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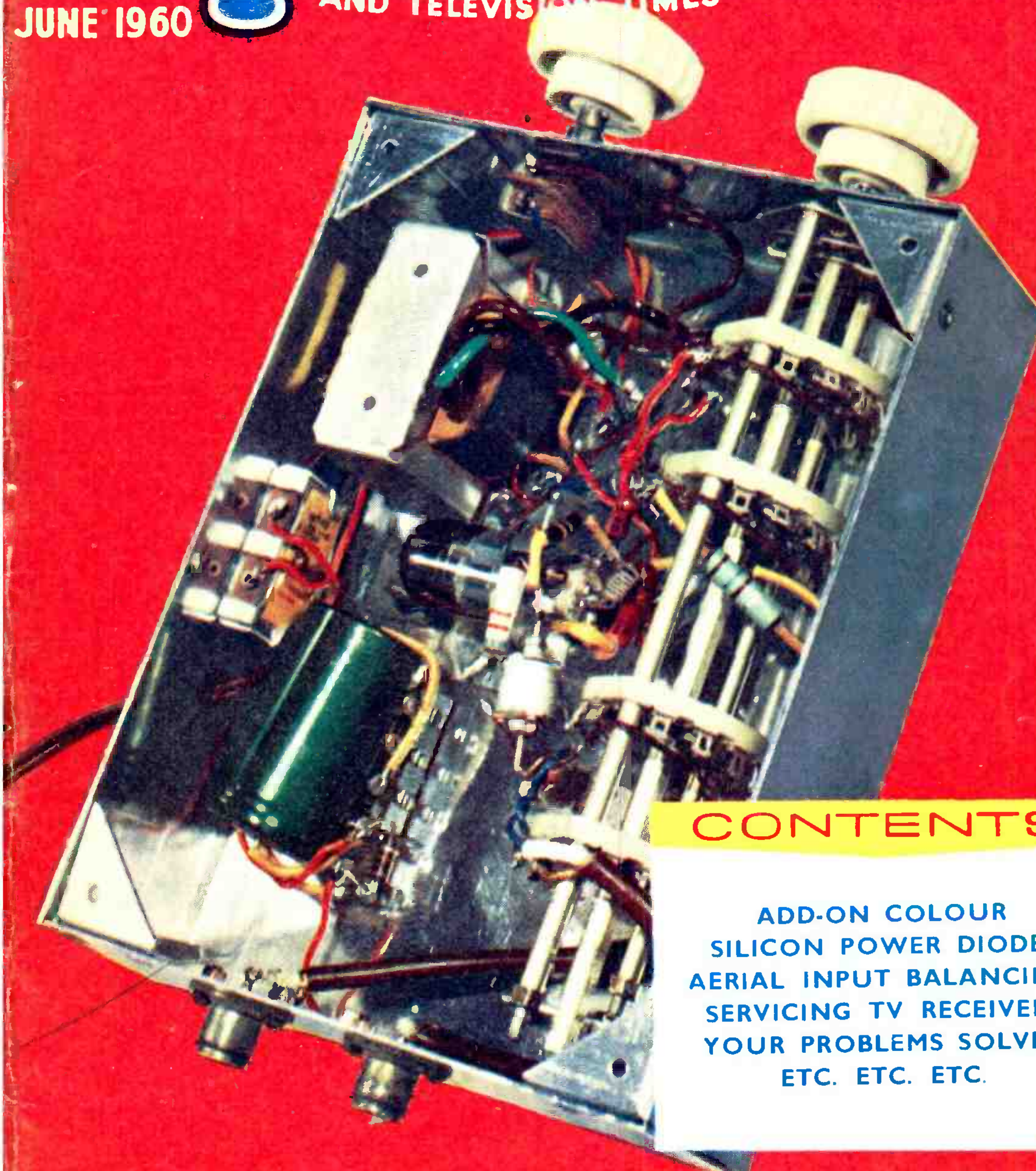

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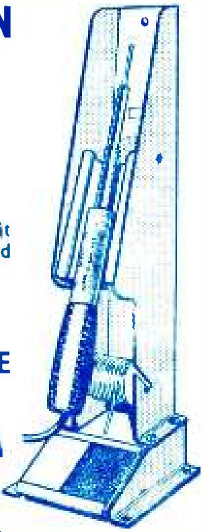

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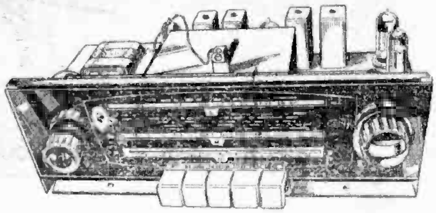

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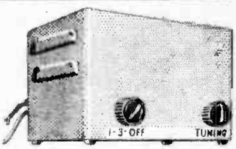

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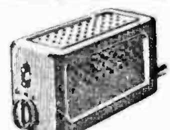

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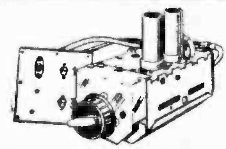

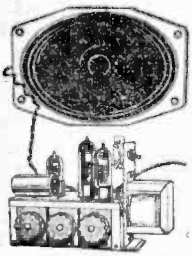

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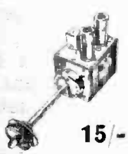

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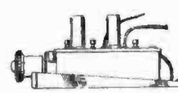

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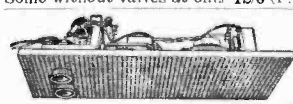

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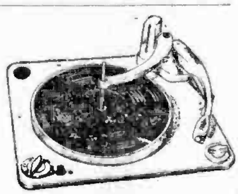

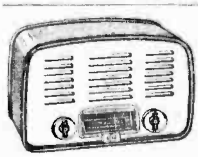

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Practical Television

& TELEVISION TIMES

Vol. 10 No. 117 EVERY MONTH JUNE, 1960

Editorial and Advertisement Offices:
PRACTICAL TELEVISION
George Newnes, Ltd., Tower House,
Southampton Street, London, W.C.2.

Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

SUBSCRIPTION RATES
including postage for one year

Inland	£1.2.0 per annum
Abroad	£1.0.6 per annum
Canada	19s. per annum

CONTENTS

The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Television". Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for the manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed to: The Editor, "Practical Television," George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2.

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

Useless Gadgets

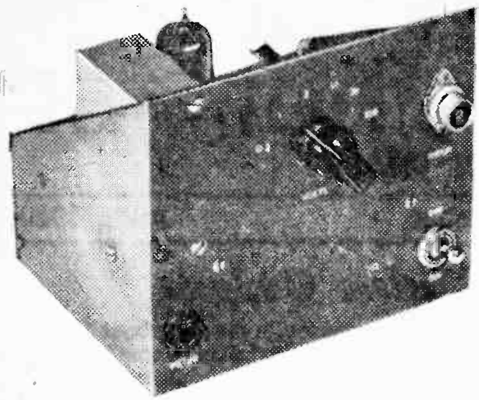
THERE have been many outcries in the past about the rapidly increasing number of television aerials to be seen upon almost every rooftop. With the opening of each television transmitter, skylines all over the country have become more and more ugly, and, while many bodies—local councils, associations of architects and the like—have been conscious of this addition to Subtopia, their arguments against it have met with little or no result. With the possibility of further alternative television programmes making their appearance, it is obviously desirable to seek some method of reducing the numbers, or at least the size, of aerial arrays. There are both aesthetic and practical grounds; large multiple aerials are not an attractive sight and, after all, most chimneys have not been built to withstand the considerable strain of supporting a large mass.

In recent years the sensitivity of standard, as opposed to fringe area, models has been considerably increased. This has been achieved by the development of new circuits and particularly new valves—the frame grid double triode for R.F. stages is an instance. The increased sensitivity has enabled simpler aerials to be employed which are less obtrusive than multiple element arrays. In fact, near the transmitter, it is now common for receivers to operate from a simple, two-rod aerial placed on top of the set.

