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Practical TELEVISION

JUNE 1967

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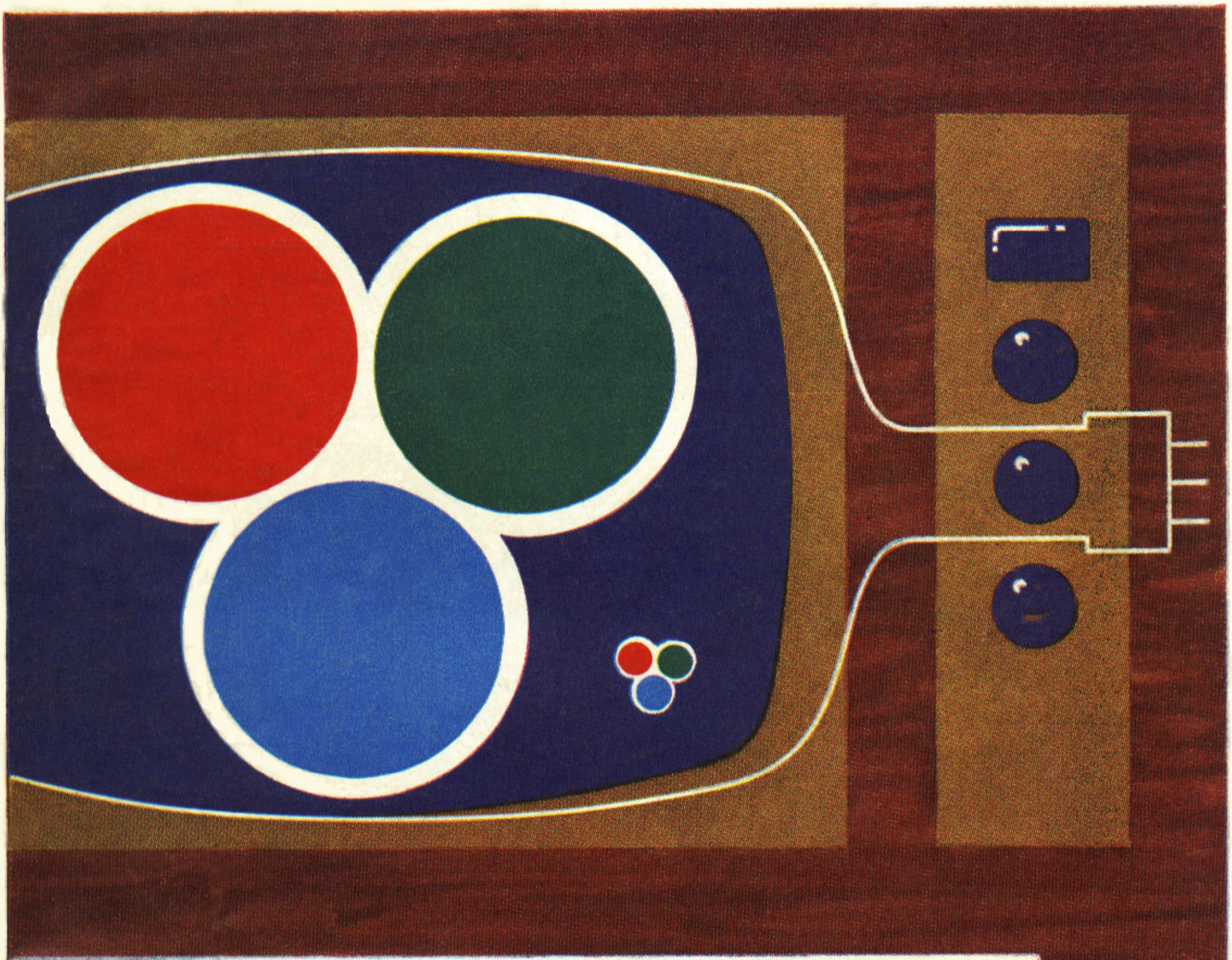

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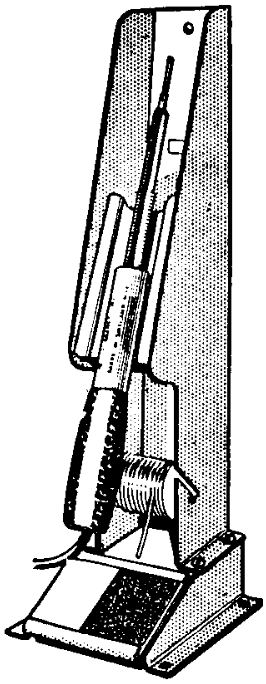

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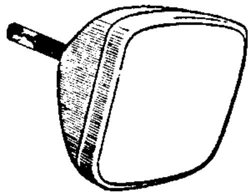

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Practical Television

JUNE 1967
VOL. 17 No. 9
issue 201

THE END OF THE RAINBOW

THE Rainbow Era is with us—at least so it would seem from the outbreak of demonstrations at which manufacturers are proudly displaying their 25-inch electronic peacocks, and from the barely suppressed excitement of the BBC, already putting out isolated colour programmes and aiming to have virtually a colour service long before the official kick-off.

Although we are not knocking colour TV, and will even be prepared to sit through *Batman* just to see if his hair is red or grey, we wonder whether, putting aside the frills and ruffles, the sales superlatives and the technicalities, colour TV is *really* much nearer for the average viewer.

Consider the economics of the case. It has been estimated that around 90% of colour sets will be rented. One well-known rental company quotes the expected weekly rental figures as between 37s. to 41s. 6d. However, an initial advance rental for 42 weeks will be required, a lump sum of around £85.

If you buy a set, taking an average retail price of £300, the h.p. down payment will be around £100, higher than the advance rental figure but not such an outlandish proposition in comparison—assuming that the prospective owner is not saving for a mortgage deposit or a new car!

The colour viewer will also be liable to the additional licence fee (£10 total) and may also need a new aerial, for even if he has an existing BBC-2 array it may need resiting or replacing to obtain acceptable colour signals. There is also the additional hazard of the £80 it will cost to replace a crt. although TV insurance companies are working on that one.

At the best of times, buying or renting, the outlay would be prohibitive to most and daunting to many. But in the present depressive climate of economic chill, it is difficult to be optimistic about sales or rentals except to the fortunate minority who have that sort of money to spare.

One such optimist is Mr. Martin Bennet of RCA who at the recent RTRA Conference, told UK dealers that colour TV is the "hottest consumer demand item of this decade". Bubbling with enthusiasm (or whistling in the dark?) he went on to claim that the trade is on the threshold of "one of the most exciting merchandising experiences that ever faced a group of retailers".

It has been said that if you find the end of the rainbow you'll discover a pot of gold. Let us hope it will not turn out to be a mirage!

W. N. STEVENS—*Editor*.

THIS MONTH

OUR NEXT ISSUE DATED JULY WILL BE PUBLISHED ON JUNE 23

TELETOPICS

FULL HOUSE AT THE 1967 FILMSHOW

Photograph above shows (left to right) Mr. A. T. Collins (Managing Editor of the Practical Group), Mr. S. L. Johnson (Market Research), Mr. W. N. Stevens (Editor of PRACTICAL TELEVISION *and Practical Wireless), Mr. I. Nicholson (Mullard Limited).*

Photograph on the left shows a section of the Filmshow audience assembled at Caxton Hall.

THE Chairman, Mr. W. N. Stevens opened the meeting and introduced members of the P.T. and *P.W.* editorial team to the audience. He explained the problems of catering for a wide variety of interests and a wide range of technical levels among readers of both journals. He then introduced Mr. S. L. Johnson who spoke of the market research he is undertaking in order to provide the Editor with facts and figures to add to the pool of knowledge as to reader requirements.

Mr. Nicholson then introduced the Mullard film "Electrons in Harness"—in essence a tour around the Mullard Research Laboratories outlining the programmes of development now being undertaken. After the film, and a break for refreshments, during which readers had an opportunity to meet fellow enthusiasts, Mr. Nicholson delivered a lecture on "Transistors in Television".

He outlined the advantages and disadvantages of the use of transistors in television circuitry, explaining that it was because of their greatly improved noise performance at u.h.f. that transistors first entered the television field, of necessity in the u.h.f. tuner.

In conclusion, Mr. Nicholson said that there is little doubt that the use of transistors in colour television would move faster than in monochrome. The stages in a colour receiver from the decoder system right up to the colour difference (chrominance) and luminance output stages would be transistorised also. He said that on average the colour set would utilise fifteen transistors in addition to the eleven or so in the tuners and i.f.'s. So, with monochrome sets having several diodes, eleven transistors and seven or eight valves, it should now be obvious to everybody that as far as television was concerned, transistors were definitely *in.*

TV STANDARDS CONVERTER

BBC engineers have now solved the problem of the electronic conversion of monochrome and colour television pictures exchanged between America and Europe.

Several different television systems are in use throughout the world, and some means of converting pictures from one system to another is essential to permit the international exchange of programmes. The most important features of the different systems concern the number of lines composing the picture, and the number of pictures transmitted each second.

The first television standards converters worked on the principle of displaying a picture on the incoming standard, and televising this picture from a camera operating on the required outgoing standard. This optical type of converter inevitably causes some degradation in picture quality and needs constant expert supervision. It is also quite unsuitable for converting colour pictures. In 1963 the BBC developed the first all-electronic television standards converter, giving high-quality conversion of pictures between systems using different numbers of lines, but having the same number of pictures per second. This type of converter is capable of operating unattended and is widely used to change pictures between the two main systems used in Western Europe; the 405-line system used by BBC-1 and ITV and the 625-line one used by BBC-2 and the rest of Europe. The optical converter has, however, been the only type which could be used in the exchange of programmes between Europe and America, because of the difference in the numbers of pictures per second used in the two continents.

It is expected that equipment using the new principle will be available in time for the opening of the colour service in this country on BBC-2 later this year, allowing exchanges to be made between Europe and America of good colour pictures. A firm commitment has also been accepted to provide pictures from the Olympic Games in Mexico in 1968, converted from the American colour pictures.

BRITISH PAVILION HAS OVERALL VIEW OF EXPO '67

WAY above EXPO 67, a Marconi colour television camera is in operation, providing panoramic views of the exhibition area for visitors down below. On top of the British Pavilion (160 feet), the tallest building in the exhibition, Marconi operators will be stationed to operate the equipment.

The camera will provide colour pictures for visitors to a mock-up of a modern television studio in the British Pavilion, and to the Canadian Broadcasting Corporation for introductory shots about the exhibition.

Electrowriters help BBC

CLAIMED to be the swiftest last-minute installation of electrical equipment ever to be provided for a BBC television broadcast, five Modern Telephones Ltd. Electrowriters which transmit and receive instantaneous written messages over a telephone line, played a major role in announcing GLC election results recently. They worked non-stop during the all-night BBC election programme "Twenty-Four Hours Special".

As the results were telephoned through to Lime Grove Studios in London, BBC staff wrote the information on a transmitting Electrowriter which immediately became visible on four receiving units strategically placed near the camera crews and commentator.

Adverse trading conditions still affecting TV

ALTHOUGH the adverse trading conditions continued to affect home disposals to the trade of radio and television receivers during the early part of this year there was a slight improvement in February over the first month of 1967, according to the Economic and Statistical Division of the B.R.E.M.A.

In February, 96,000 television receivers were delivered to the trade compared with 91,000 in January showing 27 per cent less than February 1966 and 26 per cent less than 1965.

These estimates are net figures of deliveries by manufacturers to the home market on firm and other accounts including those to rental and relay companies.

Aerial tower contract for S. Wales

THE BBC has placed a contract with Hightower Construction Company Limited, of Watford, Herts., for the erection of aerial towers and buildings for six BBC-2 u.h.f. television relay stations in South Wales, to fill gaps in the coverage of the main BBC-2 transmitter at Wenvoe.

The six new stations are to be at Kilvey Hill (Swansea), Rhondda, Caerphilly, Pontypridd, Aberdare and Merthyr Tydfil.

It is expected that they will be brought into service progressively during the coming autumn and winter.

Colour transmissions from Winter Hill and Rowridge

THE BBC-2 transmitters at Winter Hill (Channel 62) and Rowridge (Channel 24) are carrying the BBC's experimental colour television test transmissions on the PAL system.

The colour transmissions are included in the BBC-2 trade tests on Mondays to Saturdays from 1400 to 1800. They follow an hourly cycle consisting of 15 minutes of test card (in black and white) followed by colour bars, colour slides and colour films. On Mondays to Fridays there are additional transmissions from 1830 until about 1915.

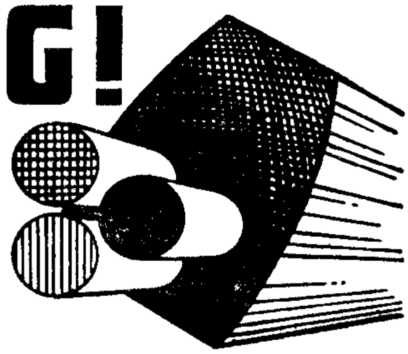
Other BBC-2 transmitters carrying the colour test transmissions are Crystal Palace, Guildford, Hertford, Reigate, Tunbridge Wells, Emley Moor, Belmont, Sutton Coldfield and Bromsgrove. The tests will be extended to all other BBC-2 transmitters by the early autumn.

EDUCATIONAL CCTV SCHEME

TWO television studios are now complete and being used for the training of teachers in programme production techniques at the Inner London Education Authority's new TV centre. It is being established at Laycock School in Islington, and will provide programmes for over 1,300 schools and colleges in London by 1970.

The first transmissions will be made in September 1968 to 300 schools in North London. By then the work of adapting the building as a TV centre will be completed with two additional studios.

COLOUR IS COMING!



A SHORT BASIC COURSE ON COLOUR TV FOR THE TECHNICIAN AND AMATEUR ENTHUSIAST

by A. G. PRIESTLEY

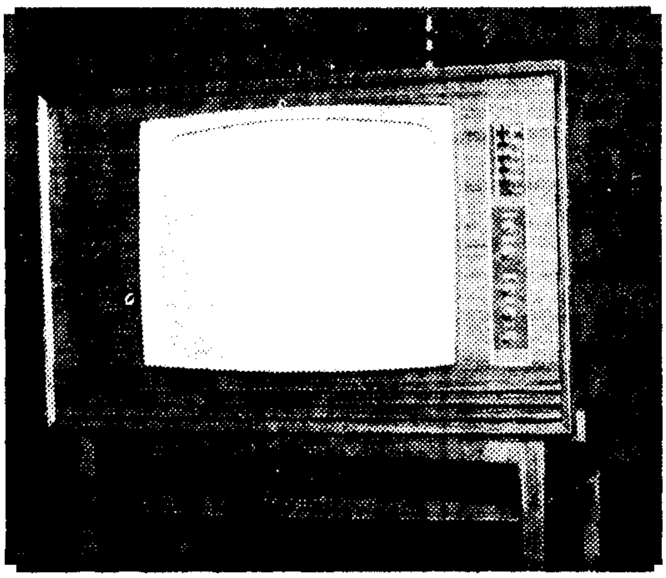
PART 1 — INTRODUCTION TO COLOUR

YES, colour TV is coming! It is the most exciting thing that has happened in the history of British broadcasting since we started the world's first television service in 1936. Once anyone has had a colour receiver in their own home for a while they will never be entirely satisfied with ordinary black-and-white pictures again. They will always miss the realism of colour.

Having said this, what is so special about colour TV? First of all it is something new and strikingly different, with an impact all its own. It is not the sort of thing that you can easily take for granted in your own home. But it has a far more fundamental and long-lasting quality than this. Television has made us accustomed to having moving pictures always available, bringing the outside world to our doorstep. So far these pictures have been presented in various shades of black and white and we have had to make our own uncertain interpretation of what they represent, and gloss over some of the things that we are unable to imagine clearly for ourselves. They have been silhouettes of the real thing.

The introduction of colour alters all this. It adds a whole new range of information previously denied to us, and gives us a picture that is truly complete. For the first time we shall be able to lean back in our armchairs and see people, places, and things just as they really are. The majesty of the Alps, the stark poverty of a native village, the pomp of pageantry, or the fascination of nature seen through a microscope can all be brought home to us far more intimately than has ever been possible before.

It is an exciting prospect, and the BBC has a very real responsibility to make sure that the potentialities of colour are fully exploited in all types of programmes, and not frittered away in colour for colour's sake.



Decca 25in. hybrid colour receiver using transistors in the tuner, i.f. circuits and other low power stages.

DON'T BELIEVE THE KNOCKERS

Human nature is a funny thing. If you show something new to a group of people there will always be a few who will knock it as hard as they can, whatever its merits. Show them a good TV programme in colour and they will determinedly see no good in it. When pressed they will reluctantly admit that it might be all right for a Coronation or an outside broadcast, but that is about all.

This actually happened with every member of a group of people invited to see a demonstration on a social occasion. It is difficult to understand this kind of attitude because at best the colour quality can be very good indeed, and the entertainment value excellent.

One evening at the 1962 Earls Court Radio Show the engineers in the colour Television Avenue were feeling very tired. They had been on duty since 9 o'clock in the morning, and the exhibition hall was at last nearly empty. They had spent the whole day in a hot dark tunnel sweltering in an August heat wave, answering innumerable questions, and watching a series of short colour films repeated every two hours day after day. The time was 9.30 p.m.

Just as they were preparing to switch off and go home the BBC unexpectedly started showing a new film. The engineers put down their brief cases and for half an hour stood there enthralled and watched a film about the building of the Kariba Dam. Surely this testimonial speaks for itself.

Those of us in the industry are accustomed to seeing various films put on at odd hours of the day as part of the trade test transmissions. After you have seen a black-and-white film a couple of times you lose interest, and you are hardly aware of what is going on. And yet if the same film is put on in colour you cannot help stopping to watch it, and the fascination lingers even when you have seen the same film several times. Most engineers feel the same way, and the reason seems to be this all-important quality of realism.

HOW GOOD IS THE COLOUR?

Colours and colour quality are very elusive things and when we try to describe them subjectively we tend to flounder in a sea of vague generalities. Probably the best way to describe the present state of the colour TV art is to compare it with film quality. A well-designed and properly set-up commercial receiver should be capable of displaying studio broadcasts more accurately than the best films. The actual quality seen in the home will of course depend somewhat upon signal strength, the aerial installation, and how the viewer handles the controls.

A good professional video tape recording introduces a barely perceptible degradation of the picture, and providing care is taken by the broadcasters we should not suffer unduly from the widespread practice of recording programmes in advance.

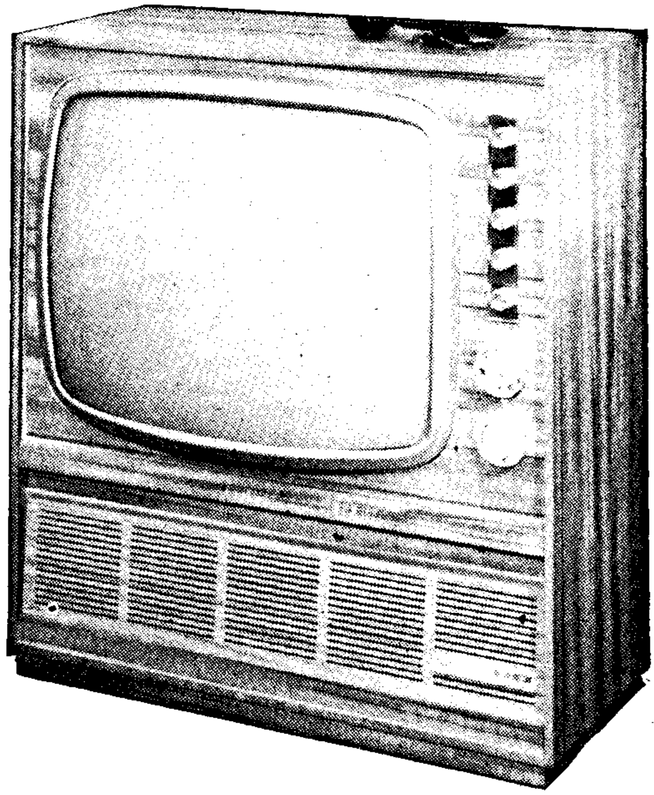
In the case of poor quality colour films we shall actually be better off in our own homes than going to see them at the local cinema. Each reel of film is inevitably processed under slightly different conditions, and so the colour characteristics vary. The BBC have devised a new technique whereby the colour distortions can be analysed at a rehearsal, and the appropriate corrections programmed into a "black box" and applied to the signal. The transmitted signal then has better colour quality than the original, and the improvement is often impressive.

FRINGE RECEPTION

Rather surprisingly, a picture received in a fringe area is often better when seen in colour. Under bad conditions the picture may be so noisy that it is difficult to see much detail, and even the outlines may be blurred. When colour is added in fairly small amounts—i.e. low saturation—the outlines can be seen much more clearly, and the extra information provided by the colour makes it easier to recognise what is being presented on the screen. Too much colour on the other hand tends to make the noise look worse.

The other side of the quality coin concerns the viewer. We all have our own ideas about how green the grass really is, and these preconceived ideas are often very inaccurate. Consequently if we are not shown the colours that we expect to see it will be the TV that gets the blame. The customer is always right! And yet it is very hard to be right because we seldom have a yardstick by which to judge the picture.

Engineers can make electronic and colorimetric measurements but subjective judgement is often the final arbiter, because the parameters are so critical. The eye can spot colour differences caused by such small changes in c.r.t. drive voltages that they are impossible to measure sufficiently accurately under ordinary laboratory conditions.



Radio Rentals Baird colour receiver. Expected to cost about £285 or 35s. per week to rent.

HOW MUCH?

This is the question that everyone is asking. The best answer that can be given at present is that most models are likely to fall in the £250—£300 range, probably edging over the £300. Now this is undeniably a lot of money, but there are good reasons to justify the cost. Firstly the circuitry of a colour receiver is about three times as complex as in a normal black-and-white receiver, and some of the components have to be made to very high standards of accuracy.

Next comes the c.r.t. A shadow mask tube involves a large number of manufacturing operations and great care in assembly, and its cost represents about one-third of the total receiver cost. By the time you have added a well-styled cabinet to house the 25-inch rectangular c.r.t. it is not difficult to account for most of the price tag.

But then, of course, we still have to add a proportion of the R & D expenses which have been incurred by all the big setmakers over a period of several years of stop-go government broadcasting policy. These must amount to some hundreds of thousands of pounds on average and in one or two cases a lot more. It will take a good many years of successful operation to pay back these sums.

All in all it seems unlikely that the price of colour receivers can be reduced dramatically. Rather we should expect to see a gradual reduction year by year as production expands, the market grows and engineering techniques improve.

HOW BIG?

Most receivers coming on to the market during the first year or so of the colour service will use 25-inch 90 deg. deflection c.r.t.'s and so the cabinet will be larger than current 23-inch black-and-white models. The pictures will be bigger too. However, the difference in cabinet size should not present any problem in the average home, and in any case most models will be fitted with stands so there will not be any table problems.

WHAT SYSTEM?

For many years arguments have continued about the relative merits of having Never Twice the Same Colour, or a System Essentially Contrary to the American Method. These have now been resolved with Peace at Last—and about time too!

It is a good system, and (on balance) a wise choice. Whatever happens to the fortunes of colour broadcasting in this country it will not be the system that lets us down but the use we make of it.

It is, of course, a COMPATIBLE system. This means that colour programmes can be displayed in colour on a colour receiver, or in black and white on a black-and-white receiver. Black-and-white programmes can be received on either type.

INSTALLING A RECEIVER

If we are to achieve good colour pictures certain basic requirements must be met. We need good transmissions received on a proper aerial installation: a well-designed receiver: and a receiver which has been properly adjusted.

In essence, a colour signal is just the same as a 625-line black-and-white one except that some extra information has been modulated on to the upper end of the video pass band. Consequently it can be received on the same kind of aerial, but anyone wishing to get the best pictures would be well advised to make sure that his aerial installation is a good one. The extra cost is not high, and it is money well spent.

Incidentally, exactly the same argument applies to ordinary black-and-white transmissions, but unfortunately many people use simple aerials where reception conditions are not good, and picture quality suffers.

With regard to transmission quality we are in the happy position of knowing that the BBC are probably the best broadcasters in the world, and we can depend upon the signals being of a high standard. They have already done a great deal of work in preparation for launching a colour service. The setmakers, too, have been busy over the years and the first models should be a lot better than those produced in the early stages of the American colour service.

SETTING UP

Now we come to the process of setting-up a receiver. However well it has been designed the resulting picture can be spoilt if the receiver has been carelessly installed. Much more so than with a black-and-white one. Conversely a little extra time spent in adjusting the preset controls is well repaid with better pictures.

Four things have to be done. First, a good black-and-white picture must be set-up in terms of scan, linearity, centring, and focus. Then the PURITY has to be checked to ensure that the colour of a blank raster is completely even over the whole screen area with no patches of spurious colour.

The next step is to adjust the three electron beams from the red, green and blue guns of the c.r.t. to get them properly CONVERGED so that only a single image can be seen. Lastly, the colour of a black-and-white picture is adjusted so that a pure white is obtained in the highlights, and a neutral grey in the half tones and darker areas. This process gives a correct GREY SCALE.

When this procedure has been carried out by the service engineer the receiver is ready for normal operation. The viewer only has to tune in a normal black-and-white picture and set the brightness and contrast before turning up the required amount of colour on the saturation control.

