very good picture indeed. If a receiver has been working off a low output h.t. rectifier for some years we usually find the tube to be in quite good condition due to reduced e.h.t. As new sets are always installed with a fair horizontal overscan and rectifiers deteriorate gradually it is only when the picture width becomes insufficient that the owners become aware that a fault exists lowering picture brilliance and focus standards.

TO BE CONTINUED

Book Review

Television Engineers' Pocket Book, 5th Edition, Edited by J. P. Hawker and J. A. Reddihough. 303 pages. Price 21/0d. Published for Newnes Books by the Hamlyn Publishing Group, 42 The Centre, Feltham, Middlesex.

ALTHOUGH PUBLISHED as a new edition, the latest printing of this popular title almost qualifies as a new book. Some of the original chapters have been retained, it is true, but there are several completely new ones and much revised material and illustrations.

The first version was published way back in 1954 but since then five editions have emerged, revealing the popularity of this kind of presentation. In spite of its title, the book is really directed more towards the *practical* television man, the amateur and service technician and student rather than the engineer as such. A vast amount of extremely useful information has been wrapped into the 300-odd pages and the well prepared index makes it easy to find, which is important in a "reference" book of this kind.

Some of the chapters are written by authorities such as D. E. A. Harvey, Gordon J. King and G. R. Wilding. An illuminating appraisal of hybrid TV sets (those using a mixture of valves and transistors) is given by Mr. Harvey. Mr. Hawker himself introduces colour TV in a very easy-to-understand way, dealing with our PAL system as well as with NTSC and a touch of SECAM. Mr. King runs through timebase fault-finding using one or two of his well-known oscillograms, while Mr. Wilding takes us hand-in-hand through the receiver side of the fault-finding jungle.

There are chapters on standards and waveforms, basic circuits, alignment, installation and servicing, aerials and interference, test equipment, picture tubes and valve data and colour codes in addition to those already mentioned.

During the course of the numerous revisions some of the information has been repeated in different chapters; but this is not at all detractory since it allows the information to be seen in two lights, so to speak. Just sufficient theory is given to embrace the fundamental principles, which is as it should be in a practical book—pity this word does not appear in the title! Quite a bit of revision would appear to have been done in the picture tube section, and there are a page and a half of tube equivalents.

The book has expanded a bit too much for pocket use I would say, but as a reference book it will be very well fingered during the course of twelve months. Of that I am convinced. At twenty-one bob the book is very good value for money—and books or titles that have been running for some time, being kept up-to-date by new editions, are like the long-lasting popular model cars, completely free of earlier "bugs". Paper is glossy, print and diagrams are clear and covers are hard. Well recommended. *J.E.*

PRACTICAL AERIAL DESIGN PART 5

A. J. WHITTAKER

FINALLY we shall discuss some aspects of television transmitting aerials. Transmitting aerials for the television Bands I and III and for the v.h.f. f.m. Band II usually take the form of stacked arrays of dipoles. These are arranged so as to produce either horizontally or vertically polarised waves and the optimum form of polar diagram required for a given service area. The aerial system may consist of banks of current-fed half-wave dipoles or arrays of full-wave dipoles (voltage fed). The ideal location for a television transmitter is a circle at whose centre the transmitter is erected and in which propagation conditions are the same in all directions.

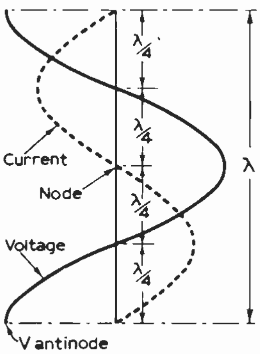
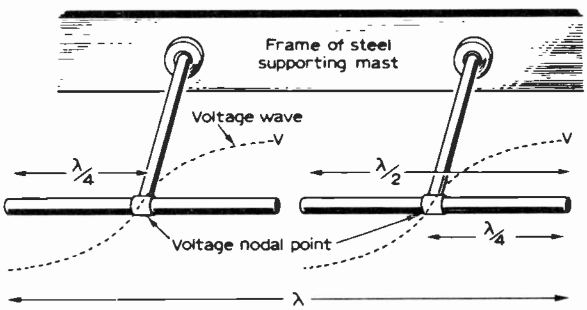


Fig. 1 (left): Voltage and current wave patterns on a full-wave dipole. When the aerial is fed at a voltage antinode point it is described as voltage fed.

Fig. 2 (below): A full-wave transmitting dipole. The dipole is attached to the supporting mast at the voltage nodal points.



The dipoles are usually erected in a plane array with a flat reflector surface. Full-wave dipoles are usually employed on television aerial systems because of their high radiation damping and thus wide frequency response. Radiation coupling between the dipole and reflector compensates for the frequency response of the aerial input impedance (i.e. facilitates matching of aerial to feeder). Figure 1 shows the voltage and current patterns on a full-wave dipole.

Longitudinal or vertical spacing of the dipoles in the array is arranged for optimum gain and band-

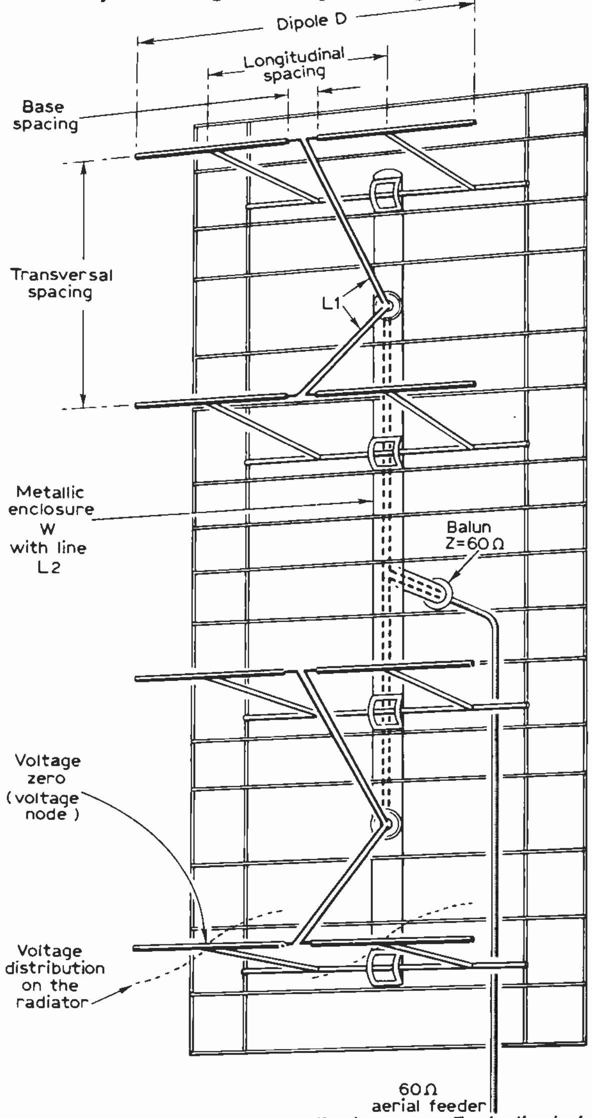


Fig. 3: Typical four full-wave dipole array. Each dipole is fed at the centre voltage antinode.

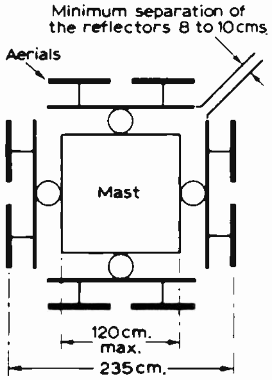


Fig. 4: Aerial arrays mounted around mast in square plan to give omni-directional radiation.

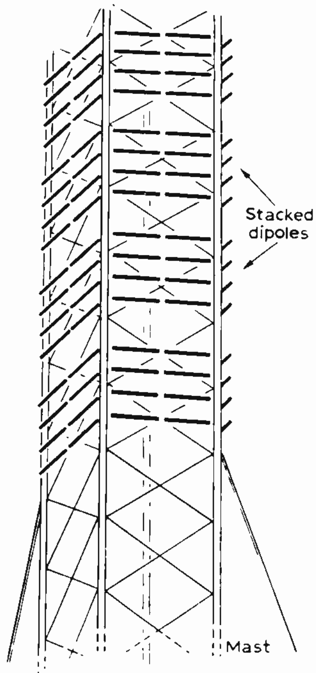


Fig. 5 (right): Stacked arrays of horizontal full-wave dipoles, four dipoles per stack.

width. The dipole is mechanically supported at the voltage nodal points by a supporting tube welded to the aerial rod at this point—see Fig. 2. The other end of the tube is fixed to the steel supporting mast thereby providing lightning protection. The dipole rods are hot galvanised as protection against the weather. A voltage node is a $\lambda/4$ point on the half-wave dipole rod which is theoretically at zero volts: it is therefore a convenient point for securing the rod to the supporting frame.

Each array consists of four full-wave dipole assemblies connected in the correct phase relationship and connecting to the feeder via a Balun terminating at 60Ω impedance at the feeder connection. Fig. 3 shows a typical array of four full-wave dipoles and the layout and connections between the dipoles and the feeder.

Ice formation on dipoles and feeders may impair the image quality. To overcome this problem the dipoles and feeders are encased in a low-loss thermoplastic cover (radome). This is superior to conventional heating arrangements and in the long run more economical.

If four aerial arrays are grouped around a mast in a square of plan such as is shown in Fig. 4 an aerial system is produced with a typical gain of 10 to 11dB. Fig. 5 is a sketch of such an aerial system. Assemblies of this nature have the advantage that different radiation polar diagrams can be realised by spatial distribution of the dipole arrays on the mast.

Aerials for u.h.f. television, transmitted on Bands IV and V, may take a different form from the conventional dipoles used in Bands I, II, and III. These aerials comprise a slot cut into a sheet of metal. Figure 6 shows this form of radiator. The feeder is connected to the slot aerial at the centre point.

The Emislot radiator (Fig. 7) is a development of this principle consisting of two metal panels a full wavelength long assembled with an aperture in the centre between the two panels.

For horizontally polarised aerials transmitting on Bands IV and V four Emislot radiating elements fed by an enclosed strip line feeder from a single input of 50Ω impedance have been developed as a building block for aerial systems. Four of these are made up into a panel occupying an aperture of four wavelengths. The number of panels required in each tier of the aerial system is dependent on the required horizontal radiation pattern. To fulfil the needs of multichannel broadcasting by high-power transmitting stations the Emislot panel has been designed with a power handling capacity of 10kW.

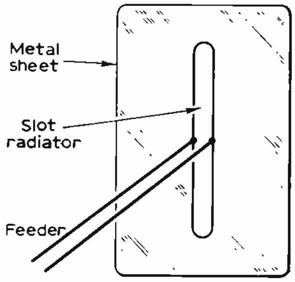


Fig. 6: For u.h.f. transmissions a different type of aerial, the slot aerial, can be used, the basic principle being illustrated above. The slot, dimensioned according to the frequency, is cut in a sheet of metal and fed at the mid-point of the sides. The slot acts as a dipole. Note however that a vertical slot as above gives horizontally polarised waves, while a horizontal slot gives vertically polarised waves.

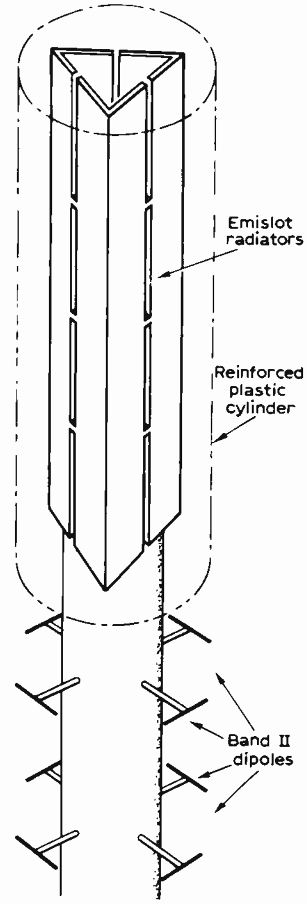
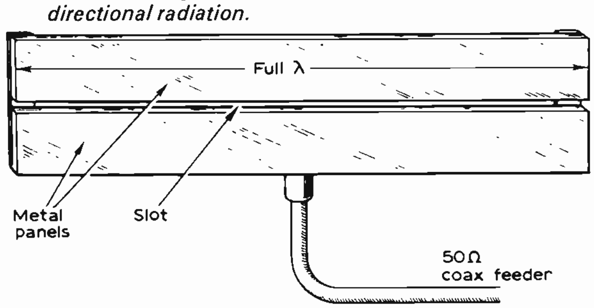


Fig. 7 (below): The Emislot radiator developed by EMI Ltd. from the basic slot aerial principle shown above

Fig. 8 (right): For horizontally polarised u.h.f. transmissions EMI have developed as a basic building block an assembly of four Emislot radiators. Three are shown here in a triangular lattice section to give omni-directional radiation.



A typical Band V aerial system occupying an aperture of 30ft. and using twelve Emislot panels with an omnidirectional gain of 24dB will handle a mean input power of 120kW. For vertical polarisation

—continued on page 562

fault finding FOCUS

S. GEORGE

TRANSISTOR IF STAGES

Transistors are being increasingly used in TV receiver i.f. stages, usually in a printed circuit sub-section, and while they perform the same role as valves in this application the different circuitry and a.g.c. techniques used plus the inability to quickly replace a suspect tend to make fault-finding in transistorised i.f. stages rather more difficult. Fortunately such circuits give little trouble in practice, but when faults do arise it is advisable in view of the many variations in design to have the service manual available when fault-finding.

With valve circuits the design is fairly standard and it is possible to identify individual stages and components quickly. In older sets the vari-mu EF85 will be the common sound-and-vision first i.f. amplifier with the straight EF80 or equivalent being the vision-only stage. In more modern receivers the EF183 is the vari-mu type and the EF184 the straight version. When in doubt about the function of a valve momentarily partially withdrawing it from its holder should—although not good practice—immediately indicate its purpose.

Basic Circuitry

With small, printed-circuit i.f. panels however it is not so easy to positively identify the various stages. A circuit diagram is therefore a great help but this in itself can cause some confusion since TV receivers may employ pnp or npn transistors with positive or negative l.t. supplies. Npn transistors operated with a positive l.t. supply follow the long established valve practice in which the cathode, equivalent to the transistor's emitter, is taken to chassis while the anode, equivalent to the transistor's collector, is connected via the load to the supply rail. However frequently in TV designs pnp transistors are used with a positive l.t. rail or npn transistors with a negative l.t. rail: this reverses the practice so that the collector load is then connected between the collector and chassis. To ease circuit draughting the transistor symbols may then be drawn upside down with the emitters at the top and the collectors at the bottom. This point is illustrated in Fig. 1 which shows two typical i.f. stages. In (a) a pnp type is used fed from a positive l.t. rail and with only the i.f. transformer primary linking the collector to chassis the collector voltage is zero while the emitter is at 14V positive to chassis. Figure 1 (b) shows an i.f. stage employing an npn type fed from a positive l.t. supply: again only the i.f. transformer primary is in the collector lead but as this is taken to the l.t. rail the collector voltage is equal to the supply voltage. Thus we have in these two examples a complete reversal of collector potentials while the emitter and base voltages are similarly changed in relation to each other.