So far as the general public is concerned, the technical problems involved in television, and wireless, are unknown and therefore the opinions of experts and, to a large extent, of advertisements, are the only sources of information. A situation has now arisen similar to that which developed early in the history of radio; readers may remember devices which were sold to eliminate the use of aerials. These consisted of a 1 or 2μF condenser in an attractive tin box to be included between the earth lead and the aerial socket. These devices were sold by the hundred at a very high profit and can still be found on sale in certain market squares. The equivalent device in television, which is now on sale, is claimed to eliminate the use of conventional aerials and enables the TV set to be moved from room to room as a "portable" receiver. One device consists of approximately 4ft of 14/36 PVC-covered wire to one end of which is fastened a coaxial plug while the other end is terminated in a small plastic container. Of course, in areas of high signal strength, a picture can be obtained with this as with any other short length of wire, but good reception will rarely be obtained—ghosting and fluctuation with movement in the room are only two of the faults.

Those who have some knowledge of television and radio are naturally aware that any device of this kind can only benefit its makers (financially). It is essential to use properly designed aerials and the layman should be protected from the marketing of virtually useless gadgets.

Our next issue, dated July, will be published on June 22nd



Simple Valve Voltmeter

COMPLETE DETAILS OF THIS USEFUL INSTRUMENT

By R. C. Marshall

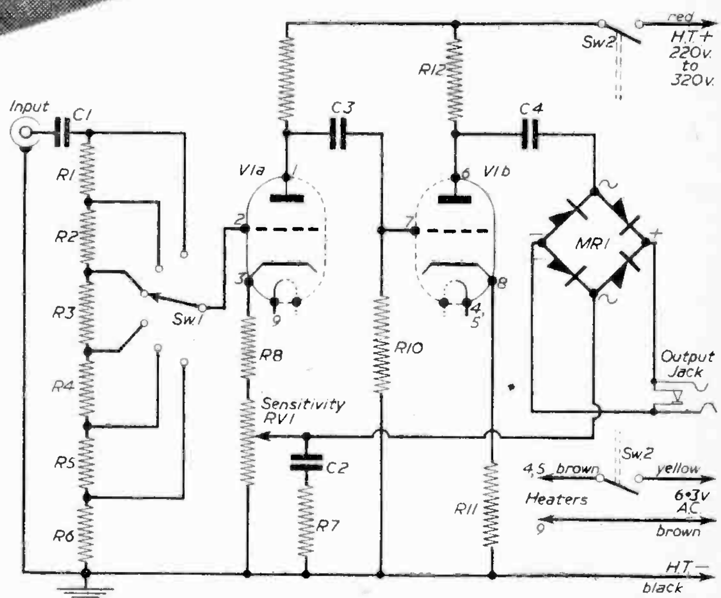


Fig. 1.—Circuit of the valve voltmeter.

THE device to be described measures, in conjunction with a 1mA meter and suitable power supplies, A.C. signals between 10c/s and 60kc/s, of amplitudes between 0·1 and 10V. It has an input impedance of 0·5M, so that it does not appreciably load the circuit under test.

It can be used for checking test equipment, audio and supersonic voltages, measuring gain, feedback factor and output power.

The voltmeter consists of an input attenuator, acting as a range switch, followed by a two-stage resistance-capacity coupled amplifier which drives a 1mA meter via a full-wave bridge rectifier. A total of 30dB feedack is provided by unbypassed cathode resistors in both stages, and by overall current feedback from the output to the first valve cathode. This gives a feedback voltage proportional to the output current, eliminating much of the non-linearity associated with meter rectifiers. The amount of this feedback, and consequently the gain of the amplifier is adjusted by the wirewound potentiometer RV1. C2 and R7 reduce the feedback at high frequencies to compensate for the fall in amplifier gain due to stray capacitances.

The minimum frequency is governed by the values of C3 and C4, and is about 10c/s.

The second stage feeds into a very low load impedance, and to give high gain without distortion a high-slope low-impedance valve is desirable. Consequently a 12AT7 double triode is used.

The attenuator consists of high-stability resistors with a total resistance of nearly 0·5M. This is a somewhat low value for a valve voltmeter, but it is the best that can be achieved without the use of a cathode follower. Even with the values specified, on the 1V range where the resistance feeding the first stage is highest, stray capacitances cause

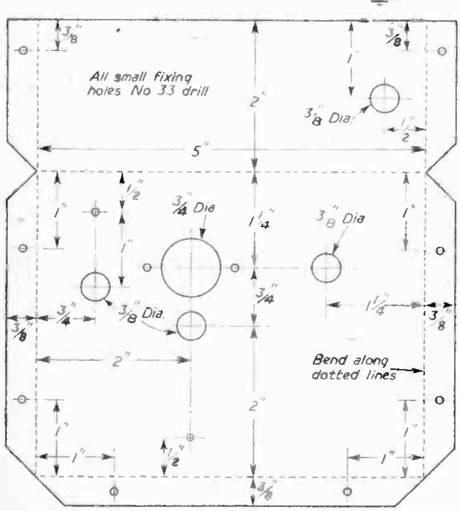


Fig. 2.—Chassis bending and drilling details.

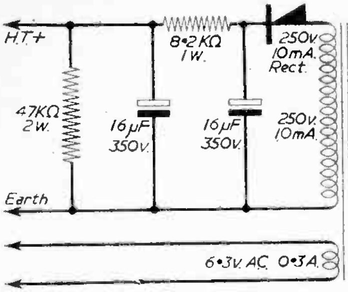


Fig. 3.—A mains power supply unit.

the meter to read 5 per cent low at 25kc/s. On other ranges the maximum frequency is 60kc/s.

The external power supplies required are 220 to 320V D.C. at 3 to 5mA, and 6·3V A.C. at 0·3A. If it is desired to make the instrument self-contained, a larger chassis may be used to provide space for the power pack and 1mA meter beside the unit described in detail. A suitable supply unit is shown in Fig. 3.

It is recommended that the layout shown in the diagrams be used, or modification to the values of R7 and C2 may be required. Chassis details are given in Fig. 2.

Wiring

First wire up the attenuator as a separate unit and then assemble the chassis and all those components which are bolted to it. Next wire up the power cable and on/off switch SW2, and connect the attenuator to pin 2 of the valve. Lastly, the remaining connections should be made and the wire-ended components fixed. The meter should be connected by the wires supplied, as soldering directly to its tags will cause damage. Note that neither side of the meter is earthed; make sure that the jack used does not introduce such an earth.

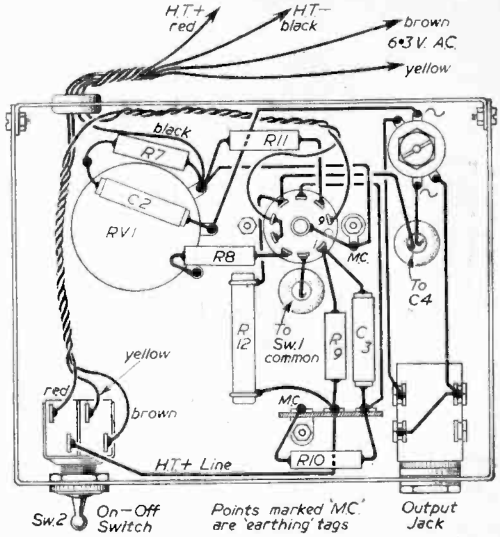


Fig. 4.—Underchassis wiring scheme.

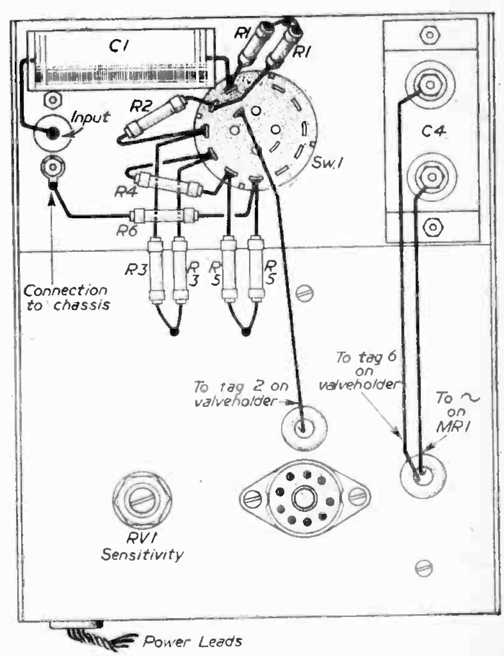


Fig. 5.—Above chassis and panel wiring details.