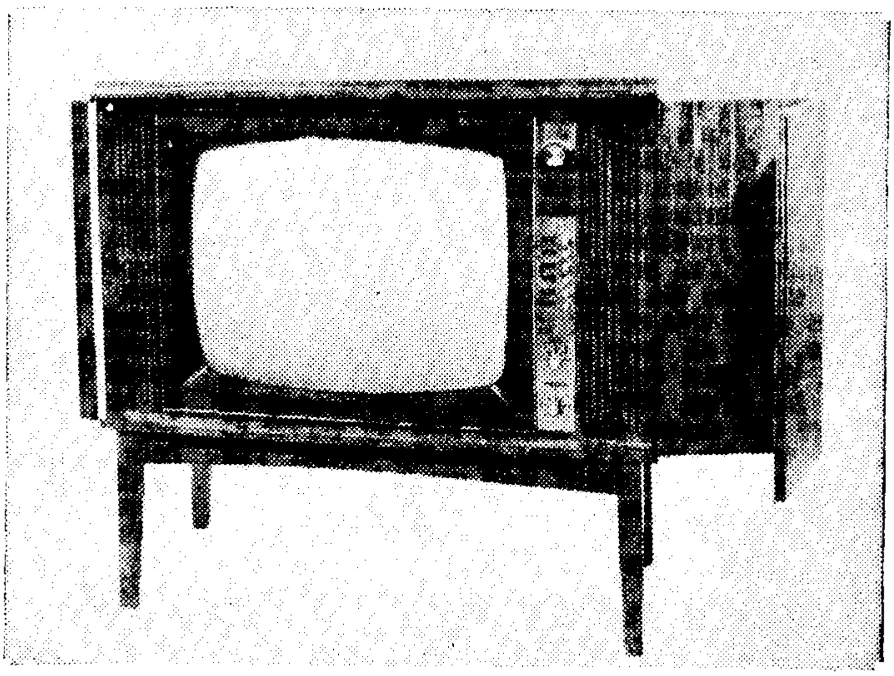
The service adjustments are not unduly difficult but they need a certain amount of practice and conscientious care on the part of the service engineer. Given this, a good picture can be had by all.

SERVICING

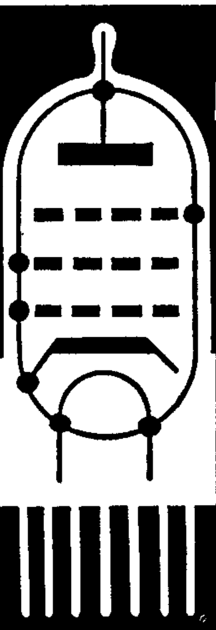
The circuitry of a colour receiver can be divided up into two categories: the parts common to black-and-white working on the one hand, and the new circuits peculiar to colour on the other.

The i.f. and timebase circuits will present little difficulty to service engineers because the techniques differ only in detail and not in principle

—continued on page 424



The first UK production set, claimed Bush when this model appeared. With Paldao cabinet and foldaway doors it retails at 310 gns.



valves AND THEIR HABITS

by H. PETERS

SINCE the list of valves and semiconductors under the above heading was published in the August and September 1965 issues of PRACTICAL TELEVISION a number of readers have written in to ask if the article can be brought up to date. The answer is "Not really", since the development of new valves for television particularly, has been rather slow. It would be true to say that during this period "valves and their habits" haven't changed much but circumstances have.

Semiconductors are establishing themselves in stages before the detector and with colour on the way a few interesting types have arrived on the scene. The "Habits" part of the feature will of course not be as great as hitherto, simply because most of the items mentioned are not old enough to have developed any habits, good or bad.

Transistor Nomenclature

Most of us are familiar with the European classification of valve types. PCF80 for example can be broken down into "P", 0·3A heater circuit; "C", triode; "F", amplifying pentode; "80", development number.

For some time, transistors followed suit and an OC44 meant "O" no heater volts; "C" triode; "44" development number, but this was clearly going to be an unsuitable method. Everything would be an "OC" something or the other. Accordingly an alternative system of numbering is used (although the OC44 still remains an OC44). This will be useful to remember. For entertainment transistors and diodes it comprises two letters and a number:

First Letter.

This indicates the material used, thus:

A—Germanium. B—Silicon. R—Photoconductive material.

Second Letter.

Indicates its general construction or use.

A—Diode (other than rectifiers). C—Audio amplifier. D—Audio power device. F—R.F. amplifier. P—Light sensitive. Y—Rectifier diode.

Then follow three figures according to the development number, i.e., AF117 is a germanium r.f. amplifier development number 117. Industrial types have a letter and two figures in place of the three-figure reference. You cannot tell by looking at the nomenclature if the device is p-n-p or n-p-n.

Before listing the types you may come across, a cautious word about replacement. Many of you have probably built small transistor radios from kits or from *Practical Wireless* designs, and have discovered that (although a heat shunt is always recommended in practice) when it comes to soldering them in, one can usually "get away with murder" as it were. This is not the case with transistors in the signal frequency stages of a TV. They are by nature more temperamental and must be heat shunted even if only by long-nosed pliers when they are soldered in. In any case the leads are invariably cut much shorter than is the case for medium-wave work and their position is critical. Most service manuals in fact say "Don't touch, send the whole unit back", and as the majority of them are still under guarantee this is the wisest thing to do. The writer has, however, discovered several "dry joints" on transistors inside one type of integrated tuner, and has managed to re-solder them without difficulty or apparent ill-effect.

Germanium R.F. Transistors (P-N-P)

AF178.

Mixer/oscillator up to 260 Mc/s. Universally used as the mixer in Pye, Sobell and Murphy v.h.f. tuners.

AF179.

Large signal i.f. amplifier. To be found in the final vision i.f. stages of Murphy and Sobell sets, usually with no a.g.c. applied.

AF180.

R.F. amplifier to 220Mc/s, the universal v.h.f. tuner/r.f. amplifier. If the set develops plenty of "snow" but no signal suspect this transistor, especially after a local storm.

AF181.

Vision i.f. amplifier used in the early stages where forward a.g.c. is normally applied.

AF186*.

U.H.F. amplifier or mixer, the universal choice for u.h.f. tuners where it has even displaced the PC86 and PC88 valves due to its better performance under noisy reception conditions.

AF139*.

Siemens version of the AF186.

* Readers without u.h.f. alignment facilities are advised to think twice before attempting replacement of these two.

Silicon R.F. Transistor (N-P-N)

BF158.

I.F. transistor used in sound i.f. circuits of Pye Group chassis.

BF159.

Large signal i.f. transistor used in final vision and sound stages of Pye Group i.f. strip.

BF164.

I.F. transistor used in vision i.f. circuits of Pye Group chassis.

Silicon Diodes

BY100.

The universal h.t. rectifier designed to give in excess of 300 milliamps from 240V mains with negligible volts drop. Doesn't appear to have any bad "habits" provided surge limiting is incorporated in the feed circuit.

BY114.

Heater rectifier. A BY100 can be used in its place but the converse does not apply since the peak inverse voltage rating is not as good and therefore a reservoir capacitor cannot be connected directly to its cathode (found in Pye Group sets).

BY118.

Efficiency diode. Silicon diode capable of withstanding high peak voltages. A "dark horse" at the time of writing.

Colour TV Valves

These are giants, bringing us almost back to the days of EL38 etc.

PL505.

Line output pentode. "Daddy of them all", can take 1·4A anode current and has an anode dissipation of 34 watts. Designed for the stringent requirements of colour line output stages where in addition to an impeccable line scan it is expected to provide 25kV e.h.t. for three guns and plenty of spare waveforms for the dynamic convergence circuits. The valve is claimed to be free from effects such as b-k oscillation and spurious line displacement.

PY500.

Boost diode, companion for the PL505, and rated at 800mA, needed for the higher boost line found in circuits associated with the shadowmask tube.

PD500.

A shunt stabiliser triode working at 25kV to ensure constant e.h.t. regardless of wide variations of beam current.

GY501.

E.H.T. rectifier capable of delivering 1·7mA at 25kV from line flyback stages.

PL508.

Frame output valve. Designed to complement the PL505. This stage also provides power into the dynamic convergence circuits from the output transformer secondary and from the cathode resistor.

PL802.

Video amplifier with the incredible mutual conductance of 40mA/V.

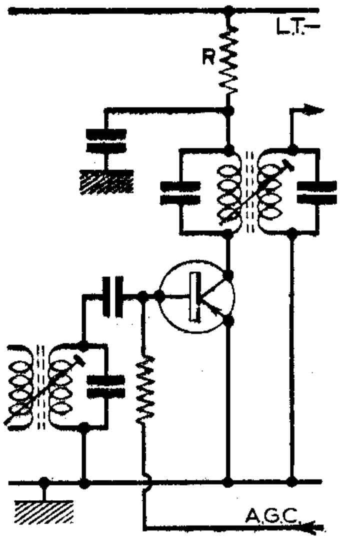


Fig. 1: Forward a.g.c. used in TV i.f. stages to give better control (p-n-p transistor). A strong signal produces more negative volts. on the a.g.c. line causing the transistor to pass more collector current thus lowering its collector voltage and gain due to increased voltage developed across resistor R in series with the collector.

Latest Habits

DY86 DY87.

These 1·5V e.h.t. rectifiers have in a few instances given short life needing continual replacement. This is usually due to incorrect heater voltage, which can easily be assessed in operation by the brightness of the heater in comparison with other valves and with the brightness of the same heater run from a 1·5 volt dry cell. The trouble usually is not the fault of the valve, but due to the e.h.t. transformer filament winding delivering slightly more heater-voltage than needed. It is a difficult thing to provide accurately the correct heater voltage and normally a small resistor is mounted in the base of the e.ht. rectifier valveholder to compensate. If you have this trouble make sure that this resistor is not shorting out, and if all else fails use a U26 (2-volt heater) in place of the DY87.

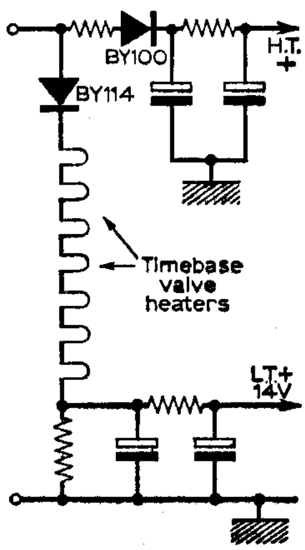


Fig. 2: Using the BY114 as heater ballast. A hybrid set only has approximately half the conventional number of valves. The BY114 acting as a ballast resistor conducts on positive half cycles only, thus restricting the series heater current to 0·3A. The 14V supply is provided for the collector rail of n-p-n silicon transistors (Pye)

—continued on page 397

PICTURE TUBE

HOW 22 MULLARD TUBES PROVIDE 118 SPARES

REPLACEMENTS

At present, so many different picture tubes are used in the television receivers in this country that few television dealers or service departments can keep a spare tube for each type. Fortunately, such a large store of tubes is not necessary because a small number of Mullard tubes can provide a replacement for most of them. From a stock of only 22 Mullard tubes, the dealer can select a replacement for any one of 118 different tubes. In many cases, the replacement is a direct equivalent; in others only a minor circuit modification is needed.

Mullard picture tubes are numbered under two systems, the old system and the present system which was adopted in 1962. In the old system of numbering, each type number consisted of two letters followed by two numbers separated by a hyphen. The first letter indicated whether the tube used magnetic focusing (letter M) or electrostatic focusing (letter A). The second letter indicated the type of phosphor, and was W for *white*. The first number gave the diameter of the tube face across a diagonal in centimetres; the second number was a serial number. Hence, picture tube type AW47-91 was a 19in. (47cm.) tube that used electrostatic focusing and produced a white picture.

Although the present system of numbering picture tubes is similar to the earlier system, there are important differences. For example, the first letter A now distinguishes a domestic television picture tube, regardless of whether it is focused magnetically or electrostically, from a direct-viewing industrial television tube, which has the letter M.

The type number now consists of a single letter followed by two numbers separated by a hyphen followed by another letter, for example, A47-11W and A59-11W. Apart from the first letter, A or M, the rest of the type number has the same significance as in the old system, the final letter denoting the type of phosphor.

Some of the tubes with old style type numbers now have the letter Z added to the type number. The letter Z indicates that the tube now uses a "straight" gun and does not require an ion-trap magnet. A tube with a straight gun is slightly shorter than a tube with a "bent" gun; in all other respects the "Z" tube is identical with a tube having the same type number without the Z.

REMOVAL OF THE ION TRAP

One of the simplest modifications that might be necessary when fitting a Mullard tube is the removal of the ion-trap magnet and any lead connected to it.

Many picture tubes are made with guns that aim the electrons off the screen; these guns are said to be "bent". A magnet around the neck of the tube directs the electrons on to the screen, but does not divert the ions. The heavy ions, therefore, cannot reach the screen and cause discolouring.

Mullard, however, make tubes in which the screen is covered by a thin layer of aluminium. This increases the brightness of the picture and, by protecting the screen from the ions, makes possible the use of straight guns.

Straight-gun tubes obviously do not need ion-traps; therefore, when a Mullard straight-gun tube replaces another type, the ion-trap magnet and any lead connected to it must be removed. Conversely, when a straight-gun tube is replaced by a bent-gun tube, an ion-trap magnet must be fitted: the magnet recommended is Mullard type IT9.

CHANGE OF HEATER REQUIREMENTS

All the Mullard tubes in the chart require a supply of 6·3V at 0·3A for the heaters. Some of the tubes being replaced, however, have 12·6V or 4·0V heaters. Therefore, when a tube with a 12·6V heater is replaced by a Mullard tube, a resistance must be connected in *series* with the heater of the Mullard tube to reduce the voltage to 6·3V; the resistance must be 21Ω and should have a power rating of not less than 2W.

When a tube with a 4·0V heater in a parallel heater circuit is replaced by a Mullard tube, a mains transformer is needed to provide a supply for the heater of the new tube in an a.c. receiver. The original heater supply in the receiver, of course, must be diconnected from the tube. In a series heater circuit, however, a Mullard type can replace a 4·0V heater tube without the need for a modification to the heater supply circuit. The 4·0V heater tubes in the chart use the same heater current, 0·3A, as the Mullard tubes. The result of replacing such a tube by a Mullard tube is merely to produce a negligible change in the voltage across the heaters of the valves.

The heaters of all Mullard picture tubes require a current of 0·3A, but some other tubes require a heater current of 0·6A. This presents no problem in a television receiver that has the tube and valve heaters in parallel. When a Mullard tube replaces a tube with a heater current of 0·6A in a receiver in which the heaters are either in series or in a parallel-series network, a path must be provided for the extra current; if this is not done, either the valve heaters will not receive sufficient power for efficient operation or the tube heater will be overloaded and will be damaged. A shunt path

MULLARD PICTURE TUBE REPLACEMENT CHART

Type to be replaced	*Mullard type*	*Notes*
A47-11W	A47-11W	
A47-13W	A47-13W	
A47-14W	A47-14W	
A47-17W	A47-11W	
A47-18W	A47-11W	13
A59-11W	A59-11W	
A59-12W	A59-11W	
A59-13W	A59-16W	
A59-14W	A59-16W	
A59-15W	A59-15W	
A59-16W	A59-16W	
A65-11W	A65-11W	
AW36-20	AW36-20Z*	1
AW36-21	AW36-20Z	1
AW36-80	AW36-80	
AW43-80	AW43-80Z	1
AW43-88	AW43-88	
AW43-89	AW43-89	
AW47-90	AW47-90	
AW47-91	AW47-91	
AW47-97	AW47-91	2, 8
AW53-80	AW53-80	
AW53-88	AW53-88	
AW53-89	AW53-89	
AW59-90	AW59-90	
AW59-91	AW59-91	
C14/3A	AW36-20Z	1
C14GM	AW36-20Z	2
C14JM	AW36-20Z	1, 4
C14LM	AW36-20Z	5
C14PM	AW36-20Z	1, 5
C17/1A	MW43-69Z	1, 6
C17/4A	MW43-80	
C17/5A	AW43-80Z	1
C17/7A	AW43-88	
C17AA	AW43-88	
C17AF	AW43-89	7
C17FM	MW43-69Z	1, 2, 6
C17HM	MW43-69Z	1, 4, 6

Type to be replaced	*Mullard type*	*Notes*
C17SM	AW43-80Z	
C19/7A	AW47-90	
C19/10A	AW47-91	
C19/10AP	A47-13W	
C19AK	AW47-90	
C21/1A	MW53-80	6
C21/7A	AW53-88	
C21AA	AW53-88	
C21AF	AW53-89	7
C21KM	MW53-80	
C21SM	AW53-80	3, 8
C21TM	MW53-80	2, 6
C23/7A	AW59-90	
C23/10A	AW59-91	
C23AK	AW59-90	
C23AKT	A59-16W	
CME141	AW36-20Z	1, 2
CME1402	AW36-80	2
CME1702	AW43-80Z	2, 9
CME1703	AW43-88	2
CME1705	AW43-89	2
CME1706	AW43-88	
CME1901	AW47-91	2, 8
CME1902	AW47-90	
CME1903	AW47-91	
CME1905	A47-11W	
CME1906	A47-13W	
CME1908	A47-14W	
CME2101	AW53-88	2
CME2104	AW53-89	2
CME2301	AW59-90	2
CME2302	AW59-90	
CME2303	AW59-91	
CME2305	A59-11W	
CME2306	A59-16W	
CME2308	A59-15W	
CME2501	A65-11W	
CRM173	MW43-80Z	1, 2, 6
CRM212	MW53-80	2, 6, 10

Type to be replaced	*Mullard type*	*Notes*
MW43-64	MW43-69Z	1
MW43-69	MW43-69Z	1
MW43-69Z	MW43-69Z	
MW43-80	MW43-80	
MW53-80	MW53-80	
SE14/70	AW36-20Z	1, 5
T908	MW43-69Z	1, 6
T911	MW43-69Z	1, 6
T914	MW43-69Z	1, 6
TR17/7	MW43-69Z	6, 11
TR17/8	MW43-69Z	6
TR17/21	MW43-69Z	1, 6
TR17/22	MW43-69Z	1, 6
TR21/20	MW53/80	6, 11
TR21/21	MW53-80	6
14ABP4	AW36-20Z	1
14ABP4A	AW36-20Z	1
14AH4A	AW36-80	
17ARP4	MW43-69Z	1, 6, 12
17ASP4	MW43-69Z	1, 6, 12
17AXP4	MW43-69Z	1, 6
17BQP4	MW43-69Z	1
17BTP4	AW43-80Z	1
17CVP4	AW43-88	
21CLP4	AW53-80	
21DKP4	AW53-88	
21DKP4A	AW53-88	
23SP4	A59-16W	
171K	MW43-69Z	1, 6, 12
172K	MW43-69Z	1
173K	MW43-69Z	1
212K	MW53-80	
7205A	AW36-80	
7405A	AW43-88	2
7406A	AW43-89	2
7502A	MW53-80	2, 6, 10
7503A	AW53-88	2
7504A	AW53-89	2
7601A	AW47-91	2, 8
7701A	AW59-90	2

Notes on Replacement Tubes

1. Discard ion-trap magnet and any lead connected to it.
2. Original has 12·6V heater. Connect 21Ω, 2W resistor in series with the heater.
3. Fit and adjust ion-trap magnet type IT9.
4. Original has 0·6A heater.
5. Replacement maximum final anode voltage = 14kV.
6. Join pin 7 to pin 11.
7. Original has 4·0V heater.
8. Replacement is 1 inch shorter.
9. Replacement is 1 inch longer.
10. Replacement maximum final anode voltage = 18kV.
11. Earth external conductive coating.
12. CT8 cavity cap connector required.
13. Original has light screen tint (75%).

** Since this chart was first published, Mullard has produced another straight-gun tube, type AW36-20Z. The older tube, AW36-20, is no longer being produced: therefore it must be removed from the appropriate columns in the chart and replaced by tube type AW36-20Z, its replacement. At the same time, the "Notes" columns in the chart must be amended to suit the change to a straight-gun tube as has been done above.*

for the extra current can be made by connecting a resistance of 21Ω, 2W in *parallel* with the heater of the Mullard tube.

FINAL ANODE VOLTAGE

In four cases in the table, it is suggested that Mullard tubes type AW36-20 and AW53-80 replace tubes that have a higher permissible final anode voltage. This does not necessarily mean that the final anode voltage supply is too high for the Mullard tubes because the tubes are frequently operated in television receivers with final anode voltages below the maximum specified. However, before fitting either of these two Mullard tubes, the final anode supply voltage should be measured by means of a valve voltmeter or electrostatic voltmeter. The permissible maximum final anode voltage is 14kV for the AW36-20, and 16kV for the AW53-80; in the unlikely event of these values being exceeded, Mullard tubes must not be fitted.

EXTRA CONNECTIONS

Although the base connections of most of the replacement tubes and those being removed are identical, this is not always so. Consequently, extra connections are sometimes needed, the most common being a connection to the focusing anode. When this occurs, it is necessary to connect pin 7, the focusing anode, to pin 11, the cathode, to ensure that the Mullard tube operates correctly.

All modern Mullard tubes have an external conductive coating which must be at earth potential. In two cases in the table, the tubes being replaced have no external conductive coating. Consequently, the receivers containing them have no provision for a connection between chassis and the coating. Therefore, when fitting Mullard tubes in these receivers, a connection must be made between the conductive coating on the tube and the chassis.

All Mullard television tubes have final anode cavity caps on the cone which require connectors type CT8. When the tube being removed uses a different type of lead termination, this should be replaced by a type CT8 connector.

TUBES OF DIFFERENT LENGTH

When one tube is replaced by another of a different length, the layout of the receiver can be very important. Because the new tube has a different length, its coils and connections will not be in the same positions as they were with the tube that has been removed. Consequently clearances between components fixed to the chassis and parts of the tube and components on it might be less than desirable. Hence, when replacing one tube by another that is shorter or longer, the service engineer must ensure that there is no likelihood of arcing or insulation breakdown between components on the tube and components on the chassis; if necessary, thin sheets of insulation should be fixed between points of high potential difference.

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VALVES AND THEIR HABITS

—continued from page 394

EF183 EF184.

The two frame grid i.f. valves giving fantastic gain. The former is vari-μ, the latter straight. Sometimes, as the constants of tuned circuits change with age, instability may result. This may only occur during weak signals, dark scenes, or the frame blanking period, and the symptoms usually point to a faulty sync separator stage. A quick way to check this classical "red herring" is to transpose the EF183 and EF184. The mismatch will dampen the gain of the stages and usually restore stability.

PCF80.

An old friend, but now almost extinct as a local oscillator/mixer this valve turns up in sync stages, and in the last "all valve" Pye Group chassis provides large signal i.f. amplification in sound and vision, using the pentode sections. The triodes respectively find themselves in the frame oscillator and a.g.c. circuits, so if you have frame drift or raster but no signal on one of this range, "*cherchez la* PCF80".

PCL82 PCL84.

In the previous article of this series these two valves were given as plug-in emergency replacements for each other. This is not the case as their basings are quite different. (A PL82 and a PL84 can, however, be interchanged.)

In this respect none of the valves PCL82, PCL83, PCL84, PCL85 and PCL86 are plug-in interchangeable. The PCL82 has the same base as the PCL88/30PL14 and the PCL800/30PL13. The writer finds that the PCL82 is more reliable and less expensive in a number of frame output stages, particularly where the valve is operated on its side.

PL36 30P19 PL302.

On most modern receivers these three valves are fully interchangeable, the latter two giving longer life in stages with high e.h.t. The PL36 has an internal connection to pin 1, whereas the other two have not. Some early receivers using 30P4/30P19 as the line output valve frequently had pin 1 of the valve-holder utilised as an anchor point for other components. Check this before fitting a PL36 or you may get a burn-up.

PY81 PY83 PY800 PY801 U193 (PY88).

All these efficiency diodes have the same basing, and with the exception of the PY88, roughly the same heater requirements. If your spares kit is small, carry the PY801 as a direct replacement for all the others. The PY88 is the "toughest" valve in the range but its heater requires 30 volts at 300mA, almost double the voltage of the remainder, which will involve some adjustment to the ballast resistor or mains voltage selector if fitted. □

RAPID FAULT Diagnosis

G.R. Wilding

Part 1 — Time-base and supply circuits

RAPID fault diagnosis is based on three main principles: observation of all symptoms, assessment of fault probabilities, and the use of quick and simple tests to check valves, components or complete stages. Observation should, of course, include signs of valve or component stress, since in many instances visual indication can save much meter work. Points to particularly watch for are:

(1) Discoloured or unduly hot carbon resistors. Wire-wound types normally dissipate considerable wattage, and it is extremely difficult to tell when they are being over-run. However, if carbon resistors show any sign of stress it can be taken as certain that the sub-circuit or valve they feed is defective or that the resistor has reduced in value and is itself causing the current increase. Often a valve passing excessive current over-heats a feed resistor and causes both to fail. Carbon resistors having a negative temperature co-efficient reduce in value when over-run, and can produce problems with only small changes in value.

(2) Electrolytics with swollen ends or any suggestion of dried chemical deposit around the soldering tags are suspect. So are cathode decoupling capacitors, mounted near power valves or close to the dropper resistor, whose outer covering seems brittle or warped with heat. Whatever the fault in the receiver, it always pays to replace these.

(3) Valves with "milky" interior appearance, indicating a cracked envelope, and valves running excessively hot (particularly if the anodes have a bronzed or discoloured appearance, indicating the possibility of internal leaks or intermittent short circuits) should be changed. Since the temperature of valves is often a guide to their serviceability and operating conditions, it may be taken as a fairly safe rule that, possibly excepting line output pentodes, if a valve is too hot to be firmly gripped for removal, it is being over-run or is defective. Often the former condition precipitates the latter, and always on replacing a valve that has passed excessive current for any length of time, check cathode and h.t. feed resistors for any change that could cause impaired results or shorten the life of the replacement valve. Remember that negative grid drive, line output pentodes are completely unbiased and without any defect in valve or circuitry will pass many times their normal current resulting in a glowing anode and "cooking" screen feed resistor. So, if a pentode is running excessively hot and the G2 suppressor grid is glowing it is certain that the anode is without h.t.—suggesting an o/c output transformer primary for audio and field valves and most usually an internal disconnection in the boost rectifier or an o/c choke in the line output stage. A cool power pentode indicates lack of screen voltage.