Base Bias

It should also be noted that employing npn or pnp transistors with a similar polarity supply involves reversal of the resistors in the potential divider that supplies the base with correct forward bias. In the first (GEC) example the top resistor is 1kΩ and the lower resistor 10kΩ, while in the second (Pye) circuit the top resistor is 8·2kΩ and the lower resistor 2·2kΩ. To determine the forward bias when the collectors are returned to chassis therefore requires that the base voltage measured from chassis is subtracted from the emitter voltage, i.e. in the example shown in Fig. 1 (a) the forward bias is –0·4V. Alternatively a high-impedance meter can be connected directly across the base-emitter junction. Clearly also as forward a.g.c. is universally employed in TV i.f. stages the a.g.c. bias polarity will depend on transistor type and

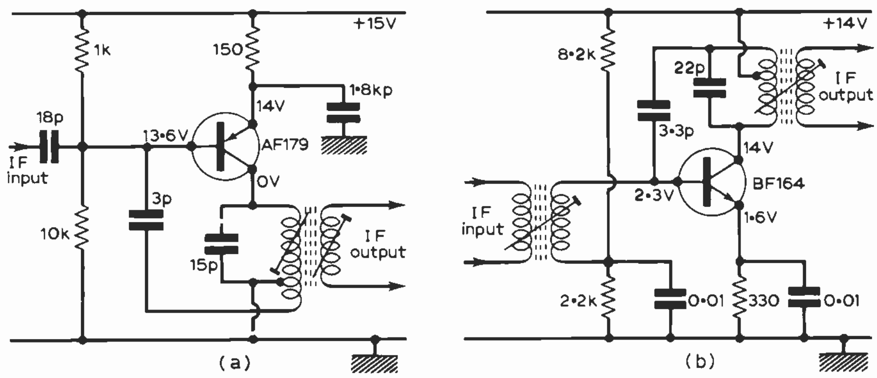


Fig. 1: Typical transistor i.f. stages, (a) from a GEC circuit using a germanium pnp transistor fed from a positive l.t. rail and (b) from a Pye circuit using a silicon npn transistor fed from a positive l.t. rail. Note reversal of relative voltages due to the collector in (a) and the emitter in (b) being returned to chassis. Neutralisation to overcome internal collector-base feedback is in each case effected by a capacitor connected from the collector circuit to the base.

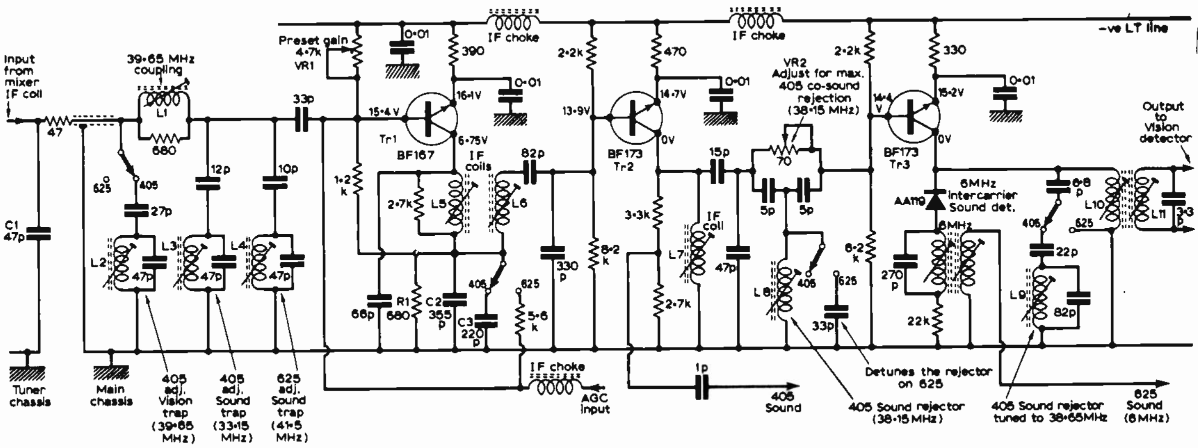


Fig. 2: Circuit of the three-stage vision i.f. strip used in the Pye 368 hybrid chassis.

supply polarity. When investigating lack of gain or incorrect voltages therefore it is essential to determine the direction of transistor voltage changes produced by insufficient forward bias or excessive a.g.c.

The main point to watch when servicing receivers with the collectors taken to chassis as in the example shown in Fig. 1 (a) is not to inadvertently short the base to chassis since this is almost equivalent to applying the full supply voltage across the base-emitter junction and can have disastrous effects on the transistor.

AGC

So much for relative voltages, now to the application of a.g.c. Valves require an a.g.c. potential negative to cathode and therefore chassis which rises with increasing signal strength to reduce gain. This voltage being applied to the high-impedance grid circuit imposes no appreciable load on the source which can very conveniently be the negative voltage developed at the sync separator grid. Transistors always require some forward bias and in TV i.f. stages are arranged to provide maximum gain under no-signal conditions, the a.g.c. potential increasing the fixed forward bias and thus the collector current as signal strength rises (but reducing stage gain because of the inclusion of a resistor in series with the collector load).

To summarize forward a.g.c. operation: with no signal the collector current of the controlled stage is minimum and hence minimum forward bias is applied to the base, but stage gain is maximum; and with maximum signal the collector current is also maximum, the base forward bias maximum and stage gain minimum. With this arrangement there is least noise at low signal strength.

Forward a.g.c. bias represents a small but definite power requirement which cannot be directly provided by a signal source. For this reason a.g.c. amplifiers are employed to vary the forward bias applied to the controlled stages in relation to signal strength. Their general circuitry is usually quite involved, generally taking their drive from the video amplifier or a video phase-splitter and involving the contrast control arrangements (see PRACTICAL TELEVISION May and June 1969). The end result so far as the i.f. stages are concerned is that rising signal strength increases the forward bias and thereby the collector current to progressively reduce the gain from its no-signal figure.

Gain and Selectivity

The overall gain required from transistor i.f. strips must naturally equal that for valve line-ups and to achieve this three stages are usually needed in the vision section and two in the sound only section (in contrast valve circuits generally have only two vision stages and one sound only stage). Furthermore transistor i.f. stages do not usually have the inherent selectivity of their valve counterparts—mainly due to ciruict damping—so that they include several wavetraps both in the input feed to the first stage and subsequently to ensure complete freedom from the sound and vision signals of adjacent channels on both systems.

Typical IF Strip

As a typical example of a complete vision i.f. circuit—but without the associated a.g.c. supply system—Fig. 2 shows the three-stage arrangement used in the Pye 368 chassis. This has npn transistors and a negative l.t. supply so that the i.f. coils and transformers are connected between the collectors and chassis. The emitter voltages measured from chassis will therefore be high (and negative) with the base voltages slightly less so that the bases are slightly positive with respect to the emitters, thus fitting in with npn transistor requirements.

When set for maximum again on no-signal Tr1 emitter voltage is 16.1V negative to chassis with the base 15.4V negative to chassis, the positive base-emitter forward bias therefore being 0.7V. As a.g.c. is applied to Tr1 it will require an increase in forward bias as signal strength rises, but to increase the base-emitter bias when the collectors are returned to chassis means that the base to chassis potential must be reduced. At minimum sensitivity (gain) Tr1 base potential measured from chassis is 12.7V. The emitter voltage follows proportionately but the increased collector current raises the collector voltage with respect to chassis from 6.75V to 8.7V. Thus while the emitter-collector voltage at maximum gain is 16.1 – 6.75 or 9.35V, it is 13.4 – 8.7 or only 4.7V on minimum gain and sensitivity.

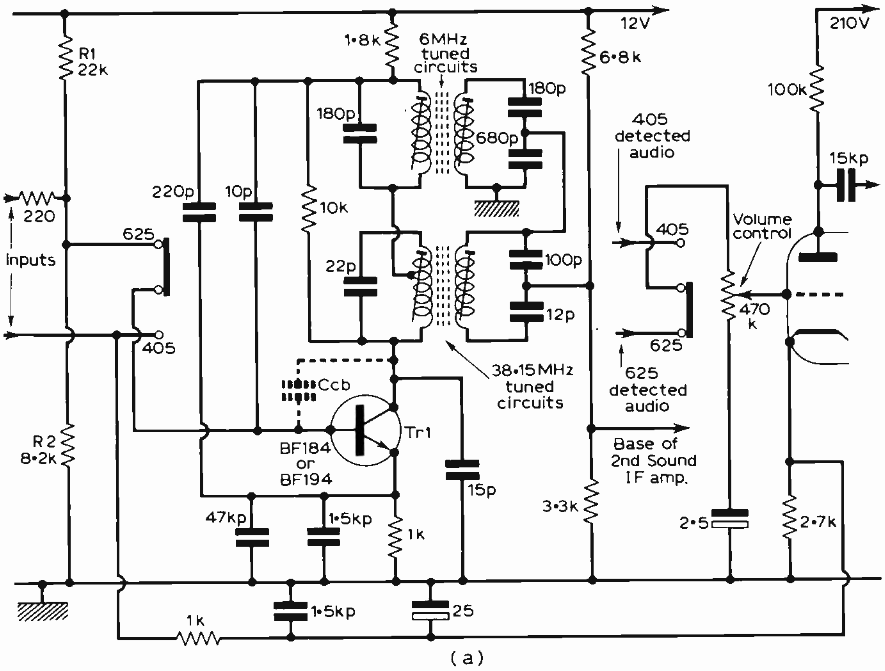
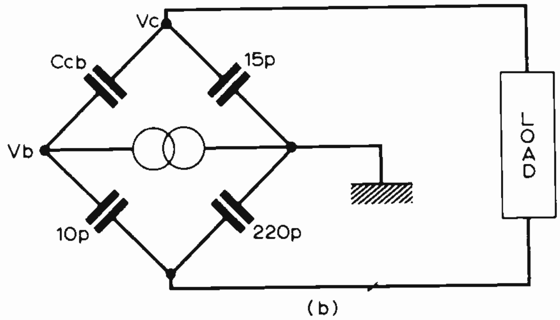


Fig. 3: First sound i.f. stage of the Philips 210 hybrid chassis used in the G19T210A series of models. In dual-standard sound i.f. stages the series connection of the tuned circuits makes it difficult to obtain the anti-phase feedback voltage required for neutralisation. The technique used in this circuit is to neutralise the stage by means of a capacitor bridge, the equivalent circuit being shown at (b) below. Ccb is the internal feedback capacitance of the transistor. Neutralisation is desirable to obtain adequate gain at 38MHz. Reverse a.g.c. is used in the sound circuits on 405-line operation and a convenient source of this is the cathode circuit of the a.f. amplifier stage, as shown here.



These figures very clearly show how increased forward bias increases transistor conductivity and thus the voltage developed across R1 in the collector lead.

The input to the first i.f. stage Tr1 is via a bottom capacitance-coupled bandpass transformer consisting of L1 and the mixer collector coil with C1 providing the bottom coupling. The bandwidth is reduced on 405 by bringing into circuit the 39.65MHz adjacent vision wavetrap (L2 and associated components). Two other wavetraps (L3 and L4 with associated components) remove the adjacent channel sound at 33.15MHz and 41.5MHz on 405 and 625 respectively. The preset gain control VR1 adjusts the forward bias to Tr1 which is increased on strong signals by forward a.g.c. action.

Coupling of Tr1 to Tr2 is by a second bottom capacitance-coupled bandpass circuit comprising C2 with L5 and L6 which are separately screened. On 405 only C3 is switched in parallel with C2 to decrease the degree of coupling and thereby restrict the bandwidth. The output developed by Tr2 across its collector tuned circuit L7 is then fed via a 15pF capacitor and VR2 to the base of Tr3. L7 is damped by the two series-connected resistors in parallel with it, and the signal developed at their junction provides the v.h.f. sound signal which is taken to the sound i.f. strip for further amplification. VR2 in series with the signal feed to Tr3 base is set for optimum rejection of the v.h.f. co-sound signal at 38.15MHz, forming a bridged-T rejector with L8 and the two 5pF capacitors. Tr3 provides the output for the v.h.f./u.h.f. vision detector via the i.f. transformer L10, L11, a feed to the separate intercarrier sound detector being tapped from the primary L10.

Neutralisation

This model employs silicon planar transistor types BF167 and BF173. These have an integrated screen reducing the collector-base capacitance to such a low value that negligible feedback occurs and neutralising is unnecessary. Earlier transistorised circuits employed types such as the AF179, AF181 and BF164 and BF159 which do require some degree of neutralisation as shown in Fig. 1 (a) and (b). In both instances the neutralisation is provided by a small picofarad capacitor connected from the supply end of the i.f. transformer primary to the transistor's base. This provides a slight feedback signal equivalent in amplitude to the collector-base feedback, but 180° out-of-phase with it, thus cancelling the internal feedback.

Sound i.f. Circuits

The sound i.f. stages broadly follow general valve practice inasmuch as the 38.15MHz i.f. transformers for the v.h.f. sound signal are connected in series with the 6MHz u.h.f. i.f. transformers without need for system switching. The two frequencies are so wide apart that negligible signal is developed across the opposite windings on either system. Two stages are usually employed in transistorised circuits, the first having a.g.c. applied to it on v.h.f. only.

Figure 3 shows the first i.f. stage of the sound strip in the Philips 210 hybrid series chassis, with a 12V l.t. supply taken from the valve h.t. rail via dropper resistors and stabilised by a shunt v.d.r. On u.h.f. R1 and R2 provide fixed forward bias for the transistor while on v.h.f. the base is d.c. linked to the cathode of the PCL82 triode a.f. amplifier. The voltage developed at this point, 2.1V, after smoothing by a 25μF shunt capacitor and 1kΩ series resistor provides forward bias for Tr1 and as its mean level varies with the v.h.f. detector output this provides a simple but adequate a.g.c. system. The output from the series-connected i.f. transformer secondaries is then applied to the base of the following stage. The two pairs of series-connected tuning capacitors across the secondaries of the i.f. transformers also provide impedance matching to the following transistor stage, giving a similar effect to tapping down a coil winding. In this way the low input impedance of the following stage does not damp the tuned circuits and reduce selectivity.

Finally although it is general British practice to tap the v.h.f. sound i.f. signal from a point in the vision i.f. strip this is not universally done and in the Sony 9in. portable for instance it is taken directly from the v.h.f. tuner for amplification by a two-stage amplifier, the u.h.f. 6MHz sound signal being amplified in a separate single-stage circuit.

The first transistor a.f. amplifier then takes its input from the two-stage amplifier on v.h.f. and from the single-stage amplifier on u.h.f.

Servicing Procedure

With both sound and vision i.f. strips the value of a signal injector or signal tracer as a means of quickly locating a defective stage cannot be over-emphasised. After this normal meter work will identify the faulty component or transistor. However many faults—a short-circuit across an i.f. transformer winding, a disconnected fixed trimmer, a break in one side of a tapped winding or an open-circuit signal feed capacitor—will produce negligible if any voltage change. Furthermore there are more stages and components involved than with valve circuits and generally these are arranged in a very compact manner.

To avoid inadvertently shorting transistor d.c. supplies always use very sharp pointed test prods and as with transistor radio receivers first suspect dry-jointed or open-circuited connections on the printed circuit panel rather than actual component failures. Transistor breakdowns are not common and when they do occur are most likely caused by e.h.t. or h.t. flashovers.

It is advisable to have the circuit diagram to hand since unlike valve circuits where low anode or screen grid voltages are very obvious and easily traced normal voltages are so low in transistor circuits that even a small reduction can result in markedly decreased gain while if the a.g.c. or contrast-control system is involved the prime cause of the fault could be the transistor phase-splitter or video pentode from which the a.g.c. drive is generally derived.

Application of Forward AGC

A simplified forward a.g.c. system is shown in Fig. 4 to illustrate the application of a.g.c. to the controlled stage. The a.g.c. amplifier Tr1 is fully conducting (i.e. bottomed) under no-signal conditions, when the i.f. stage Tr2 is operating at maximum gain. As Tr1 is hard on most of the 22V l.t. supply is

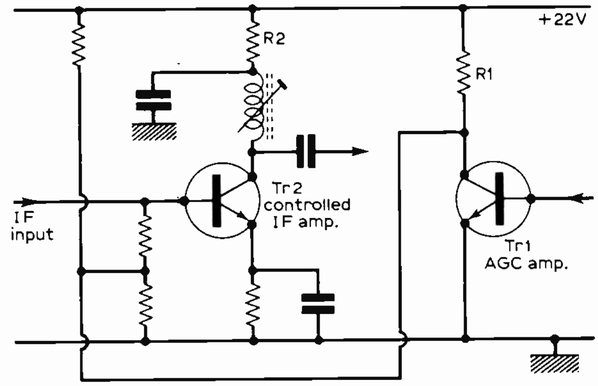


Fig. 4: Application of forward a.g.c. to the controlled stage. This is a simplified circuit omitting the delay circuitry, contrast network etc.

dropped across R1. As signal strength increases the heavy forward bias applied to Tr1 is reduced. Its collector is thus positive-going and this positive-going signal is applied to Tr2 base as forward bias. Tr2 thus passes greater collector current as signal strength increases but as its collector voltage falls due to the inclusion of R2 in its collector lead stage gain is reduced. In practice the circuitry is complicated by the inclusion of delay networks, contrast controls and so on.