COMPONENTS LIST.

Capacitors:
- C1—0·5μF paper 350VW.
- C2—0·001μF paper 350VW.
- C3—0·005μF paper 350VW.
- C4—2μF paper 350VW.

Resistors:
- R1 to R6 are attenuator resistors and must be of high stability. The table on the next page lists these and at the same time shows the voltage readings which these values will give.
- R7—3·9k.
- R8—150Ω.
- R9—100k.
- R10—1M.
- R11—680Ω.
- R12—68k 1W.
- All ½W except R12 and all of 10 per cent tolerance.

Miscellaneous:
- MR1 1mA meter rectifier.
- V1 12AT7.
- SW1 1-pole 6-way wafer switch.
- SW2 DPST toggle switch.
- RV1 500Ω wirewound potentiometer.
- Closed-circuit jack socket.
- Coaxial socket.
- B9A valveholder.
- Aluminium (18s.w.g.) nuts, bolts, solder, tags, tag strips, grommets, wire, sleeving, knob.

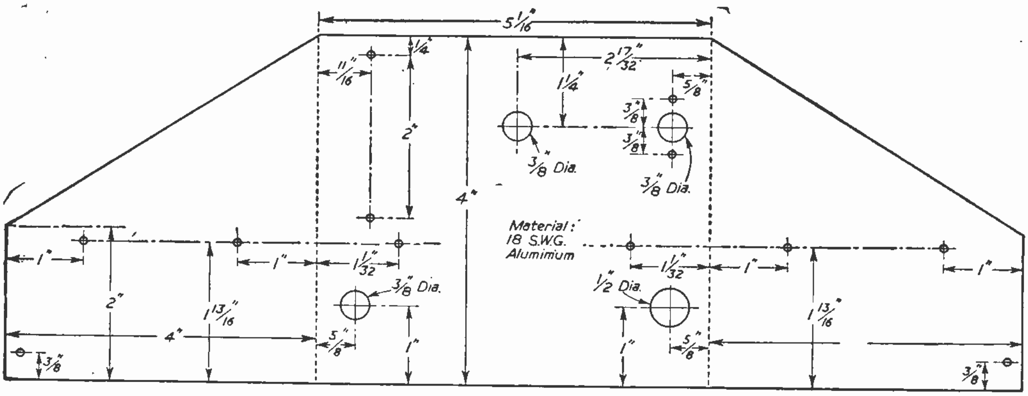
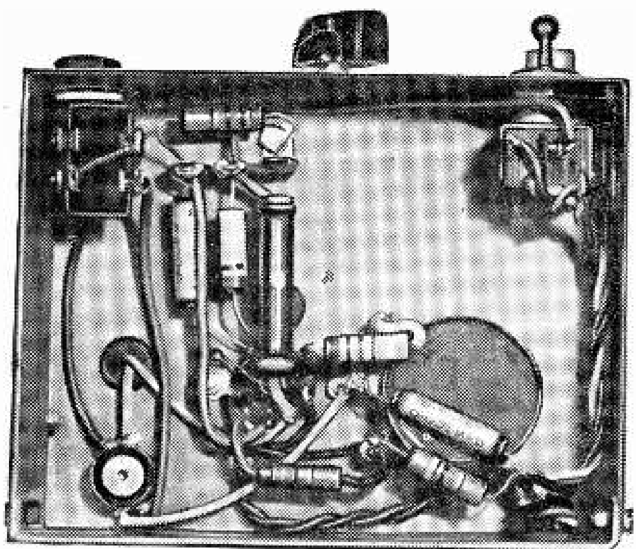


Fig. 6.—Case bending and drilling details.



Underchassis wiring.

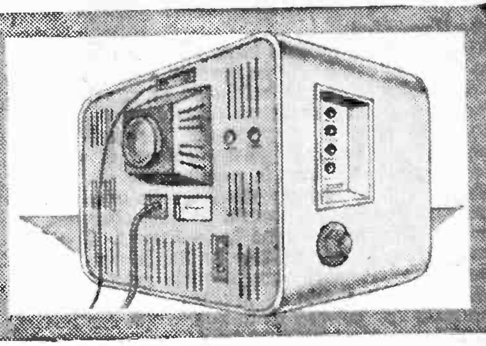
ATTENUATOR RESISTORS (All ¼W high-stability)
R1—700k i.e. 200k + 500k.
R2—200k.
R3—70k i.e. 20k + 50k.
R4—20k.
R5—7k i.e. 2k + 5k.
R6—3k i.e. 2k + 1k.
With these resistors, ranges are:
1—300mV.
2—1V.
3—3V.
4—10V.
5—30V.
6—100V.

Calibration

The meter should be calibrated initially against a standard, which may be any accurate A.C. meter. This may conveniently be done at 50c/s. The comparison should be made on as many ranges as possible, to check the attenuator. The meter sensitivity is adjusted by RV1. As a check on open-loop gain, turn RV1 to the position of maximum sensitivity and check that the meter is 7 to 10 times as sensitive as it was when correctly adjusted.

When correctly adjusted the meter reading is unlikely to be in error by more than +1 per cent or −4 per cent over any of the operating ranges specified above. Changing valves may introduce up to 2 per cent variation, so recalibration is desirable but not essential.

When the meter is used with speech or music signals, it must be remembered that whilst calibration is in terms of r.m.s. voltage this is only true for sinusoidal inputs, as the meter actually measures average voltage.



Servicing Television Receivers

No. 56—THE H.M.V. 1824 SERIES

By L. Lawry-Johns

THIS series of models include the 1825, 1826, 1827 and 1829 which are all single band, five channel A.C./D.C. receivers, the 1824 and 1825 being 14in. with an emiscope 4/14 tube, the others being 17in. with an emiscope 4/15. Most of these will have been fitted with a dual band tuner unit but notes will be included on fitting such a unit for the benefit of those who have the receiver as originally supplied and who are thinking of adding dual band facilities. The chassis layout diagrams show the position of most components and it is pointed out that CK7 (choke) is only fitted on console models with P.M. speakers. The table models use an energised speaker, the field winding of which functions as a smoothing choke. Several modifications were made from time to time and the circuits shown will not apply in every detail to all models.

Later Versions

Dual band models were produced with an incremental inductance tuner, some with some without AGC. These dual band models were suffixed "A". Thus the 1824A is the dual band version of the 1824.

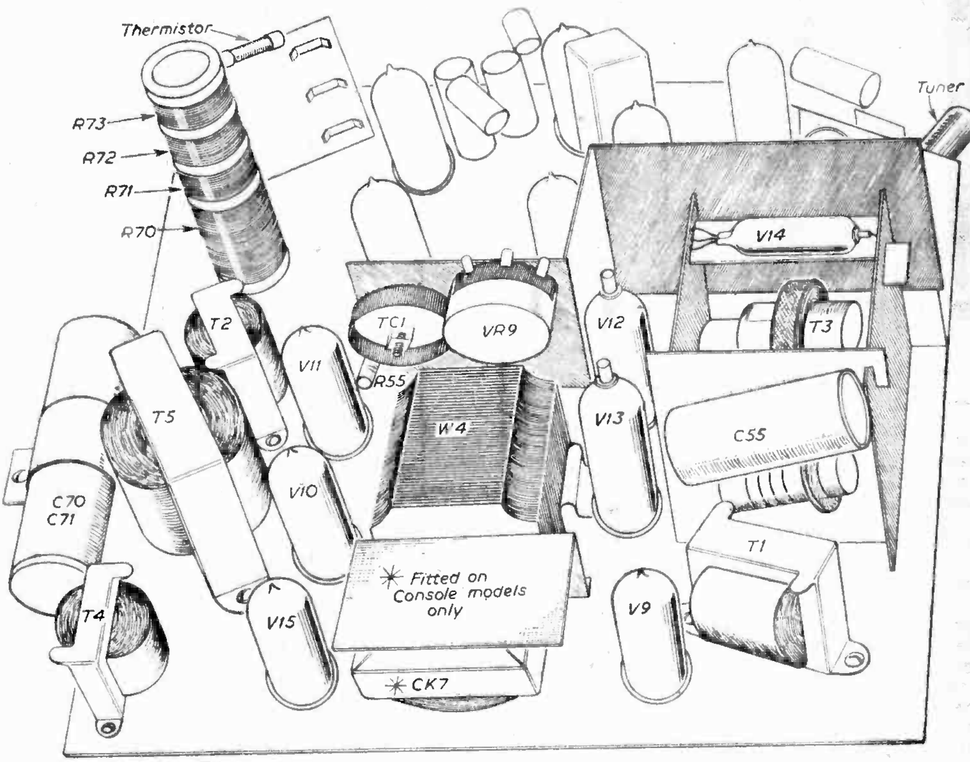


Fig. 1.—View of the timebase chassis.