When servicing a receiver with no e.h.t. and a

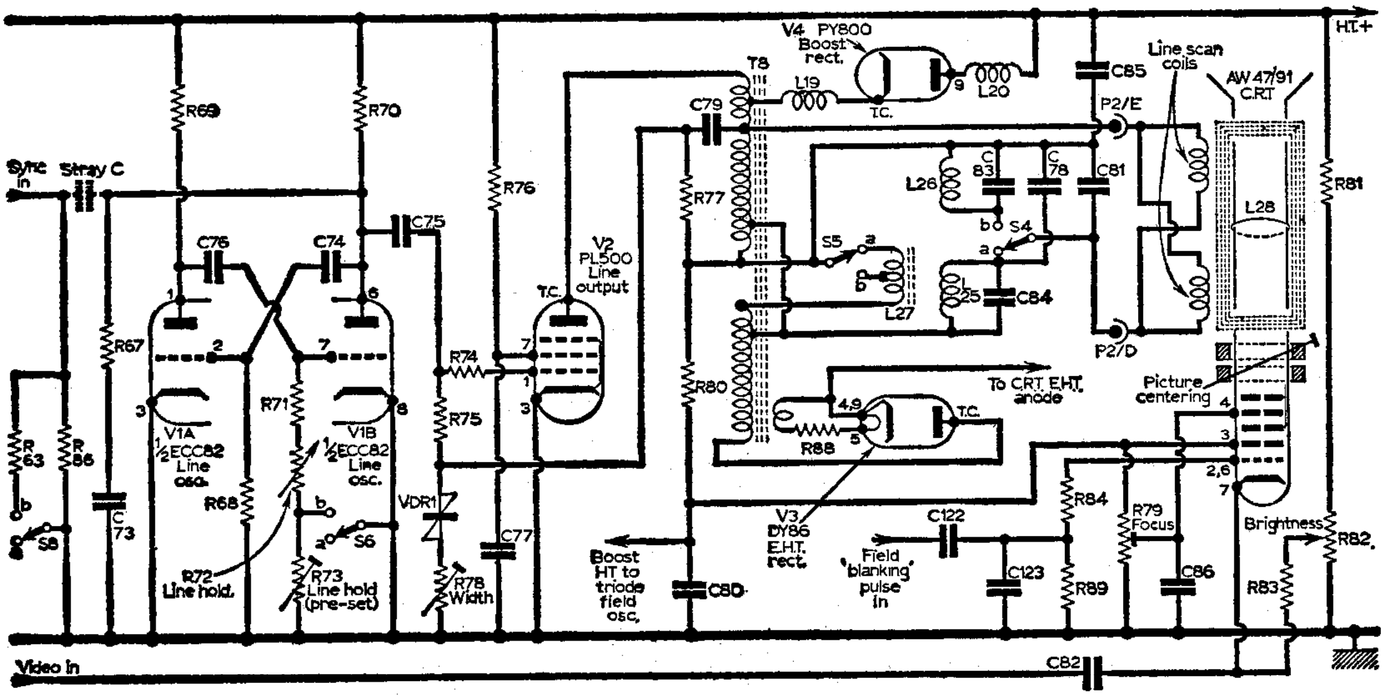


Fig. 1: Typical line time-base and picture tube circuitry.

spark test has shown there is nothing at either e.h.t. rectifier anode or line output pentode anode, observation of the latter valve will indicate where the fault lies—visibly glowing anode, no grid drive, visibly glowing G2, no anode voltage, running cool, no G2 voltage, and so on. With no G2 voltage it is a safe assumption that the screen feed resistor (usually wire-wound) is o/c. Momentarily shorting it will instigate valve output, if no other fault exists.

If line output is adequate or nearly so when first switched on, but decreases within minutes as valve temperature increases, it is almost certain that the screen feed resistor is of carbon type and has markedly decreased in value and over-running the valve. Again, visual inspection will show whether the resistor has changed in value, for if the coding rings are discoloured the resistor is sure to have changed in value. Where doubt exists, apply light pressure to the resistor and if it has been over-run, it will crumble. Thus, observation can indicate the prime cause of reduced or zero output in line output stages.

Where line drive is present, as indicated by substantial negative voltage on the grid, and lack of stress by the valve, failure of the line output stage to develop significant e.h.t. is often due to a short-circuited boost reservoir capacitor. The quickest and most positive check is to remove the boost rectifier top cap and check if the e.h.t. reappears. If it does, it is certain that this boost reservoir capacitor is short-circuited, for unless this is so, removal of the rectifier top cap will also remove e.h.t. from the line output pentode anode.

LINE FAULT PROBABILITIES

Insufficient width may be caused by one or more of the following:

(a) Low emission LOP, boost rectifier or triode generators. If due to left-hand cramping rather than overall lack of width, o/c boost reservoir capacitor or very low emission boost rectifier.

(b) Low h.t. rail voltage either due to a substandard rectifier, or if accompanied with high hum level, a faulty reservoir capacitor.

(c) Insufficient or excessive G2 voltage.

(d) Dry jointed or disconnected output transformer "harmonic tuning" capacitors.

(e) Faulty line output transformer.

(f) Faulty width or linearity coils. (Short-circuited turns in the scan coils would be apparent by "keystoning" or trapezoidal raster distortion.)

Insufficient h.t. voltage (b) commonly occurs with older receivers employing PY33 thermionic rectifiers and all types of finned or contact cooled metal rectifiers. When replacing the older types with more recent components like the BY100, make sure that sufficient value of surge limiting is included in relation to the size of reservoir capacitor, otherwise the rectifier's extremely low forward resistance will cause failure.

No line oscillation: As outlined above, inspection of the LOP usually indicates the basic cause of "no e.h.t." If anode over-heating shows there to be zero grid input, it will be safe to assume that the valve is serviceable, so attention can then be directed to the associated line generator valve. Some receivers use a single triode as line generator, some two triodes in a multi-vibrator arrangement, while others use the output pentode itself in conjunction with a triode as the line generator pair. A heavy strain is imposed on line output pentodes—and boost rectifiers—when passing this heavy no-signal current, so it pays to employ used but workable types if the fault proves at all lengthy to pinpoint. Once valves have been eliminated (remember that e.h.t. rectifiers with internal short-circuits can heavily load a line output stage and prevent oscillation), lack of line oscillation usually proves to be due to dry or o/c connections on printed circuit panels rather than actual component failures.

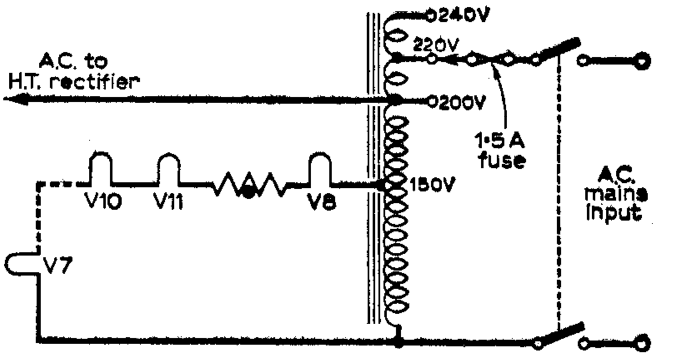


Fig. 2: Auto-transformer power supply circuit used in recent Thorn (Ferguson, HMV, Ultra) receivers.

Incorrect line oscillation: A sudden change in line oscillation frequency is often due to the disconnection or dry jointing of a time-base capacitor, but where it is noticed that adjustment of the line hold control produces negligible effect there is strong possibility of an internal disconnection between the line hold potentiometer track and the riveted end contact. If control adjustment only appears to make any difference after passing a particular spot, it is fairly certain that a complete break exists in the track.

A constant need to re-adjust the line locking position every few minutes first suggests a faulty valve, and usually the line output valve if it is part of the oscillator circuit. A gradual drift of the line locking position to one extreme over a period can imply the gradually changing characteristics of a line generator valve or the slowly changing value of an associated time-base resistor—the first suspects must be any high value, low wattage current carriers. In many receivers, there are additional chassis or panel mounted pre-sets to compensate for slight circuit changes so that the exterior line hold control can be arranged to lock at about the centre of its travel.

FIELD FAULT PROBABILITIES

Insufficient height: Low emission valves and/or reduced capacity cathode by-pass capacitors. Reduced anode voltage to triode field generator are likely causes. To obtain a more linear waveform, the anode supply to the field generator is taken from boost h.t. line instead of the smoothed h.t. rail. Thus, reduced boost voltage, due either to a fault in the line circuit or to an excessive load being applied to the boost circuit can be the cause. Many focus controls take the form of miniature high value "strip" potentiometers connected from boost supply to chassis with the slider feeding the c.r.t. focus electrode. After some years of use it is not unknown for these control tracks, especially when mounted in a heated position, to reduce in value, impose an increased load on the boost supply and thereby reduce height. Reductions in boost voltage often produce more noticeable effects on the field oscillator than on the line output circuit.

In most receivers the boost h.t. rail also feeds the picture tube's A1 and focus electrodes so that a leak from either of these points to chassis (directly or indirectly) can result in low boost voltage, reduce width and e.h.t.. co-incident with lack of height. This again demonstrates the need to observe all symptoms, for if the picture tube is old and presents any evidence of internal leaks (usually inability to obtain complete black-out), the lack of height can well clinch the supposition.

The best and quickest way to check for tube "leaks" is to note if other electrode voltages vary as grid voltage is varied by operating the brilliance control from one extreme to the other. Normally this voltage variation should not produce any voltage changes on the other electrodes. Similarly the removal and replacement of A1 and focus electrode supplies should not produce any significant variations in cathode or grid voltages. When any doubt exists that the inability to reduce grid voltage sufficiently (may be due to leakage from other electrodes), remove the c.r.t. base, short-circuit the heater connections and after switching the receiver on, note if it is possible to reduce grid voltage to zero or to a markedly lower level (according to the circuitry) than previously was possible.

Any significant reduction obtainable is usually an indication of a positive leak from other electrodes.

Non-linear vertical scan: Field output valve, especially if cramping is at base and increases with time. Incorrect bias. Open circuit or reduced capacity cathode decoupling capacitors. Faulty components in negative feedback (linearity) loops. If with reduced amplitude, insufficient field oscillator anode voltage may be the cause.

SUPPLIES

Open circuit heater chains: Only in a minority of cases is such a fault caused by an o/c valve heater. Much more common is a broken mains lead (where it enters the plug), an o/c fuse, mains switch, or section of the dropper resistor. Thus tests should first be applied to these, after noting if the receiver on/off switch seems to have lost its normal "positive" snap action. The quickest drill with an o/c heater chain—excluding the recent Thorn auto-transformer chassis—is to ohms-test alternately from each side of the mains lead to chassis to discover the earthed lead. If there is no electrical connection from either mains lead to chassis, then there is a break in that lead or in the neutral pole of the switch. Assuming that there is "short-circuit" continuity from one lead to receiver chassis, an ohms-test from the other lead to the live (high voltage) end of the mains dropper will check the other mains lead, fuse and "live" switch pole. If there is no continuity, as is usually the case, the precise fault can readily be determined but again assuming continuity, ohms-test along the dropper, then to the thermister, and then to the first valve in the heater chain.

If against all the odds, a valve is at fault, it will almost certainly be of the high voltage heater variety, i.e. line output pentode, boost rectifier, or a triode-pentode situated high in the heater chain. Mullard (European) valves with 6·3V heaters have the prefix E, i.e. EF80, ECL80, EF183, etc. Valves with high voltage 0·3A heaters have the prefix P, i.e. PCL82, PCL83, PL36, etc. Mazda 6·3V heaters have 6 as the first numeral indication i.e. 6F18, 6F25, 6PLI2, etc. High voltage 0·3A heater valves have 30 as the first indication, i.e. 30P12, 30L17, and 30P4, etc.

Where a PY33 valve rectifier is used, by ohms-testing from the "live" mains lead to the rectifier heater, all the main suspects can be tested in one go. Intermittent heater chains are usually due to a defective valveholder, incorrectly seated valve or a dry joint on the dropper resistor—very common when the soldered connections are on top rather than below the component. Defective valveholders are best located by connecting an ohmmeter across the mains lead and manipulating each valve in its holder until continuity appears. When faced with an o/c heater chain in the Thorn auto-transformer receivers, if h.t. is present (clearing the mains lead, fuse and on/off switch) check those valves with high heater voltages or split the chain in two halves by removing any valve at about the centre of the chain and continuity check from the vacant valveholder to chassis, and thus halve the number of valves to check, as the lower half of the chain terminates at chassis and the other half terminates via a thermister and a section of the auto-transformer winding.

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

CONDITIONS

AT last things have been a little better (during the period March/April 1967) and it seems that Sporadic E activity is beginning to build up again after the past three months of almost complete inactivity.

This is, of course, *not* before time and from experience of previous years we should, within the next three or four weeks, be getting the eagerly awaited (and often spectacular) openings that normally arrive during May each year. So by the time you read these words, Sporadic E should once again be delighting us all.

The Tropospheric signals have had their moments as well, the best being as follows:

25/3/67: F2 Caen, excellent; Ch. 25 Caen, very good; Ch. 21 Lille, good.

4/4/67: F2 Caen, excellent; Ch. 25 Caen, excellent; F8 Brest, good; F8a Lille, good; Ch. 21 Lille, good; Ch. 21 Brest, fairly good.

Via S.P.E.:

28/3/67: R1 USSR, E2a Austria, E2 W. Germany, R2 USSR.

10/4/67: R1 USSR, E2 Sweden, E3 Spain.

12/4/67: R1 USSR, E2a Austria.

14/4/67: R1 Czechoslovakia, E2a Austria.

Note that, in spite of what I said recently, the activity during this period seems to have been on the l.f. end of Band I, not the h.f. as previously—just another example of the erratic nature of S.P.E. propagation.

NEWS

Cpl. D. Maden of Cyprus reports that after a recent break, Lebanon Maasa-El-Chouf E4 is back on the air again; on reduced power it seems, still it is with us once again.

Another "mystery" from him too, Marconi Resolution Chart No. 1, (like Data Panel No. 18 J.R.T.) but with the letters "TEST" and "O 1" below it, on the right-hand side of the centre circle, received by him on 9/1/67 at 15.25 on Ch. E3, with Aerial to N. or N.W. of Cyprus. I would hazard a guess that this just might be E. Germany via Helpterberg, with a new test card for 1967. Did any other DXers see this one?

Just for the record (and the best of luck to you all!), Mauritius Forest Side E4, 5kW is using test card "C". I do not fancy our chances much, however!

From E. Baker of Blyth, more details of "Exotics" Rhodesia E3 3kW is horizontal polarisation (previously unknown). He also includes a very comprehensive list of W. German u.h.f. transmitters, and we will deal with these very shortly.

He, too, has a "mystery" test card to report, reception on 3/4/67 at 08.30 BST on Ch. E3, with aerial to South. The card has a narrow-grid type background, and superimposed on this is a diagonal white cross with a small centre circle at the point of intersection containing a "bandwidth" grid, and the legs of the cross also contain shade gradation inserts. There may be some lettering at the bottom of the card, possibly "625 lines". This could of course be another of the African "exotics"; did anyone else see this one too?

F2 AND SUN SPOT MAXIMUM

Things are beginning to wake up here too. R. Bunney of Romsey, has been active again after his report of Orlando, Florida, USA and he now reports the following frequencies as being used by "Paging" stations in the USA.

35·22Mc/s, 35·58Mc/s, 43·22Mc/s, 43·58Mc/s, and a nation-wide police network on 42·00 to 42·10Mc/s.

He himself had one in Oklahoma City over Easter, so their reception is now possible here if one can "ferret" them out. There is also an interesting report of the reception of the sound channel of BBC London Ch. B1 41·50Mc/s in New York in January this year.

Of course, all these channels are l.f. of the lowest USA channel A2 (vision 55·25Mc/s), but it certainly looks as if we are moving in the right direction, and it may well be only a question of time before the A2 channel is receivable here.

He also reports that there was an "unprecedented" increase of sunspot activity for a short period around 27/2/67, when a count of 186 sunspots was recorded, and allowing for the 27-hour lapse before this would affect the ionosphere this brings us to 28/2/67, and could account for the (? F2) reception of Nigeria recently reported.

With all this in mind, we are now going to list the higher power Band I Canadian TV stations for future reference:

CANADA ENGLISH NETWORK

CBHT. Halifax, N.S. Ch. A3. 56kW.
CBUT. Vancouver, B.C. Ch. A2. 47·6kW.
CKCW. Moncton, N.B. Ch. A2. 25kW.
CKVR. Barrie, Ont. Ch. A3. 100kW.
CJIC. Sault Ste Marie. Ch. A2. 28kW.
CKPR. Port Arthur, Ont. Ch. A2 55·4kW.
CKCK. Regina, Sask. Ch. A2. 100kW.
CHCT. Calgary, Alt. Ch. A2. 100kW.
CKSA. Lloydminster. Alt. Ch. A2. 116kW.
CHBC. Kelowna, B.C. Ch.. A2. 3·7kW.

—continued on page 423

Philips enter colour receiver market with four 25-in models

RELIABILITY and simplicity of operation are the key features of the Philips range of colour television receivers, which will soon be finding their way into your local dealer's showrooms. There are four models (with suggested retail prices from 295 to 325 gns.) all four using a 25-inch Mullard shadow-mask tube, which can be viewed under fairly high ambient light conditions.

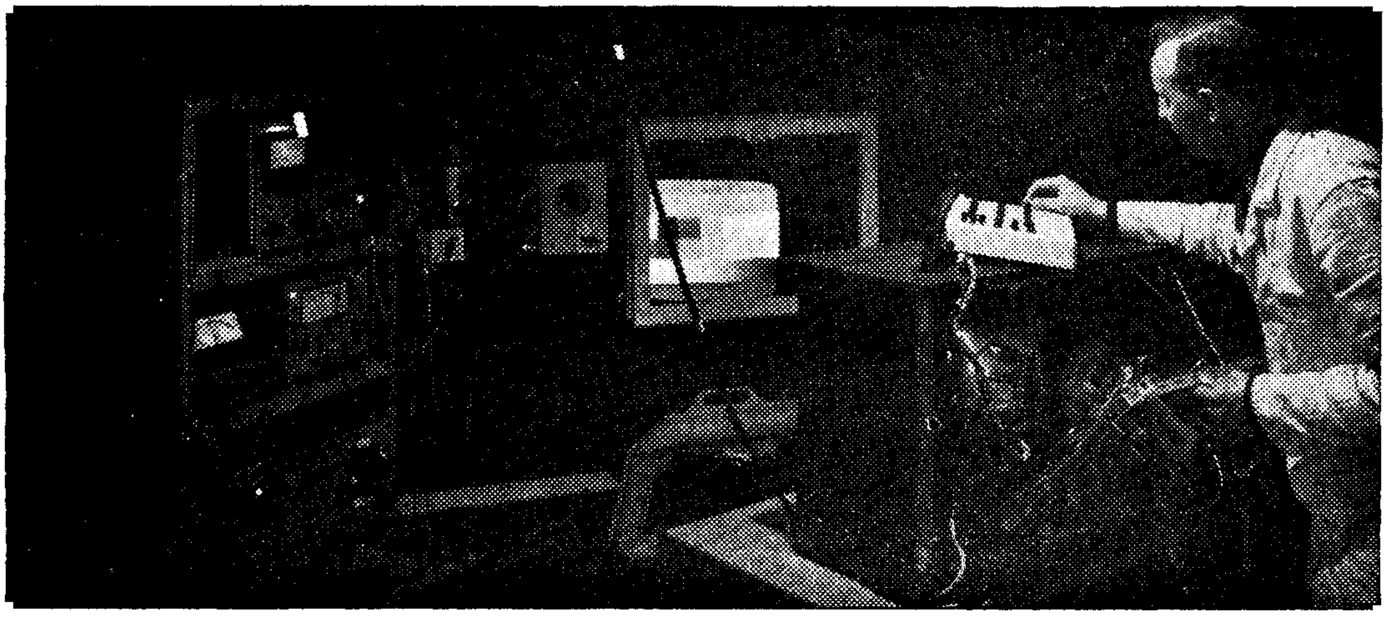
Philips, who have six previous designs under their belts—over a period of fifteen years—use one basic chassis for all four receivers, three of which will be marketed under their own name (the other will carry the Stella brand). All the receivers are being made at the company's Croydon factory.

Employing the latest fully integrated tuners, the colour receivers are capable of receiving all present and future BBC and ITA programmes in colour or black and white. The push-button programme selector can be pre-set to six different stations by the dealer on installation. Fine tuning is provided in the normal way, but to assist the user a tuning indicator is provided. This is but one of the refinements of these sophisticated and costly receivers. Even a colour suppressor button is provided. This button, the manufacturers claim, simplifies the adjustment of contrast and brightness and "enables the superiority of colour over black and white to be demonstrated on the same picture". Another Philips press statement suggests that "some colour viewers may be calling it a status button"!

A built-in feature of the Philips colour receiver is an auto-white relay. This has been included to ensure maximum quality on black and white, and on colour. Apparently, to achieve a good white on a black-and-white receiver, the whites have a blue tinge. This of course is not acceptable on a colour picture.

The sound circuits have been improved in quality, and quantity—having almost double that of a conventional black-and-white receiver. A tone control is one of the new buttons on the front panel. There is only one extra control for colour. This enables the viewer to adjust the depth of colour to his or her tastes.

Two of the four models are full console receivers with full length tambour doors to conceal the screen and control panel when not in use. The other two models are floor-standing consolettes with matching legs.



TECHNICAL NOTES

The receivers are designed for reception of the PAL de luxe system; utilising a glass delay line to give optimum quality of picture reproduction. Twenty-one valves, 17 transistors and 44 other semiconductor devices are used. Most of the transistors are silicon types and are used in the low-level signal circuits, such as the tuner, chrominance and i.f. circuits, for optimum performance in fringe areas.

The main chassis is mounted vertically at the rear of the cabinet and can be either hinged backwards or removed completely for servicing. All the components that are not attached to the main chassis are connected by plug and socket interconnections. All the convergence controls, together with the three grid controls and switches, are mounted on a separate panel in the receiver. This panel is easily removed and can be placed on top of the receiver cabinet (G25K500) to enable the serviceman to converge the picture whilst viewing the picture directly.

Answering questions at a London press conference, Philips suggested that the life of colour sets would be about the same as black-and-white sets—10 years or thereabouts. As to servicing, the company have a team of mobile service engineers and are providing training courses for their dealers, so it should not be a problem. The crunch would seem to come, should a picture tube go down. Philips would not commit themselves to an exact price for a replacement picture tube, but thought it would be around £80. When asked about guarantees, the press were told that nothing has been decided at this stage.

Both the photographs were taken at the Company's Croydon works, where all the colour receivers for the British market are being made. As can be seen, the designers of these sets have had the serviceman in mind, for everything is easy to get at. Plugs and sockets are used to interconnect components that are not fitted to the main chassis.

It is now only a matter of weeks before colour gets under way in this country. Incidentally, Britain will be the first country in Europe to have a regular colour service.

COLOUR RECEIVER SPECIFICATION

Channels:

Channels 1 to 3—Band IA
Channels 3 to 5—Band I
Channels 6 to 13—Band III
Channels 21 to 68—Bands IV and V
} To either 405 or 625 line standard

Valves and Semiconductors:

Valves	*Function*
PFL200	Luminance output and sync separator
EF80	Sync amplifier
PCF802	Line reactance and oscillator
ECC81	Field oscillator
PCC85	Field buffer/fly-back suppression
PL508	Field output
PL505	Line output
PY500	Boost diode
PD500	Line shunt stabiliser
GY501	E.H.T. rectifier
EY51	Focus diode
EF183	1st Chroma amp.
EF184	2nd Chroma amp.
PCC85	Chroma a.g.c. colour killer
PCC85	Auto-white c.r.t. protection
PCF200	R-Y amplifier/clamp
PCF200	G-Y amplifier/clamp
PCF200	B-Y amplifier/clamp
EF184	Burst amplifier
PCF802	Reactance/ref. oscillator
PCL86	A.F. amp./output

Transistors	*Function*
BF194	1st sound i.f.
BF194	2nd sound i.f.
BF167	2nd vision i.f.
BF167	3rd vision i.f.
BC108	Luminance phase splitter
BC108	Luminance a.g.c. amp.
BF173	Luminance amplifier
BF173	Chrominance amplifier
AF239	R.F. amplifier
AF139	Mixer
AF139	Oscillator
BC108	A.G.C. invertor
BF195	B-Y preamplifier
BF195	R-Y preamplifier
BF194, BF194	Bi-stable oscillator
BC107	Identification signal amplifier

Tuner:
Fully integrated v.h.f. u.h.f. type with six push button selection

Picture Tube:
A63—11X 25in. Mullard "Colourscreen"

E.H.T.:
25kV stabilised

I.F.:
Vision—v.h.f. 34·65Mc/s; u.h.f. 39·5Mc/s
Sound—v.h.f. 38·15Mc/s; u.h.f. 33·5Mc/s

Colour sub-carrier frequency:
4·43361875Mc/s

Delay Line:
Mullard DL1

Loudspeaker:
Front mounted 6in. x 4in.