SERIES TO BE CONTINUED

DX-TV

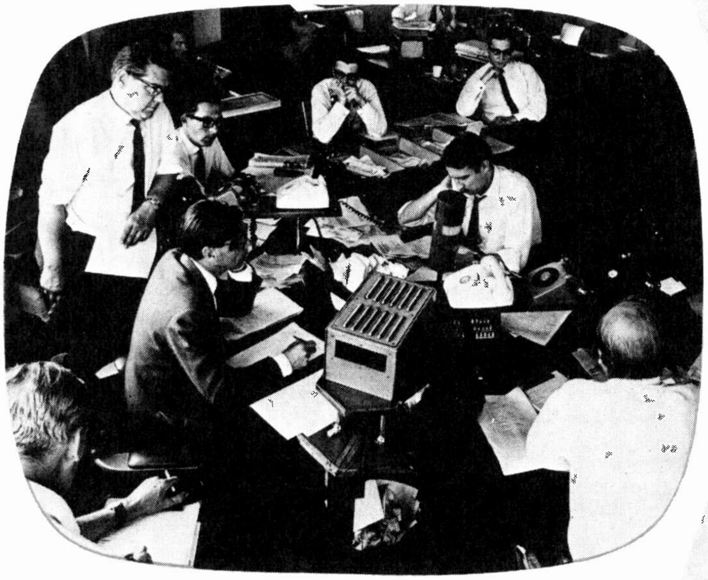
—continued from page 543

Leonids Nov. 15-17 peaking 16th.
Geminids Dec. 9-14 peaking 13th.
Ursids Dec. 20-22 peaking 22nd.

New stations are as follows: *W. German 3rd chain*: Schnee Eifel Ch.30 250kW hor.; Stuttgart Ch.39 276kW hor.; Saarbrücken Ch.42 430kW hor.; Langenburg Ch.42 200kW hor.; Angelburg Ch.52 430kW hor.; Schnitsee Ch.54 252kW hor.; Rottweil Ch.55 300kW hor.; Ahrweiler Ch.56 210kW hor.; Osnabrück Ch.56 138kW hor. *2nd chain:* Angelburg Ch.24 500kW hor. *1st chain:* Bittelburg Ch.55 400kW hor. *France:* Amiens St Just Ch.42 500kW hor. *Norway:* Griepstad E2 further power increase to 60kW.

Mr. Thynne of Birmingham says that May 1969 was better than May 1968. He logged Finland E2, W. Germany E2, Italy IA, France F4, Spain E2 and E3, Poland R1, USSR R1, Czechoslovakia R1, Hungary R1, Austria E2a, Sweden E2 and E3, Norway E2 and E3, Portugal E3 and rare for most of us this year Switzerland E3. He has made a good start for this season.

We have a most interesting CDX (colour DX) report from J. Boswell of Hornsey, London, N8 who has really excelled himself this time. At u.h.f. he logged Sweden Uddevalla Ch.24 and Göteborg Ch.30 (in excess of 700 miles), W. Germany Hochsauerland Ch.27 and Torfus Ch.23, with Oslo Ch.E6 as a good Trop catch. His most interesting log however was Sweden Ch.E3 on May 30th and 31st in colour with a 22in. Decca TV receiver. This is the very first colour DX report that we have had via SpE in Band I and he says that the colour was much better than he expected!



TV NEWS

INSIDE TV TODAY PART 19

M. D. BENEDICT

ONE particular type of television programme is far more effective than any other medium. Drama, light entertainment and documentaries can all be presented on radio, films or the theatre: news and current affairs however are presented best on television. The ability with television to transmit pictures instantaneously into millions of homes gives news coverage a completely different set of horizons to those of the film newsreel in the cinema, the radio news report or the newspaper. It could be said that news and current affairs programmes make television a unique medium and it is in these fields that television comes into its own.

Current affairs, often in the form of magazine programmes, are transmitted by most of the established broadcasting organisations in this country. But news coverage is limited to the two specialists, ITN and BBC News. Both are largely independent of the rest of the network as television news requires its own organisation and equipment in order to cope with the immediacy of its work. Programmes like *This Week*, *Panorama* and *24 Hours* back up the hard news coverage and use news techniques to deal with the events they cover in greater depth than is possible in the news itself.

News events occur all over the world but within this country they are gathered into two places: ITN at Television House, Kingsway, London and BBC News at Alexandra Palace, Muswell Hill, North London. Both organisations plan to move to new premises in the next year or two to allow new colour equipment to be installed from scratch. At their present bases ITN have a single studio whilst BBC News has two studios one of which is equipped for colour.

BBC News HQ

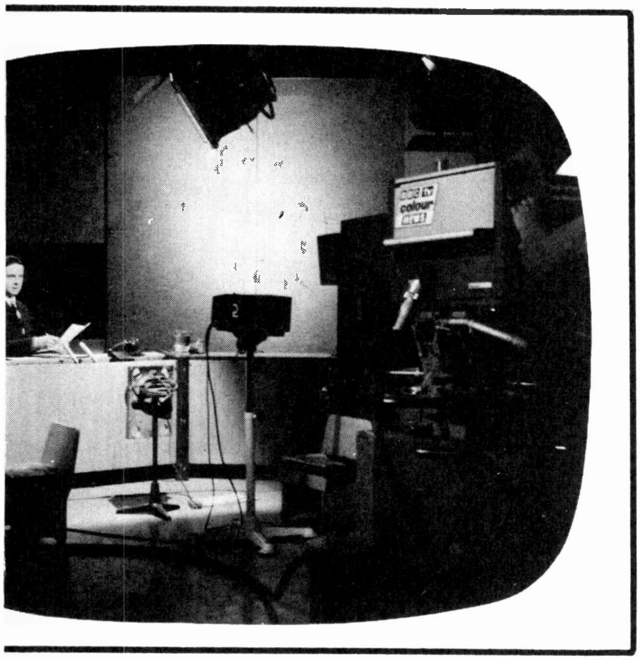
High on a hill overlooking most of London in the same building that the first high-definition public service television was created is one of the two fast acting TV organisations for disseminating information to the public. Within the now dilapidated east wing the BBC have a colour studio, a monochrome studio equipped with remote-controlled cameras, eight telecine machines (which have to be protected by plastic sheets when the rain becomes heavy), four videotape machines, three caption and one newsroom camera, an £18,000 colour film processing plant, three monochrome processing plants, dubbing and editing facilities, an outside broadcast base with a three-camera outside broadcast unit, and one of the most compact Central Apparatus Rooms (c.a.r.) possible. Built in a corridor, the second operational position involves sitting on the stairs as there is only room for one chair!

Central Apparatus Room

Most signals are routed through the c.a.r. but a fair amount of use is made of inter-area tie lines. With three outgoing lines to the switching centre at Broadcasting House and five incoming lines, all of which have on occasion been in use at the same time, the c.a.r. staff often have their hands full handling these along with the pulse generating equipment, including slave lock and colour facilities. A camera fixed to the ceiling of the newsroom is used for news headlines and the occasional news flash.

Although situated in historic surroundings at College Mews (part of Westminster Abbey building) in the centre of London, a monochrome camera in an unmanned studio is also controlled from the Alexandra Palace c.a.r. It is used for Parliamentary reports as it is only 30 seconds from the Houses of Parliament. Control of zoom, pan, tilt, focus, gain and lift on this camera are instantly effected from the c.a.r. or either control room at Alexandra Palace by use of telephone lines carrying

Our heading photographs show on the left the editor of the day conferring with the staff of the news room and on the right John Timpson, a "Newsroom" newsreader. The colour "Newsroom" can be seen on BBC-2. BBC photos.



a control signal. C.A.R. also has control of ten line-up controls including beam focus, shifts, height and width by dialling the function and then adjusting a motor-driven potentiometer. Before this device was introduced any last minute adjustments had to be made by the reporter obeying telephone instructions to "Adjust the yellow knob please . . . No, wrong way!"—not a very satisfactory system but on occasion necessary.

C.A.R. staff also check the levels and, if necessary, the phasing of incoming and outgoing signals. Bookings are made via a lines booking unit and the c.a.r. allocates, selects and then patches (connects) the lines through to the required area, along with control of the remote lines selectors at the Broadcasting House switching centre should this be required by, for example, the studio. Conference circuits are handled by the c.a.r. as well as a special conference room and mixing point used mainly to combine contributions from the BBC to Eurovision's news exchange.

Studio B

Next to the c.a.r. is Studio B, for a long time the only BBC News studio, equipped with four vidicon cameras based on the EMI design. These cameras, rebuilt on to a special frame and without a viewfinder, are remotely controlled from the gallery. This is a unique feature of this studio as is the sound mixer, probably the oldest still on active service in television. It uses rotary stud faders yet is highly reliable—probably because all faults were cured many years ago!

In the gallery behind the control desk and the vision mixing panel is a raised area known as the "bandstand" where the vision controller sits along with his assistant. On each side of them are two sets of controls, one for each camera. The control system is similar to that of the College Mews camera whose control system was developed from the studio cameras which were the first of their kind. Each function is controlled by potentiometers set vertically into the panels. A different shot can be set on the row of potentiometers adjacent to the first set and a total of six shots can be selected in this way as well as a seventh on a hand controller.

Each shot is selected by a row of push buttons and the camera responds by swinging swiftly to the new shot. Smooth changes are made by using a hand controller which allows single-handed control of pan, tilt, zoom and, with a little bit of dexterity, focus. Any shot requiring the simultaneous adjustment of more than one of these functions is almost impossible using the preset controls as co-ordination of two rotary movements to provide a smooth diagonal movement is very difficult, so the hand controller is then used. However for a series of fixed shots, such as a series of photos of various non-standard sizes, the preset controls are almost perfect as they allow the shot to be changed accurately and quickly.

If news photos cannot be re-photographed in the time available and several are required in quick succession alternate photos are pinned on one of two boards and each board is viewed by a camera. As each photo is used the operator can change to the next photo without delay in framing and focusing, while the vision mixer is on the other camera. Two of the four cameras are used in this way, being placed by the only engineer who works on the studio floor so that if one fails the other can easily take the other's shots. If a second set is used for a reporter to make his report from the studio these cameras would be used to cover him. The other two cameras are on the newsreader's set, one being directly in front of him and the other, a reserve, alongside the first.

Vision Mixer

Up in the control room is one of the most compact vision mixers in use, yet it can select more sources than any other standard vision mixer—sixteen, comprising four studio cameras, three caption cameras, three telecine lines, three videotape lines and three outside broadcast lines. It is one of the earliest BBC designed transistorised vision mixers and can cut, wipe or mix between any of these sources declared synchronous by the Senior Television Engineer who co-ordinates the activities of the studio crew or group and who decides if a source line videotape or an outside broadcast is genlocked or pixlocked. Also available is an inlay device used to add captions and surround them with a black edge, ensuring maximum visibility against a light background. Behind the gallery the camera control units are installed. Standard units are used since there is no need for remote controls for lining-up as the units are easily accessible from the camera control position.

Caption Cameras

Also in the same room are the three caption cameras known as scanners A, B and the micro-scanner. Scanner A and B are two-port caption scanning cameras using Pye camera channels which view two 12×9in. hatches loaded with captions of that size. Each hatch or port is separately illuminated before being combined by an optical multiplexer so that by switching the illuminating lamps on and off an optical "cut" can be achieved, as can mixes simply by varying the illumination by means of a variable transformer. Superimpositions are achieved by switching on the lamps for both ports. A large number of 12×9in. captions can be loaded into each port and a continuous series of captions transmitted in this way, yet using only one camera channel.

The third camera, the microscanner, can go in close enough to an object to make a postage stamp fill the whole television picture. This indeed is one of the reasons for its existence; that and obtaining a close-up of other small objects and pictures. Looking like a photographic enlarger with its vertical pillar, the head amplifier and scan units from an EMI camera are mounted with the vidicon tube and its yoke and view the baseplate on which the object is placed. Varying the height adjusts the focus so that the baseplate is always in focus and a zoom-like effect is achieved. The lens is chosen to enable the very close shots described to be obtained.

Telecine Area

On the far side of Studio B is the telecine area—six crossfire Pye telecine channels are installed here along with a three-way multiplexed channel and six separate magnetic reproducers, two for 35mm. track and four for 16mm. Some of the telecine channels are the oldest channels in service, being installed in 1954, but these have been constantly modified to increase performance so that their present performance compares remarkably well with modern equipment. No other type of channel can handle poor-quality newsfilm as well as these are able to do.

Telecines 1-6 are mounted in pairs with each projector and its camera mounted at right angles to those of its partner. In this way should a camera fail a mirror can be swung into the beams where they cross thus reflecting one projector into its partner's camera. At the same time controls and sound channels change as do the outgoing lines so that pictures continue to be transmitted. Telecine 6 is a 35mm. Philips FP7 projector and is used for the news titles and the occasional sequence from a feature film, the other machines using 16mm. Philips EL5000 projectors.

The seventh channel is a more modern channel made by Pye and using an EL5000 projector equipped with a three-way multiplexer allowing any of three light sources to be fed into the camera. Camera circuitry is the same as the earlier cameras but this channel is unique in that one input to the multiplexer is unused, one has the usual 16mm. projector, but the third input is from an 8mm. projector allowing film shot by amateurs to be used if sufficiently newsworthy. A standard good-quality 8mm. projector as available to the public is used, although the drive is from an external motor via a toothed belt, and variable lamp brightness from a variable transformer is fitted to give an extra adjustment for dense film. Operationally it is very similar to an ordinary 16mm. film projector, normal controls being used, and quite reasonable pictures can be achieved provided good-quality film is used.

Sound is usually recorded on sepmag (separate magnetic) tracks when it arrives in telecine but commag (combined magnetic) and comopt (combined optical) sound can be replayed from the projector. A switch lowers the commag head on to its track and switches off the exciter lamp used for comopt sound. Sepmag sound is patched from the selected reproducer to its projector, as are the locking voltages which hold the projector and reproducer drives in sync. At the control console a switch selects either combined sound from the projector or separate sound from the reproducer. A fader is incorporated to correct for great variations in level and a peak programme level meter is used to indicate the sound level sent to the studio.

Control Console

On the control console are stop, start, inch, lamp show, lamp cancel, target and lift as well as the controls for line up—height, width and shifts, beam focus and beam current. These latter controls are tucked out of the way so that accidental operation is difficult. In front of the console is a sound control and peak programme meter, which is usually switched to monitor the sound level leaving the channel, a waveform monitor to show video levels and a high-quality picture monitor. Besides controls for changing pulse generator chains and selecting the picture displayed on the monitor there are also line selector push buttons.

Selection Unit

Vision from the camera and sound from the control console are fed to the studio via a selection unit which feeds two studio lines to each studio and a line to the c.a.r. On each machine are five push buttons, each one corresponding to a line, so that pressing a given button on the machine control relays and puts that machine on the line selected. Pressing the button for the same line on another machine removes the first machine and puts the second machine on to the line. At the same time one machine can feed any number of lines. When the vision mixer selects a line a d.c. voltage fed back into telecine from the studio inhibits any reselection, preventing accidental changes whilst on the air. When a changeover sequence on transmission is required, for example when positive and negative film follow each other on different reels, an extra over-ride control allows one reselection to take place so that another machine can take the line. As an alternative the second machine could feed the second studio line and the vision and sound switch made in the gallery. If a wipe or a mix is required this latter procedure would be necessary as only a cut can be made in telecine.

Videotape Area

Situated two storeys down at what approximates to ground level at Alexandra Palace is the v.t.r. area in its own prefabricated hut inside one of the old halls. Four RCA videotape recorders are installed, three TR22s and one colour-capable TR70. Each machine has a line selector similar to those used in telecine, feeding two lines to each studio and one to the c.a.r. This latter is often used to replay items for regional programmes as those centres not equipped with their own v.t.r. machines use Alexandra Palace facilities.

Inputs from the five outside broadcast lines can be connected via a patching system to any machine along with talkback and telephone lines. Although most of the work of each machine consists of recording contributions from the regions and prerecording reports, a fair amount of work is involved in recording outside broadcasts and replaying the highlights into bulletins. If time is available the highlights would be transferred on to VTN4, which is equipped for electronic editing, enabling a continuous recording to be made. If VTN4 is busy a physical edit would be made and the required sequences physically joined to each other. Unfortunately that part of the tape would have to be avoided during future recordings so this is avoided if possible. VTN1, the colour-capable TR70, is also able to edit electronically but is often in use for colour recordings.