Tube Troubles

Most of these models have by now had a new tube fitted or are badly in need of a new tube.

When advancing the brilliance or contrast fails to produce a brighter picture merely causing a grey picture to become greyer with the light areas appearing to have a silvery effect, it can be assumed that the tube is nearing the end of its useful life. A temporary relief can be obtained by increasing the heater current passing through the tube and this can be done in two ways. The first is to apply a higher voltage to the heater from a separate transformer, removing the existing heater leads from pins 5 and 7. The second is to add an extra path for current to flow through the heater, in addition to the normal 0·3A of the heater chain. This is done by connecting a resistor of about 5 or 6k (10W) from a mains point to pin 7. This method is particularly useful when the receiver is operated on D.C. mains where a transformer cannot be used.

Heater Voltages

Where a transformer is used, the existing voltage dropped across pins 5 and 7 should be measured as the type of the tube fitted has had its voltage rating altered over recent years. Most of the original tubes were rated at 13 volts but later tubes were produced with 10 then 8·5V heaters. Thus, if the voltage across pins 5 and 7 is 13, a transformer of this rating with a boost tapping of say 20 per cent may be used. If the voltage is lower, the transformer can be used but without the boost tapping.

When the original heater leads are removed, they should be connected together to preserve the continuity of the heater chain and the mains adjustment raised say from 4 to 5 to compensate for the absence of the tube heater.

When a resistor is used to boost the heater current, one end should connect to terminal 1 or 3 on the mains panel, the other to the tube base pin 7 leaving the original wiring intact.

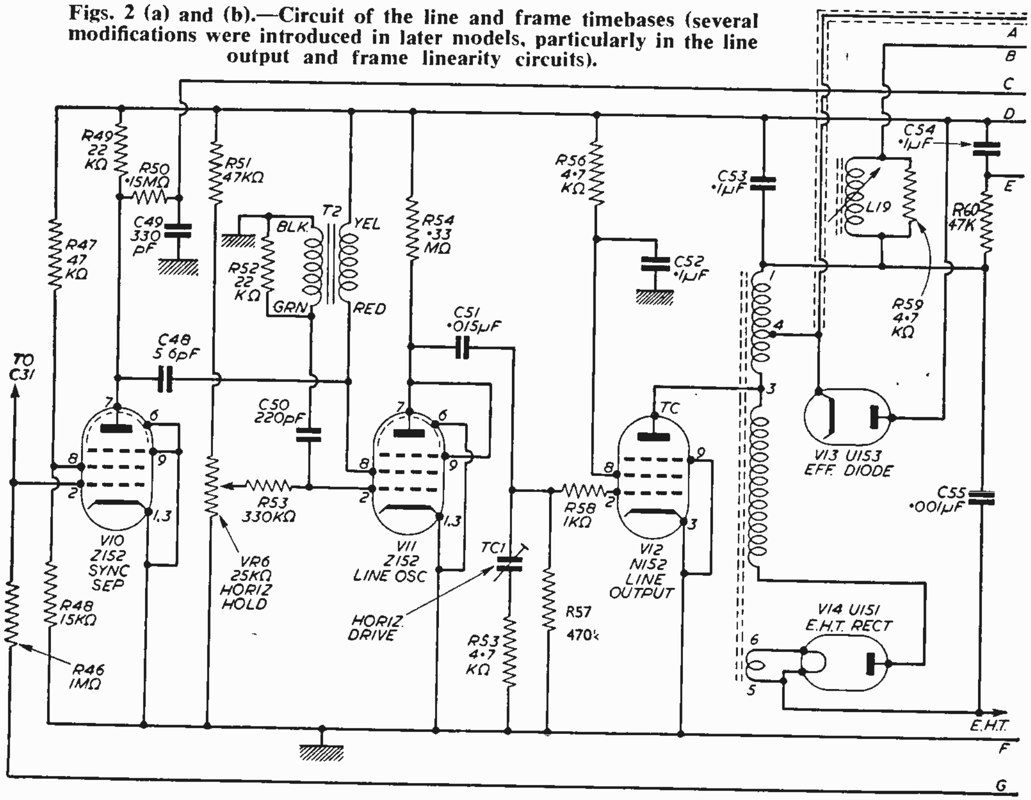
Fitting a New Tube

There comes a time however when these methods fail to coax even a small increase of emission from the tube cathode and it then becomes necessary to replace the tube. Most tube rebuilders do not undertake to regun Emiscope tubes but there are some who do and one at least advertises regularly in PRACTICAL TELEVISION. Sometimes it is necessary to change the base socket to B12A (duodecal) but this need cause no alarm. Reference to the timebase diagram will show the tube base connections as, heater 5 and 7, cathode 6, grid 3 and first anode 2. The resistors R76 and R77 should be removed altogether. The duodecal base has base connections: heater 1 and 12, cathode 11 grid 2 and first anode 10.

Electrostatically Focused Tube

Sometimes it is desired to fit a different type of tube and in the case of the 14in. models and where

Figs. 2 (a) and (b).—Circuit of the line and frame timebases (several modifications were introduced in later models, particularly in the line output and frame linearity circuits).



it is necessary not only to alter the wiring as above but also to add an ion trap magnet, difficulty is experienced in correctly placing this owing to the new tube having a shorter neck. The beam shift ring can be dispensed with but even so difficulty is experienced. To avoid this, it is quite in order to remove the actual focus magnet completely and to use an electrostatically focused tube such as the Mullard AW36-21. With the focus magnet out of the way, the beam shift ring can be pushed forward and the ion trap magnet properly positioned. The focus electrode (pin 6) can be supplied from pin 10, 11 or 12, whichever gives the best focus or if the resistors R76-77 are left fitted, the junction of these provides an intermediate tap for optimum focus. If the beam shift ring cannot be used to centre the picture properly, a shift magnet (clamp) can be obtained and fitted immediately to the rear of the scanning coils.