Sound Output:
2·5 watts

Main Controls (all at front):
Colour, Brightness, Contrast, Volume, On/Off, Tone, Colour Off, Channel Selectors

Pre-set Controls (at rear):
Colour tint, Vertical hold

LETTERS TO THE EDITOR

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

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

A SOUND ONLY TV TUNER

SIR,—There are now advertised tuner units for BBC-2, both valve types and transistor units. Would any readers have any information on using one of these units as the basis of a not-too-simple sound-only system. I say not-too-simple, bearing in mind potential drift problems and assuming that as these tuners have been designed for television, some form of intercarrier system will be needed. The unit I visualise might either have its own detector system, or switch in the final stages of a Band II f.m. tuner.—W. EVEREST (Orpington, Kent).

Well, how about it? If any readers have any comments or contributions, we will be very pleased to hear from them.—Editor.

THE TV COIN SAVER

SIR,—Anyone contemplating building the Coin Saver in the February issue of PRACTICAL TELEVISION may be interested to know that Proops Bros. market a 12V relay which has one pair of light duty contacts and two pairs of heavy duty contacts. The light duty ones could be used to bias off the relay thus obviating the need for the second relay, the heavy duty contacts handling the mains circuit. This relay costs 5s. Proops also market micro-switches having a roller on the rocker arm which prove admirable for this unit. —C. R. JUDGE (Pitsmoor, Sheffield, 3).

EMERSON S/704 SCANCOIL

SIR,—I regret to tell you that the information given in reply to my query has proved to no avail. Tates Electronic Services have written to me to say that the UK distributors of Emerson products have closed down their service division and Tates themselves have no further stocks.

In consequence, I should be grateful to hear if anybody happens to have a serviceable scancoil (OP 139902/s) for an Emerson S/704 TV receiver, and/or service sheet, or can advise on the rewiring of my present faulty one.—T. B. CALVER (3 Norman Avenue, Epsom, Surrey).

EXCELLENT RECEPTION

SIR,—Further to Mr. S. T. Green's letter in the April 1967 issue of PRACTICAL TELEVISION, in which you said he was doing well in receiving ITV Wales in Cheshire, I would like readers to know that I (living in South Shropshire) can receive the following ITA stations: Channel 6 (Sandy Heath) ITV East of England. Channel 7 (St. Hilary) ITV Wales. Channel 8 (Lichfield) ITV Midlands. Channel 9 (Winter Hill) ITV North (Lancs.). Channel 9 (Stockland Hill) ITV South West (Devon). Channel 10 (Emley Moor) ITV North (Yorks.). Channel 10 (St. Hilary) ITV West of England. Channel 11 (Mendlesham) ITV East of England (Suffolk). Channel 11 (Moel-y-Parc) ITV Wales. Channel 11 (Chillerton Down) ITV South (I.O.W.). Channel 12 (Caradon Hill) ITV South West (Cornwall). Channel 12 (Winter Hill) BBC North. Channel 13 (Wenvoe) BBC Wales. All these stations are received with reasonable gain, i.e. watchable picture and are in Band 3. A list of stations receivable in Band 1 is as follows:

Channel 1 (BBC Wales) Llandrindod Wells. Channel 2 (BBC North) Holme Moss. Channel 3 (BBC Midlands) Northampton. Channel 4 (BBC Midlands) Sutton Coldfield. Channel 5 (BBC West) Wenvoe.

I have quite an array of aerials pointing in different directions although Ch. 9 Stockland Hill, Ch. 11 Chillerton Down, Ch. 11 Mendlesham and Ch. 12 Caradon Hill, do fade out quite a lot but only come up with reasonable gain in foggy weather.

I would be interested to learn if anyone else has done as good as this or even better. The receiver used is a GEC DST2000 19in.—K. CUNLIFFE (Stottesdon, Kidderminster).

ISSUES REQUIRED

SIR,—I would be grateful if any reader could supply me with the April to August 1965 and the December 1965 issues of PRACTICAL TELEVISION.—M. F. Bradley (77 Silk Bale Close, Temple Road, Cowley, Oxford).

SIR,—Could any kind reader please supply me with the February, March and May 1965 and the November 1966 issues of PRACTICAL TELEVISION.—23784579 Cpl. Symes, R.E.M.E., Wing Tera, Ty Croes Camp, Anglesey.

SIR,—I require the July to October 1963 inclusive and the June and July 1965 issues of PRACTICAL TELEVISION. I would be grateful if anyone could help me. Also, has anyone any details on what kind of circuit a Beaumont 5096 has?—S. Bergman (16 St. Mary's Avenue, Harrogate, Yorkshire).

SERVICING VOLUMES REQUIRED

SIR,—I would like to ask if any reader could help me with the volume of *Radio and Television Servicing* 1963-1964.—J. LUXFORD (5 Meadow Close, Hemsby, Great Yarmouth).

SIR,—I would be grateful if any reader has a copy of *TV Troubles in 10 Minutes* which they wish to dispose of.—H. LODDER (Farmers' Arms, Lytham Road, Blackpool).

625 LINES IN 405 CHANNELS

A. O. Hopkins

Three-field scanning to complete the picture — Part 2

WHEN THE 405-line service was resumed in 1947, a "higher standard", meaning "more lines" was advocated by some, but the method of calculating TV standards was not questioned. American television copied our interlaced-scanning technique, developing and expanding during and after the war. The line total increased from 441 to 525, and video channel bandwidth to 4·5Mc/s. American television channel calculations are based on a scanning formula inherited from their own "mechanical" period of development. The line total and scanning pitch are calculated from the fallacious "picture element" theory; the lines are spaced at "element" pitch, but are traced by a half-element spot to obtain resolution along them.

625 lines in Europe

As "telecasting" spread to Continental Europe and Asia the general choice has been of a 625-line standard of definition, the C.C.I.R., in which American practice is closely followed. Although an agreed "standard", the numerous channel bandwidths range from about 5Mc/s to 6·5Mc/s (USSR), revealing more uncertainty by the station planners. On all TV screens the traced lines are too thin for the strips they are trying to scan, so they separate, revealing a dark grid which loses about one-third of the picture content. Two simple tests on any receiver prove this, as I mentioned in Part 1, and the remedy suggests itself. Also, I explained how failure to apply sound visual and optical principles to TV technique has led to universal wastage of about one-third of every vision-channel bandwidth due to premature picture renewal.

Optically the structural "grain" of any picture should be smaller than the finest pictorial detail, and this grain should be distributed evenly through both dimensions. At its best, TV grain is the smallest detail, the scanning spot size; at its worst the small picture detail falls between the traced lines, where there is no grain—no scan in fact! The annoying *moiré* patterning when line-structure clashes with horizontal formations at the camera is only too familiar: rows of details slipping in and out between the cracks of the scan. Visible structure, substantial loss of scenic content, and maltreatment of fine pictorial detail prove that all current scanning analysis is unbalanced, being continuous along the lines (but not in the "line" dimension), and discontinuous (visibly disconnected) in the "field" dimension. Only one direction, the horizontal, is scanned out of the infinity of directions in two dimensions, yet the lines in that chosen direction fail to touch and simulate vertical coverage.

Low definition formula

The Baird experimental transmission was allowed an audio channel of about 9kc/s in the medium wave-band for a picture of 30 lines, to form $12\frac{1}{2}$ pictures each of about 2,000 elements. The scanning spot (aperture) was fixed at element size, and traced with lines touching, so an elemental formula was accepted:

$$f_{max} = \frac{L^2aP}{2}$$

in which L is lines per picture, *a* is aspect ratio (picture shape was 7 : 3) and P is picture renewal speed. Maximum frequency should have been about 13kc/s (for 26,000 elements), so definition was low. Pictorial movement was acceptable, and only the flicker frequency, $12\frac{1}{2}$ per second, was unpleasant. This single renewal speed for both purposes was unsound, because two separate parts of the eye are affected: visual persistence of the

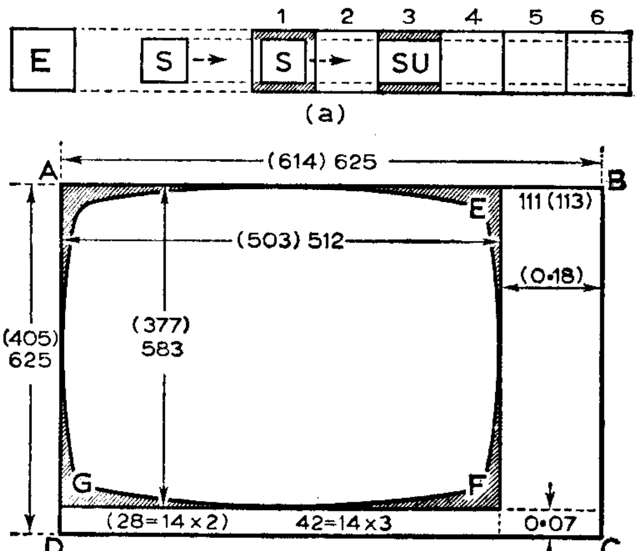


Fig. 6: Picture aspect and scan format. The picture and sync signals occupy ABCD, the scan format. Line and field sync pulses take the proportions of the lines shown, leaving AEFG for the screen: the aspect ratio is 4:3. Twin-interlace traces 377 visible lines out of its total 405. Three-field scanning can trace 583 contiguous lines out of 625. The scan unit and scan format have the same shape, ratio 3:2.

retina is satisfied with 15 or 16 renewals (to sustain movement), while the iris muscles (which vary pupil size) cannot tolerate a flash frequency much below 50.

High definition gain and loss

The "high definition" system started in 1936, but the new "all electronic" TV took over the old element ideas and the basic low formula, thereby fixing line spacing (scanning pitch) as elemental. The 405-line service was allowed about 3Mc/s on v.h.f.; within this limit the formula set the line frequency at 10,125. For P the wastefully high sound-film rate of twenty-four was copied (twenty-five because half of 50, the field frequency). This excessive repetition starves our TV screens by losing one-third of the lines, because the practical half-element spot cannot fill the too-widely spaced strips.

Scan unit and scan format

Figure 6 represents (a) part of a line of theoretical square elements, 1 to 6, with element E indicating the thickness and scanning pitch. Practical half-element point S, starting at 1, is clearly able to move freely before entering 2. The total movement of S within 3 is seen to cover a practical "scan unit" SU, which is one element long but only two-thirds as high. The dimensional ratio of SU is 3 : 2, so this must replace the "square element" idea in any formula intended for a really "complete" picture traced to cover the screen with contiguous lines.

For "high definition" scanning the aspect ratio chosen was that first used by Edison for cine-film, 4 : 3. All other countries with television services have copied this picture shape. Electronic scanning requires a complicated train of synchronising pulses to keep it in step (in both dimensions), so whole lines and part-lines are made invisible to accommodate them. This reduces the resolution of the part-lines left to show the picture equivalent to stretching them to coarser "grain" in both dimensions. Aspect ratio is widened to a scan format of about 3 : 2.

Figure 6 (b) represents the scan format of our 405 standard; as it is at present, and with its potential to improve to 625 quality shown for comparison by measurement in real scan units whose shape (see SU) is identical to that of format A B C D (ratio 3 : 2). The elemental dimensions (in brackets) of the current vision channels are 405 high and approximately 614 wide. Each picture line (AE) is about 503 elements long, but only 377 lines are traced within AEFG by twin-interlacing (188½ lines per field) to cover two-thirds of the screen, leaving room for a 50 per cent increase, from 405 to over 600 lines.

Invisible scanning

To close up the lines, making the scan invisible, the line total AD (picture + sync) can be increased to 625, with slight increase in length AB to 625 scan units. The 50 per cent line increase would reduce scanning pitch by one-third to equal line-thickness. About 583 picture lines (about 512 scan units long) would be traced within AEFG, abolishing visible "raster" and giving 625 definition. The only true test of scan perfection is to check it with Test Card D rotating slowly about its centre. No change in resolution should be seen in any direction, no "structure" could omit or distort any of the "test" details and patterns. Imagine any current 625 system daring to try that!

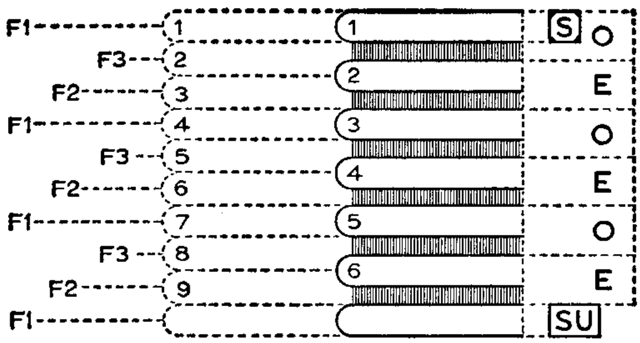


Fig. 7: Twin-interlace versus three-field scanning. Using half-element point S, twin-interlace scans at elemental pitch, it is possible to trace only 6 lines in 6 elemental strips, leaving a dark grid. With the three-field method, F1, F2, F3, it is possible to trace 9 contiguous lines at "scan unit" SU pitch.

Scan unit formula

The choice of about 10,000 as line frequency for the first TV service is fortunate for Britain because the vision bandwidth of about 3Mc/s is adequate for 625-line definition. The two scanning faults: spacing too wide for 405 lines (caused by element formula), and premature line retrace (optically unsound), are compensatory and can be made to cancel out.

The format ABCD contains a square of scan units (625^2 for our 405 standard). An incredibly simple formula presents itself:

$$f_{max} = \frac{L^2P}{2} = \frac{625^2}{2} \times \frac{50}{3} = 3{\cdot}25\text{Mc/s}.$$

Three-field scanning

Although one-third of the lines are missing (visibly) from our screens, they are traced but are virtually hidden by renewal of all lines while still visually active. One field is hidden, one field is wasted. Twin-interlacing covers only two-thirds of the screen; three fields are needed to complete the picture. Half of 50 gives us the present (too numerous) twenty-five pictures; the only suitable picture total is 16 2/3, one-third of 50. Triple-interlacing was tried successfully years ago, but offered no advantage over twin-interlacing because the lines were traced at elemental pitch by the usual half-element point. Patterning between the separated lines was found by some to be worse. Correct the pitch to two-thirds elemental, and the three fields trace their lines in rapid succession and close formation. The previously hidden lines are placed where they should be: in the picture!

Figure 7 shows the great advantage of three fields over two. Part of six elemental strips are represented, and the relative size of the scanning point S. Twin-interlacing can only trace six separated lines, three "odd": 1, 3, 5, and three "even": 2, 4, 6, as indicated by O and E, and repeats these, leaving the dark grid between them. Three-field scanning traces 9 lines within the six strips, covering them properly: F 1 lines 1, 4, 7, F 2 lines 3, 6, 9, F 3 lines, 2, 5, 8. This spaced-line succession sweeps upward, within the normal downward sweep of the field succession, both as invisible as the compact line structure.

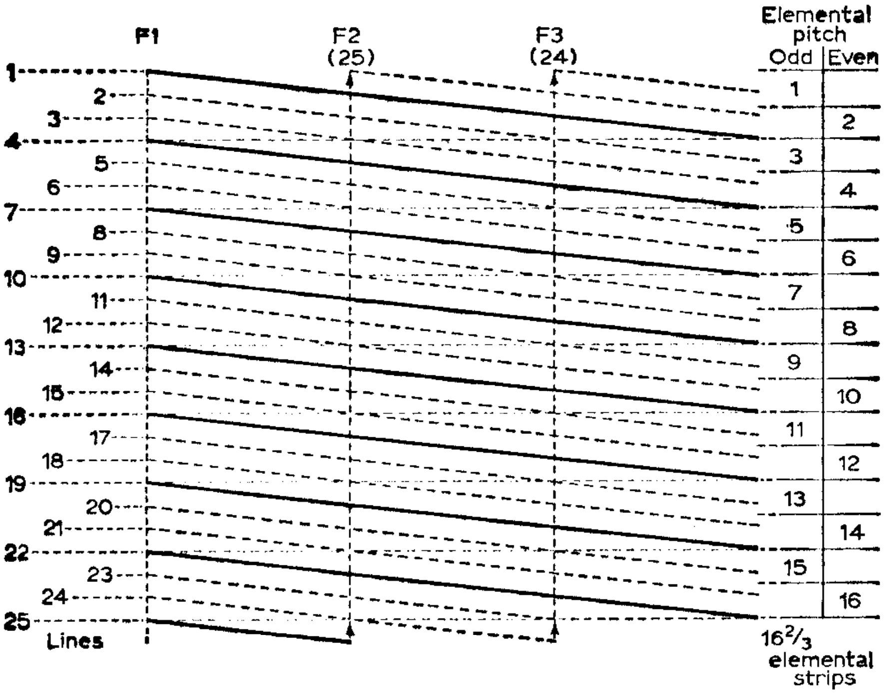


Fig. 8: Three-field scanning. Sweeping downwards, three fields trace 25 contiguous lines: starting at F1, F2, F3, each field traces $8\frac{1}{3}$ lines at "scan unit" pitch (line thickness). The odd $\frac{1}{3}$ line shifts the scan succession upward. Elemental pitch is shown on the right: twin-interlace can trace only 16 separated lines in the 16 elemental strips (8 odd and 8 even).

How three fields interlace

As is well known, the required shift of successive fields in two-field scanning (twin-interlacing) is achieved by including an odd half-line in the line-total of each field. In the same way inclusion of either one-third or two-thirds of a line in their line-total shifts three fields so that their line successions link upward or downward; the lines of each field (which always cover one-third of the screen) fit together without gap or overlap. 625 (which is 5^4) is an ideal line total, since division by 3 gives each field $208\frac{1}{3}$ lines. The odd one-third line shifts the line succession upward as in Fig. 7. Were the odd line-fraction two-thirds, the line successions would sweep downward within the fields, equally invisibly. F 1: 1, 4, 7; F 2: 2, 5, 8; F 3: 3, 6, 9 would result, achieving the same "invisible" scanning.

In Fig. 8 the whole screen is represented with only 16 elemental strips for easy scrutiny. Twin-interlacing, scanning at elemental pitch, would trace only 16 visibly separated lines, 8 "odd" and 8 "even", in the strips as indicated. By three-field scanning the whole screen is fully covered by 24 contiguous lines traced by three fields: F 1, F 2, F 3. The line numbers point to the bottom edges of the traced lines; for clarity the 8 lines traced by F 1 are bolder, and their fly-back lines are shown connecting them: 1, 4, 7 - - - - - 22. Other line fly-back is omitted. Field fly-back is simplified to show clearly the change of starting point from field to field.

Three-field telecine

For telecine, as with live sources, the lines in interlaced fields are linked up visually with those traced by earlier and later fields. When scanning 25 film frames, twin-interlacing traces only two-thirds of each and links these parts with those of the preceding and following frames; we do not need 25 "two-thirds" pictures from telecine. Instead, *three* 25-speed film "stills" can be progressively scanned by six interlacing fields to form two complete television pictures.

The application of three-field scanning to telecine is demonstrated in Fig. 9, in which three film frames (stills) are scanned progressively by six successive interlacing fields; field 1 traces lines 1, 4 - - -, and so on as explained above. Only the first two lines of each field are shown, for clarity. The interlace succession is downward, but each line is seen to link above and below, whatever the "picture", "frame" or "still" number within 1/25 second (field frequency 50). The first and second pictures are fully traced, because the two-thirds of each "still" are selectively chosen and blended smoothly without gaps (unlike twin-interlacing, which repeats the same two-thirds and omits one-third). $16\frac{2}{3}$ three-field pictures an be obtained from 25 film frames increasing the number of lines in each picture (spreading the original partly hidden, total) by 50 per cent.

Standards conversion

Only one difficulty remains in exchanging television programmes between countries with different line-total standards; transmission methods have been perfected, but their differing visible structure reduces the quality despite efforts to hide it. Were there no picture structure, in either country, the difference in line total would not matter.

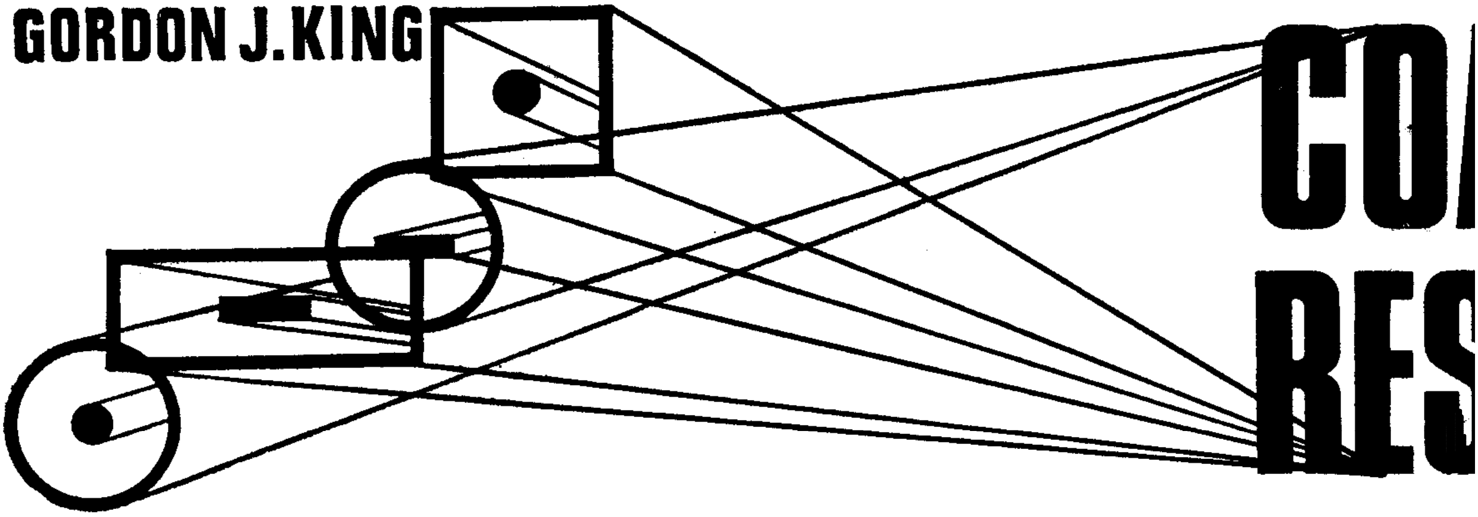
Complete picture	Scanning frame No.	First two lines scanned in each frame	Film frame "Still"
First	1	1 4	1
	2	2 5	
	3	3 6	2
Second	4	1 4	
	5	2 5	3
	6	3 6	

Fig. 9: Telecine by three-field scanning. Two complete (structureless) television pictures can be traced by 6 scanning fields from 3 "sound film frames". The first 6 lines of picture are seen to link upward and downward within 1/25 second (field frequency 50).

British 625

The line resolution of 405 receivers aligned for 3Mc/s would be adequate for the 3·25Mc/s of our three-field 625 system. Existing synchronising circuits are suitable for the few additional equalising pulses which our v.h.f. transmissions should include with the present sync pulse formation to ensure accurate interlace. But for the war, which interrupted research and development in Britain, our lead in television would not have been lost; now is our chance to regain it. □

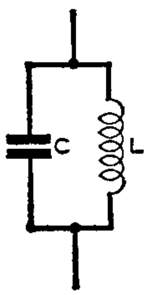
GORDON J. KING



ONE of the simplest electrical resonators is the conventional coil tuned by capacitance as shown in Fig. 1. The effective impedance appearing across this circuit rises to a relatively high value when the frequency of the signal current fed into it corresponds to the circuit's tuned frequency. From the d.c. point of view the circuit has a low resistance, governed solely by the resistance of the wire making up the coil (L), and at v.h.f. and u.h.f. this is an ohm or less. When the circuit is introduced as a load in a transistor or valve amplifier, its low resistance d.c. continuity allows it to feed power to the valve or transistor, as shown in Fig. 2.

Signal currents in the load circuit at frequencies other than that tuned by the coil/capacitor combination are effectively short-circuited, but current at the tuned frequency is opposed by the high impedance of the circuit (dynamic impedance) and a substantial signal *voltage* is developed across it. This signal voltage can be extracted by a capacitor or coupled inductor (making a transformer) or by a bit of each.

Just how high the dynamic impedance rises at resonance is governed assentially by the losses of the circuit which can be represented by resistance in series with the coil and in parallel with the capacitor (C). Relative dynamic impedances for a low-loss circuit and a lossy circuit respectively are given at (a) and (b) in Fig. 3. The higher the dynamic impedance, the greater will be the signal voltage developed across the circuit. The curves



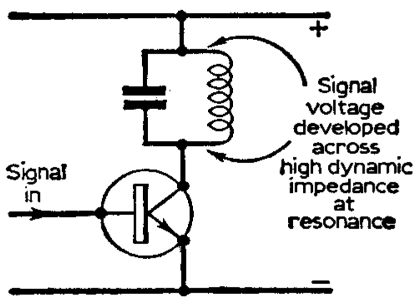


Fig. 1: Simple LC tuned circuit, sometimes called a rejector circuit.

Fig. 2: Tuned LC circuit loaded into the collector of a transistor amplifier.

in Fig. 3 show that a low-loss circuit (high dynamic impedance) has a very peaky response, while a circuit with a greater loss characteristic produces a response having a wider frequency range. For television application, a very peaky response may be needed when such a resonator is geared into, say, the sound rejector of the vision i.f. channel to avoid attenuation of the vision signal sidebands, while a response embracing a wider frequency spectrum is demanded for the vision i.f. to handle all the video sidebands and, especially, for the front-end tuning as this has to handle both the vision and sound carriers plus their sidebands without undue attenuation or phase distortion.