Cable Film Link

In the same area as these machines are a couple of examples of television history. In these days of satellite communication across the Atlantic and Pacific Oceans, when if it is to their advantage the US military authorities can open an excellent TV satellite link to or from anywhere in the world, it seems rather a long time ago that cable film was the most direct link with the States. Cable film was the technique of transmitting pictures across the Atlantic by using the existing sound cables. Naturally a slow-scan television system was used and to effect further economies of bandwidth the definition of the transmitted picture was reduced, a 200-line sequential scanning technique being adopted, and at the transmitter only alternate frames were transmitted, being reproduced on two adjacent frames at the receiving end. At these rates the time taken to transmit 30 seconds of film was about 50 minutes, in fact 100 times as long as the film running time. Sound was sent direct with a special locking signal to ensure synchronisation. Provided any movement in the original pictures was small the pictures received were very good considering the crudity of the technique.

Film Recording

In the room next to the cable film equipment are two items of equipment almost as obsolete as cable film. Film recording is still required but with the introduction by Technicolor of colour telerecording techniques using sophisticated electronic circuitry to correct for errors a very good transfer can be made. However Visnews, the newsfilm agency, requires copies of sequences from outside broadcasts as film is still the only really international medium for news, so some use is made of the two 16mm. film recording channels.

Colour Recording

Only a few feet from these items of historic interest is the latest of RCA's videotape recorders—the TR70. As with the other machines, outside broadcasts originating in colour are recorded and moments of news value selected. Marconi channels not now being used at the Television Centre are installed in the regional centres so that more reports from the regions will be recorded in colour. A large amount of VTN1's colour material originates in the United States and is sent via the Early Bird satellite and the new all-electronic BBC field store converter. In this way reports can be recorded without losing any quality in a matter of seconds. When first installed VTN1 was used to record half the film for the 7.30 p.m. *Newsroom*, film from colour telecine being transferred to the TR70. With only one colour telecine channel operational this allows items to alternate between the TR70 and the telecine channel. Transfers of film from telecine to v.t.r. would take place at about 7.00 p.m.

Colour Telecine

Installed near the monochrome telecine area are the two colour channels both made by Pye, but bringing colour to *Newsroom* was held up by the late delivery of the first channel and videotape was used to back up this channel until the second channel was installed. These channels consist of a four-Plumbicon camera and the usual Philips projector fitted with a "light valve" with automatic control to vary the gain of the channel without affecting the colour temperature of the illuminating light source. BBC-designed TARIF units are installed to help control the wide variety of poor-quality film that News has to handle. Telerecordings from the United States, errors in processing and bad grading can all give violent colour casts, and colour film underexposed by over three stops has to be transmitted and an attempt made to correct for some of the deficiencies.

"Newsroom" Colour Studio

Four Marconi VII cameras along with a colour synthesiser are installed in Studio A, the *Newsroom* studio, which is next to the caption-scanner room. Originally three colour cameras were installed, two being used for the newsreader and reporters and the third for captions or colour slides. These are projected by a back-projection device consisting of two sets of slide projectors with their lamps controlled by dimmers and projecting along the same axis. The captions are illuminated in a similar way to that used with the monochrome caption scanners and all three beams are combined by half-silvered mirrors to be viewed by the third colour camera. With the extra camera now in use any other studio set can be covered and a standby can be provided for the newsreader.

Any captions involving writing on a plain background can be synthesised using the BBC's version of the "Coxbox". Any of a range of colours can be selected to fill in the writing or the background although this is often left black. A switch operated by the vision mixer inlays this or other sources into the picture. Lighting facilities have been extended with quartz-iodide lights and remotely-controlled dimming channels. A vision mixer similar to that in Studio B has been installed and all the monochrome sources are still available since some of the news events cannot be covered in time in colour. A monochrome EMI vidicon channel is still installed and used as a main camera during monochrome transmissions. For stability all encoding equipment is in one apparatus room including the telecine and synthesiser encoders and the decoders for the colour monitors installed.

Filmed News

It has been said that news comes in 16mm. width with sprocket holes down one side. Indeed television news becomes more and more visual as film facilities and coverage expand. In one five-minute bulletin the newsreader was seen for eight seconds while over thirty different film stories and eight videotape stories were transmitted. This does not imply the imminent redundancy of newsreaders but it does show how film is becoming more and more important as the medium for news coverage. Imagine the bombshell that would hit the world of television engineering and operations if a miniature colour camera and videotape recorder could be built into a case the size of an Arriflex.

Film units consist basically of a cameraman and a sound recordist but an assistant cameraman is used to help with rigging and if it is not too complex to handle the lighting, be it a set of Colortrans (lightweight units with quartz-iodide bulbs balanced for colour stock) or the hand-held battery-powered lights such as the Sungun. More complex lighting is available and an electrician would assist with this if necessary.

Film Units

The normal equipment of a BBC crew is an Auricon 16mm. camera equipped to record commag on stripe-film stock. A BBC-designed recorder with two microphone channels drives the record head in the camera while a monitoring head adjacent to the record head allows the sound recordist to check the recording. The microphones used vary: for an interview in the street the reporter would use a hand-held microphone to thrust under the victim's nose, but for an indoor fixed interview two neck microphones might be used. Gun microphones are becoming popular but their size can be a disadvantage in crowds; however they can be used to cover almost any situation. To cover a reload when the 400ft. reel runs out a second camera, usually a simple but sturdy Bell and Howell, is carried. It is also used as a mute camera for events not requiring a sound track or one that could be dubbed on later.

Colour Film Processing

The film is rushed back to Alexandra Palace or to the regional centre by dispatch riders. A radio link is provided from base to the camera cars so that the film unit's progress can be determined quickly and messages passed to and fro. Only Alexandra Palace is equipped with a colour processing plant at present so any regional film needed for *Newsroom* has to be flown to London by the BBC's private plane. If a great rush is required or the story is for BBC-1 only it is rushed to a regional centre where it is processed and edited before transmission to an Alexandra Palace videotape recorder where it is recorded for replay in a later bulletin.

On arrival at Alexandra Palace colour film is rushed to the processing plant for development. Reversal film is used so that a positive copy is obtained and this is viewed in a preview theatre. All concerned with the story, including the supervisory film editor, film editor and the scriptwriter view it and select the sequences required. If the story is wanted by both BBC-1 and *Newsroom* on BBC-2, and different editing is needed, a black-and-white print is made for BBC-1. A film editor is allocated the job of handling the film and he or she will cut the story as instructed by the scriptwriter and the senior film editor.

Any dubbing or printing needed will be handled by the film editor, who takes the film to processing for printing on the high-speed printer installed or for dubbing which is performed by the dubbing mixer or editor. Two dubbing systems are available as well as several transfer units. A dubbing suite with interlocked recorders and reproducers as well as grams and tape recorders allows a mix between speech from a sepmag producer, spot effects also from a reproducer and general sound effects from grams. Occasionally a skilled gram operator will lay a spot effect from grams by accurate cueing should pressure of time force this.

A new dubbing system is installed at Alexandra Palace. Instead of several separate bays of recorders and reproducers locked together with selsyn motors this utilises four transport mechanisms mounted on one large table. Each can be coupled together and three of them record or reproduce magnetic film. The picture transport arrangement utilises a television camera on the picture head, and can play optical and combined magnetic tracks. Grams and tape recorders are used in the same way as in the other dubbing theatre but a great deal more flexibility built into the system allows all tracks to be rolled back, still in sync, and the recording repeated. A smooth junction between old and new recording is achieved by controlling the build up of the erase head field so that a sequence can be inserted into a continuous recording without being noticed.

When each film story is ready for transmission the editor takes it to the make-up room where another film editor assembles it on to the required reel in the correct order for transmission.

Adjoining the dubbing suite is a sound transcription unit equipped with several tape recorders and a disc cutter. Sound reports from capitals outside the normal television links, Africa and the East in particular, are sent by reporters based in these areas and recorded for later editing. Stills of the reporters and general views of these areas are held in the photograph library. Also in the library are photographs of leading personalities and politicians, maps and famous landmarks enabling the subeditor to illustrate a sound report.

A photographic unit works closely with the graphics artists in making caption slides as well as re-photographing pictures for the photograph library. When a foreign reporter is in this country for a holiday a number of portraits of him will be taken, often holding a telephone to imply that a report is being telephoned into the studio. This can in fact be done but in most cases reports are sent from a sound studio. Most countries' broadcasting authorities allow this in exchange for reciprocal arrangements in this country.

Overall Organisation

Such a vast organisation operates with efficiency if little imagination, and operates with remarkable speed. Controlling all television news is the Editor, Television News, who is responsible to the Editor, News and Current Affairs. This illustrates the close links with sound news service. In many cases the same reporter will cover an event for both radio and television. Indeed reporters may often be seen in film stories carrying two microphones, one for the film sound and one for their tape recorder for use in a sound report.

The Deputy Editor, Television News assists the editor but day-to-day responsibility for the content of the news on the two channels is in the hands of Assistant Editors. Backing up these are Senior Duty Editors, Duty Editors and Subeditors or Scriptwriters.

News Sources

Starting with the News Diary which shows details of events, press conferences, speeches and other stories arranged for a given date the editor makes a rough list of those events most likely to be of interest. Morning papers give an indication of events that may require following up along with events from the previous day's news coverage. Discussions with the regional centres using a "conference" sound circuit in which all taking the circuit can talk with any other centre, a similar link with the European capitals via Brussels and the Eurovision network, film stories from abroad filmed by news film agencies such as Visnews, all contribute ideas for items. A rough idea can thus be gauged of the day's news prospects. Intake is the general name given to the organisation responsible for obtaining information on those events that are of interest to the editor. Organisers are responsible for the deployment of film units, reporters, and technical facilities. Many of the film units start by covering events decided on the previous day, but allowance must be made for coverage of events occurring during the day.

Teleprinters carry the world's press services—Reuters, Associated Press, United Press and several other such companies. Each have reporters based all over the world so that events breaking anywhere are rapidly reported to the rest of the world by teleprinters installed in newspaper offices, television companies and large company offices. Local events in this country are similarly covered and reported. In addition to these the BBC have many foreign reporters of their own as well as representatives overseas who report for the BBC as well as their own newspapers. At the regional level local coverage will be organised by those responsible for the local news and magazine programmes. Each event as it is reported on the teleprinter is read by a "copy taster" and interesting reports are followed up. Modifications to the rough running order occur as events develop.

Selecting Material

Formal discussion of events with the editorial team—the newsreader, the duty engineer, the film supervisor, and the director—allow a running order to be drawn up. Although not final this allows each person to proceed with his or her duties, any alterations being passed on to those who need to know. As all the editorial team work in one large room most are in direct contact with what is occurring. Intake organise the booking of engineering facilities direct with the c.a.r. and the supervisors of each area. Any problems in this field are dealt with by the duty engineer who is responsible for the smooth running of all engineering facilities and the operational effort.

In the film department the organisers watch the process through filming, rushing to Alexandra Palace, processing, editing and dubbing so that an estimated time of completion is always available. Organisers along with the editors, subeditors and a film editor view the film. When the required sequences have been selected the scriptwriters, using details from the reporter or the cameraman's "dope sheet" as well as the News Information Service (a library of information on past events and general information) the teleprinter reports and their own memories, write the script for the newsreader.

Timing and Cueing

Using approximate times from the film preview the scriptwriter can ensure that the newsreader's words remain in step with the film by marking a check cue on the script. These coincide with an edit or shot change on a point of action. When the reader sees the cue he stops reading until a cue light is flashed to tell him to proceed. A time is marked against the cue and this refers to the time into the film of the sequences to be described. A subeditor or the director operates the cue lights and several checks will be used in one short film. Naturally the writer always "underwrites" the story by putting fewer words than the normal three words per second that is the average reading rate for newsreaders.

In the same way stories coming into the videotape area are viewed by the editorial team although the basic instructions will have been telephoned to the regional film editor who cut the story. Only events such as outside broadcasts and Eurovision material would be edited on videotape and the story dealt with as film, even to the extent of dubbing through the dubbing suite.

Assembling the Bulletin

More stories are included in the final running order than time would allow so the editor will drop some stories or cut part of a story after rehearsal or even during transmission should an item overrun. As transmission approaches the director takes stock of his arrangements and requirements. He allocates the film stories a reel number so that, for example, the first, fourth and seventh stories are reel one, fifth and eigth stories are reel two, the third, sixth and ninth stories are on reel three. A really late story would go on to a fourth reel but as each reel is run from a different machine the telecine supervisor is always informed of the film order and the type of sound track.

The telecine supervisor draws up a running order for the guidance of the operators and would be consulted regarding telecine commitments; similarly the order and stories from videotape are discussed with the VT Supervisor. Time must be given for the telecine or videotape operator to run on to the next story from the same machine, so if a film story is likely to be dropped a check that time still exists for resetting telecine and videotape is necessary. Running on to or back to a different story from videotape is quite critical due to the mechanical problems of winding heavy spools of videotape without damaging it. Full speed is in fact about 10 times playing speed so that if a story is 30 minutes long it will take three minutes to reach it from the following story on the same tape. If this occurs it may be necessary to dub on to another machine for reproduction or alternatively to use a separate tape and to change-over. This is to be avoided if possible due to the possibility of damaging the tape when threading up in the middle of a recording.

Script Conference

Finally the director goes to the gallery where the crew and newsreader await a "script conference" when the director "talks through" the planned bulletin. Although the script will have been handed out by the production secretary most pages will be blank sheets of white paper. Notes are made on these while the script for these pages is dictated by the scriptwriter, typed, duplicated and distributed to each person, when the notes can be transferred to the final page of script. In this way rehearsals are not held up by lack of scripts.

Rehearsals

As the films arrive into telecine from the make-up editor and videotape recorders become available rehearsals can start. With the formalised presentation of the news and a skilled director rehearsals are unnecessary but it is always better and safer to check through all the items available for rehearsals. It allows the director to check his cues, sound to check their balance, grams to check the effects on mute films, telecine to see the film and grade it, the vision mixer to check for a cue dot two-thirds of a second before the film runs out (indicating the latest cutting point), the newsreader to check his script and the secretary to check the actual duration of the item.

In spite of rehearsal being a very rough and ready affair with films being run when available and not necessarily in the correct order it does give a chance for all to see what is going to happen. If a story is not available for rehearsal however no one is very bothered. About this time the senior members of the editorial team come into the gallery and any alterations will be made and in consultation with the secretary times adjusted to bring the overall duration within the times that network control will allow.

The Broadcast

Obviously a lot of the timing depends on the newsreader maintaining a constant reading speed both on transmission and during rehearsals. Not only correct durations depend on this but accurate cueing from the director will suffer if the reader changes his speed. With the tensions of live transmission it is only natural for the reader to speed up and on a bad night there might be a change of over 10%. A good director will realise this and alter his cues to compensate. If timings are being affected the editor can and will drop stories whilst on the air. At a push the newsreader's telephone can be used.

To aid the newsreader, a teleprompter device is used. When each page of script is typed a copy goes to another typist who types the script on to a reel of paper. After checking the script is loaded into a cassette and placed in a machine which displays the script through a magnifying lens, allowing it to be read from a distance of several yards. A motor winds the script through the machine which is placed on a stand so that its lens is just below the camera lens. Speed is controlled by the typist so that the reader can look almost straight at the camera and read the script.

Just before air time the director goes in detail through the script so that all alterations are clear to every one, including the newsreader. The director uses loudspeaker talkback and the reader hears the director via a special loudspeaker in the studio. At this point the teleprompter roll is edited to remove those stories no longer in the bulletin, using an assembly based on the design of a videotape editing block and using adhesive tape to splice the roll.

Cue dots from network control start the bulletin but even after the start of transmission stories might still come in. Film has often arrived in telecine after the start of the bulletin and late news might still come in. As soon as it arrives a scriptwriter will dictate the story as the typist types it out and the carbons are rushed to the studio for the newsreader, director, editor and sound mixer. For really dramatic news the director or editor can ring the telephone on the newsreader's desk and pass on the information. In this way the death of President Kennedy was broken.