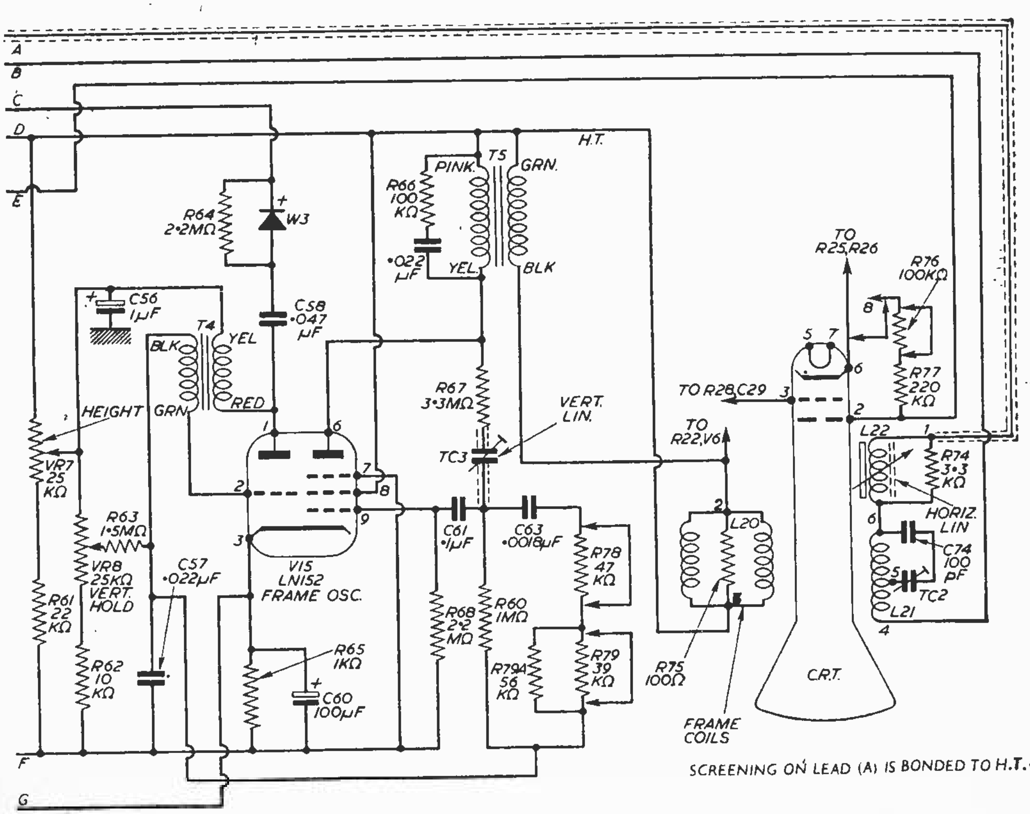
Dismantling

Remove the volume and brightness knobs. These are secured by P.K. screws. Remove the two screws securing the chassis to the cabinet at the rear. Remove the CRT base socket and the beam shift ring. Slacken the four knurled screws securing the focus and scan assembly and free it. Withdraw the unit from the tube neck. Free the CRT anode lead and the cabinet wiring (which connects to the chassis) and remove the chassis completely. Remove the loudspeaker, on table models, and lay the cabinet face downwards. Remove the four screws securing the neck clamps to the cabinet. Lift out the CRT and mask. Observe the positions of the corner pieces as these are not all the same.

Common Faults

When the picture lacks both width and height it is usually necessary to replace the 14A86 metal rectifier marked W4 on the chassis layout. Compression at the bottom of the picture normally denotes a failing LN152 (ECL80) (V15 on the chassis layout) but this symptom is aggravated by heat in the cabinet and also if the 14A86 is beginning to fail.

Lack of width should direct attention to V12 N152 (PL81), to R56 (4·7kΩ to pin 8) and to the setting of TC1. When a new line output valve (V12) is fitted, this control (TC1 line drive) should be adjusted to suit the valve. To adjust, turn the control fully anti-clockwise (*minimum* capacity). On an otherwise normal picture, remove the aerial plug and observe the white line or kink down the centre of the screen. Screw in the control until this white line just disappears. Do not screw in beyond this point as damage may result.



SCREENING ON LEAD (A) IS BONDED TO H.T.+

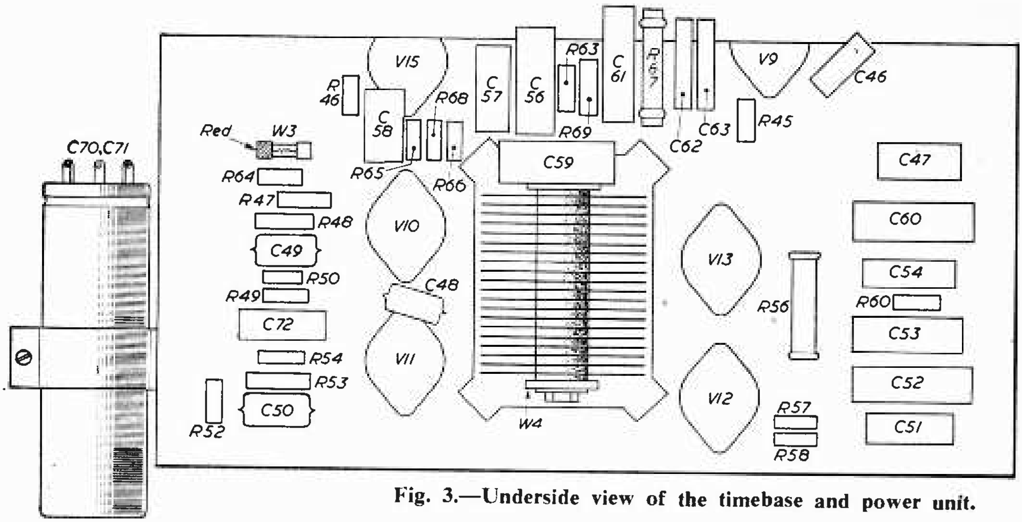


Fig. 3.—Underside view of the timebase and power unit.

Striations

If rulings are apparent on the left side of the picture, adjust TC2 to eliminate them. If the striations are very noticeable and extend to the centre, check R74 (3·3k across L22) and then R59 (4·7k across width). R74 is on the scanning coils panel.

No Picture

If there is no illumination on the screen when the brilliance is advanced, check for EHT at the U151 and listen for the timebase whistle which denotes that V12 and V13 are working. If the whistle is obvious and a spark is available at the single wire end of the U151 (V14) but this valve does not light up, it can be assumed that it is at fault and a replacement (U151-EY51) is necessary. If there is little or no spark at the U151 attention should be directed to the N152 and associated components. In some cases it will be found that the line output transformer is at fault or perhaps

(Continued on page 459)

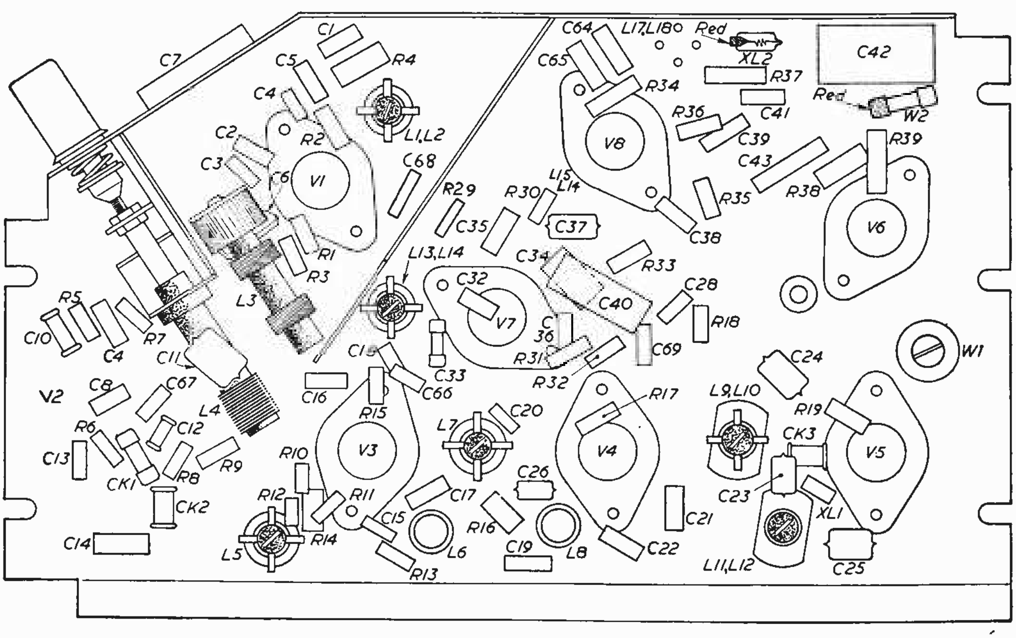
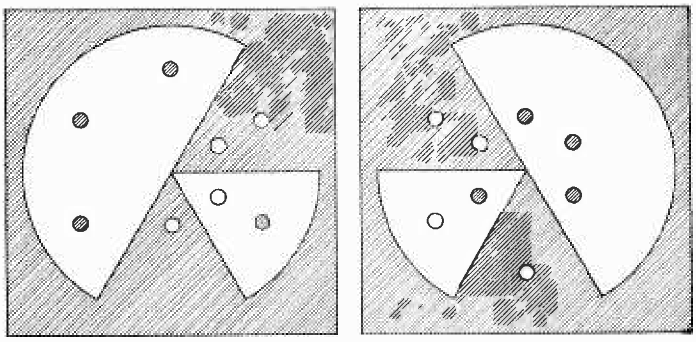


Fig. 4.—Underside view of the RF unit.