This article is concerned essentially with front-end tuning of the u.h.f. channels and it will show how so-called coaxial resonators are now taking over the job of simple LC circuits in u.h.f. tuners and integrated v.h.f./u.h.f. tuners. But before we get on to this there are one or two rather important points that we must have in mind.

TUNED FREQUENCY

The frequency at which a simple LC circuit tunes is governed not only by the values of the elements themselves but also by the magnitude of L and C reflected into the tuned circuit from the circuit to which it connects. Many experimenters of v.h.f. and u.h.f. amplification tend to forget this; they arrange for the circuit fundamentally to tune to the required channel, yet when it is rigged up in circuit they discover that resonance is occurring quite a few Mc/s *below* the channel frequency. This is due to the extra of L and C imposed by the wiring and components activating the tuned circuits.

Take Fig. 2 for example. Reflected across the L and C as it stands is the collector capacitance of the transistor. This might well be small, but at u.h.f. it can shift the frequency substantially away from the required channel. Then there are the wire connections from the LC combination to the transistor and thence to the output coupling. These add extra inductance to L, again dropping the resonant frequency. Capacitance reflected from the circuit into which L and C are loaded appears in parallel with C, and proximity effects of wiring, chassis parts and other components add to the confusion.

The frequency at which an LC circuit resonates is given by

$$f = \frac{1}{2\pi\sqrt{(LC \times 10^6)}} \qquad \text{.............. (1)}$$

when the d.c. resistance is small in comparison

AXIAL SONATORS

with L and C. This can be simplified to:

$$f = \frac{159}{\sqrt{(LC)}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

In both expressions f is in Mc/s, L in μH and C in pF.

Now, the bandwidth of a circuit is generally considered to be that frequency spectrum between the points on the curve where the response is 3dB down as shown in Fig. 4. The bandwidth between these points is given by:

$$\text{Bandwidth 3dB points} = \frac{159}{C \times R_d} \ldots\ldots (3)$$

where R_d is the dynamic impedance in kilohms and C is in pF. This shows that the lower the dynamic impedance (sometimes called dynamic resistance), the wider the bandwidth. Thus, (a) in Fig. 3 would derive from a circuit with a high dynamic impedance and (b) from a low dynamic impedance.

DAMPING RESISTOR

The bandwidth of some TV tuned circuits is purposely widened by damping down the dynamic impedance with a *parallel* resistor. Such damping resistors are found across the windings of i.f. trans-

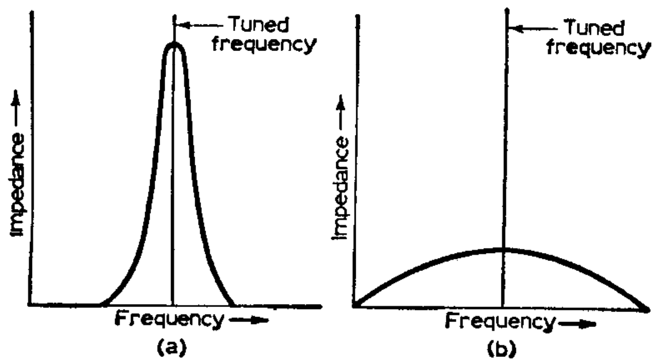


Fig. 3: The response curve at (a) implies little damping, while that at (b) is obtained only by heavy damping.

formers and some r.f. coils. Often, however, especially in tuners, the circuits coupling to the tuned circuit themselves "damp down" the circuit sufficiently to give the required bandwidth. The alternative is an arrangement of bandpass coupling to secure the required bandwidth without the response very gradually tailing off at the extremes of the spectrum. Bandpass coupling gives the necessary wide top to the curve with fairly rapidly falling sides, as in Fig. 4.

So far, so good, but what about coaxial resonators? Well, try using the expression at (2) to give resonance at, say, 800Mc/s. Both L and C would need to be extremely small. Conventional tuned circuits can be employed at these frequencies, but the associated circuitry has to be very critically arranged to prevent the strays of L's and C's from swamping the real elements of the tuned circuits! Moreover, the bandwidth of an r.f. circuit of this kind in, say, a u.h.f. tuner, has to be at least 8Mc/s, and expression (3) shows that this may have to be done by making C large with respect to L. This makes L smaller than ever. In a u.h.f. aerial amplifier the bandwidth may have to be in excess of 88Mc/s fully to embrace all the channels of a regional group (see, for instance, Points on u.h.f. Aerials, PRACTICAL TELEVISION, March 1967).

V.H.F. TO U.H.F.?

Some enthusiasts write to find out whether it is possible simply to reduce the number of turns on a turret v.h.f. tuner coil set to secure resonance at a u.h.f. channel. This can be answered straight away with a big NO! Even if the number of turns was cut to a bare minimum (say, two or three left on the formers), the extra inductance

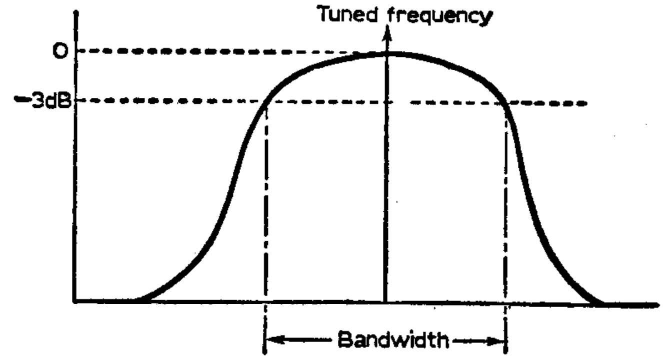
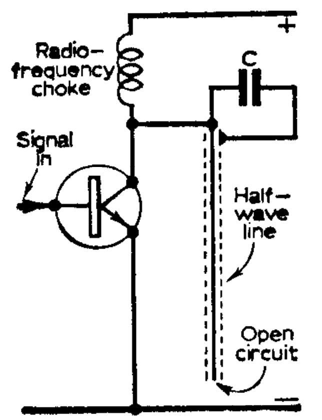


Fig. 4: The definition of bandwidth (see text).

of the coil connecting contacts and wires would keep the total effective inductance up to a value making it impossible to get much higher than about 300Mc/s; then there are the parallel stray capacitances to take into account. By a similar token, it is rarely possible to get a v.h.f. aerial amplifier to tune to a u.h.f. channel simply by reducing the number of turns on the coils. Point-something of a μH is not very important at v.h.f., but at u.h.f. it can become extremely significant, and when it is realised that a 4-in. length of 18s.w.g. wire has an inductance of about 0·1μH it will be appreciated that the basic wiring in a v.h.f. circuit could be *greater* than the required inductance.

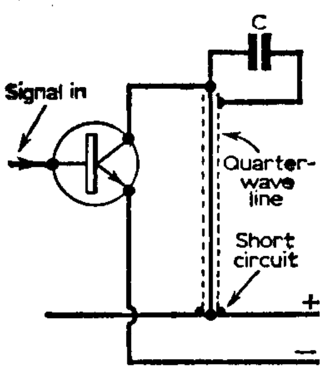
The Q value or magnification of a tuned circuit can also be impaired when attempts are made to get a v.h.f. design to tune over the u.h.f. channels. This is because the Q value is equal to the reactance of L or C in the tuned circuit divided by the d.c. resistance (losses) of the coil or capacitor. At resonance, of course, the impedance is the same for both capacitor and inductor.

A recent development in the field of u.h.f. tuners and aerial amplifiers is the abandonment of the conventional LC tuned circuit in favour of capacitively-loaded coaxial resonators. Owing to its distributed capacitance and inductance, coaxial cable (or, indeed, any transmission line) exhibits all the effects of an LC circuit, but in a somewhat less critical manner. Cable shorted at one end is resonant to an applied signal when its length is $\frac{1}{4}$, $\frac{3}{4}$, 5/4 (etc.) of the signal wavelength, while cable without the end shorted is resonant when its length is $\frac{1}{2}$, 3/2, 5/2 (etc.) of the signal wavelength. The physical length of coaxial cable is slightly shorter than the signal wavelength because the velocity of the signal is reduced a little below its through-space velocity when it travels along coaxial cable.



(a)

Fig. 5: Half-wave coaxial resonator (a) and quarter-wave one at (b), the first open-circuit and the second short-circuit.



(b)

A signal wavelength of, say, 25 inches in the u.h.f. spectrum may correspond to a 22-inch length of coaxial cable (depending upon its velocity ratio). The half-wave-length of such cable, therefore, would be about 11 inches, and this would correspond to a signal frequency of about 570Mc/s. This would be with one end open-circuit (the other end would be capacitively-loaded across the signal source). By shorting the far end, however, the length could be reduced to about $5\frac{1}{2}$ inches. The former half-wave and the latter quarter-wave. Half- and quarter-wave coaxial lines loaded to the collector circuit of a transistor amplifier are shown respectively at (a) and (b) in Fig. 5. Now, the value of the capacitor across the launching end of the cable determines the length of the cable to resonate at a specific frequency. At a given frequency, the cable length can be reduced by increasing the value of the capacitor at the source end. This, indeed, is just how half-wave resonators are designed, but in addition to the capacitor at the launching end, a second one is shunted across the open-circuit end. The end capacitors allow the cable to be reduced in length at each end while the electrical resonant length is retained, and the net result is a resonator of remarkably small dimensions. Moreover, tuning is possible simply by replacing the capacitor with a low-loss, low value variable capacitor or trimmer *designed for u.h.f. applications.*

Quarter-wave resonators are favoured when a transistor is the active device, but when this is a valve, half-wave resonators are better. This is because transistor electrodes and lead-outs are considerably less inductive than valve counterparts owing to the smaller electrodes and shorter lead-out wires in transistors than valves. The length of valve connecting leads (in bases) and the relatively large dimensions of the electrodes themselves (anodes and grids) add up to a substantial proportion of the overall length of the resonator itself when of a quarter-wave design. There is no doubt that transistors lend themselves to resonator applications.

TYPES OF RESONATOR

Because it is possible for the coaxial structure to be of very small dimensions, ordinary coaxial cable is never used in the design of resonators. Based on a quarter-wave resonator, which is the type that transistors have made popular and which will become even more popular as time goes by, a coaxial length of only 3cm with a capacitance (C in circuit (b), Fig. 5) of about 2pF will tune to 800Mc/s. With the same coaxial length, increasing C to about 9pF will bring down the resonant frequency to about 470Mc/s. That is, from the top to the bottom of the u.h.f. spectrum with a change of from about 2pF to about 9pF, depending upon the characteristic impedance (Zo) of the line.

Figure 6 shows a number of coaxial structures which can be used or which are, in fact, already in use. That at (a) is the type of structure that

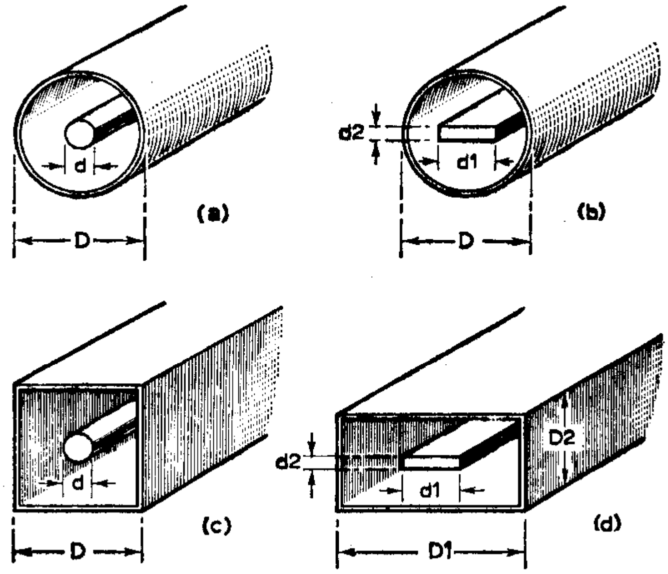


Fig. 6: Coaxial structures. The characteristic impedances of these are given in the text.

we relate to coaxial cable proper, while (b) employs a centre conductor bar instead of a rod or wire. Structure (c) utilises a rod or wire inner with a tunnel of square cross-section as the outer, while (d) has an inner bar and a tunnel of rectangular cross-section as the outer.

The nature and dimensions of the coaxial structure used determines the Zo of the resonator and, in turn, the Zo effects the resonant length. Zo also influences the loading of the line to the active circuit device (i.e., transistor or valve) and in this way has a bearing on the response band-width, in rather a similar manner to R_d of an LC circuit. The Zo of pure coaxial ((a) in Fig. 6) is expressed as:

$Zo = 138 \log_{10} D/d$ .... (4)

where D is the diameter of the outer conductor and d the diameter of the inner conductor. We can, however, condense this down to the expression:

$$Zo \text{ of (a)} = 60\ D/d \text{ ohms} \quad \text{......................} \quad (5)$$

and based on this we can easily discover expressions for the structures deviating from pure coaxial configuration, as follows:

$$Zo \text{ of (b)} = 60 \times 2D/(d1 + d2) \text{ ohms} \quad \text{...} \quad (6)$$
$$Zo \text{ of (c)} = 60 \times 1{\cdot}08D/d \text{ ohms} \quad \text{.........} \quad (7)$$
$$Zo \text{ of (d)} = 60 \times (D1 + D2)/(d1 + d2) \text{ ohms} \quad \text{...} \quad (8)$$

Zo is also important from the length calculation aspect. However, to avoid pages of figures, an abac is often used, and such has been published by Iliffe, for instance, for *Wireless World*. Telefunken has also published a series of curves (Report No. 6004) to facilitate the calculation of resonator dimensions, and from this series are the curves given in Fig. 7. Curves at (a) are based on a tuned frequency of 800Mc/s, and each curve is related to a specific Zo as marked on it. The vertical scale gives the capacitance in pF and the horizontal scale the resonator length in cm. As an example, suppose that we have made a quarter-wave resonator of 2cm length and Zo of 300 ohms, and wish to find out the value of C necessary to tune to 800Mc/s. By reading vertically up to the 300 Zo curve from the 2cm point on the horizontal scale, we find by moving horizontally to the vertical scale that 2pF is needed. 3pF would be needed with a line of the same length but with a 200-ohm Zo Curves at (b) provide the same information but this time relative to a tuned frequency of 470Mc/s. By interpolation, therefore, it is possible to assess line lengths and loading capacitances at other intermediate frequencies.

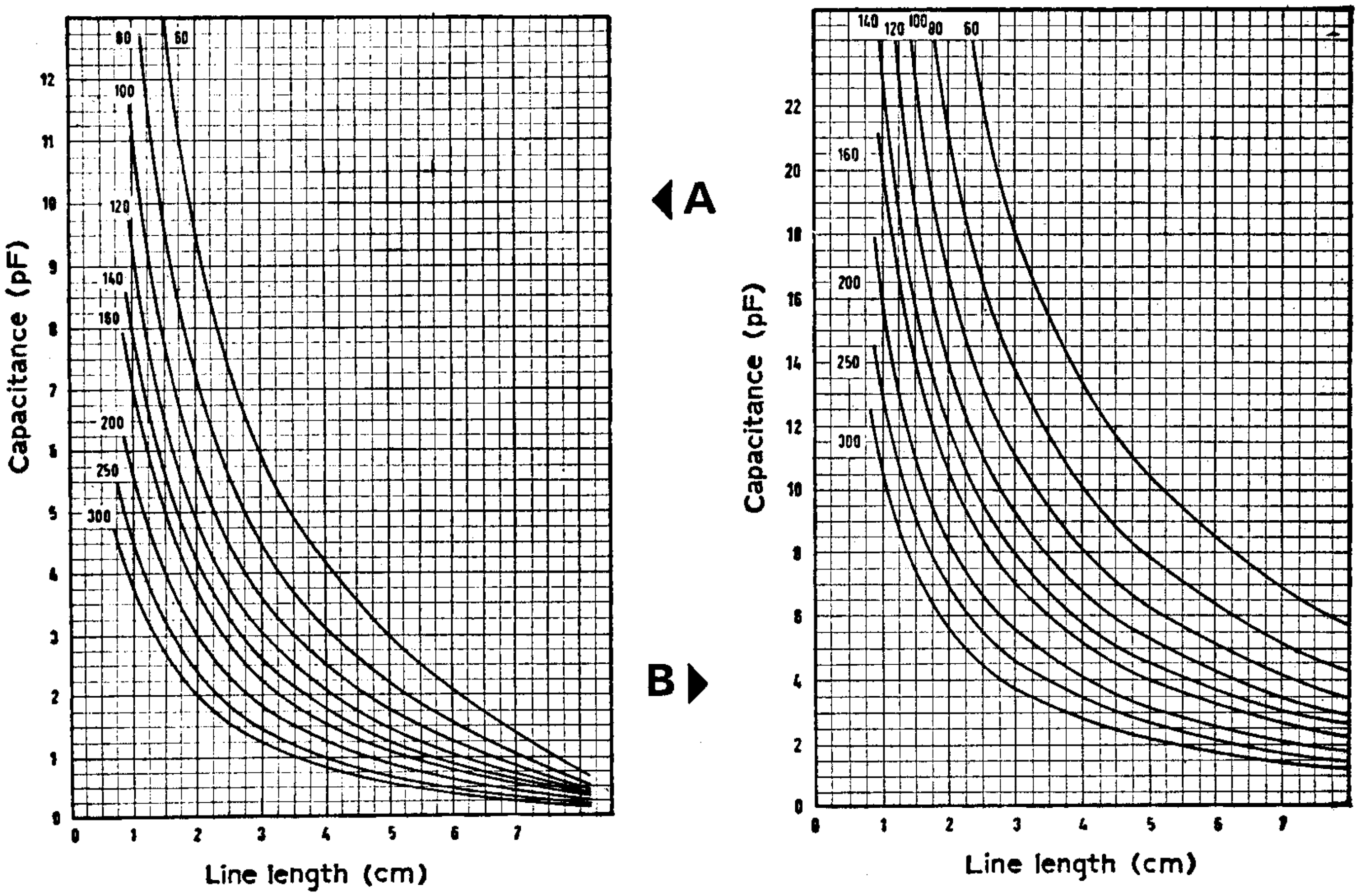


Fig. 7: Sets of curves for finding the line length or the tuning capacitance against characteristic impedance, (a) for 800 Mc/s and (b) for 470 Mc/s.

CONSTRUCTION

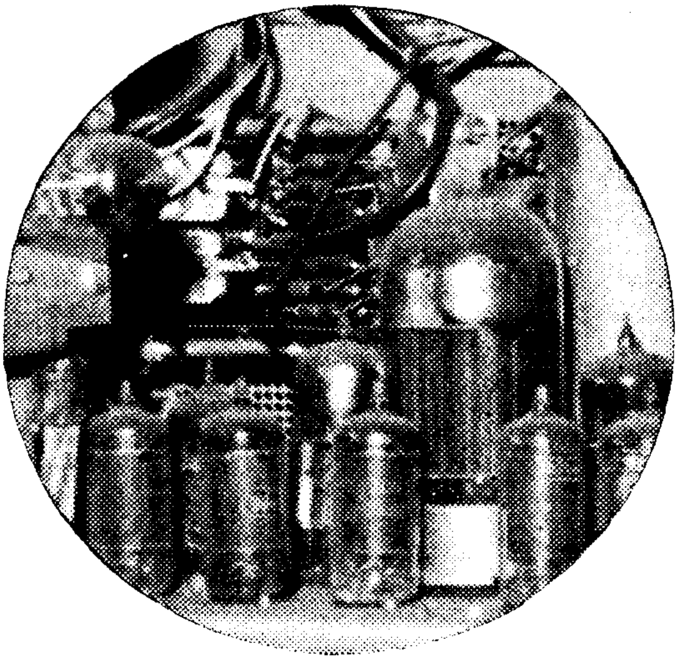
Resonators should be constructed with fairly thick pieces of tinned or silver-plated sheet steel, and the inner conductor should be supported within the centre of the outer conductor on low-loss insulating material. Copper tube can be used for the type of resonator shown at (a) in Fig. 6, and low-loss discs for pushing into the tube can be made for holding the inner conductor concentric. The far end of the tube can be shorted to the inner conductor by a metal disc of diameter equal to the outer diameter of the tube. At the launching end it is not too difficult to arrange for the transistor to be mounted along with its supply resistors and etc. In this way a very compact and efficient u.h.f. transistor amplifier could be built.

Signal can be extracted from the resonator by tapping up a little from the shorting end, aiming for a tap where the impedance is about 75 ohms to match the aerial input of the receiver. Remember, however, that a very low-loss tuning trimmer is necessary to get the best possible gain from the device. Techniques relating to u.h.f. practice must always be observed, and the circuit can be any conventional earthed-base or earthed-emitter configuration. The resonator is the only difference, and this simply replaces the conventional tuned circuit. □

"We wash our 'scopes

SERVICING professional oscilloscopes at Tektronix's Harpenden plant is truly a white-collar job, for all instruments returned for repair and re-calibration are thoroughly washed before the service department see them. A television serviceman's dream come true!

This practice originated in the States, the home of the parent company, was carried on by their British agents, Livingston Laboratories (now the British import agents) and is now done as a matter of course at the Company's Harpenden plant, where all new instruments are pre-checked and used ones serviced. At first the Company used to wash the costly instruments in their back-yard. Now they have a special washing and drying section, for what they feel an essential function of service. Tektronix have on record a customer who sent his 'scope in for repair complaining that he did not want a new 'scope when his old one was returned. It is difficult to please everybody, but it must be nice to receive complaints of this type.



before we service them," say Tektronix

the professional electronic instrument makers

The valves and the cathode-ray tube are removed and any paper-capped capacitors are covered before the cleaning operation begins. A high-pressure water and detergent spray is used for the actual cleaning and this removes all the dirt; even the greasy e.h.t. dirt comes off.

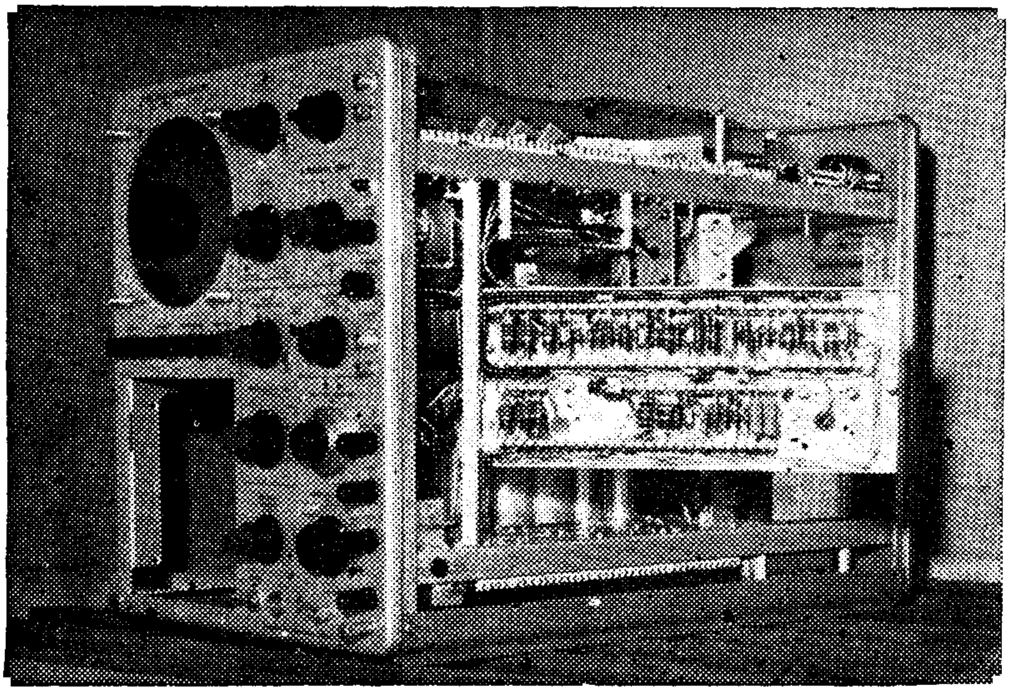
Faults have been known to be cleared by the cleaning process. Certainly it makes servicing easier, for it takes the dirtiness out of the job and the resistor and capacitor colours are—in the majority of cases—restored to their original state. The instrument washed before one of our staff correspondents was fairly dirty—as you can see from the enlarged section of the unit shown in the first column of this article.

Ian Gurton, G8ASP, a licensed amateur, removed the valves, the c.r.t. and covered a couple of the capacitors and then, donning a surgical type face mask and a rubber apron, sprayed the whole of the circuitry. Five minutes later the 'scope looked like a new one (except that there were pools of water lying in the base of the unit. The 'scope, worth approximately £700, was then transferred to an adjoining drying cabinet and left to cook.

Later the valves and tube were replaced, the capacitors uncovered, and the scope was moved to the servicing bays. In this case, the washing process did not cure the fault, nor cause further faults. In fact, the Company claim that no set so far, and they have washed hundreds, has been affected by washing, other than a transfer on the front panel coming adrift.

We do not recommend that readers take to washing their equipment, for serious damage can result if standard components are fitted. Transformers, coils, potentiometers, switches and the like don't take to water. Also, if the water does not damage anything, it is still a difficult task to thoroughly dry out equipment.

Tektronix are very proud of their servicing arrangements and claim that their turn-round time is unequalled. So far as they know, they are the only company to wash their instruments. □



The instrument featured is a Model 585A. It costs £700 and has a bandwidth extending from zero frequency to 85Mc/s. Many of these units are used inside and outside the electronics industry. One returned recently for servicing had been used by the National Coal Board. From the state of it, obviously it had been used on one of the coal faces: the cleaning process restored it to its original condition. The photograph on the left shows a Model 585A ready for stripping. Note the dust layer on top of the valves in the enlarged section.