Newsflashes

News of the shooting started the newsflash procedure and a line from the BBC's Monitoring Section at Caversham Park was set up so that the Voice of America transmissions could be monitored. When actually on the air with the newsflash the news came through of the President's death in a Dallas hospital. Normally news of this importance would require a double-check, but as the Voice of America is the nearest thing to a government broadcasting authority the United States has it was very unlikely to be wrong. The editor therefore phoned through to the reader and told him to announce the death of the President.

Major news may warrant a newsflash interrupting the normal programmes, so when such a story breaks the editor contacts network control and a time is fixed, normally during the next programme change. At Alexandra Palace the news story is typed out and if time allows any captions prepared. The c.a.r. sets up the lines to the Television Centre, and the duty engineer decides whether to use the *Newsroom* cameras or the newsreader's set in the studio; use of a caption would demand the studio, for example. As soon as possible the newsreader is placed in front of the camera but if he is not on duty a subeditor or a *Newsroom* reporter would be used to read the flash. Cue dots may be used but the reader might simply start as soon as he is on the air. Naturally the *Newsroom* camera and lighting set-up is permanent and only needs switching on.

After each bulletin work continues, the editor and his team returning to the newsroom ready to put together the next news, the film editors collecting the film from make-up should any re-editing be required to fit the story into a longer or shorter bulletin, while the engineers prepare for the next transmission.

TO BE CONTINUED

waveforms in COLOUR receivers PART 3

GORDON J. KING

LAST month we were left with a bird's-eye picture of the chroma signal which, derived from the V and U signals, is a composite signal represented by the resultant of a vector whose amplitude and phase change continuously in accordance with the colour of the televised scene. We saw that the chroma vector is effectively pivoted at the intersection of the V and U axes and that because the V and U signals can swing over both positive and negative values, as determined by the colour in the scene, the chroma vector can rotate over a full 360deg., like the hand of a clock.

Because the chroma vector represents the phasing of the signal it is often called the *phasor*, which is quite a good name for it and one which we shall use throughout the series. We must not forget though that the amplitude (length) of the phasor varies as well as its phase. The exact phase of course indicates where round the 360deg. the phasor points and this is determined by the colour in the scene at any instant in time, while the amplitude of the phasor is geared to the degree of colour. If there is no colour the V and U signals fall to zero and so the phasor diminishes to zero too.

Defining a Colour

To define any colour three parameters need to be known. These are: (1) *luminance*, meaning brightness; (2) *hue*, which is the actual colour resulting from the wavelength of the light emission; and (3) *saturation*, which is how much colour there is in the hue of specific wavelength. Red for example has the same wavelength when diluted with white even though we discern it as pink. In other words, pink is desaturated red.

The phasor thus caters for parameters (2) and (3) and we shall see later that parameter (1) is given by the ordinary monochrome black-and-white signal information.

The Chromaticity Diagram

At this juncture it will be as well to see how the phasor is related to hue and saturation, but before we can really do this properly we shall have to learn a little about colour itself. Way back in 1931 the Commission International d'Eclairge (CIE) evolved a scheme for representing colour in terms of the so-called chromaticity diagram. This is shown in Fig. 1. It is really an extension of the earlier Maxwell colour triangle which shows the results of mixing coloured lights. However, the chromaticity diagram caters for spectral hues which fall outside the scope of the Maxwell colour triangle.

In Fig. 1 the spectral hues are represented on the horseshoe locus and the numbers attached to them give the light wavelengths. All the colours lie inside the horseshoe which is closed by the straight line between the two ends of the spectrum, along which are plotted the purples. Thus any colour can be represented on the diagram merely by using the Cartesian co-ordinates.

Areas of colour shades are indicated on the diagram. We can see an area of red at the bottom-right which embraces all shades of that hue, and this merges with an area of orange shades above and an area of purple shades to the left. Similarly, we have areas of blue merging with green, green merging with yellow and yellow with orange round the horseshoe shape. It will also be seen that red changes towards pink and then goes to white at the point marked C. Thus as we spread outwards from point C we get a change from white to the hue in the direction we are going and this is of increasing colour intensity, or saturation, the closer we get to the edge of the horseshoe shape. The colours, then, are highly saturated round the periphery of the horseshoe, becoming less saturated towards the middle C mark of the diagram, until the colour disappears altogether when the C mark is reached.

Complementary Colours

The diagram also reveals the complementary colours, which are any two coloured lights that together appear as white (the two lights being integrated by the eye to give this subjective effect). Typical complementaries are yellow and blue, red and green, and purple and yellowish-green. Any two

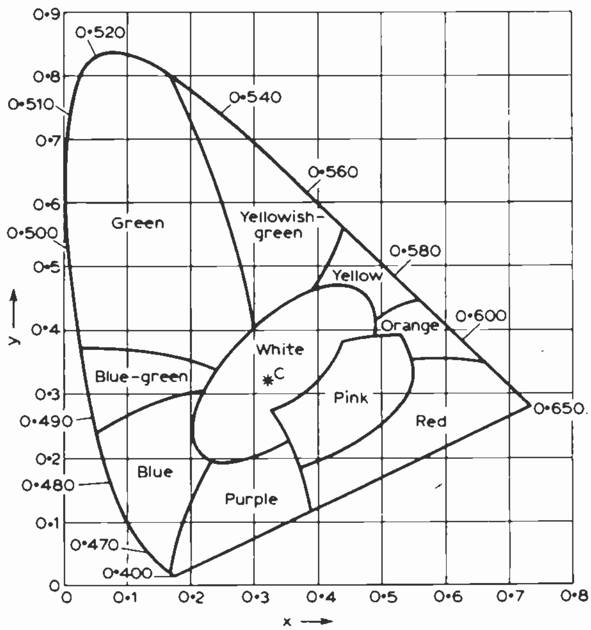


Fig. 1: The CIE chromaticity diagram.

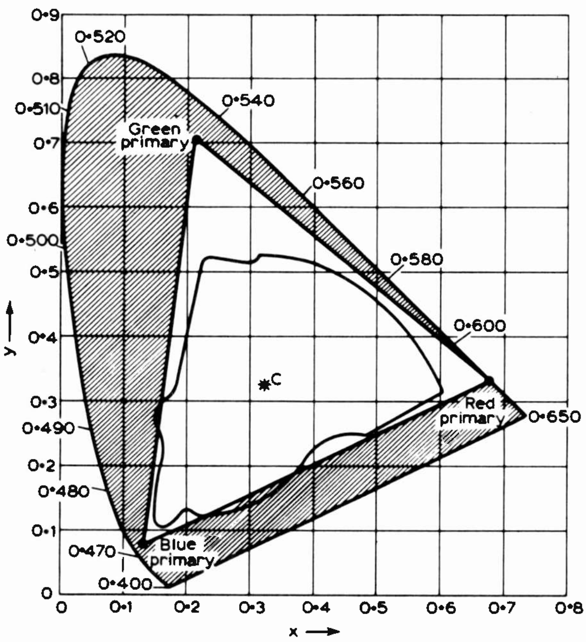


Fig 2: The characteristics of the colour phosphors used on the screen of a colour tube limit the colours it is possible to display to the area within the triangle.

complementary colours are found simply by placing a line through point C, the line then cutting through the complementary colours at opposite sides of the locus.

Colour Reproduction Limitations

The chromaticity diagram encompasses all the colours in nature, and although we try to reproduce all these colours on the screens of our colour TV sets we fall down a bit because the colour-glowing phosphors used on the screen fail to match exactly the red, green and blue additive primaries of nature. The triangle within the horseshoe locus of Fig. 2 indicates the colour compression brought about by the phosphors, the primaries here being indicated at the three corners of the triangle. The colour areas in the shade outside the triangle cannot be reproduced either by TV or printing inks. Indeed, the wavy, near-triangular shape inside the real triangle indicates an even greater limitation imposed by most printing inks used in three-colour printing. Colour TV has better fidelity than this however and although colour TV falls short of nature the reproduction is nevertheless very pleasing and the eyes become accustomed to the inhibited wavelengths.

Chromaticity and Colour TV

Colour television starts as an exercise in the integration of the V and U axes and the chromaticity diagram. The V axis is superimposed upon the red area (since as we saw in Part 1 the V signal is derived from the R−Y colour-difference signal) and the U axis then neatly ties in with the blue area (U being derived from B−Y). Figure 3 shows the idea. Only the essential parts of the horseshoe locus have been drawn and because convention requires the V axis to be presented vertically the chromaticity diagram has been rotated through approximately 60deg.

It will be seen that the V and U axes extend over both positive and negative phases and that the intersection coincides with the white, point C, part of the chromaticity diagram. Clearly the phasor is effectively pivoted at point C and is thus geared in phase to the colours of the diagram. In this way a colour element of the televised scene is given a phase reference, so to speak, by the relative position of the phasor. This is because the phasor, being free to swing round 360deg, can be considered as pointing to the colour on the chromaticity diagram that at any instant is being transmitted. However the V axis is usually drawn as ±90deg. relative to 0deg. on the U axis, rather than 180deg. between its two ends, although the U axis is usually marked 0deg. on the right and 180deg. on the left, as shown in Fig. 3.

Saturation is determined by the strength of the V and U signals, so if the strength of both signals changes equally the phasor will alter only in length and not in angular position. Thus if it is pointing, say, to red, a reduction equally in V and U amplitude will keep it pointing to red but its reduction towards white in the chromaticity diagram will imply that the red in the scene is being desaturated towards pink. If there is no colour in the scene at all both the V and U signals will shrink to zero and the reproduction will be handled exclusively by the monochrome luminance signal, as we shall see later.

Exact Colour/Phasor Relationship

The angular position of the phasor is, therefore, directly influenced by the *relative* strengths of the V and U signals, while its amplitude is also influenced by the strengths of the V and U signals according to the basic expression $\sqrt{(V^2+U^2)}$. Based on unit values, the phasor points to *yellow* when V is +0·1 and U −0·44, its amplitude then being 0·44. Values for the other colour bars in the standard colour-bar test pattern are: *cyan* V −0·62, U +0·15 and phasor

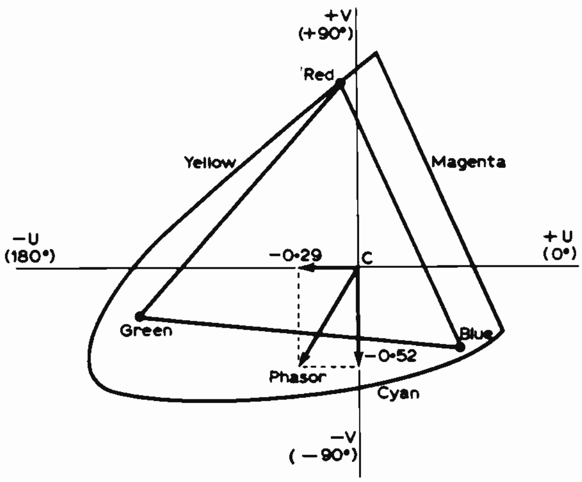


Fig. 3: How the V and U axes are superimposed on the chromaticity diagram. To follow the convention that the V axis be shown vertically, the chromaticity diagram has been rotated by about 60°. The phasor is pivoted at point C (white) and is here positioned and dimensioned in accordance with a green picture element.

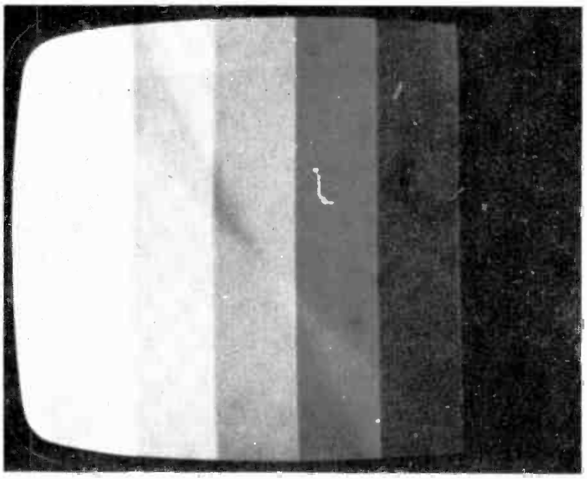


Fig. 4: The colour bars are displayed like this on a monochrome set or a colour set when the colour control is turned right down or the input to the decoder removed. The shaded bars result from the stepped Y-signal waveform.

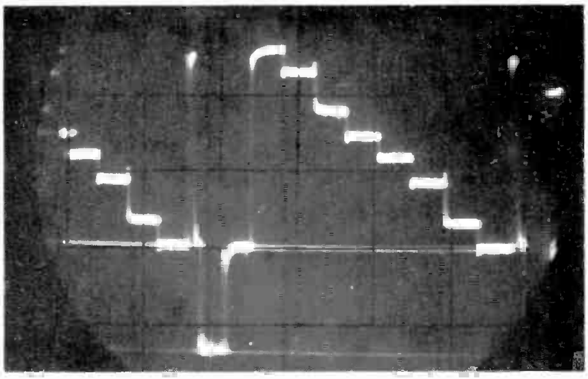


Fig. 5: The stepped Y-signal waveform of the colour bars. The chroma signal is not present here.

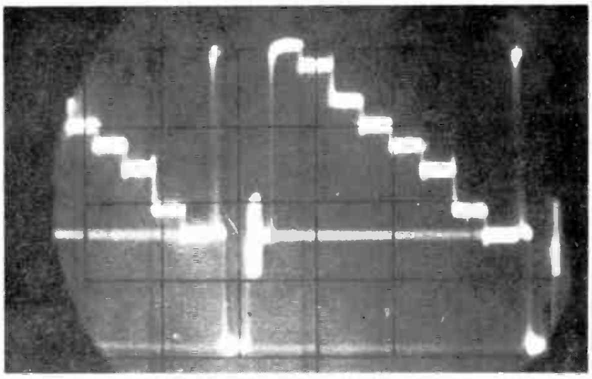


Fig. 6: Stepped Y waveform with colour burst added.

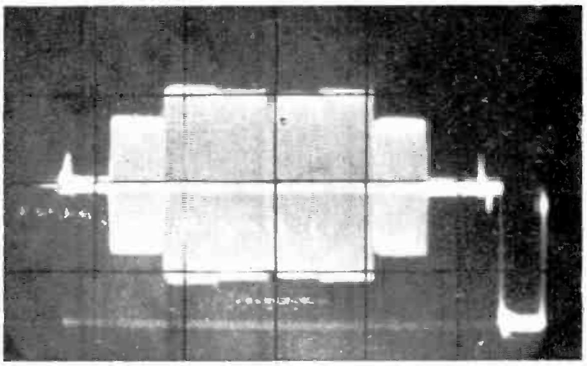


Fig. 7: Colour-bar chroma signal (V chroma plus U chroma).

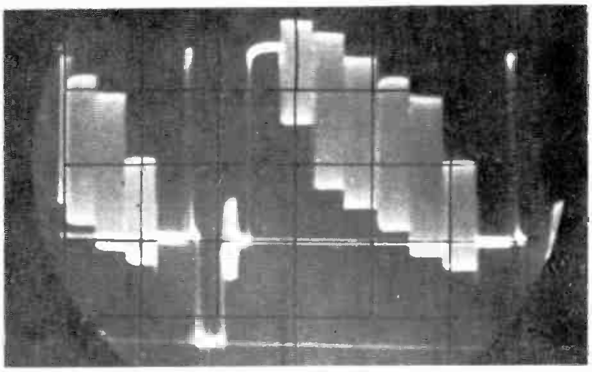


Fig. 8: Colour-bar chroma signal added to the stepped Y colour-bar waveform.

amplitude 0·63; *green* V −0·52, U −0·29 and phasor amplitude 0·59; *magenta* V +0·52, U +0·29 and phasor amplitude 0·59; *red* V +0·62, U −0·15 and phasor amplitude 0·63; *blue* V −0·1, U +0·44 and phasor amplitude 0·44. The other two bars, white and black, are of course colourless.

When servicing colour sets we would not need to work out the angular position and amplitude of the phasor; but it is as well to know how these parameters are linked to the chromaticity diagram. Moreover some block diagrams and circuits of colour sets and systems illustrate the chroma signals in the various sections by phasor arrows pointing in appropriate directions. We shall see some examples like this later.