ADD-ON COLOUR

OLD-ESTABLISHED PRINCIPLES REVIEWED

By A. O. Hopkins



Red Positive   Cyan Positive

Fig. 1.—The two colour-wheel "positives".

THE Editorial of the February issue under the title Colour Vision, described Dr. Land's experiments with coloured light; and also voiced the need to simplify present colour systems, perhaps by similar methods.

Although appearing revolutionary to the general public, Dr. Land's colour demonstrations owe their effects to two long-established chromatic optical principles. The first is that white light can be seen when blue, green and red lights of suitable relative intensity are superposed. The second principle is that of complementary colour, which is always present as a "trick" of the retina, but which can be seen clearly if presentation and relative intensity are favourable.

Old Principles

The first of these principles even allows two colours, preferably orange-red and blue-green (cyan), to combine to show white light. The second principle ties in with this because this red and cyan are complementary colours. Thus when Dr. Land makes a red image by using a filter-screen (red) which excludes blue and green light, he correctly uses a cyan filter for the complementary image. Superposed in their true colours the two images would form a perfect picture. To project the non-red image upon the red one, instead of cyan light he uses white, which is cyan plus red. Whatever the intention, he adds red to all the non-red parts of the picture. Complementary contrast resists this maltreatment in some small areas, but loses the fight in larger, possibly more important, areas. The result is an inferior picture caused, not by simplifying the process, but actually by adding an unwanted colour. I cannot think of any pictorial process which would benefit by such bizarre treatment.

The trick fails completely if complementary colour is absent, a frequent condition in natural scenery. For example, a common scene has green fields and foliage, blue-green hills and sea, and blue sky. This makes an excellent cyan positive, with almost invisible red-filtered image. Try white light instead of cyan and all trace of colour disappears. This is an important limitation which obviously robs the idea of any practical value.

Too Much White Light

We can, at least, say with certainty that Dr. Land's optical novelty will not help television, because it cannot convert our present picture—which is "black and white" (and therefore "black and blue + green + red")—to a two-colour system. We do not want more white light added; we want some of this tri-coloured light taken away from our "monochrome" screens.

Dr. Land has rediscovered a colour phenomenon which I tested in 1937, using apparatus which cost only a few shillings. Two domestic tungsten lamps and two cheap condenser lenses were housed in an empty (suitably cut) tea box. Two simple "reading" glasses completed my double projector.

I planned a "colour wheel" which would show in contrast large and small areas of the two colours red and cyan, and which would also show them combined to form white and two other colours. To serve as my "positives" I cut two identical masks in thin black card, as shown in Fig. 1. I punched out a few pieces of both, and fixed tracing-paper over the smaller sector in each, punching one hole in each as shown. I mounted the masks on ground-glass, and stuck black punched-out pieces on glass and tracing-paper as shown.

Colour Wheel Chart

The diagram (Fig. 2) shows how I arranged my projector, with the two masks set relatively at 120deg. (by reversing one). A red filter covers one lens; two filters, blue and green, cover the other. Superposed on a screen the two images formed a colour wheel of six equal sectors, with red and cyan sharing the colour combinations equally as in Fig. 3. I show the colour wheel inverted to make comparison with the two "positives" easy. Red has one whole sector and so has cyan; the two colours combine in a white sector, and are both obscured in a black one. Two sectors show orange and yellow-green respectively. Within each sector small areas of colour appear: five red, five cyan, and two white. This simple chart gives four distinct colours with contrasts demonstrated in each by large and small areas. Intermediate effects were easily deduced from this, and the same method later gave a colour wheel of ten sectors, showing a closely graduated spectral range, with small spots contrasting in each sector. I found that cyan looks more blue when contrasted with yellow or yellow green, and that red varies its hue widely in contrast with colours from orange to cyan. This proved that the two basic colours could give a continuous range of colours extending from red almost to pure blue. This fact has, of course, been effectively applied in economical colour film processes and in other pictorial media.

White Instead of Cyan

The six-sector colour wheel having shown the anticipated effects, I decided to experiment by reducing the relative filter densities with a view to increasing brightness. This meant letting white light replace the cyan. First retaining the red filter, I tried several lighter blue and green filters, at last applying just enough cyan to correct the tungsten light (now called Illuminant A for colorimetry) to approximate white (now Illuminant C). As I expected, although white light was replacing the cyan, that same colour, as complementary to the red parts, still persisted although at decreasing strength.

White Instead of Red

I then reversed the experiment, retaining a strong cyan filter, and weakening the other filter by stages from red, through orange and yellow to clear lamp-light. Again the complementary colour, reddish this time, persisted with decreasing strength. I claim no special credit, believing that others will have noticed these colour tricks during optical experiments, and have also considered them of secondary value.

My experiment demonstrated that colour is far less stable than generally believed by many who, relying upon orthodox three-colour practice, make no allowance for "tricks of the retina". Having trained in youth as an illustrator, I knew the importance of contrast in colour and monochrome. An artist learns that every colour must be translated to a chosen shade of grey to obtain acceptable "black and white" pictures of any kind. I knew also that red parts of a subject to be reproduced in line or half-tone, for example lips, "ruddy" or tanned faces and skin, and red objects generally, appear best as a darker grey than green or blue parts of similar brightness with which they must contrast.

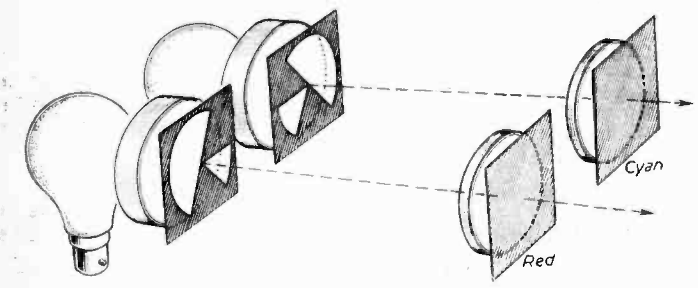


Fig. 2.—The projection system.

Black and White Technique

Photographers know the annoyance of weak grey or white effects when the perfectly lit subject showed bright colour patterns, the attractive contrast being lost because the colours were of similar light value. The better the panchromatic quality of the film, the worse the effect. The camera result is true—yet false! An artist must be artful, knowing that "black and white" pictures are completely unnatural, yet very effective when made to satisfy the eye by their only possible effect: contrast, the separation of light and dark.

With this illustrator's technique in mind, I reasoned that a linked system of monochrome and colour television would present no problem, technically or artistically, provided that a suitable monochrome picture were transmitted for display as "black and white", and also to serve as the foundation image in colour receivers. The latter should receive an additional signal conveying the colour omitted from the monochrome picture, and would combine the two images in full colour.

Poor Contrast

Television pictures before the war tended to be rather "flat", badly needing some method of adding contrast such as an illustrator would employ. Some films televised would have cloud effects enhanced by photographic filter, but "live" television pictures received no such improvement. Technicians only called for stronger light, more sensitive photo-electric mosaics, and brighter C.R. screen phosphors. Contrast could then be improved electronically, they hoped. My idea, a much simpler one, was to filter the whole televised image through a light cyan filter. This would insert contrast where most needed, darkening the "warm" colours while leaving all other colours unchanged yet more effective in the general monochrome distribution of light and shade. Such a picture would be acceptable and even advantageous for monochrome reception.

A "red filter" image would be simultaneously televised for reception by colour receivers, in which it would be added to the complementary image also received and reproduced in full cyan.

Add-on Colour

Having experimented with television from early pioneer days, I was able to test the idea by scanning portions of coloured lantern-slides by various "mechanical" methods, and by using a mercury-vapour discharge tube as lamp for the cyan-monochrome monitor picture on closed circuit. Comparison showed the cyan filter to increase the contrast without causing any parts such as faces, clothes and scenery to appear unnatural. I split the image to obtain the complementary pair by the method now used in some stereoscopic films; two mirrors set mutually at 270deg. My red image was provided by a neon discharge-lamp, and I superposed this on the cyan image to complete the coloured picture.