On the right, the top photograph shows the cleaning process; below: the scope drying off in the heated drying cabinet.

Servicing TELEVISION Receivers

No. 135
RADIO RENTALS (BAIRD) 460 series

by L. Lawry-Johns

THESE are 17in. and 21in. models with or without f.m. radio facilities. The 17in. model uses a Mullard AW43-80 tube and the 21in. a Mullard AW53/80.

The standard model is marked 460 (over the aerial bracket). The 460 f.m. has more gain than the standard model in addition to the extra discriminator stage and f.m. coil biscuits. The two EF80 sound i.f. stage in the f.m. model is sometimes found in the standard version, replacing the single EF183 (or single EF80 in early standard models).

A further version, the 460X, uses the 440 series circuit and valves. Therefore the information contained in this article will not apply wholly to this model. Flywheel sync may be found used in fringe areas, and in this case an extra ECC82 will be found fitted.

Controls

Models 462, 464 and 468 have the Brightness, Contrast, Volume on/off, Station Selector, Horizontal Hold and Vertical Hold controls in the panel at the top of the cabinet. Models 466 and 470 have edge type controls for Volume on/off, Brightness and Contrast which are mounted with the "Rotorpush" station selector and fine tuner on the front of the cabinet to the right of the tube face.

The Height and Vertical Form controls (and in the 466 and 470 the Line and Vertical Hold controls) are accessible at the back of the set. The Width control in all models is inside the cabinet, and the linearity (closed loop) sleeve, centring device and ion-trap magnet are carried on the tube neck.

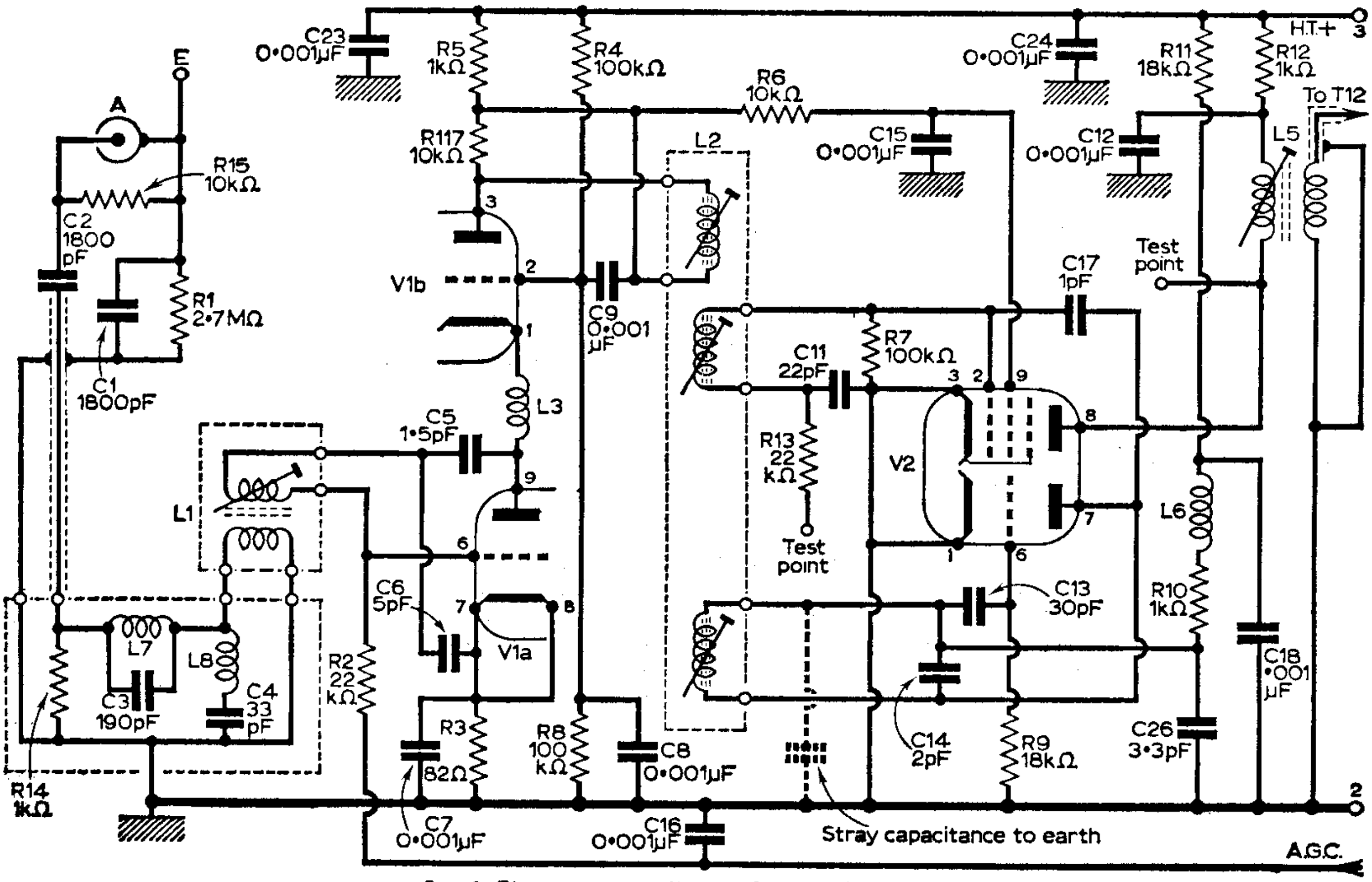


Fig. 1: The tuner unit. V1 is a PCC[illegible]—V2 PCF[illegible].

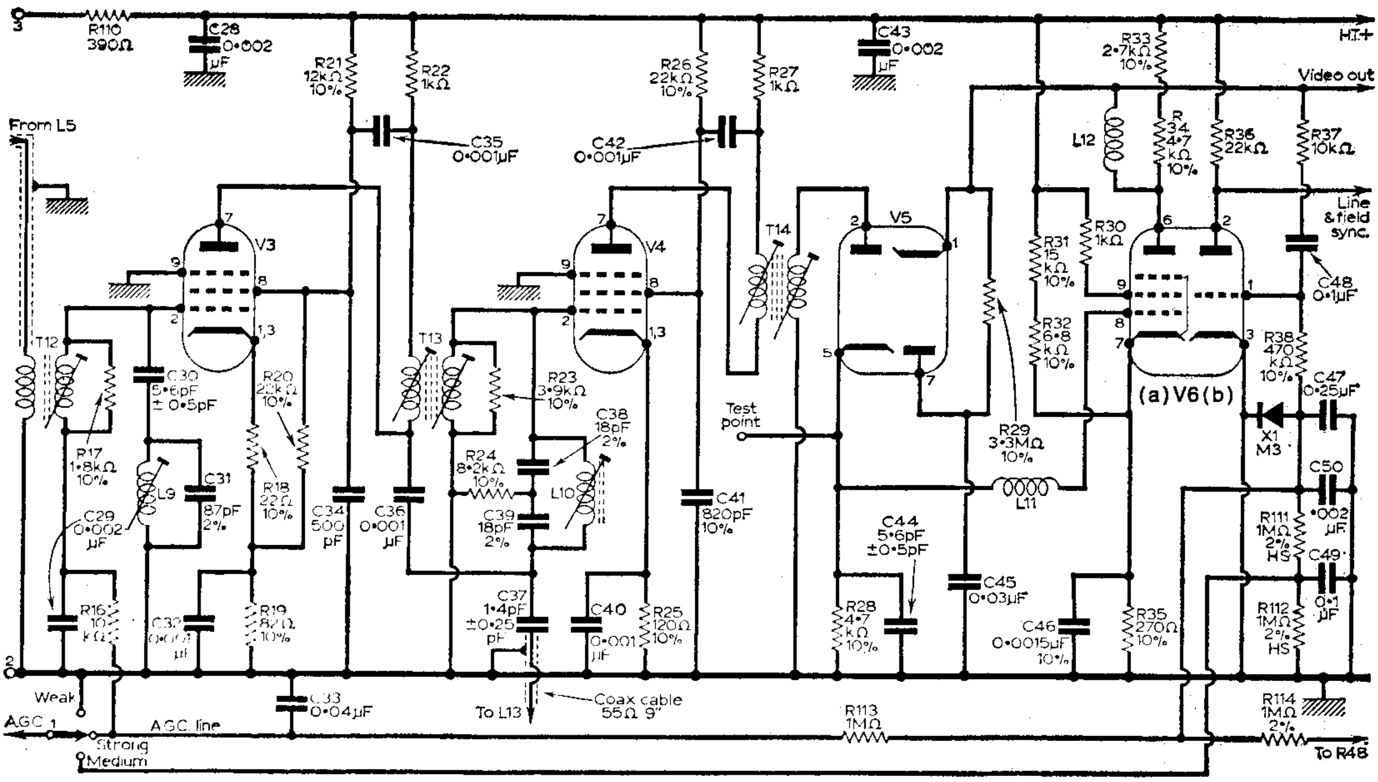


Fig. 2: Vision i.f. and video stages. V3 EF183. V4 EF183. V5 EB91. The triode -pentode (V6a,b.) is a PCL84.

Tuner unit

A fine tuner is only provided on models 466 and 470. The 462, 464 and 468 do not have this adjustment.

Automatic gain control

Mean level a.g.c. is used and the amount applied to the tuner may be varied by means of a spring clip which may be connected to the Strong, Medium or Weak (latter is chassis) tags.

The clip should be set for the best grain-free picture which is free from cross modulation, i.e. sound on vision, vision buzz on sound.

It may be found that when a new PCC89 (V1) valve is fitted to the tuner some degree of cross modulation may occur in medium or strong signal areas due to the previous valve being weak and the clip being set to "weak". In this case it should be reset to the Medium or Strong tags whichever is necessary to clear the effects.

Centring

Immediately behind the deflection coils is an offset magnet which is the centring device, actually on the closed loop sleeve. The whole magnet assembly can be rotated and the small magnet can be rotated independently to obtain correct centring.

The ion-trap magnet may have to be slightly adjusted to compensate for any loss of brilliance due to a revised position of the centring device.

Width

This is a metal rod under the line output transformer screening can.

Linearity sleeve

The closed loop sleeve is a tube which is partly inside the deflection coils. To adjust, it is necessary to slacken the deflection coil clamp and slightly slide the tube in or out of the coils. This adjusts the left to right aspect of the test card, but on no account must it be pushed too far in or serious loss of width and overheating may occur.

It is recommended that all adjustments be carried out on test card D or some other regular and constant pattern.

Chassis removal

Complete chassis removal is unnecessary for the majority of servicing and a pivot arrangement is provided for maximum access.

Models with front controls

Release but do not remove the two screws in the rear bracket carrying the selector arm and move this away from the chassis as far as it will go thus disengaging the tuner. If a flywheel sync unit is fitted this must be unplugged and removed before the chassis is lowered.

Remove the pilot lamp from the selector arm and clip it on the bracket on the tuner. Remove the preset panel (two screws) and lay it on the chassis. Use both hands on the side flanges and pull gently away from the cabinet and lift about an inch to locate the pivot screws with the lead-out slots. Pull further out and lower to disengage the pivot screws.

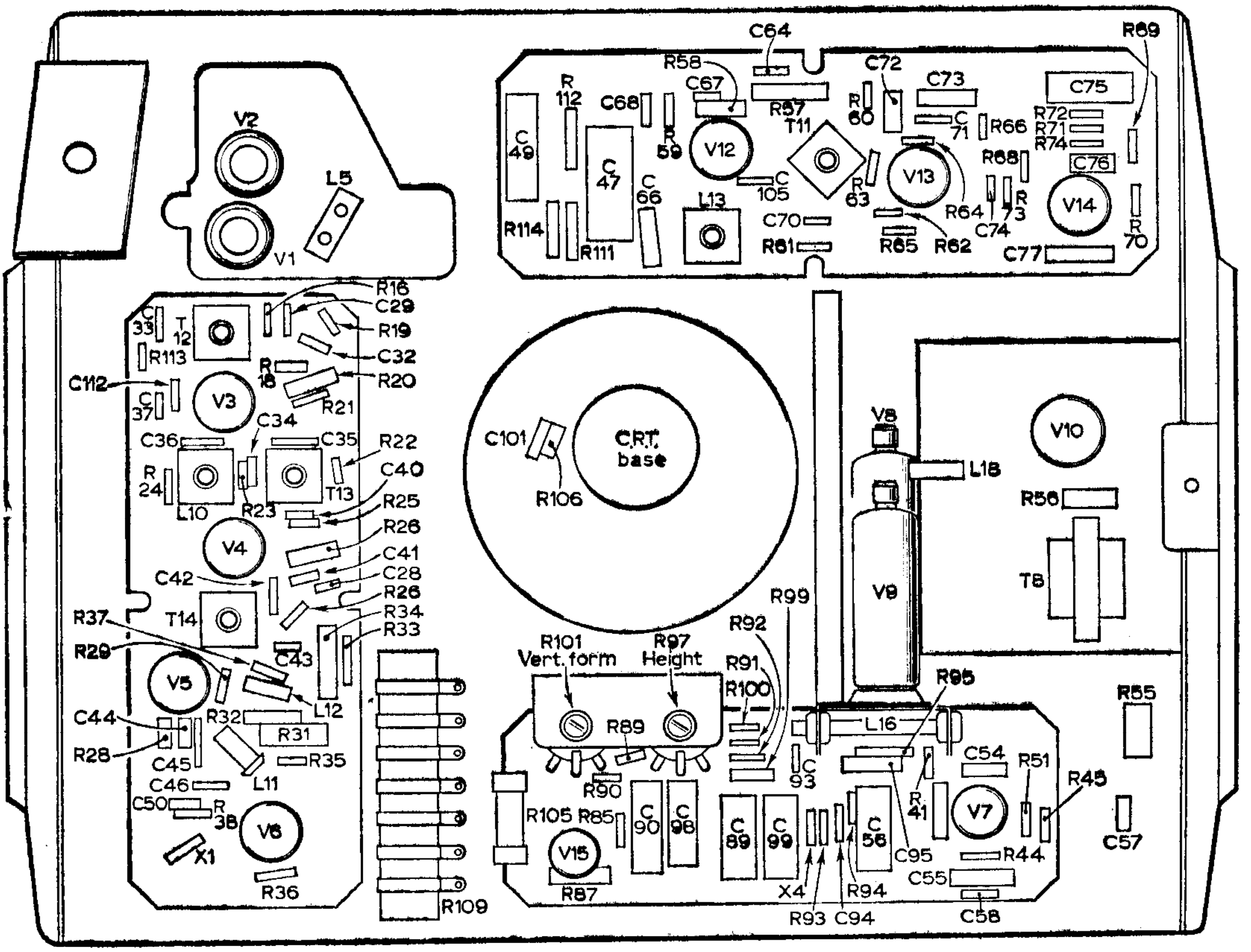


Fig. 3: Front chassis layout—non f.m. version.

If the plugs, tube base socket and e.h.t. lead have been removed the chassis can now be completely removed.

When reassembling the selector arm the selector control engages with the turret first and the chassis screws should be left slack until the coupling is engaged with the centre pin. Rotation of the selector knob will then correctly align and engage the selector dogs.

The fine tuner coupler only rotates within limits and it is preferable to set both knob and tuner to mid-positions before assembly. After the selector is engaged a rocking movement of the fine tuner knob will allow the dogs to engage. Then the chassis screws and selector bracket screws can be tightened.

Models with top controls

Take off the back cover and pull off the station selector and volume control knobs. Release the two side screws and slide the chassis toward the rear, keep it upright to avoid fouling the tube neck components. It can then be lowered to the horizontal position.

To fully remove, disengage the preset panel by removing the two fixing screws. Remove the loudspeaker plug and the deflection coils plug. Disconnect the e.h.t. clip from the side of the tube and remove the tube base socket.

Tube removal

Remove chassis and lay cabinet face down on soft surface. Remove the four screws and lift out the tube complete with deflection coils, etc, leaving the glass and mask in the cabinet.

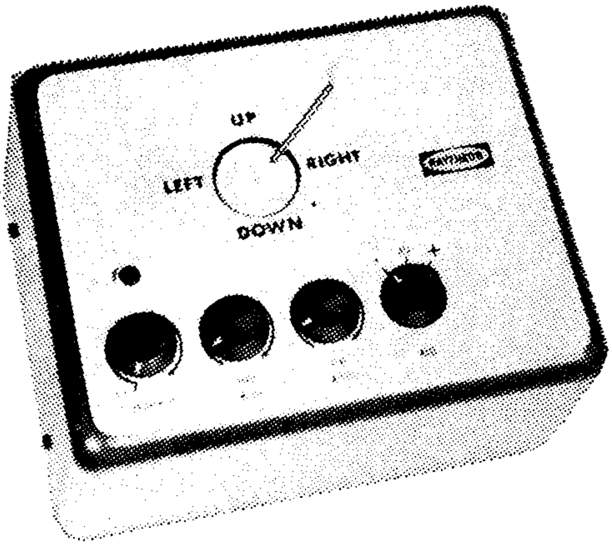
Note the distance between the front of the tube and the mounting lugs. If this is too great the mask will be damaged when the screws are driven home when the tube is replaced. If too little, a gap will be left and the whole assembly will be loose with no dust seal.

The rubber band—if fitted—should protrude about 1¼in. and should be rolled back when the tube is being refitted. When the tube is resting correctly, roll the band forward to seal the mask. Models 462 and 464 use a loose rubber band which should be hitched around the harness lugs until the tube is properly located when it may be released to fill the groove between the mask and tube face.

to be continued

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

ELECTRONIC TV POINTER

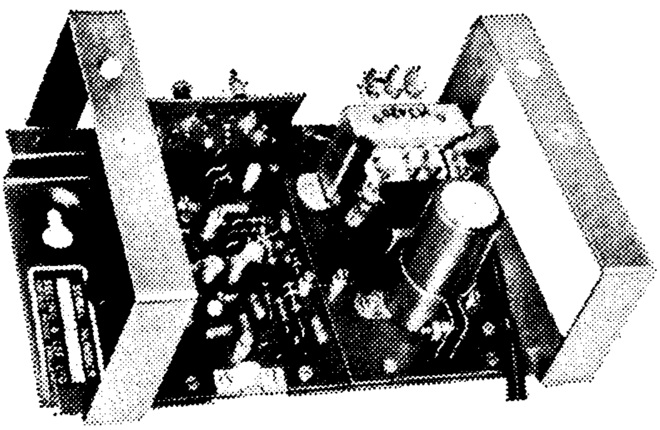


AN electronic television pointer has been introduced by Raytheon Company to aid instructors in schools and industrial training programmes employing instructional television systems.

Using a miniature "joy stick" a teacher at his desk or lectern or a technician at a control panel can superimpose a bright spot or cross-hair reticule on the transmitted picture to call attention to any point on the screen.

The call-out spot or crossed lines can be faded in or out or presented at any level of brilliance. When added to the transmitted picture they are then seen on every receiver in the system.

BROAD BAND TRANSISTORISED AMPLIFIER



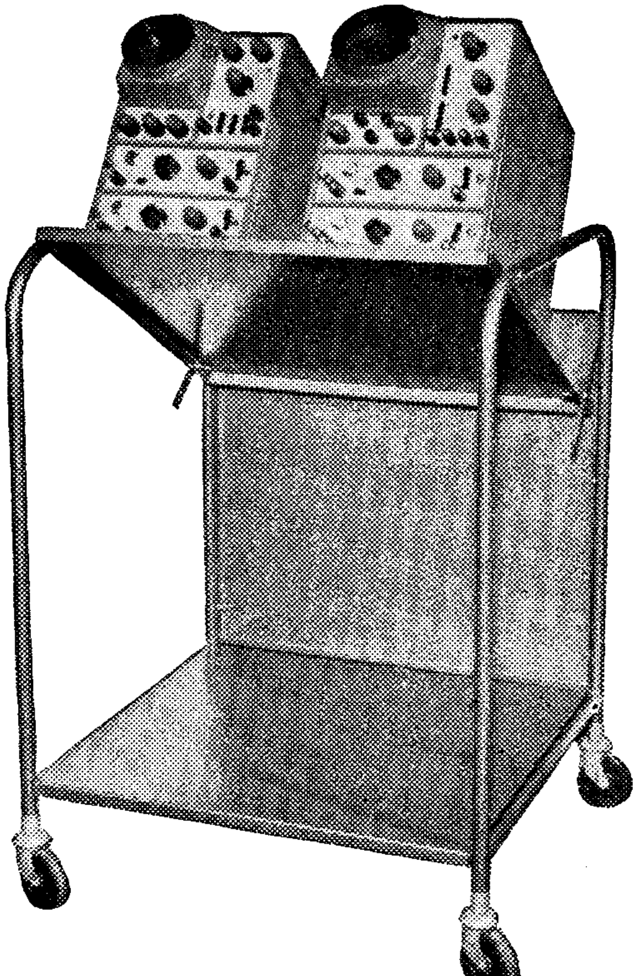
BELLING & Lee Limited have added a fully transistorised amplifier to their range of Silverline Television Distribution Equipment.

The L1812 is a v.h.f. amplifier for small distribution systems. It is completely self contained with its own power pack, and covers a continuous frequency range from 40 to 220Mc/s, i.e. Bands I, II and III. The basic amplifier is broad band, but facilities are provided to enable the installer to use the equipment either as a single input, broad band amplifier, or as a three band amplifier. The change is made to the input circuit by plugging the appropriate filter network into the connector provided. Two filter networks are available, the first provides the single input signal for wide band facilities, the second is a triplexer to allow the use of separate aerials for Bands I and II and III.

The power pack which utilises capacitance smoothing and a bridge rectifier is constructed on a separate printed circuit board mounted alongside the main amplifier. The L1812 amplifier is housed in an all metal case with a perspex window so that the input voltage setting on a mains transformer can be readily checked. The unit is wall mounted by means of two keyholed slots in the base of the amplifier.

Gain: 24dB measured in a 75Ω system.
Output: Not less than 100mV r.m.s. (peak white).
Input Output Impedance: 75Ω nominal.
Size: $7\frac{1}{2}$ x $4\frac{3}{4}$ x $2\frac{3}{4}$in.

MOBILISE YOUR 'SCOPE



THE Lektrokit division of A.P.T. Electronic Industries Limited, Chertsey Road, Byfleet, Surrey, announces an addition to its range of Rack and Chassis system components—a larger version of the LKR-5041 oscilloscope and general purpose trolley—viz. the LKR-5051. (Kit No. 5).

The new trolley has trays $20\frac{15}{16}$in. square, instead of the $13\frac{1}{4}$in. wide trays of the existing trolley and will be able to accommodate any oscilloscope up to $20\frac{15}{16}$in. wide.

Price of the new unit will be £8 15s.

UNDERNEATH THE DIPOLE

THE year 1967 will obviously be a year in which big decisions on colour and many other matters will be made by the Independent Television Authority. The main objectives will be for ITA to bring colour to British viewers' screens by 1969; to increase the number of its major ITV networking companies from four to five; to reallocate or amend its licences to regional ITV companies and . . . to regulate the payments for networked shows.

Engineering problems, of which there are many, are to be dealt with by two main technical "crash" programmes of (a) development and planning of colour presentation, and (b) the building of new u.h.f. transmitters in many areas plus the co-siting of new ITA transmitters at existing BBC u.h.f. transmitting stations. Fortunately some of the BBC masts are capable of carrying extra aerial ironmongery. The same forethought was applied to the later high masts erected by the ITA which will be utilised for some of the BBC's many u.h.f. transmitters. The co-operation between BBC and ITA Engineering Divisions has been first-class and given mutual satisfaction.

ITCA'S contribution

Coupled with the ITA's engineering know-how has been the very solid support of the technical sub-committee of the Independent Television Companies' Association, of which Bernard Marsden (Technical Controller of A-TV Network) is Chairman. Great technical contributions to progress in colour television have been made by engineers of several ITV companies, notably ABC Teddington Studios, A-TV Borehamwood Studios, and Tyne-Tees.

For the 35mm. films specifically for colour television, Rediffusion have installed an Electronic Cam equipment, which enables 35mm. colour film to be vision-mixed from several cameras, just the same as with "live" TV cameras. The motion picture cameras made by Arriflex have integral Plumbicon TV cameras which reproduce on monitors the pictures that are being photographed. This method opens up a big world export market to all Television Stations which have 35mm. colour or for that matter, black-and-white, telecine. That includes the "big-time" networks —or, by optical reduction from the same negative to 16mm. colour prints, to the smaller stations which will use 16mm. colour telecine.

Colour film production of TV series and serials by ABC, A-TV and its associates have already built up an enormous export market and have justified the higher costs of film production for television as compared with video taping, which is limited by differing line standards and quality degradation which often arises during standards conversion.

ITA getting tough?

The ITA seems to be getting tough. It has sent out questionnaires and contract forms to potential licensees in all areas, large and small, plus the new major one in Yorkshire. The questionnaires are a work of art; plain speaking, businesslike, and practical. In a sense, they are like examination papers, the replies to which will enable ITA to sort out good new applicants as well as keeping the best of the original licensees in business. The successful companies will be under an obligation to inject a fair share of their own productions into the network, retaining their individuality of outlook; this does not mean that they should be parochial or have a strong local area flavour or accent.

Applications to ITA for the original commercial television broadcasting licences thirteen years ago in the London, Birmingham, Manchester and Glasgow areas were fewer than expected. The initial financial losses were frightening for the first couple of years or so, until an enormous and sudden increase in revenues occurred. Somebody said when those Golden Days arrived, that the licences were permits to print money. The winning applicants of 1967 will be fully aware that they will *not* be able, metaphorically, to print pound notes.