Adding the Y Signal

A good colour-bar generator or the colour bars transmitted by the BBC or ITV produces a stepped waveform and shows on a monochrome set as eight vertical bars of decreasing brightness from the left to the right of the screen as shown in Fig. 4. The signal which produces this monochrome display is the signal that provides the luminance on a colour picture, and is called the Y signal, explained in Part 1 of this series. Figure 5 is a direct oscilloscope photograph of the stepped waveform produced from the colour-bar signal. This represents just over one line of signal; the line sync pulse between the full line shown and the previous part of a line is clearly revealed.

The waveform in Fig. 5 is devoid of chroma signal and a major process at the colour transmitter involves the addition of the chroma signal to this signal so that the composite chroma-plus-luminance signal can be used to modulate the main carrier wave. Since the chroma signal is related to the burst signal used for colour synchronisation this too has to be added to the Y signal and is incorporated on the back porches of the line sync pulses. An interesting oscillogram of the burst signal sitting on the back porch of a line sync pulse is shown in Fig. 6. The stepped waveform is again the Y-only signal of the colour bars (chroma switched off). Figure 7 shows the chroma signal (V chroma *plus* U chroma) in isolation (no luminance signal) while Fig. 8 shows one full line and a bit of the composite chroma-plus-luminance signal corresponding to the colour bars, complete with the associated burst. In the latter the chroma+Y addition has taken place.

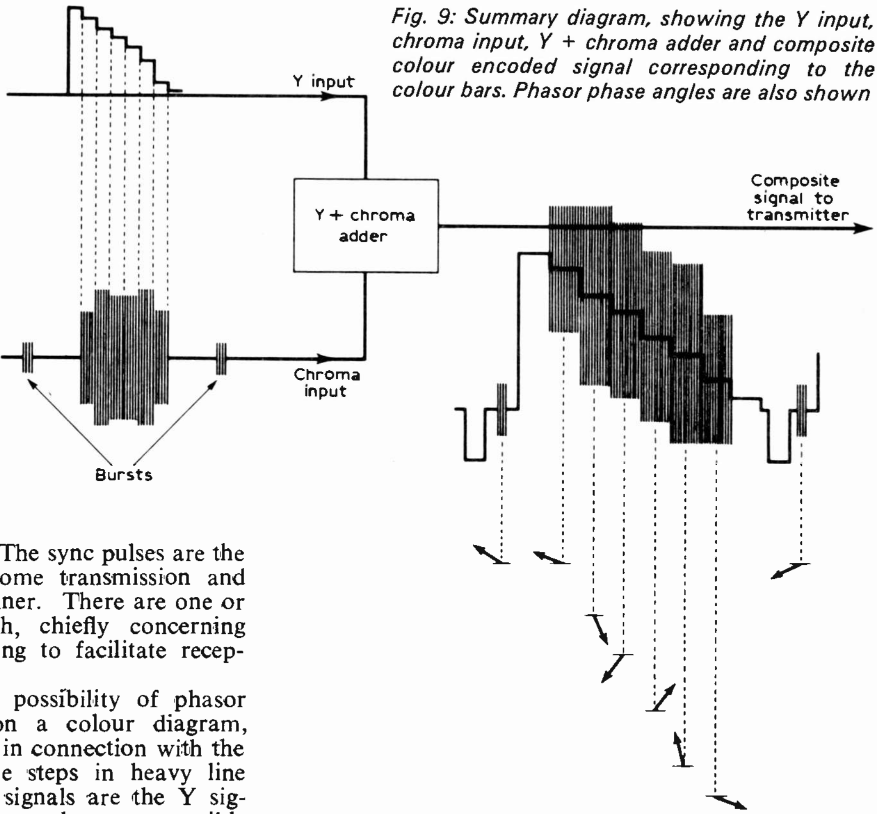


Fig. 9: Summary diagram, showing the Y input, chroma input, Y + chroma adder and composite colour encoded signal corresponding to the colour bars. Phasor phase angles are also shown

Summary

Figure 9 summarises the whole position, showing the Y+chroma adder, the Y input, the chroma input with bursts and the multiplexed output signal. This is the sort of signal that is used to modulate a colour transmitter. The sync pulses are the same as those of a monochrome transmission and are generated in the same manner. There are one or two slight differences though, chiefly concerning the nature of the field blanking to facilitate reception of the PAL signal.

Just now I mentioned the possibility of phasor arrows being incorporated on a colour diagram, and such are present in Fig. 9 in connection with the composite colour signal. The steps in heavy line within the integrated chroma signals are the Y signal values or luminance steps—those responsible for the display of Fig. 4 on a monochrome set even when the signal is colour-encoded (or, indeed, on a colour set with the colour control turned right off). There are eight of them and starting from the left they correspond to white, yellow, cyan, green, magenta, red, blue and black. The black and white steps of course carry no colouring signals. Thus there are six sections with chroma signal, and each section is shown tied by the dotted line to a phasor arrow drawn relative to a horizontal axis. The phasors reveal quickly and roughly the angular positions of the chroma signal for the six coloured bars, and the positions tie in with the values detailed earlier.

It will also be seen that the two bursts shown are similarly labelled, and the phasors here indicate that there is a ±45deg. swing of the bursts from line to line (that is, 45deg. up from the 180deg. U axis and 45deg. down on alternate lines). This swing, it will be recalled, is synchronised to the V signal line-by-line phase alternation used in the PAL system—one line of V signal being transmitted as +V and the next as −V and so on.

TO BE CONTINUED

PRACTICAL AERIAL DESIGN

—continued from page 547

EMI have developed an aerial using full-wave dipoles mounted on a channel section spine in a structural glass reinforced plastic cylinder. A single column of dipoles is used to produce a cardioid horizontal polar diagram. A figure-of-eight type of pattern can be produced with the addition of parasitic elements.

These aerial assemblies are shrouded against the weather and icing in severe weather conditions by a fibre glass cylinder which surrounds the radiating elements, ample space being allowed for climbing up inside when adjustments or repairs may be necessary. Coaxial feeders between transmitter and aerial have a nominal characteristic impedance of 50Ω.

The u.h.f. Emislot radiator system is mounted as a cantilever top mast to obtain the greatest possible height above the ground, remembering that the greater the height the larger the area covered and that the signal strength increases by the meter-amperage, i.e. the electrical height of the aerial multiplied by the r.m.s. current going into the aerial. Figure 8 shows an omnidirectional aerial system employing a number of Emislot radiators in a triangular lattice section. It is the usual practice to support on the same mast the Band II v.h.f. f.m. dipoles.

Instruments for the measurement of signal (field) strength are available. These take the form of a television tuner followed by the usual i.f. strip and demodulator stage driving a calibrated meter (25μV-10mV). This scale may be extended by the addition of plug-in attenuators. For instance if we fix a 20dB attenuator plug between the aerial input and the feeder to the instrument the instrument will now be extended to read times 10 (i.e. 20dB—ratio 10:1). The meter scale will thus be multiplied by 10 to read 250μV to 100mV.

Typical figures for field strength are: Cambridge 100W e.r.p. (relay station), 1 mile from the station 10mV; Croydon 400kW e.r.p., signal strength recorded at Cambridge 50μV.

SERVICING television receivers

L. LAWRY-JOHNS

THORN 850 CHASSIS—cont.

Shorts in the IF Stages

Whilst it is difficult to say where a short may occur to cause overloading and resistor burn-outs, it is quite possible to state that such conditions will be caused by a shorted decoupling capacitor of the ceramic type. When one of the decoupling capacitors does short it is a question of whether the fuse will fail or whether the feed resistor concerned will burn out and thus disconnect the shorted capacitor from the h.t. line.

Let us assume that C15 shorts. R17 will overheat. This is hardly surprising as it is being asked to pass some 200mA. The resulting heat causes the small resistor to change value thus increasing the current and the heat until the fuse fails or the resistor disintegrates. The value of the replacement decoupling capacitor is not too critical, around 1,000pF.

Some trouble was experienced with the actual i.f. coils soon after these sets were first produced but if this has not occurred after several years it is not likely to occur now.

What is likely to occur however is the symptom of a practically inoperative contrast control, with obvious overloading. Whilst this could be due to a number of different causes—a shorted diode, grid-cathode leakage in the controlled valves, etc.—we have often found that a positive voltage at pin 2 of the EF183, V3, rises alarmingly when the valve is removed, thus proving that the valve is not at fault. The trouble is therefore in this immediate stage and C8 (300pF) will be found shorted.

Tube Faults

Readers are referred to the April issue, page 303, for notes on tube defects and possible remedies.

Line Timebase

Lack of width is usually due to a low emission PL36 (30P19) but the width circuit should not be overlooked. R100 can change value, the width control R99 can be faulty and the v.d.r. Z1 can give trouble. The PY81 and the ECC804 should also be checked.

If there is no picture at all, with no line whistle on 405 and the EY86 not lighting up, check the above valves, then the boost capacitor C89 0·1μF and the screen feed resistor R103 (1·5kΩ). This latter component is often damaged by a faulty PL36. A check on the boost capacitor can be made by removing the top cap of the PY81. If this restores some degree of line operation the boost capacitor is shorted.

If the line hold control is at one end of its travel check V7, R94 and C82. If these are in order check

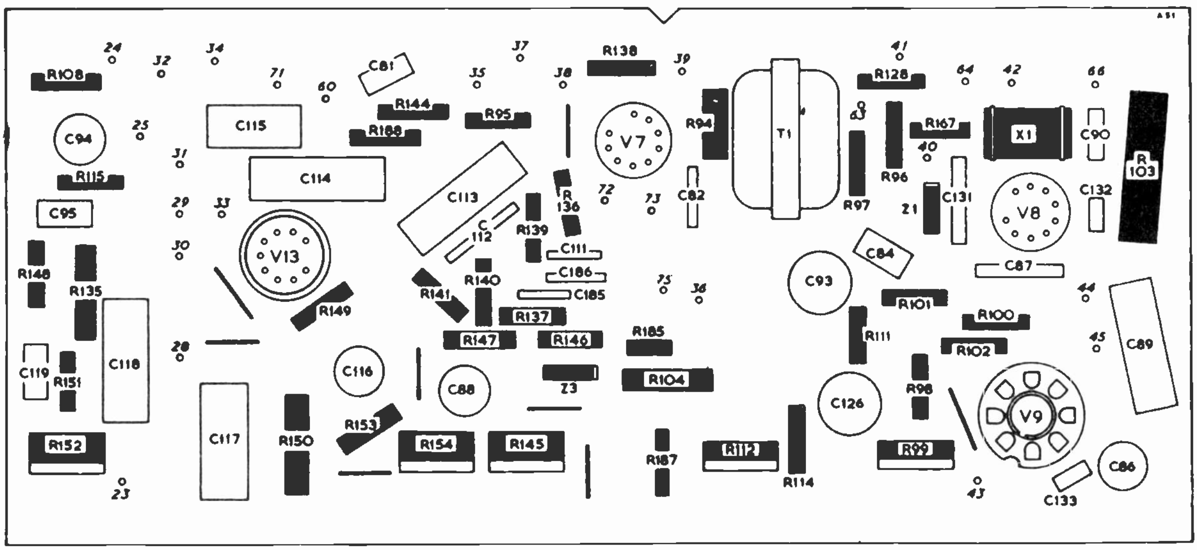


Fig. 5: Layout of the timebase printed board, component side. Figures in italics are tag connections.

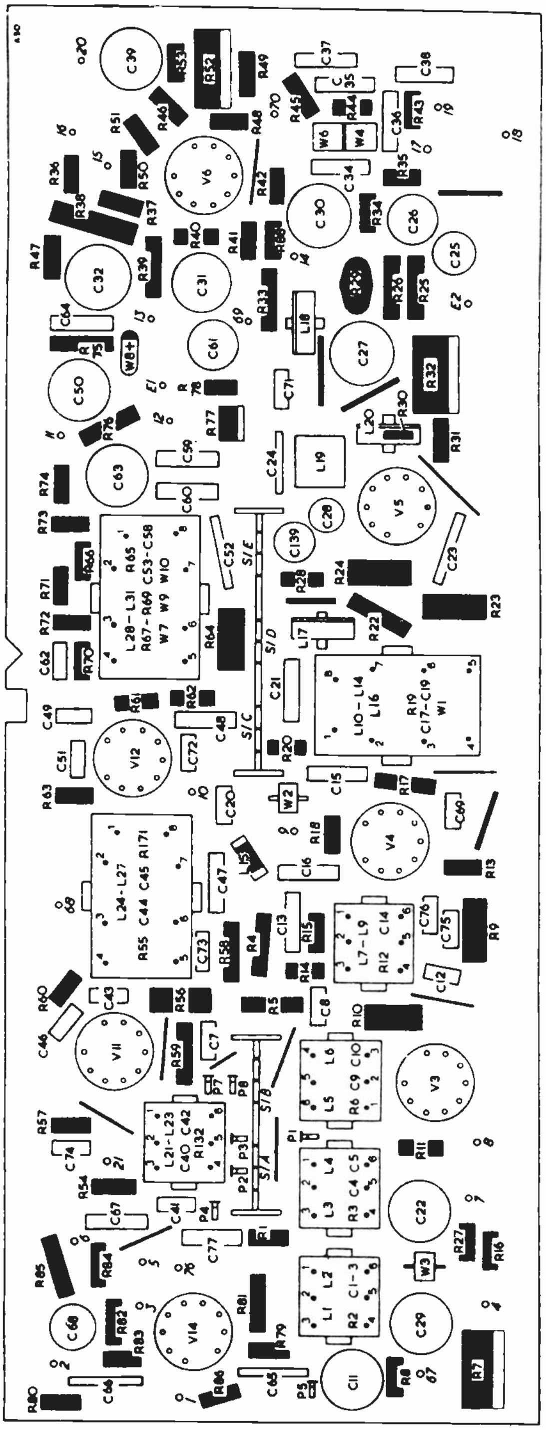


Fig. 6: Layout of the i.f. printed board. The tag connection numbers (italics) correspond to those given in the circuit diagram.

V6 and the associated components, and if necessary the FSY11A discriminator diodes W4 and W6.

Deflection Coils

Severe brushing resulting in white flashing across the screen can be due to insulation breakdown in the scan coils and new coils may have to be fitted. Quite often however the brushing and noise of discharge on the sound are due to the line coils arcing to the closed-loop sleeve, puncturing the paper covering at one point. Whilst a new sleeve can be fitted, moving the existing one out or turning it round so that the puncture is to the rear may stop the effect permanently. We hasten to add that the sleeve must not be rotated as it will then interfere with the field scan and cause distortion of a pincushion nature at the top and bottom.

The Line Output Transformer

Insulation breakdown can and does occur in the transformer. In some cases there is no alternative to a replacement transformer but it is often possible to move the EY86 heater winding slab around or insert insulation. A single turn of well-insulated e.h.t. cable is sufficient to work a DY87 in place of the EY86/87.

Top Cap Coils

The coils (L32 and L33) to the top caps of the PL36 and the PY81 sometimes become open-circuit. Thus in the event of the stage becoming inoperative check both ends of these coils.

Modifications

On chassis with an *additional* A after the schedule suffix letter a different v.h.f. tuner unit is used. This has a PCC189 cascode r.f. amplifier stage and PCF801 frequency changer. C77 is reduced to 15pF with this tuner.

In early production models L16 is omitted, C7 is 4,500pF, R33 8·2kΩ, R150 390Ω and the v.h.f. tuner a.g.c. lead unscreened.

In schedule D models the field deflector coils L37/L38 are returned to h.t. instead of to the printed board earth and capacitors (C41 etc.) with 4,500pF value may be 4,300pF.

In schedule E models C23 is 200pF and R135, C140 supply V13B instead of V14B.

Fine Tuning Range Adjustment

If the fine tuning range is insufficient to tune a particular channel, adjust the oscillator core as follows: Set the fine tuning control to the middle of its range—on receivers fitted with a preset fine tuning mechanism turn the control to bring the cogged wheel of the preset fine tuning screw to mid-position. With the volume control at minimum inject the sound carrier frequency of the appropriate channel at the aerial socket. Adjust the signal input for an adequate deflection on a video output meter (e.g. Avo Model 8 on its 100V d.c. range) then adjust L206 (for access see Fig. 2) using a fully insulated trimming tool for minimum video output. The video output meter should be connected across R29, its positive lead being taken to tag 18 and its negative lead via a 22kΩ resistor to L18 and via an 800pF capacitor to tag E1. The positions of these connections are shown in Fig. 6.