Since the war I have scanned slides by C.R. tube on closed circuit, testing the density of cyan filter possible which improves contrast while retaining natural light and shade distribution on a modern monochrome screen. I have found that a cyan screen deep enough to use as complementary to a strong red is perfectly satisfactory.

This add-on idea would be easy to apply to current monochrome transmissions in this country, allowing our present transmitters and our ten million receivers to continue undisturbed, with some pictorial features and settings even improved. Development of suitable colour receivers would call for no new inventions or techniques. Projection receivers would again be in demand, for it is obvious that two small tubes, with suitable colour filters or phosphor, would be ideal for presenting

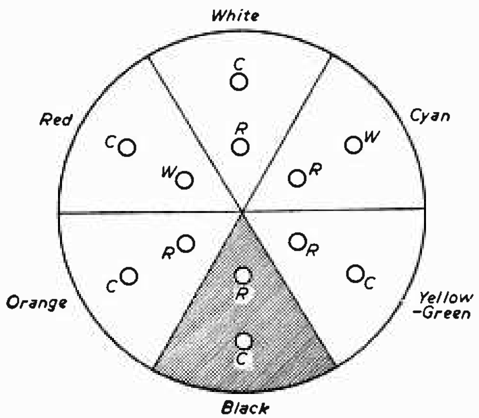


Fig. 3.—Six sector colour wheel.

the two superposed images as a picture in colour, especially for public viewing on large screens. Other methods would include scanning two images on one tube face, and combining them by a choice of several optical arrangements.

Highlights

Every artist who uses colour knows that a "highlight", a small area of light reflection upon a larger area of one colour, is not an intensifying of that same colour. For example, the "shine" on a red billiard-ball is not red—it is just *bright*. My experiments showed me this, proving that the maximum frequencies of the cyan-monochrome signal would not be required for the red signal. This old principle of highlights, understood and practised for centuries by painters, has also been "rediscovered" in the U.S.A. since the war. It is incorporated in the colour system developed in N.T.S.C. laboratories.

Were three primary colours to be insisted upon for my simplified system, the green signal would serve satisfactorily for both monochrome and foundation images, utilizing the widest band of video-frequencies; the two add-on images, in blue and red, would each need much less bandwidth.

Clever Electronics

The determined search for "color" in the U.S.A., first by rotating filter and later by covering the screen with lines or dots of phosphor, pooling all inventive and financial sources, has left Britain waiting hopefully for several years. The pioneering spirit in this field, first opened up by Baird and others, the originators of "Do it yourself", seems dormant. Despite this, there is, I believe, a growing feeling that colour television based on N.T.S.C. standards and technique is too complicated and fault-prone for general use, and too expensive for general enjoyment. Despite all the effort and prodigal expenditure, no new optical or colour principle has been discovered in the U.S.A. Clever electronics are no substitute for a practical and economical solution.

Some additional circuitry was expected, but the N.T.S.C. system has trebled most of it. How many times have the fault and adjustment factors increased? Many monochrome receivers run for long periods of daily use without fault or even adjustment. What "color" receiver has run even one day without twiddling one or more of the many extra controls? The complications have also trebled the price, disadvantages reflected in slow sales in the U.S.A., which would be even slower here.

New Principles

My add-on idea does, at least, break fresn ground while retaining simplicity. Many keen experimenters have never tried mixing coloured lights, misled into thinking it must be a difficult subject. I hope some readers will try my easy experiment, and that some may hit on even simpler ideas, remembering that to add colour, colour must be extracted from our already too-white screens.

Only simple chromatic principles can bring an inexpensive foolproof system to our millions of viewers, accustomed to years of trouble-free monochrome television.

SERVICING TV RECEIVERS

(Continued from page 456)

C55 (0·001μF) the EHT smoothing capacitor is shorted. In the case of this latter component being suspected it may be disconnected at one end to prove the point.

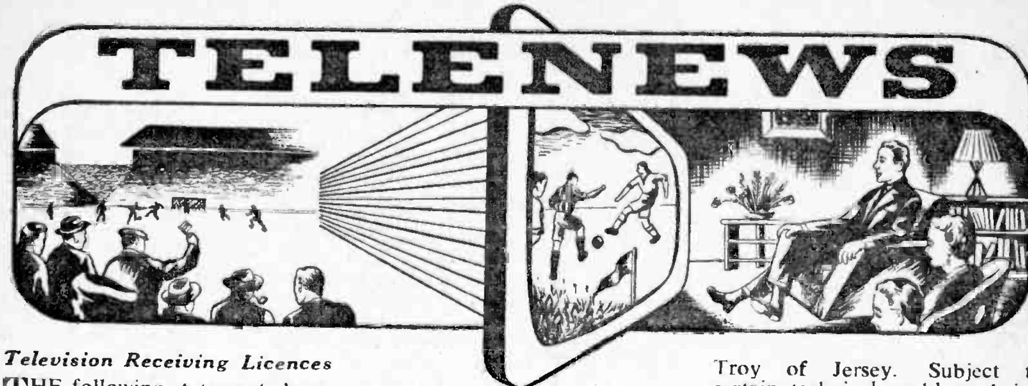
Frame Hold

If the control VR7 is at one end of its travel it is reasonable to suspect R63 (1·5M) of changing value. If the height control seems to act as an additional vertical hold, even slight adjustment necessitating resetting of the hold, check C56 (1μF). Where the hold control is at its optimum setting, but the picture will not lock securely, check W3, the interlace rectifier. A faulty rectifier often causes a jittery picture but C49 and V15 could also be at fault in this case.

Poor Linearity

As previously stated, when the picture is cramped at the bottom V15 is often responsible and should be checked first. The bias resistor R65 should also be checked and the resistors and capacitors associated with the pentode section generally. When the lower section of the picture expands enormously with severe cramping at the top, check R67—TC3. A faulty component in this circuit could cause a serious rise in voltage at pin 6, leading to sparking across the base pins.

(To be continued)



Television Receiving Licences

THE following statement shows the approximate number of Television Receiving Licences in force at the end of March 1960, in respect of television receiving stations situated within the various Postal Regions of England, Wales. Scotland and Northern Ireland.

Region	*Total*
London Postal	1,810,384
Home Counties	1,411,351
Midland	1,586,569
North Eastern	1.707,121
North Western	1.401.442
South Western	877,890
Wales and Border Counties	629,105
Total England and Wales	9,423,862
Scotland	903.111
Northern Ireland	142.780
Grand Total	10.469.753

Australian TV Station

A NEW Australian television station was officially opened by the Australian Postmaster-General, Mr. C. W. Davidson, at Adelaide recently. Situated at Mount Lofty, at a height of 1.130ft above sea level, and about 13 miles east of Adelaide, the station was equipped by Marconi's Wireless Telegraph Co. Ltd., of Chelmsford, Essex. The order, placed by the Australian government with Amalgamated Wireless (Australasia) Ltd., was part of a larger order for the supply and installation of transmitting stations and studio equipment worth approximately £400,000. The equipment supplied for the national transmitting station at Adelaide included two 10kW television transmitters with associated 2kW FM sound transmitters, combining equipment and eight-stack high gain aerial, a control desk, programme input equipment (vision and sound), transmitter studio link and extensive monitoring facilities and spares. The outputs of one vision and one sound transmitter are combined to feed four stacks of the aerial array, while a similar procedure with the second set of transmitters feeds the remaining four stacks. The two vision transmitters are thus effectively in parallel, as also are their sound counterparts. The total E.R.P. (vision) is approximately 100kW.

ITA for Channel Islands

THE ITA has decided that, if the Television Act is extended to the Channel Islands, it will offer the programme contract for the Islands to a group known as Channel Islands Communications (Television) Ltd., which has been formed under the chairmanship of Senator George Troy of Jersey. Subject to certain technical problems being overcome, the Authority hopes to be able to build a station in the Islands towards the end of 1961 or early in 1962. This station which is likely to be in Jersey, will receive mainland programmes via the Authority's Devon station which will begin programme transmissions earlier in 1961. There will, however, be facilities for the broadcasting of programmes produced locally, and Channel Islands Communications (Television) Ltd., intends to establish a studio centre in the Islands. The Authority's station is expected to have a population coverage of nearly 100,000 and to give service to the whole of the Islands with the possible

The ITA's transmitting station at Dover came into full programme service on January 31st. This photograph shows the Transmitter Control Room with a view of the transmitter cabinets beyond.