The ITA will want to know all about the financial background of applicants, their ability to face the colossal costs of colour television capital equipment and its operation over a period of time, its estimates of expenditure and income, its budgets for production. No wonder there has been a kind of "general post" game going on in connection with the new major Yorkshire franchise, to be based on Leeds or Sheffield.

Yorkshire ITA

At one time, a few months ago, there were said to be no less than seventeen syndicates being formed to apply for ITA's new Yorkshire area contract. Lord Hill's "In" tray must have been overloaded with gimmicky glossy brochures, eye-catching illustrations and other ingenious devices for suggesting a super-quality image with Yorkshire regional associations.

I am not suggesting that cunningly concealed mini-magnetic play-offs regaled the reader with a robust choral rendering of *On Ilkla Moor Ba't 'at* nor the more subtle chirrups of the grouse. Nevertheless, a great deal of enthusiastic proposals were put forward. Any ideas of embellishing the covers with attractive reproductions of five-pound notes were instinctively rejected as being outdated.

There was no point in attaching micro-reproductions of Brontë works on a pin-head. The ITA's clear and clipped questions brought the inspired copy-writers down to earth with a bump to the "Out" tray.

The final line-up is likely to be only three or four applicants. At the time of writing, it is difficult to tell. Changes in partnerships have occurred frequently, with local interests becoming most important factors. There are likely to be so many of the original local and London syndicates merged into single licence applications that the winner's prize will be a cake of many slices. Their venture will be a stiff challenge. Just think of what they will have to undertake!

Studio complex

Setting up a brand new major network commercial television station in Britain is bound to be an immense artistic and technical undertaking. It is quite a different proposition from the evolution of a regional commercial station, whose peak programme audience slots are at present obtained from the four major networks: Rediffusion, A-TV, Granada and ABC-TV. Nevertheless, the regionals have to find between six and eight hours of local programmes of all types, many of which are parochial and of no special interest for exchange with other regionals.

However, some of these "parish pump" programmes have great charm and achieve high TAM ratings in their particular areas, whether production costs are high or low. Advertising revenues often fall far short of the production costs of associated programmes. All of these facts, plus the costs of training personnel, plus the costs of building a new purpose-built studio complex in Leeds plus hiring other television stages while the Leeds premises are built and equipped —! Well, it's a challenge—an expensive venture which will not be penny plain, nor tuppence coloured!

Running the gauntlet

But wait! The last hurdles that the TV competitors still have to overcome are the verbal cross-examinations by Lord Hill, Sir Robert Fraser and the Members of the Independent Television Authority. This requires careful preparation, even rehearsals, before facing up to a kind of artistic and technical inquisition, a kind of Grand National with lots of loose horses jockeying for places.

With pale faces and knees knocking, they present their cases with all the gimmicky reasons that might tip the scales. But I can assure them that they will not win by singing songs with bare feet nor taking a lucky nanny-goat with them, borrowed from Foinavon's stable. Iconos, who periodically gives you the winners of TV races, tips you off that the winning post is likely to be a "Yorkshire One" coupled with a rampant lion on an Arts Council field.

Toast 'the guests'

In the palmy pre-war days of Paramount Pictures, a popular innovation was guest appearances by stars (under contract to Paramount) in one another's films. I recall this gimmick particularly in the Hope-Crosby pictures. The same kind of invited (and sometimes uninvited) appearances were occasionally made by music hall artistes during acts of other artistes, in the balmy days of Moss Empires and Stoll Hippodromes.

Alf Garnett is hardly a Hope, a Crosby or a George Robey but the BBC perhaps returned to an earlier era—that of the music hall, for their Easter Monday production of *Till Closing Time Us Do Part*—and with his usual sureness, Dennis Main Wilson created a pub full of guests to share Bank Holiday luck with the unique Warren Mitchell and Dandy Nichols. Full marks to Ray Barrett, Jimmy Tarbuck and Kenny Lynch for playing themselves so convincingly—not the easiest thing to do in a staged pub atmosphere. Alcoholic note —did Auntie BBC purvey the real stuff perhaps?

But I fear the "Alf Garnett" idea is now wearing rather thin, and Johnny Speight must find other angles, so that the joke doesn't become old and corny.

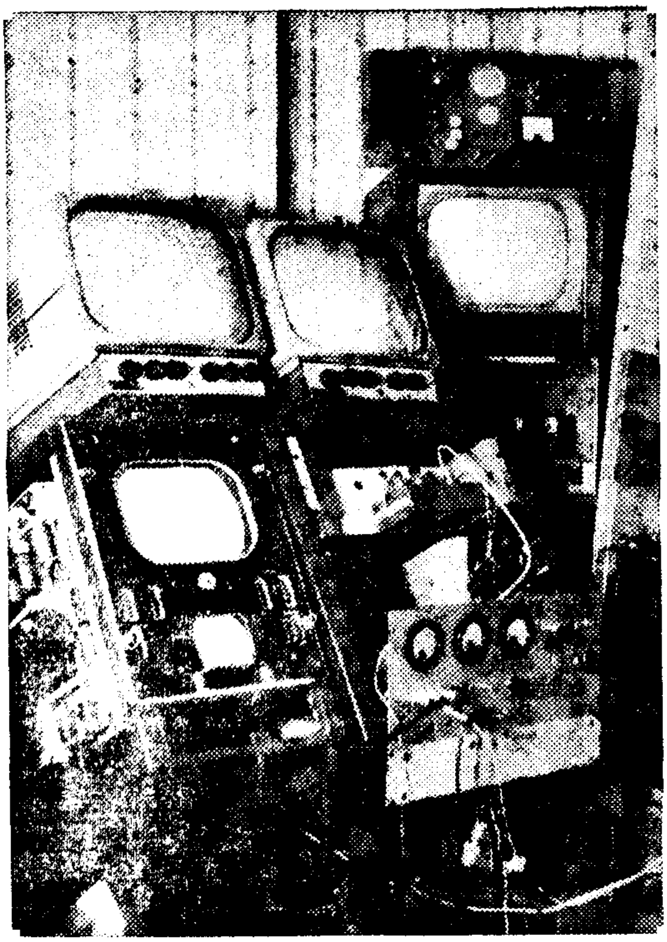
Art of Mogul

In racing parlance, one could describe *The Trouble-Shooters* as by Peter Graham Scott out of *Mogul.* Here is yet another BBC series which is poles apart from the Garnetts or the Forsytes, and consistently first-class teamwork is the key to this success. This team of directors and writers turn out a highly sophisticated presentation; the attention to detail is worthy of Feature Film standard. One main criticism is that often good dialogue lines are lost through poor diction by the distaff members of the cast.

This high standard of presentation is matched by the huge dollar earning success of *The Avengers,* Albert Fennell and Brian Clemens are the producers —and as a first-class script writer, in his own right, Mr Clemens added *Epic* to his gallery of exciting episodes. James Hill's direction of this send-up of the early movies with naturally sinister overtones—with epic performances by Peter Wyngarde and Isa Miranda brought back memories of *The Exploits of Elaine,* Creighton Hale and Pearl White. Let's have a sequel to this one—*Son of Epic* perhaps?

Commercial television companies in Britain cannot now expect to print money, but they certainly are able to supply prints of these exciting serials, for dollars from USA.

Iconos



IDEAS FOR..... amateur TV

M. D. BENEDICT.

Part XI

WITH an A/B vision mixer the output of each bank of the mixer is fed into the Special Effects unit in the same manner as the fader amplifiers. Output from the video switch via the output amplifier and the output of the fader amplifiers are fed through cut amplifiers to the stabilising amplifier, so selection of fade or Special Effect is controlled by a a switch which operates these cut amplifiers. This system allows a very neat and easily operated unit of less complexity when used with the cut/fade type of vision mixer, although the basic A/B vision mixer is more complex.

Greater flexibility is obtained with the special effects unit feeding a cut/fade type of vision mixer. A or B video sources are selected by push buttons, as for the A/B mixer, and the selected output of each is fed to the two inputs of the video switch, the output of which is fed via its output amplifier to a synchronous input of the vision mixer. This simple system is satisfactory until there is a requirement to cut between vision sources on one bank while the Special Effects unit is on the air. Unless cut amplifiers controlled by push buttons are use this cut would suffer from the usual defects of mechanical switches carrying of video. This system is rather complex but has the advantage of being very flexible to use. For convenience, the X and Y potentiometers should be mounted at right angles to each other on the control panel so that the position of the wipe controlled by these potentiometers is indicated by positions of the controls. Also mounted on the control panel are the remote lift and gain controls for the stabilising amplifier used in the Inlay or Overlay functions. The panel, which carries the selector plugs and the wipe potentiometers, etc., should be the same width as the vision mixer and is best mounted above the vision mixer so that it is further away from the operator.

VIDEO SWITCH

On each input to the switch (Fig. 65) an emitter follower, used as a buffer stage, is followed by a clamp which is used to balance the black levels of both inputs. This is to compensate for slight differences between the two circuits. The action of the black level balance control is to raise the clamping potential of the A side whilst reducing that of the B side, and vice versa. To set this control mixed syncs should be fed into both sides of the switch and a line wipe selected, a 'scope will show any variation in black level between the two signals. Gain controls on each channel are similarly adjusted to give 1 volt of sawtooth out of the output amplifier. Another emitter follower feeds the switching diodes, which are not dissimilar from the cut amplifier switches, but the biases are arranged so that hole storage effects do not slow the switch, as is the case with the cut amplifiers. The drives to the switch are derived from the matting waveform and are on opposite phase so that only one side is switched to the output at a time. Clamp pulses are derived from the trailing edge of line syncs and operate the diode bridge during the 'back porch' period. Another source of clamp pulses is shown when dealing with the stabilising amplifier.

STABILISING AMPLIFIER

The stabilising amplifier allows adjustment of lift and gain of a video signal, strips off the syncs, and re-inserts local syncs. In doing this hum and low frequency noise is reduced, and the signal 'cleaned up'. A remotely controlled variable gain stage similar to the fader amplifiers is followed by an emitter follower to provide a low impedance for the clamp stage. A diode bridge clamps the video signal during the back porch period to a particular potential. This potential (6 volts) is derived from the 12 volt supply by a dropper and stabilised with a zener

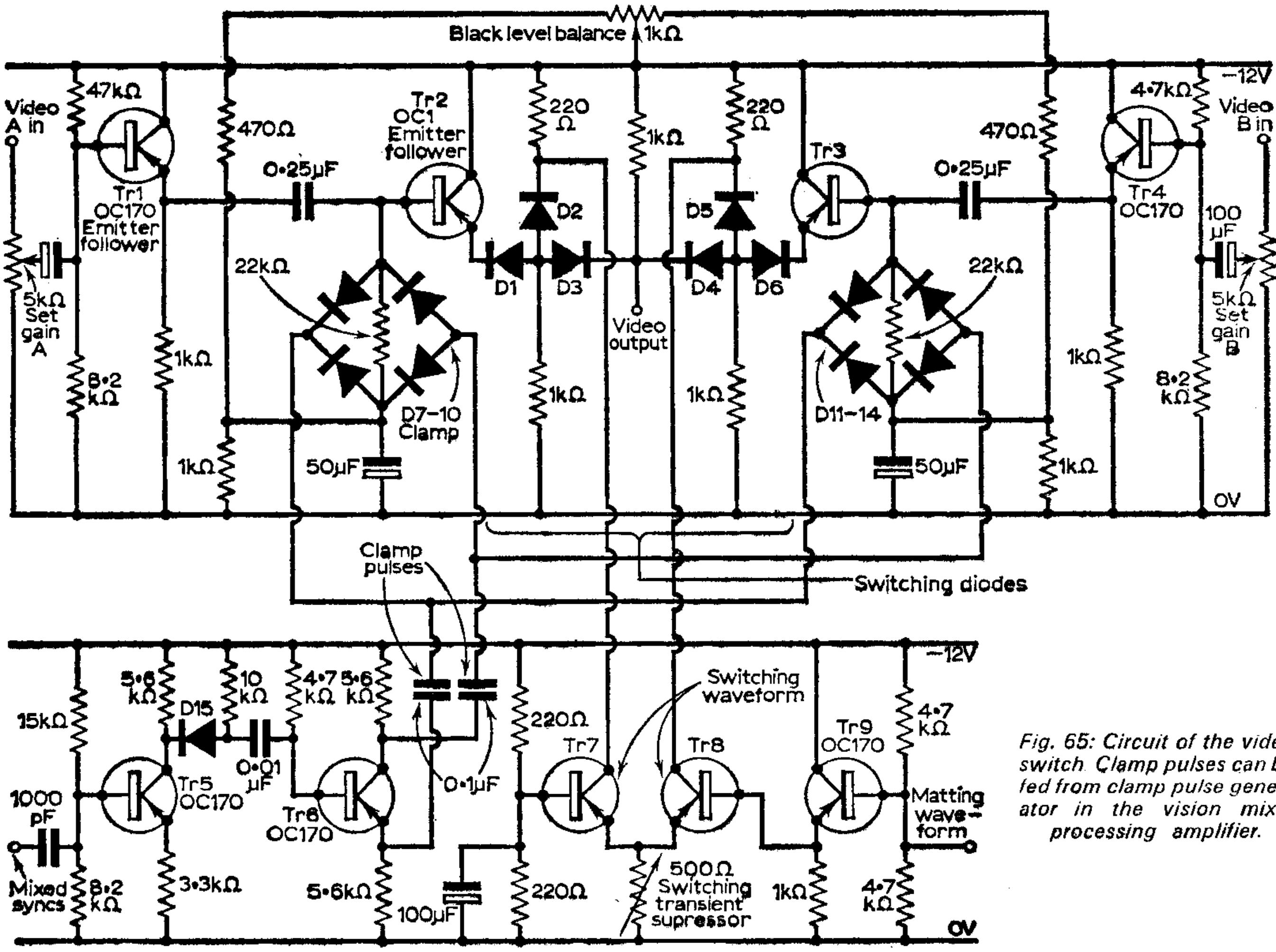
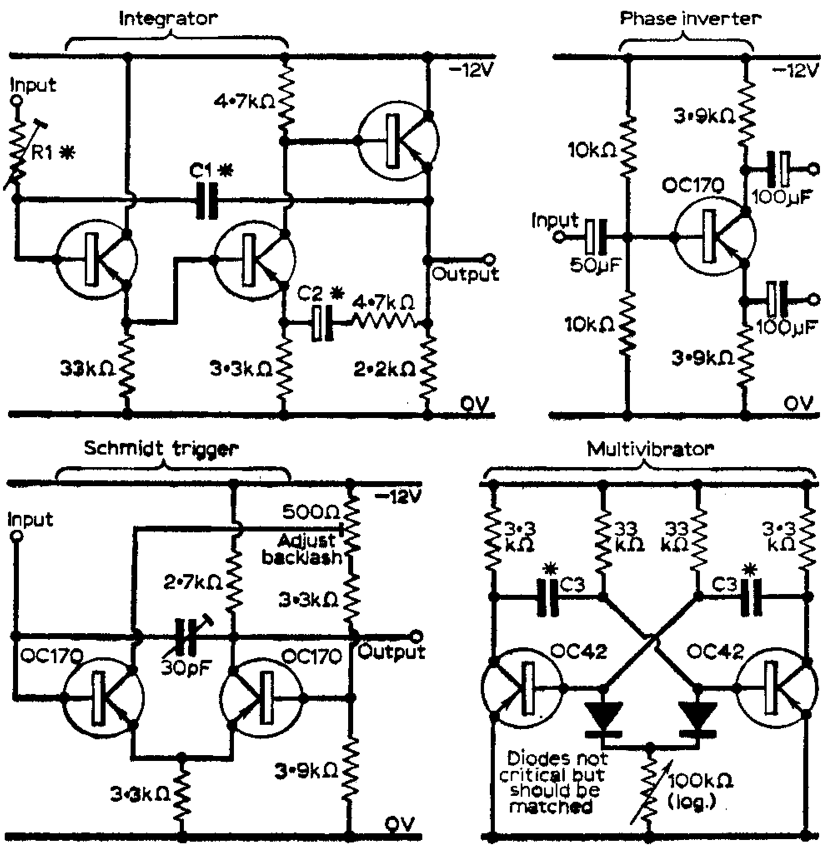


Fig. 65: Circuit of the video switch. Clamp pulses can be fed from clamp pulse generator in the vision mixer processing amplifier.



diode. After passing through two emitter followers this signal is biased by the lift potentiometer which alters the reference black level by a set amount. Mixed blanking is added through its emitter follower and all signals below six volts are removed by the black clipper stage. This effectively removes all signals during blanking, including the original syncs. It will be remembered that, after the fader amplifiers, the original syncs varied in amplitude along with the video. Finally the local syncs are added at the output stage

Fig. 66: The four circuits on the left are—integrator, phase inverter, Schmidt trigger and astable multivibrator. Different values are required for line and field operation in the integrator and multivibrator circuits, these are given in the table below.

*	R1	C1	C2	C3
Line	10kΩ	0·005μF	0·04μF	1500pF
Field	100kΩ	0·22μF	100μF	0·25μF

although a directly coupled output for the Schmidt trigger is taken off after the black clipper for Inlay/Overlay use.

Clamp pulses are derived by differentiating mixed syncs and taking the trailing edge of line syncs and shaping it in what the Americans call a 'Boxcar' circuit. After clipping these are phase split and fed to the diode bridge. Only one clamp pulse generator is really required and this can drive the bridges in both stabilising amplifiers and the video switch. However, it is much better to build a clamp pulse generator for each unit, which is why the simpified unit is shown with the video switch.

The Schmidt trigger (Fig. 66) is another type of multivibrator which changes state when the input voltage exceeds a certain potential (about 6 volts with respect to earth), and changes back when the voltage drops to slightly below this voltage. The difference in voltage is called the 'back lash' and cannot be reduced to zero without the circuit becoming unstable. The practical effect of the back lash is that very small barn door, box or iris wipes have a ragged edge. The variable resistor and the 30pF capacitor are adjusted for minimum ragging.

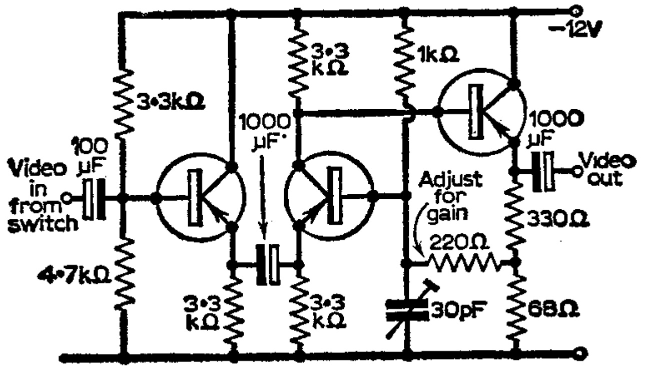
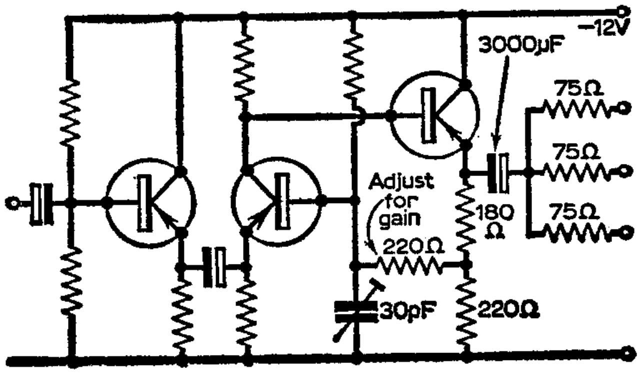


Fig. 68: Vision amplifier (above) giving 10dB gain. The circuit below is for 0dB gain—with three outputs. In both circuits the 30pF trimmer is adjusted for maximum h.f. response.



INTEGRATOR

The two versions for line and field components have some different components but the action is similar; a buffer stage emitter follower precedes the integrating capacitor with a high gain stage connected as a feedback amplifier. A second emitter follower is used as an output stage.

A basic astable multi-vibrator (Fig. 66) is used with a variable resistor shunting the usual discharge path through the 33kΩ resistors. Diodes switch this resistor to whichever capacitor is being discharged at high frequencies when the resistance is reduced, the mary/space ratio, which should be 1:1, alerts unless the diodes are matched for forward resistance. This is best achieved by selection.

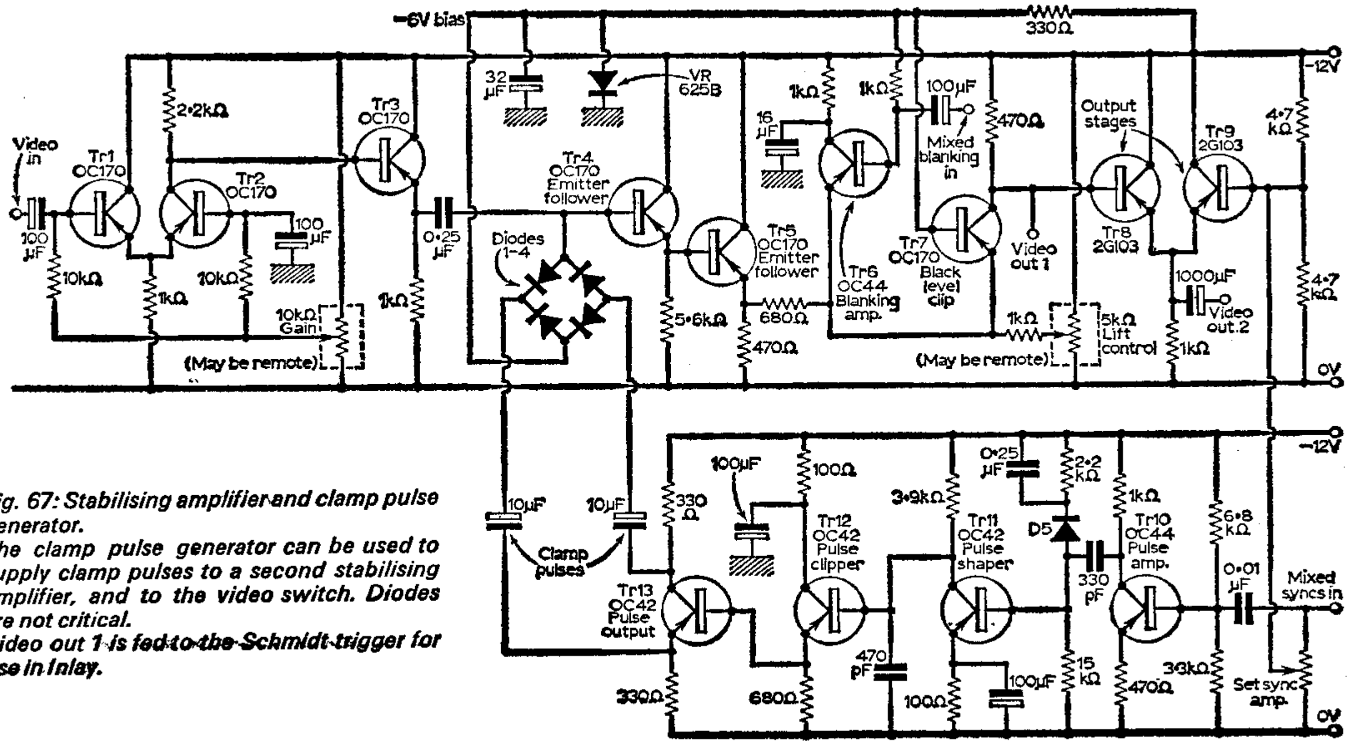
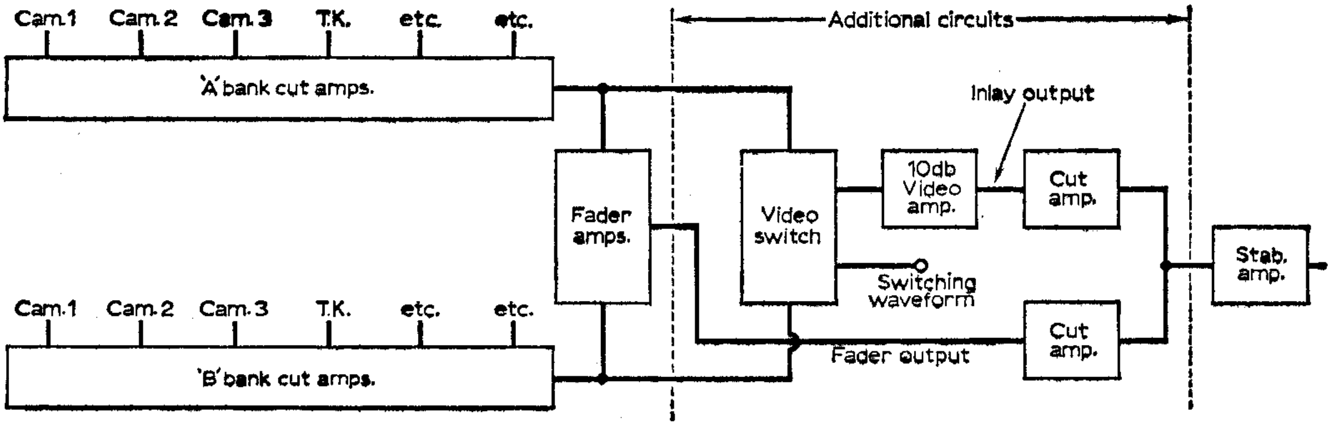


Fig. 67: Stabilising amplifier and clamp pulse generator.
The clamp pulse generator can be used to supply clamp pulses to a second stabilising amplifier, and to the video switch. Diodes are not critical.
Video out 1 is fed to the Schmidt trigger for use in Inlay.