NEXT MONTH: THE STC VC11 CHASSIS USED ON KB PORTABLE MODELS.

letters

Bush/Murphy TV125/V849 Series Hint

Following the article *Servicing Television Receivers* in the June, 1969 issue dealing with the Bush/Murphy TV125/V849 series, readers may be interested in the following hint:

When the slider of the v.h.f. tuner breaks it is not essential to replace the plastic tuning wand in the coil former. All that is required to make an effective and lasting repair is a spring taken from a discarded ballpen and a piece of fairly heavy gauge tinned copper wire. The spring is pushed into the slider aperture and the piece of wire soldered across the end of the aperture to retain the spring. To do this job it is not necessary to remove the tuner from the set.

Many of my colleagues and I have used this simple but effective repair in hundreds of sets of this type without a repeat of this trouble.—**L. V. Carr** (*Ongar, Essex*).

A Reader comments

I would welcome comments from any readers who have successfully converted for v.h.f. sound the Bush chassis type A71 (G. F. Clarke's article in PRACTICAL TELEVISION October, 1968) operating as an a.c./d.c. circuit with a voltage dropper in series with the heater chain. Could any readers who have time to suggest to me suitable coil changes and component modifications for Amateur band reception on 70MHz to 145MHz please contact me?

S. G. Woodbridge of Middlesborough writes in the letters page of the April 1969 issue under the heading "What's wrong with the Trade?" This spelt out many of the shortcomings of the Trade at present and I feel the points he made should be carefully noted by those who wish to improve the Trade as a whole.

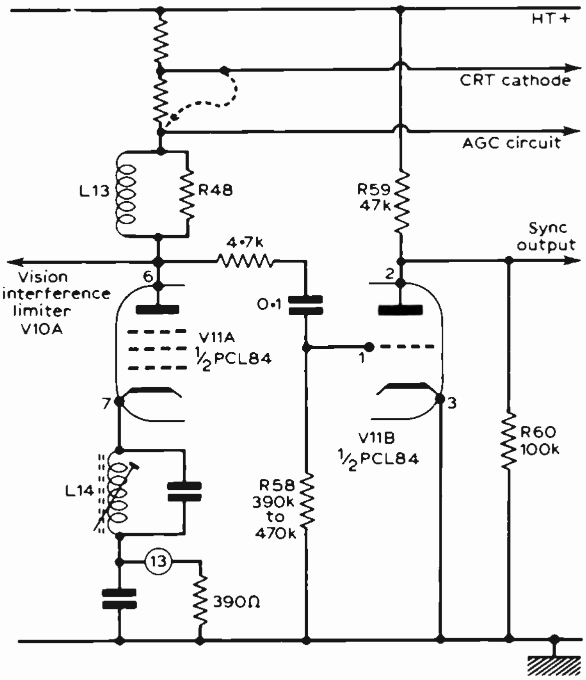
I would also support his suggestion that a Union —or perhaps in view of current affairs it should be named a Federation—of TV service engineers should be formed to foster the interests of its members. I would welcome any further comments from Mr. Woodbridge or other readers interested in this idea.

Finally, I have a number of Newnes Radio and TV Servicing volumes, from Volume 1 to 1962/63, edited by J. P. Hawker. It would appear that during the time these copies were published Newnes also published another series to run alongside edited by Molloy and Poole. The two sets would appear to be very similar but there are slight variations in the earlier volumes. I would welcome any comments on this apparent duplication—**D. Webb** (Southampton).

(*Most Radio and Television Servicing volumes in Newnes' series were edited by J. P. Hawker. E. Molloy, with W. F. Poole as Advisory Editor, started the series in 1952 with a two-volume edition, going back as far as to include several pre-war sets. Early volumes were published under the names E. Molloy and W. F. Poole, later volumes under J. P. Hawker's name. There were many editions, and the volume numbering changed from edition to edition so that, for example, volume 3 of the third edition does not correspond to volume 3 of the fourth and so on. Because of the method of issue it was not possible to state the edition on the books. It's best always to go by the year dates given in each volume. Since 1962-63 the volumes have been dated only. The series was sold to Buckingham Press in 1965 and volumes after the 1965-66 one have new editors.*—EDITOR).

Sync Mod for Pye V700 Series

This group of models, which includes the V700, V700A, V700LBA, V830A and V830LBA, features a transistor sync separator, mounted on a separate subassembly board, which feeds a triode sync clipper stage. Sync trouble is common with these models and a useful "dodge" is to remove the transistor sync panel completely and convert the sync clipper stage to act as the sync separator. The modification is



shown in the accompanying diagram, the details being as follows:

Completely remove the sync separator board and associated wiring. In the triode stage V11B (½ PCL84) replace R60 with a 100kΩ resistor and R58 with a resistor of 390kΩ to 470kΩ. Connect a 4·7kΩ resistor and 0·1μF capacitor in series between pin 6 (anode) of the pentode section of V11 and and pin 1 (grid) of the triode section. Fit a 390Ω resistor between point 13 and chassis (this resistor is R50 on the sync panel).

This modification makes the line and field hold controls much less critical and is our standard practice when we come across this chassis.—**A. H. Rushton** (London, N10).

UNDERNEATH THE DIPOLE

WHAT a week! *Film '69,* the "international technological conference and exhibition", was a week of supercharged education in the techniques of film and television organised by the British Kinematograph Sound and Television Society. The more erudite side was unfolded and expounded in two lecture halls that were in operation simultaneously. Then there were outside visits to film and television studios, the equipment exhibition, historical exhibits and hospitality galore. No wonder there were over 1,000 registered delegates, about 30% from 32 countries abroad as well as no less than 730 tickets for "covers" at the *Film '69* banquet at the Royal Lancaster Hotel. This compares more than favourably with the banquet of the International Broadcasting Convention last year, when about 200 were present. International events of this kind always have a banquet. It is essential, right and proper. It is diplomatic—"Hands Across the Sea" and all that. It is, moreover, good business and costs the taxpayer nothing.

THE SNOWBALL

Nothing succeeds like success, and several representatives of PRACTICAL TELEVISION attended the event on the first and on subsequent days. My fellow contributor Baynham Honri (Chairman of the Exhibition Committee) confided to me at the Monday "*Get Together Luncheon*" that he savoured the sweet smell of success and expected it to snowball before the end of the week. This it certainly did and many of the 200 delegates from USA (plus their wives) made of the visit one week of a three weeks' holiday in Europe. The ladies were given sightseeing tours of London, trips down the river, visits to the Tower (Post Office style), Blenheim Palace, Kingswood Warren (BBC) and Pinewood Studios. At the last named place their husbands joined in the parties to see the new dual-purpose film and TV stages, the workshops, the lawns, the exterior "lot" and enjoy the hospitality. Pinewood ties and scarves, unexpected, became valued souvenirs for them to take back to the USA, USSR, Japan, etc. Other outside hosts who appealed to both husbands and wives included Strand Electric's Theatre, Midnight Matinee at the Odeon Marble Arch, Elstree Studios, Thames Television (Teddington) and several others.

A SHOW BUSINESS BANQUET

To attract such a large audience for a banquet it is essential to have a star speaker. What a wonderful idea it was to invite Lord Louis Mountbatten as guest of honour to mark his 69th birthday. He flew over specially from Paris with Lady Mountbatten and, being a top engineer himself, brought a few electronic overtones into his speech. This was the high spot of the week of *Film '69*, a unique international event which suitably marked with a bang the integration of television and films into show business.

The echoes of that bang will reverberate around the world for many months. A year's preparation and hard planning work had been worthwhile. The fact that the BKSTS Secretary Paul McGurk had been an actor, an assistant stage manager and a touring manager and director in the live theatre stood him in good stead. This was a fine technical production by the Society as a whole.

FILM '69 PAPERS

There were 46 lecture papers read during the five days in two large halls at the Royal Lancaster Hotel, both equipped with slide and film projectors and other visual and audio aids, including a translation system and colour television monitors. There is insufficient space to comment on the lectures but a few high spots ought to be mentioned.

High-Speed Cinematography Equipment was a subject of great interest in research and science, from observing a shell emerge from the muzzle of a gun to the breaking up structure of a bubble. Such high-speed photography requires about 11,000 frames per second compared with the 300 frames per second that is the maximum achievable with a 35mm. camera mechanism with register pins for complete steadiness. Examples of both were shown on the screen by John Hadland.

Fibrox and its Uses in Cinematography and Television were dealt with by Dr. Flitcroft or Rank Precision Industries. This covered usage for decor and display as well as for research and medical purposes. Dr. W. J. Jansen of Philips, Holland, dealt with the *New Developments in Sound Production in Cinemas*, and their acoustic problems. Messrs Fitch and Down dealt with *A New Concept in Film Processing*, equipment for which was displayed in the Exhibition Hall.

Karl-Erik Condesen from Munich gave a splendid paper on *Improvement of Picture Steadness in 16mm. Films*, covering many advanced points to do with accuracy in the perforations of the film—or rather its frequent inaccuracy.

LIGHTING

Closing the Gap between Film and Television Lighting Methods by T. Earle-Knight dealt with the different types of lighting now being introduced in film studios, particularly those with stages suitable for television, television aids for feature film and for conventional production methods for the cinema. Other angles on the same theme were the subject of a debate under the chairmanship of E. A. R. Herren. Another debate concerned the *Educational and Training Problems of the Film Industry* at which it was clear that the proposed National Film School, with university status, was not wanted by the speakers. After all there are several reasonably good film schools already in existence so "why waste the nation's money?" seemed to be the general opinion. Film, particularly the colour film for commercials for television, was dealt with by R. Laughton in *Film in Advertising*—and demonstrated that the speed of cutting and editing, shot-to-shot, ought to be slower for colour film than with monochrome. S. J. Gadgeon's paper on *Film Sprocket Design* might be considered an unglamorous subject but attracted a lot of attention from foreign delegates as well as "locals". Its presentation received much praise.

FILM '69 EXHIBITION

The Exhibition area was not very large but the standard was extremely high, including many very expensive television and film cameras, processing machines, projectors and accessories. I decided to make for PRACTICAL TELEVISION my own assessment of the seven best technological innovations exhibited, disregarding the artistic and display characteristics. Here is the list of seven, set out in alphabetical order and not in order of merit:

Bell and Howell, for the very fine colour helical-scan videotape machine made by the International Television Corporation of America.

Berkey Technical (UK) Ltd. for the very comprehensive range of lighting equipment and lamp suspensions for films and/or television.

Mellotronics Ltd. for the cassette-loading magnetic tape recorder/play-off for sound effects, known as the Programme Effects Generator (PEG).

Ernest F. Moy Ltd. for a beautifully designed and built geared-head for professional motion-picture cameras. This has a variable speed and variable tilting wedges.

Rank Audio Division for a comprehensive new range of high-quality projectors of every film gauge, including their automatic operation types and spools to take an hour or more of programme material.

Samuelson Film Service for several splendid professional 35mm. motion picture cameras, particularly the reworked Mitchell BNC which is now fitted with a built-in reflex prism for brilliant viewing of the actual picture being photographed with the eye or with a television camera and monitor aid. This type of modified camera has been adopted by Paramount Studios in Los Angeles for their top feature cameras.

Studio Film Labs for a down-to-earth display of the best of all the modern bits and pieces that make up a film-editor's cutting room, especially the adhesive-tape jointing splicers for 35mm. and 16mm. film.

CONCLUSION

These innovations are put down here as of equal merit, worthwhile developments in the technical side of show business. The nationalities of the delegates moving around the exhibition hall were equally divided, about the same number coming from television as from films and film studios. A very large proportion of, them were from abroad, from the USA, Russia, Germany, Canada, Australia, France, etc. All went back home satisfied that they had attended a very notable event.

Iconos

Workshop HINTS

by VIVIAN CAPEL

A SURPRISING amount of the service engineer's time is spent in cleaning of one description or another (unless there is an available apprentice to pass it on to). There is often rather more than meets the eye in these apparently simple cleaning operations and this month we will concentrate on tips to facilitate some of these cleaning jobs.

Noisy Controls

Volume and other variable controls frequently become noisy in operation when they have been in service for some length of time. There are several possible reasons for this but the most likely one is that dirt has accumulated on the carbon track or on the metal contact ring which connects the wiper to its solder tag. Sometimes this ring or its sliding contact becomes oxidised and tarnished giving rise to noisy operation.

The only way to make a proper job of cleaning a control is to dismantle it and clean it by hand. The rear case of the control is usually held in position by three or four metal lugs which are bent over the main body. These can be prised up and the casing removed. Both track and contact ring can then be cleaned with some cloth or felt dipped in a switch cleaner.

Unfortunately dismantling and reassembling can involve more work than the job warrants, especially where the control is only slightly noisy, perhaps at one extreme end of its travel. It may be one section of a double control with short soldered leads all of which have to be unsoldered to remove the control. Because of this and with time at a premium as it usually is at the workshop complete dismantling of the control is not often carried out. Instead the control is flooded with a switch cleaner, the spindle then being rapidly rotated to distribute the cleaner and to loosen and clean off the dirt deposits.

The main difficulty here is getting the switch cleaner inside the control and ensuring that it is distributed over all the moving parts. With some controls there is a gap behind the solder tags into which the cleaner can be introduced. With others there is no gap here but there may be one or two slots in the casing. Some are completely sealed, or at least there is no aperture which is readily accessible. With these the easiest way out is to drill a small hole in the control casing. This is usually of soft metal and one of the spiral push-drills will usually do the job conveniently. Care must be taken not to go too far and damage the track inside.

Having found or made suitable access the cleaner must be introduced. Running in a quantity of liquid cleaner does not always find the appropriate parts and in a number of cases it has been found that controls treated in this way and later dismantled were completely dry over some areas of the track or contact ring. By far the best method is to use one of the many aerosols which are now available. It is then not necessary to use gravity as it is when running in the pure liquid; the end of the nozzle is placed against the aperture and the cleaner forced in under pressure, in this way being distributed to all the necessary parts.

Occasionally one comes across a stubborn case where the contact ring is badly oxidised and the normal rotation of the spindle fails to clear it. What is needed here is extra pressure on the contact ring by the wiper. The spindle is held in place in the control by means of a groove and circlip in front of the threaded fixing bush. This however only prevents the spindle moving backwards away from the knob. It is prevented from forward movement or being pulled out of the control by means of the wiper and the ring and track. It follows then that if the spindle is pulled in an outward direction the extra pressure will be taken by the wiper on the contact ring. Hence if it is pulled out at the same time as it is rapidly rotated the extra pressure should remove all dirt and oxide.

Poor RF Contact

Sometimes a control may be noisy although it is perfectly clean inside. The trouble may be due to poor r.f. contact between the spindle and the inside of the threaded bush. It may be noticed that noise only occurs when the spindle is rotated without the knob being in position. This is due to the operator's hand being at earth potential so that the chassis which is in contact with the threaded bush is in intermittent r.f. contact with earth through the spindle and the operator's hand. When the knob is fitted the fault disappears, but it is as well to make sure of things by running a little switch cleaner down the spindle so that it lubricates the contact between spindle and bush.

In some controls there are tiny carbon contacts fitted in the wiper which makes contact with the track. These sometimes drop out and are lost. The only answer is a new control, as also is the case when the track becomes worn. It is sometimes however possible in the case of a worn track to make a temporary improvement by rubbing the worn area with an ordinary pencil. This may be practical in one's own equipment if a replacement is not immediately to hand but is not commercially good practice for the professional engineer. It entails the labour of dismantling and reassembling the control which is certain to give trouble again.

Noise due to Current

While on the subject of noisy controls, although cleaning is not involved one cause should be mentioned which is sometimes overlooked. The majority of controls, even new ones, will become noisy if a current is passed through them. Thus a leaky coupling capacitor, or a leak in a valve electrode where the wiper is taken directly to the grid of the next stage, will result in current flowing and give rise to noise.

Tuner Unit Cleaning

Noisy tuner contacts are a very common trouble. The symptoms are intermittent sound and vision with noise on both when the channel switch is moved. Sometimes the trouble will start by itself and rocking the switch will temporarily clear it. Some engineers daub large amounts of silicone grease over the coil biscuit contacts and while this may effect some improvement it is not doing the job properly. In most cases it will be found that the contacts are dull and tarnished and need cleaning before the application of any lubricant. The phosphor-bronze tuner leaf contacts also need cleaning but these are frequently completely neglected. To clean a tuner properly first of all remove as many coil biscuits as necessary to gain access to the leaf tuner contacts. These contacts can then be cleaned with a cloth damped with methylated spirit. This can be used wrapped around a small stick or over the finger. Another convenient tool which could be used is a jeweller's cleaning bud or an orange stick.

Once the contacts have been cleaned they can be smeared sparingly with either silicone grease or a liquid lubricant. Next the coil biscuit contact should be treated in the same way. First clean those still in the tuner with spirit and then a slight touch of lubricant. In rotating the switch to bring the biscuits to a convenient cleaning position however make sure that the dirty biscuits do not pass over the cleaned leaf contacts. After they have been dealt with those which may have been removed can be cleaned and refitted.

Ordinary biscuit contacts are quite easy to clean; just a rub along the length of the biscuit with the spirit cloth followed by a polish-off with a dry one will in most cases suffice. Some printed circuit coils made by Philips however are not quite so straightforward. These have wire contacts which must be cleaned individually; a complete tuner full takes quite some time. An old toothbrush will be found to be about the best instrument for this purpose. The bristles can be dipped in the meths and then the brush used to scrub along the contacts on both sides of the flat biscuit.

Earthing Contacts

Noise in tuners is sometimes caused by poor contact between the switch rotor and the tuner chassis. Some tuners use phosphor-bronze contacts between rotor and chassis, but as with the other contacts these occasionally get dirty and need cleaning. When cleaning the switch contacts make sure to clean any earthing contacts fitted.

If no special earthing contacts are used the rotor will be earthed through the bearings and also the position-locating roller. These too should be cleaned off and lubricated in order to facilitate good earthing. Do not forget the tuner valveholders as it is sometimes these that are noisy rather than the tuner switch but because of being disturbed by the mechanical action of the switch it is the switch that appears to be at fault.

Cleaning the Chassis and Inside the Cabinet

It is sometimes desirable to clean the chassis or printed panel when there is a large accumulation of dirt which can considerably impede diagnosis and repair. Such cleaning is absolutely essential when fitting a new tube in an older receiver where the implosion shield cannot be removed from the front. If any trace of dust or dirt is allowed to remain in the cabinet then almost certainly this will find its way on to the front of the tube after fitting and the whole tube mounting will have to be removed in order to get rid of it.

A vacuum cleaner is essential for chassis and cabinet cleaning in the workshop. If cleaning is attempted without it the state of the workshop will be much worse than it probably is at present! A cleaner should be chosen with a long hose, one of the stretch-hoses currently in vogue being very suitable. A flat crevice nozzle will be found to be the most useful tool for getting into the corners of the cabinet and between valves and coil cans on the chassis. For some areas it will be found more convenient to remove the nozzle and use the open end of the hose.

The method of working is to use a small brush to brush the dirt towards the hose nozzle which is held in the free hand. Starting at the highest points such as the top of the cabinet, work down to the lowest. Although most of the dirt settles on horizontal surfaces vertical surfaces collect their fair share too so sweep over the sides of the cabinet to remove dirt that will invariably be found clinging to them.

Cleaning Agents

Methylated spirit is a versatile and excellent cleaning agent for workshop use. It will soften and clean the majority of dirt and greasy deposits as well as oxidised metal surfaces. It can be used for switch cleaning, as we have seen, for cleaning the record and erase heads of tape recorders, for degreasing idler wheels and turntable rim drives, as well as for cleaning tube screens and implosion shields. It has the advantage of drying quickly and being safe on most surfaces.

There is an exception to this. Some printing and lettering as used on station scales and control knob labels is fixed with a spirit solvent and will be quickly removed by the use of methylated spirit. Exercise caution then when cleaning any of these with spirit otherwise one may have the unhappy experience of wiping part of a station scale not only clear of dirt but also clear of stations!

Some c.r.t. masks have sprayed finishes that will also be dissolved by spirit. So care must be taken with these too. If in doubt try cleaning a small area on the back first to see what happens. For such surfaces there is nothing to beat soapy water. So in addition to the bottle of meths it may be found convenient to have a bottle of soapy water made up ready in the workshop for such cleaning operations. Plastic cabinets respond well to soapy water and the ones with a rough-finished surface can be cleaned by using a nail brush.

TO BE CONTINUED

YOUR PROBLEMS SOLVED

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply service data or provide instructions for modifying 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 page 573 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

DECCA DR41

The picture fails to lock horizontally, the horizontal lock control being at the end of its travel. The sync separator valve (EF80) and line oscillator (ECC82) have been replaced with no result.

This fault starts after approximately 15 minutes and switching the tuner to and fro sometimes cures it as does operating the system switch.—D. Hazell (Oxfordshire).

We would suggest you change the 250pF capacitor wired to the line blocking transformer and pin 7 of the ECC82 (C82). Also check the resistor R94 (220kΩ) wired from pin 7 to tag 39 which is the lead-off to the control. Check R169 (390kΩ) if necessary.

HMV 2624 (Thorn 900 chassis)

I am constantly replacing the video amplifier/sync separator valve, a PFL200. These valves seem to over-run and get destroyed.

In use for two years, I have replaced eight of these valves—H. Hilt (Wales).

This valve has in the past caused a great deal of trouble in video stages of dual-standard sets; but the latest versions are far more reliable. The writer suffered exactly the same trouble on his own set and, in spite of modifications, could only be cured by valve replacement. However, fitting a recently-produced valve has permanently solved the trouble—or at least appears to have done so to date. You must also ensure that the mains adjustment is set as close as possible to the mains voltage, as the PFL200 is rather sensitive to heater current error.

ION TRAP SETTING

Is it in order to replace a broken ion trap magnet with one of a different design providing that a good clamping can be achieved or is it so critical as to demand an exact replacement to obtain a raster at all?—A. Turnbull (Yorkshire).

An exact replacement ion trap magnet should be used for unless the correct magnetic field is available to deflect the beam this may not be fully bent so that it all passes through the anode aperture. If the field is wildly wrong it will be impossible to secure screen illumination.

MURPHY V510

The sound is perfect but the screen is blank and no raster is present. I have changed valves U26, U191 and 30P4 but no difference was noted. The tube heater lights up and the line whistle is audible but the U26 does not light up and remains cold.—E. Whiting (Wales).

The trouble you describe could well be due to the wiring inside the oil-filled transformer becoming brittle. Unfortunately replacement transformers are no longer available from the manufacturers.

GEC BT448

The fault is lack of width. There is a 2in. strip down each side of the raster. All voltages seem normal. The PY33 and the 30P19, U193 and 6F23 in the line timebase have been changed without correcting the fault. I have also changed the 0·047μF capacitor in the width control, and 0·1μF and 0·25μF capacitors on the 405-625 switch.—W. Cotterill (Staffordshire).

Check the 3·9kΩ screen feed resistor, the 0·01μF coupling capacitor and the 150kΩ load resistor from pin 7 of the 6F23. If these are in order check the 120pF capacitor and the 1·8kΩ resistor across the line deflection coils.

KB NEW QUEEN

The picture has disappeared but the sound remains perfect. When using the channel selector white clicks appear on the screen. After switching off a white spot comes in the centre of the screen, a thing that never happened before.—R. Hindson (Durham).

Since you can obtain a switch-off spot you can at least be sure that the e.h.t. voltage to the tube is correct. It is possible that the tube is being correctly modulated by the picture signal but that something is amiss with the tube bias, preventing screen illumination. The fact that the switch-off spot has only recently occurred may also have a bearing on this. If it is impossible to obtain screen illumination by turning up the brightness control to full then you should check the brightness control circuit to the tube grid and also the feed to the cathode from the video amplifier. Check the video amplifier valve as well. It is, of course, possible—though not too likely—that the tube has failed.

KB FEATHERLIGHT KV003

On switching on the sound comes through normally after about ½ a minute. The picture appears after about 1 minute with the bottom half on top and vice versa. The two halves of the picture are separated by a thick black line across the centre and there is considerable jumping of the picture. At the same time there is a loud buzz on the sound channel. After 1½ minutes the picture is perfect apart from the left-hand edge of the screen not being filled for a ¼in. at the edge. There is also a faint line running vertically approximately 1in. from the left-hand edge. After 2 minutes the buzz disappears for the remainder of the time the set is on and it functions perfectly apart from the minor symptoms previously described.

There is a certain amount of difficulty with the height as despite full adjustment of the height preset control R98 the picture is still too big for the screen. This is particularly noticeable on subtitles at the bottom of the screen, when the last inch or so is missing.—R. J. Wombwell (Scotland).

It is possible that the resistor connected between the boosted h.t. line and the top of the height control has decreased in value. This might well upset the initial timing of the field oscillator and certainly increase the height of the picture. The slightly reduced width should lead to a check of the booster diode and line output valve. Low h.t. voltage is another possibility.

BAIRD 650

The sound suddenly drops to a low level, varying but never disappearing completely. The fault is common on all three channels and the time of occurrence is random. When at a low level, flicking the tuner control to another channel often temporarily cures the fault. The picture on all three channels is always very good.

I have checked the switch contacts and all appears to be well. Sometimes the set will go well for an evening but on other occasions the sound goes low at frequent intervals.—J. Hale (Berkshire).

This symptom could be caused by intermittency almost anywhere in the sound channel. Poor soldered connections, a bad resistor or capacitor, badly seating valves and so forth are typical examples. You will have to examine all such possibilities. Since surges such as those obtained by "flicking" the tuner remedy the trouble temporarily, it is likely that a dry-joint exists somewhere in the sound channel i.f. stages—especially in the i.f. transformers (and fixed tuning capacitors) themselves.

EKCO TC268

There is no sound or vision or e.h.t. on this receiver. All the valves and the c.r.t. light up except the U26 which I had tested and it was found to be in good order. The U301 valve was replaced when vision only failed a short while ago. Reception was perfect for a few days then the present trouble occurred.—H. Penrose (York).

You appear to have an h.t. failure. We advise you to check the h.t. rectifier and also the mains dropper sections which carry the h.t. feed.

PHILIPS 19TG173A

There is excessive brightness on BBC-2 with the brightness control turned fully down. Also there is talking in the background which gives the impression of another station cutting in.—J. Jones (London, N.W.10).

We would advise you to replace the PFL200 video amplifier valve and reduce the value of the grid leak resistor R258 to approximately 220kΩ. Capacitor C249 could be increased to 0·1μF.

DECCA DM21C

The quality of the sound and picture is good but I cannot eliminate the field flyback lines. I also think that the contrast may lack a little sharpness, so I wonder if the fault lies in the area of the video output?—R. Monagahan (York).

Check the resistors and capacitor on the tube control grid, the latter transferring signal to the grid from the field timebase. If all seems well here, the tube itself could be responsible, especially if the lines disappear when the picture brightness is reduced. This possibility is strengthened by your mention of poor contrast, etc.

EKCO T221

There is perfect sound on ITV and BBC but no picture. All the valves are lighting up but there is no line whistle or spark from the tube. I have changed the U301 which was faulty and the U25 with no improvement.

The U25 lights up a tester screwdriver ¾in. from it. I have replaced the 500mA fuse and the U301 and 20P4 both give a good indication on the tester.—F. Tinkler (Yorkshire).

A common fault is failure of the e.h.t. reservoir capacitor. As a quick check the e.h.t. lead can be taken directly to the tube anode, disconnecting the capacitor completely.

FERGUSON 308

The sound is perfect but the picture signal seems to be very weak. All the valves have been tested and are up to standard. The tube seems all right and there are no flyback lines visible. The raster with no signal is at normal brilliance.

The fault appears to lie between V3 (common sound and vision i.f. stage) and V5 (vision output). Can you say what components in V3, V4 and V5 stages I should check to cure what appears to be lack of vision signal going to tube and sync separator, the slightest reduction of the gain control breaking up the line and field synchronisation.

New valves fitted include both tuner valves, vision output and EY86—all to no avail. This fault occurred suddenly after an EY86 failure.—J. Hitchcock (Surrey).

As you suggest this fault could be caused by low vision signal and the trouble could well be in the aerial system and not in the receiver itself. If possible check the aerial on a different set or your set on a friend's aerial before getting too involved in the vision stages of the set itself.

EKCO TP308

I have unstable horizontal line hold from time to time even when the contrast is well up. This fault can be "heard" if the brilliance is turned down but increasing the brilliance will sometimes restore the hold for a while.

I have also noticed that the picture sometimes jerks in and out at the right side of the screen. I have changed the sync separator and line output valve.—C. Baker (Morden, Surrey).

A faulty e.h.t. rectifier could cause your trouble. Alternatively brushing may be occurring in the line output stage: this ought to be seen in a sufficiently darkened room. If the line output transformer shroud appears to be burnt or buckled we advise you to suspect this component.

PYE VT4

The symptoms were sound OK but screen blank. There is a loud line whistle but the e.h.t. rectifier heater does not light up. I switched off and tested the heater using a 6V battery and the valve then lit up. Using a meter I tested the voltage across the e.h.t. rectifier heater winding on the line output transformer and found that this was only about 0·5V, suggesting that the heater winding had shorting turns. Would it be possible to rewind this?—D. Brock (London, N.8).

Your trouble is probably not in the transformer itself but in the deflection coils. To check this, disconnect the pink and screened wires from the deflection coil tagstrip. If this produces a weak e.h.t. the deflection coils are faulty.

PETO SCOTT TV960

BBC-1 and ITV are both good. BBC-2 has developed trouble after being on for about 2 minutes, it being impossible to lock the vertical hold. The contrast fades almost to nil and the sound fades completely away leaving a "mush" noise coming from the speaker.—R. Hogwood (London, N.17).

If BBC-2 is OK when the set is first switched on, fading after a couple of minutes, the u.h.f. tuner is almost certainly at fault and this must be sent back to the dealer so that he can return it to the maker for repairs and/or replacement.

PYE VT7

The set is working all right except that the sound is distorted.—H. Hale (Bedfordshire).

We advise you to check the ECL80 sound output valve which is beside the main smoothing block. Check also the WX6 interference suppressor diode, below the chassis adjacent to this valve. A quick check here is to short the diode out, which should clear the fault if the stage is faulty.

QUERIES COUPON

This coupon is available until September 19, 1969, and must accompany all Queries sent in accordance with the notice on page 571

PRACTICAL TELEVISION, SEPTEMBER 1969

TEST CASE

82

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.

? *The field of a Decca DR2 was badly disturbed by a "wave motion" causing picture rolling and folding alternately at the top and bottom of the picture. This was thought to be caused by the usual asynchronous effects which now trouble sets with poor smoothing or high residual mains hum due to the field repetition frequency of the transmission no longer being locked to the 50 Hz mains supply. Accordingly attention was directed to the h.t. smoothing electrolytics and to possible heater-cathode leaks in the timebase and vision valves, but to no avail.*

Extra smoothing was next tried with a choke and two 200μF electrolytics, but the symptom persisted. There appeared to be absolutely nothing at all wrong with the field circuits or smoothing, and the experimenter eventually gave up and contacted our Query Department.

Do you know what a less probable cause of this trouble is? If not see next month's PRACTICAL TELEVISION *for the answer and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 81

Page 525 (last month)

The fact that the symptom of hum disappeared on bypassing the cathode of the picture tube signified conclusively that the hum was being injected via the video amplifier valve, and tests indicated that the video valve had in fact a slight heater-cathode leakage.

It is noteworthy that this model can exhibit similar hum symptoms due to tracking between the tags of the tagstrip to which the grid circuits of the tube are connected. In this case though the hum symptom disappeared when the cathode, not the grid, was bypassed through an 0·25μF capacitor to chassis. Trouble in the field blanking circuit, also connected to the tube grid, can also induce a similar symptom.

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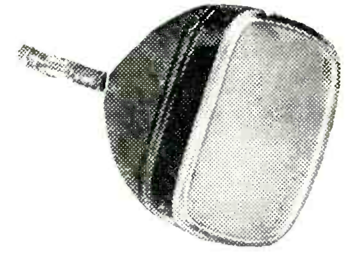

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