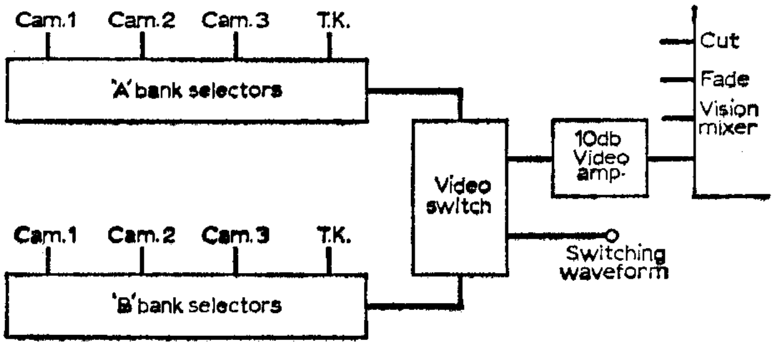


Fig. 69: The upper block schematic shows the A/B vision mixer incorporating Inlay. To the left is shown the cut/fade layout of the vision mixer.

The switched output of the video switch is about 0·3 of a volt and so a gain raising amplifier is needed. This is shown in Fig. 68 and is the same as the output amplifier which follows the cut amplifiers in the vision mixer. The amplifier is an emitter follower input stage feeding a grounded base stage. Grounded base stages are familiar in r.f. circuits but there the advantage is the gain without changing phase. An output emitter follower stage follows with feedback to give the correct gain of 10 dB. In the video switch the output amplifier is built on the same piece of Veroboard.

In designing a complete studio system the video and pulse distribution systems cannot always be 'looped through' so distribution amplifiers are used to provide three isolated outputs from one input. The circuit of the Distribution amplifier is very similar to that of the output amplifiers, so that it is shown in the same diagram. By altering the feedback the gain is reduced to zero and the output impedance at the emitter of Tr3 is reduced so that three outputs can be obtained. Due to this low impedance the outputs are padded out by 75Ω resistors and this results in excellent isolation between outputs so that any interference, mis-terminations, etc., will not reflect on any other output.

to be continued

DX-TV

—continued from page 401

CFTK. Terrace, B.C. Ch. A3. 4·1kW.
CKSO. Elliot Lake, Ont. Ch. A3. 3·7kW.
CFCL. Kearns, Ont. Ch. A2. 14·6kW.
CFCQ. Stranraer, Sask. Ch. A3. 6·8kW.

CANADA FRENCH NETWORK

CBFT. Montreal, Que. Ch. A2. 100kW.
CBWFT. Winnipeg, Man. Ch. A3. 59kW.
CBFT/2 Mont Laurier, Que. Ch. A3. 5·54kW.
CJBR. Rimouski, Que. Ch. A3. 49·3kW.

I hope that we shall be able to illustrate the test card next month when I have it to hand. The call letters are quite large and clear on the card, so if we are lucky we should not have too many identification problems, even with F2 "smearing" of the image.

We have a most interesting report from D. Bowers of Saltash, Cornwall, who says that T.V.E. Spain Ch. E4 was coming in nearly all day on 21/3/67 apart from an interval around mid-day, and that all French channels were good at this time. This would suggest that tropospheric propagation was very good at this time, and I feel that the Spanish reception was by this method and not by S.P.E.

His "star" performer was on u.h.f. on the same date when he received T.V.E. Madrid Navacerrada Ch.24, which is quite a fantastic distance for Band IV.

There is no doubt about this one, and he has even got a photo of the test card, like the Band I version, but with some lettering in a rectangle just above the centre circle, probably the words 2nd Chain, or its equivalent in Spanish, unfortunately not legible on his photo, but what can you expect on these distances on u.h.f.!

PHOTO-CONDUCTIVE LAYER IMPROVES VIDICONS

ENGLISH Electric Valve Co. Ltd has developed a new photoconductive layer which has light-integrating, long-lag characteristics. When used in vidicons for television pick-up from an X-ray image-convertor tube, these layer properties give a much improved picture by increasing the signal-to-noise ratio, eliminating grain, and removing flicker. Picture quality is similarly improved in closed-circuit systems for the transmission of radar displays. This new layer is available in two vidicons (P865 with integral mesh, P868 with separate mesh) which fit into existing standard vidicon cameras.

THE DISCOVERY OF TELEVISION

"THE Discovery of Television", the 50-minute documentary shown on BBC Television in November 1966 has been selected for showing at EXPO 67, the international exhibition being held in Montreal.

The film will be included in a special programme of the best films on Science from seventy countries being sponsored by the National Research Council of Canada under the heading "Insight '67".

The programme will run for the duration of EXPO 67 and will be held in the Du Pont (Canada) Auditorium, Montreal.

"The Discovery of Television" was produced by Mullard Ltd. in association with the BBC to mark the 30th anniversary of the opening by the BBC of the world's first public high definition television service at Alexandra Palace on November 2nd, 1936.

PAL COLOUR TV HANDBOOK FROM MULLARD

MULLARD Ltd. announce the publication of a new book entitled "PAL COLOUR TV . . . The PAL system and Mullard circuits described".

The promise of colour on three channels by 1969 has increased the already considerable demand for information on Mullard circuits for PAL colour receivers and this new book is designed to meet it.

Briefly, the book describes a complete experimental hybrid dual-standard PAL colour receiver, as well as giving a general introduction to the subject.

Chapters are devoted to the vision and sound i.f. amplifiers; the luminance a.g.c. and synchronising circuits; colour decoding circuits; a shunt stabilised line timebase circuit; a field timebase circuit; convergence and raster corrections circuits; coils and circuits for automatic degaussing; and power supply circuits.

Items of circuitry featured are: 405-line monochrome—625-line colour; hybrid luminance amplifier; mean beam-current limiting; true signal level a.g.c.; hybrid colour-processing circuits; 25in. 90 degree scanning; dual-standard convergence; and automatic chrominance control.

The price of the book is 12s. 6d. plus 1s. postage and it may be ordered from Home Trade Sales Division, Mullard Ltd., Mullard House, Torrington Place, London, W.C.1. Cash should be sent with orders.

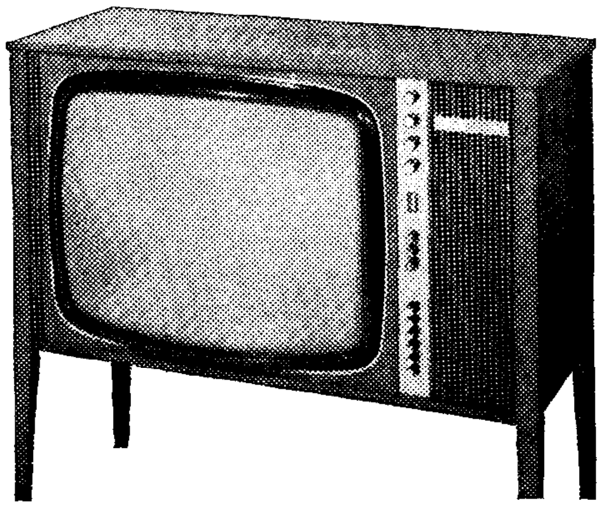
COLOUR IS COMING!

—continued from page 392

from normal black-and-white practice. The chrominance and convergence circuits may seem a little formidable at first, but in fact their functions are not difficult to grasp, and once these are understood any competent service engineer can soon become proficient in the new skills.

HOW RELIABLE?

Although a colour receiver is more complex than a black-and-white one the standard of reliability should be high. Setmakers and component manufacturers have learned a lot over the



Philips first British colour TV receiver, model 500, will sell at about 295 gns.

past few years, and component breakdowns are becoming increasingly uncommon. Added to this the careful design work needed in a colour receiver should leave fewer loopholes for subsequent failure. Shadow mask tubes, too, have to be manufactured so carefully that, although they are inevitably expensive, failures should be very rare.

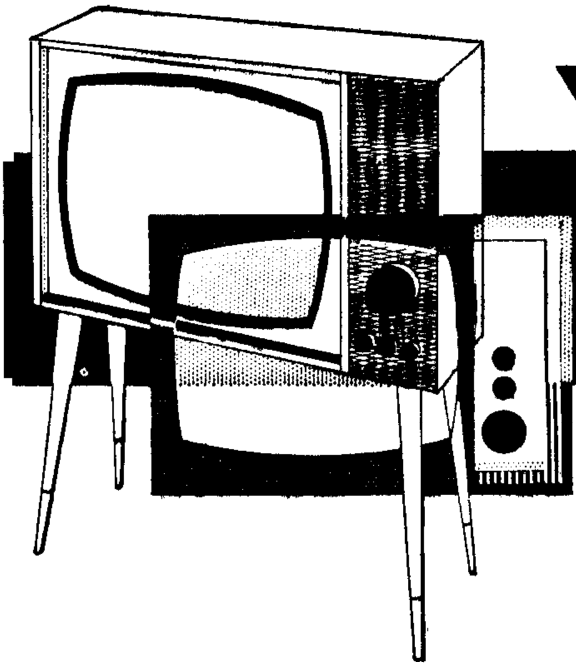
All this seems to indicate that the knowing knockers are going to be disappointed once again, and that colour receivers should give a good account of themselves for at least as long as their more humble black-and-white counterparts.

COLOUR TV AND YOU

The tone of this roundup has been one of restrained optimism because this is how colour TV CAN be, and SHOULD be. Those of us lucky enough to have receivers in our own homes ought to get good colour pictures and excellent entertainment. The rest of us will have a fascinating time catching up on all the new techniques, or learning how to handle receivers.

If the broadcasters and the setmakers do a good job, and all service engineers use conscientious care when installing receivers, most people will agree that COLOUR TV IS EXCITING!

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 diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from page 429 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

PHILIPS 23TG170A

The trouble is the brightness on BBC-2 which is far too great, even with the control turned right down. This excessive brightness occurs after the set has been running for about 5 minutes.—J. Halliwell (Cheadle, Cheshire).

It appears as though the video amplifier valve in your set is slightly defective. On the 625 standard, a.c. coupling to this valve is used, and drift in its characteristics or slight grid current, can disturb the anode conduction sufficiently to give the effect described, although 405 standard is quite normal. This is because the latter is d.c. coupled.

STELLA ST1089A

This receiver needs a new tube. Is it possible to use a 21in. tube without any major circuit changes?—B. Lockwood (Manchester).

We know of no "official" modification allowing the use of a 21in. tube in your chassis, and we have no details of this ever having been tried. We can see no reason apart from mechanical difficulties, however, why this should not work provided you select a tube with the same heater voltage and current ratings and gun characteristics as the existing 19in. tube. 21in. tubes generally require slightly more e.h.t. voltage than their 19in. counterparts for a picture of equal brightness, but it is not possible to step up the e.h.t. in your chassis.

EKCO T293

There is no raster. The sound is quite good but there is quite a large amount of background hum when either BBC or ITV is correctly tuned. All the valves light up, and after about two minutes, once the set has been switched on, a blue glow develops in the line output valve. This valve has been changed for an older one from another TV but there was still no improvement. I checked the voltage for the first anode for the cathode ray tube and it was slightly low i.e.: 100V.—G. Sloan (Cobham, Surrey).

We would advise you to check the e.h.t. rectifier on top of the line output transformer. Check the line timebase generally.

PYE FV4C

This receiver had a broken mains dropper. I replaced it with the mains section from a Ferguson 205T.

The sound is quite good but the picture is very weak and appears negative. The raster does not fill the screen heightwise and it is cramped at the top even with the height control fully advanced.

I have changed the MW36-24 tube and this has improved the strength of the picture but the faults are the still same, and with the vertical hold control fully clockwise the picture rolls.

Also, maximum sound and vision do not occur at the same place on the fine tuner. HT voltage is 195V. Heater voltage of tube is 6·4V (measured with a 20kΩ/volt meter).—M. Hews (St. Ives, Huntingdonshire).

Check the video amplifier, EF80 and the 2μF capacitor coupling the video anode pin 7 to the c.r.t. base pin 11. Check the electrolytics.

For the height fault, check the PL82 valve and associated components, also ECL80 and interlace diodes.

K-B NV40

After this receiver has been on for some time, the picture goes upward about 1in. from the bottom of the screen. Switching off then switching on again sometimes restores the full picture.—A. Thistlethwaite (Darlington).

Check the field output valve by replacement.

PETO SCOTT 1729

There are three or four vertical dark lines on the left-hand side of the picture. They are not apparent on the raster when the aerial is disconnected and barely noticeable when the brightness is turned fully up.—H. Page (Basildon, Essex).

There are two capacitors associated with the deflection coils. Check both of these—one is 56pF 12kV and the other is a 0·001μF. Severe ghosting sometimes gives rise to bars down the left side of the screen.

FERGUSON 246T

Several weeks ago the picture began to flicker and a double image appeared, one image being about ½in. above the other. This was accompanied by cramping at the bottom. After 2-3 days, a foldover of about 3in. appeared and sometime later, this foldover was reduced to about ½in. but the flickering double image still persists. It can be stopped by extremely critical adjustment of the vertical hold, but returns after about 5 minutes. Substitution of the ECL80 field output valve has not improved matters.—P. B. Golding (Carlton, Nottinghamshire).

Try the field timebase oscillator valve. If this is okay and substitution fails to effect a cure, check the field sync feed from the sync separator to the generator section, especially the interlace filter diodes. If all is well here, suspect the field output transformer. That is, if you are absolutely sure that the field valves *are* satisfactory.

GEC BT302

The c.r.t. has been destroyed. I have quite a good Mullard AW43-88 and would like to know if this may be used in this receiver.—P. Donnelly (Glasgow, E.1).

While there are differences between the c.r.t.'s, we feel that the Mullard one would work okay. Theoretically, it needs more e.h.t. than the GEC c.r.t. at present in the set and the first anode and focus potentials differ a little. The base connections are the same, but the heater on the GEC c.r.t. is 12·6V against 6·3V of the Mullard tube. This could be easily buffered of course.

ALBA T644

Sometimes the picture loses both width and height then fades out completely, only to return again as a perfect picture after about thirty seconds or so. Sometimes, however, the picture contracts but does not fade out.

In the right-hand corner of the screen, the picture is distorted slightly and the controls have no effect on this.

The tube was bought new, about three years ago.—R. Alderson (Lincoln).

It is not very likely that the picture tube is causing the symptoms you mention. If the sound fades when the picture faults occur, suspect intermittency in the h.t. rectifier. You could prove this by metering the h.t. line voltage when the set is working normally and also when the trouble occurs. If the voltage drops substantially, the h.t. rectifier should be tested and replaced if necessary.

REGENTONE 192

The sound and scan are perfect but this set developed a fault which burned out resistors R38 (8·2kΩ), R39 (8·2kΩ) and R36 (270Ω). I have replaced these resistors and V6 (EF80), V5 (PCL84), MR1 (OA70), but there is still no vision.—C. Nelson (North Shields, Northumberland).

Check R35 (270kΩ) also the continuity of R33, L26, L25 and L24. Check L23 if necessary.

ULTRA V1780

The picture tends to meet on the right-hand side of the screen, giving a cramping effect. The sound is perfect.—L. V. Harris (Southampton).

The trouble is almost certainly due to the deflection coils. To confirm this, reverse the line coils leads and note whether the distortion is still on the same side of the screen. If it is, replace the deflection coils.

EKCO T418

When first switched on, picture and sound are normal, but frequently after a while, a zig-zag vertical white line flashes momentarily in the centre of the screen and the picture and raster disappear. Sometimes the picture reappears a few seconds later but sometimes will not come back until the set is switched off, then on again. All this time, sound remains quite normal.—J. Bell (Northumberland).

The symptom described indicates that the line timebase fails momentarily and then restores to normal. Almost any component in the line timebase, if intermittently defective, could cause the effect, but the booster diode or the line output valve, in the e.h.t. section of the set, is a frequent offender in this respect. Testing on a valve tester would not reveal the trouble and you will have to check with valves known to be in good order.

MURPHY V150

There is a good picture three-quarters of the way down the screen, but at the bottom there is reflection and several white lines. When the vertical hold is adjusted there is rolling of picture and this will not lock into a full picture.

I should also mention that the slider of the control must be at the earthy end before I can receive the picture mentioned above.—G. Jones (Halesowen, Birmingham).

Have both field timebase (20F2) valves tested for emission. If they are both in order, check the 25μF bias electrolytic of the output 20F2. Assuming this is up to capacity check the 1·2MΩ and 1·5MΩ resistance which are in the anode circuit of the field oscillator. There is a possibility that these resistors may have "gone high".

PHILIPS 1768U

There is a flickering on the screen. I have changed the field valves but this has made no improvement. The field hold control locks the picture, but the picture cannot be slowed down or made to travel upwards or locked in any other position. Furthermore, the field hold control is nearly at the end of its travel when it does lock the picture.—H. Munday (Finsbury Park, London, N.4.).

If the picture is locked properly and normal rolling occurs when the vertical hold control is turned from its locking point, the flicker effect could well be caused by the use of too great a brightness control setting. This often happens when a set with a fairly reasonable tube (i.e. good emission) is being run in high ambient light. Alternatively, check the interlace filter diodes in the field sync circuit from the sync separator stage to the field timebase generator and the h.t. smoothing electrolytics, the latter particularly if hum on sound is rather high.

K-B OV30

The sound was normal but the picture collapsed and disappeared. Only a weak spark could be drawn from the e.h.t. lead removed from the tube. An arc about ⅛in. could be drawn from the top cap of 50CD6G, but after a few moments this spark diminished to nothing. The 50CD6G, PY83 and R19 were tested but pronounced all right.—A. Durn (Birmingham, 14).

We would advise you to check the PCF80 video amplifier-line oscillator. Check the boost line capacitors if necessary (0·2μF 1kV etc.).

STELLA 1043A

There is no picture or line whistle present. I have fitted a replacement line output transformer and renewed associated valves, DY86, PL36 and PY800 but no improvement has been noted.

Prior to this fault occurring there was a reduction in sound on plugging in the armchair control unit.—J. Clare (Oldham, Lancashire).

The trouble could exist either in the line timebase generator or the line output stage, and there is no clue at all in your letter with regard to this. Listen very carefully for the line whistle, with the aerial removed and when the line hold control is operated over its full range of travel. If a weak whistle is heard you can be sure that the generator section is working. In this event, check the screen grid feed to the line output valve, booster reservoir capacitor and associated components. Otherwise, concentrate attention to the generator section.

PHILIPS 1768U

The picture is locking halfway with a black line across the middle. I have replaced V6 and V14 but the fault still persists.—V. Cole (Andover, Hampshire).

If the PCL82 and ECL80 valves are in order, make a general check on electrolytic capacitors. If the hold control is at one end check the associated resistors.

SERVICING BOOK

I would be obliged if you could let me know of a suitable book to buy on television for an absolute beginner, with a view to servicing one's own TV set, etc.—A. H. Barnett (Solihull, Warwickshire).

There is no one book which would suit an absolute beginner to service his own set.

Gordon J. King's *Television Servicing Handbook* is an admirable work and could be coupled with one of the Sim-Tech book courses.

PHILIPS 23TG170A

The picture on 625 lines is much too bright—even with the control turned right down.—G. Wallace (Redcar, Yorkshire).

We would advise you to replace the PFL200 video amplifier. If necessary also check the associated components.

PHILIPS 1115U-15

The picture appears with the top half at the bottom of the screen and vice versa. Also, a resistor on the furthermost back mains dropper has cracked in half and is sparking. Could you please state the value of this component?—J. Regnault (Great Bookham, Surrey).

It is possible that the resistor across the mains dropper is a thermistor. This is an all-black, carbon-looking component and is a Brimistor CZ4.

The picture fault indicates trouble somewhere in the field timebase. If the vertical hold control is at range centre and turning it through its range fails to affect the symptom described, check the components connected directly to the vertical hold control, particularly the series resistor, for changed value.

SOBELL ST285DS

I would like to fit a u.h.f. tuner to this set. Could you let me know the type or make of tuner and also say what additional components may be required.—H. Shepherd (Rotherham, Yorkshire).

Only the tuner is required and this can be obtained from a Sobell dealer or from one of the advertisers in this journal.

VIDOR CN 4231

Could you suggest how I might cure the appearance of the Pulse and Bar signal on BBC-1? This appears about ½ to 1in. down the screen, depending on the frame hold setting which makes the lock ineffective if it is taken too far.—U. J. Smith (Egham, Surrey).

There is very little that can be done to eliminate the pulse and bar when an oscillator (blocking) transformer is used, as it is the design of this which determines the retrace period. The only solution is to replace the blocking transformer.

DECCA DM22C

I would like to convert this receiver to receive BBC-2 programmes.—D. White (Co. Armagh, N. Ireland).

Although a u.h.f. tuner can be fitted with an i.f. panel with output to the c.r.t. and sound output, the trouble is getting the line output stage to work on the 625 standard. Whilst the frequency change is quite easy, the line output transformer and scancoils do not take kindly to modification and we do not recommend it.

PHILIPS 2157U

The sound on this set is perfect and the picture quality is good on ITA and BBC, but it is very hard to control it from sliding to the left, off the screen. If I do finally succeed in centring, the picture it breaks in at both sides.—G. Porter (Lanarkshire, Scotland).

First check the ECL80 line control-oscillator valve. Then check the OA71 discriminator diodes and associated components. Check the video electrolytic capacitors if necessary.

ULTRA V600

On the receiver, I am having trouble with loss of picture height, the line and bottom of the picture remain normal.

I have changed the field amplifier valve which is designated V4, this has not cured the trouble. —D. Goldberg (Gants Hill, Ilford, Essex).

Check the condition of the 6K25 and the resistance associated with the height control. Often, either this valve or, one or more of the associated resistors becomes defective and causes the reduction of field scan amplitude.

FERGUSON 3621

The picture keeps rolling, then suddenly it rights itself. The control does not remedy this fault and is at the end of its travel. All the valves are okay.—D. Griffiths (Bridgend, Glamorgan).

Check R138 (22kΩ) to the anode of the field oscillator ECC804 (6/30L2) and the 2·2MΩ R144 in series from the hold control to the PCL85 triode grid.

HMV 1843

Although this set is giving quite a good picture, I think there is a heater-cathode short on the tube. On advancing the brightness control, the picture moves in from both sides and stretches from top to bottom. I have had PL81, PL83, PY81 and U151 valves tested and found in good order. Also, with the brightness at maximum, the picture blacks out.—P. Summersby (Newcastle upon Tyne, 2).

If the tube had a heater-cathode short, there would be no picture at all. Check the PL81 line output valve (N152) also the video amplifier and 15kΩ loading resistor.

QUERIES COUPON

This coupon is available until JUNE 23rd, 1967, and must accompany all Queries sent in accordance with the notice on page 425.

PRACTICAL TELEVISION, JUNE, 1967

TEST CASE -55

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.

? *A picture fault on a Murphy was described by its owner as a gradual creep-in from the right of the screen, eventually leaving a black, vertical 1in. edge to the right-hand side of the picture. It was proved that this fault developed to its maximum after about an hour from switching on.*

Both the line output valve and the booster diode were checked by substitution for this kind of thermal fault—taking an hour or so fully to develop—is frequently caused by a valve falling in emission or changing in characteristics. The Murphy in question uses a 30P19 output valve. This and the booster diode replacements had no effect on the condition, and neither did changing the line generator.

A check was made of the smaller components in the line timebase and booster diode circuits with no luck. It was thought that the line drive reduced in amplitude as the fault occurred, but this was disproved by checking with an oscilloscope—the waveform to the input of the 30P19 remained constant even when the picture closed in at the right.

Knowing that the valves were not responsible, what factor should have been looked for by the technician investigating this symptom?

The answer will be given in next month's PRACTICAL TELEVISION, *along with a further Test Case item.*

SOLUTION TO TEST CASE 54
Page 381 (last month)

Vertical ripple if unaffected by the line hold control is often caused by ringing in the line output stage. This is a form of damped sine-wave oscillation modulating the line scan. Trouble of this kind can result from an open-circuit damping resistor across an inductive component in the line output stage, the damping resistor effectively reducing the amplitude and time of each oscillatory burst.

Rarely does the trouble cause a whole series of vertical "wobbles" across the screen, since the oscillation is usually damped out right at the start of the line scan. However, there is a fault of this kind which is caused by the retrace pulse of the field timebase triggering the line scanning coils into a ring due to mutual coupling between the line and field coils. This gives a diminishing series of vertical wobbles at the left of the picture.

Having this knowledge, the technician went on to investigate the scanning coils in detail and was rewarded by discovering a fracture in the brass band locking the coils to the cores. Tightening the coils to the cores by an improvised band cleared the symptom completely. The effect was caused by the reduced coupling from coils to the cores having less influence on the deflection of the electron beam—giving the reduced width—and encouraging mutual coupling between the line and field coils and consequent ringing effects.

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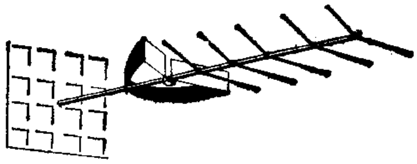

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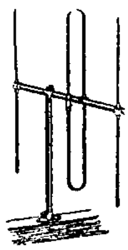

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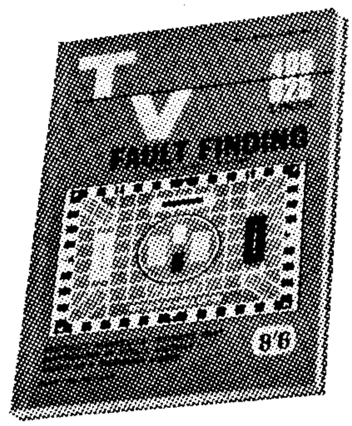

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