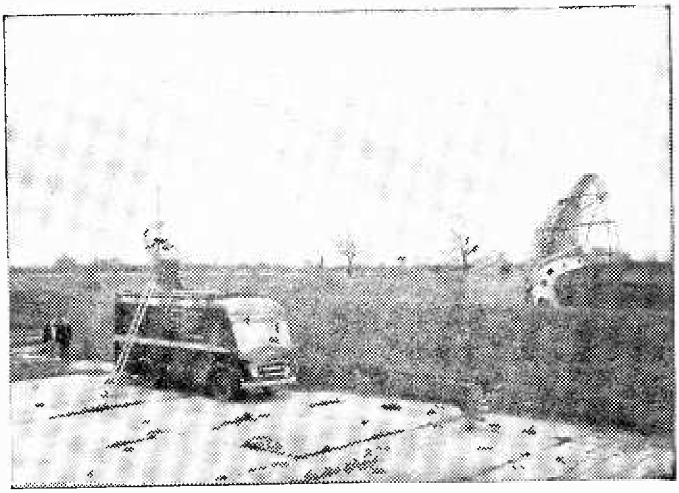
exception of Alderney. The Television Act which governs the Authority's operations, does not at present apply to the Channel Islands but provision is made in the Act for its operation to be extended to them by Order in Council.

E.M.I. at Hanover Fair

A NEW Portable Contamination Monitor, which carries its own battery supply and uses dual phosphor techniques for simultaneous monitoring of Alpha and Beta contamination on laboratory benches and other surfaces was among exhibits on the E.M.I. Electronics Ltd., stand at this year's Hanover Fair. Being battery powered this compact lightweight instrument, which has been developed to meet the full requirements of the U.K.A.E.A. gives maximum coverage without being restricted by length of power leads. The E.M.I. dual phosphor system makes it unnecessary to go over the same area twice with Alpha and Beta probes. Using all-transistor circuitry for long life and utmost dependability, the monitor gives high accuracy over the 0°C to + 45°C temperature range.

"The Unseen Universe"

TO commemorate the tercentenary of the Royal Society the BBC produced a new series of the well-known "Eye on Research" television programmes, each one dealing with the work of a Fellow of the Society. To launch the new series the BBC "Eye on Research" team visited the Mullard Radio Astronomy Observatory, which is part of the Cavendish Laboratory of the University of Cambridge, to report on the work of Martin Ryle, F.R.S. Professor Ryle and his team have made contributions of outstanding importance in the relatively new science of radio astronomy and their eminence in this field is recognised throughout the world. Many people will remember how they made news by tracking the first earth satellite, launched by the Russians in 1957. Radio astronomers study those stars and galaxies in outer space that emit radio waves, in much the same way that visual astronomers study bodies that emit or reflect light waves. The radio telescope, however, can "see" further into space than optical instruments and may help scientists unravel some of the unanswered questions about the origin of the universe. In the programme Professor Ryle, assisted by Drs. Graham Smith, Anthony Hewish and David Dewhirst (a member of the optical observatories at Cambridge), described some of their past and present work. Viewers were shown the large radio telescope at the Mullard Observatory, which is the most powerful in the world for detecting the radio waves emitted by the distant galaxies. Models and photographs illustrating modern ideas on the structure of the universe were also shown.



The BBC "Eye on Research" production team visited the Mullard Radio Astronomy Observatory for the first of their new programmes in the series commemorating the tercentenary of the Royal Society. This picture shows the microwave link, which transmitted the signals from Cambridge to London, on top of the TV Outside Broadcast van.

Closed-circuit TV for Wall Street Brokers

THE first British closed-circuit television system to be installed in Wall Street is now enabling busy executives of a large New York stockbrokers to study the latest ticker-tape stock market movements without leaving their offices. The television system relays a continuous picture of moving ticker-tapes giving price changes on the New York and American Stock Exchanges to seven large-screen monitors in offices throughout the building.

The order for this equipment, which was designed and manufactured by E.M.I. Electronics Ltd., follows the recently announced trading agreement between the British company and the Fairbanks Whitney Corporation of New York. Without closed-circuit TV the stockbrokers, Bear and Stearns, would have had to install fourteen ticker-tape machines and seven optical projectors in order to provide the same on-the-spot service. The television system is much less expensive and eliminates the need for noisy tape machines throughout the building.

Australian Factory

EARLY this year Mr. C. R. Belling, M.I.E.E., laid the foundation stone of the new Belling and Lee (Australia) Pty. factory, on the outskirts of Melbourne, Victoria. Mr. and Mrs. Belling spent two and a half months in Australia, New Zealand and Tasmania. The new factory opened on March 1st and will produce TV aerials and accessories and electronic components. It stands on a 14-acre site at the intersection of two main roads near the foothills of the Dandenong Mountains where the Melbourne TV transmitters are sited.

Synchronising Timebases

PULSE SHAPERS, INTERLACE AND OTHER CIRCUIT DETAILS EXPLAINED By G. J. King

Timebase Synchronisation

THE composite picture and synchronising signal is fed to the input of the synchronising separator stage. which should—for successful synchronising—completely eliminate the vision content. leaving only the sync pulses such as shown in Fig. 1 (a) and (b).

Both line and frame saw-tooth oscillators are synchronised by these pulses which ensure that neither line scan nor frame scan last too long—and keep the electron-beam in the receiver picture-tube exactly in step with that in the television camera.

The sync pulses initiate the commencement of frame and line flyback. They are thus radiated at the finish of each frame and line scan respectively. The repetition rate of the former being 50 per second and that of the latter 10,125 per second. Usually about eight frame sync pulses are radiated collectively to form the frame sync signal.

Obviously then, in order to supply either saw-tooth oscillator with its appropriate sync pulses a means is necessary whereby the line and frame pulses may be separated from each other. A popular method of achieving this function is to feed the line timebase from the sync separator through a differentiating circuit and the frame timebase through an integrating circuit.

The Differentiator

Essentially. a differentiating circuit is a "high-pass-filter". By its conclusion. not only are the relatively high-frequency line sync pulses conveyed to the line-generator with little attenuation, but they also undergo a shaping process necessary for correct "firing" of the line generator. The action of such a circuit is fairly straightforward and may be readily understood in conjunction with Fig. 2.

As will be remembered. a resistor R connected in series with a capacitor C produces a time constant T equal to CR, which is the time required. in seconds, for the voltage or current to grow or decay to 63 per cent of its maximum value.

It will now be instructive to consider the effect such a curcuit has on a square wave. Let the square wave be that of a line-sync pulse (Fig. 2 (b); as will be observed such a pulse occupies a time period of 10μs.

Now, because the capacitor is uncharged, the circuit responds suddenly to the leading edge of a pulse. and the initial current through CR equals *ein*/R. Therefore, *e*R equals *ein*.

As time goes on, however, C charges exponentially and the potential across R falls, so that *e*R equals *ein*-*e*C. Thus, after time CR, *e*R will fall to 37 per cent of its initial value, but, by the time the trailing edge of the pulse is reached, *e*R will have a relatively higher value if CR is greater than the pulse duration.

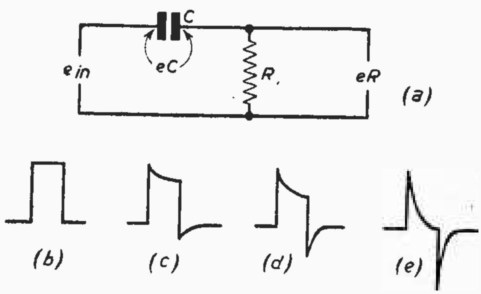


Fig. 2.—A basic differentiator circuit is shown at (a) and a line sync pulse at (b), while (c), (d) and (e) are the output waveforms for a time constant much larger than, equal to and smaller than the pulse duration.

A change of input in the negative direction is created by the trailing edge of the pulse and *e*R is thus changed instantly from a positive to a negative magnitude depending on the initial positive of *e*R,

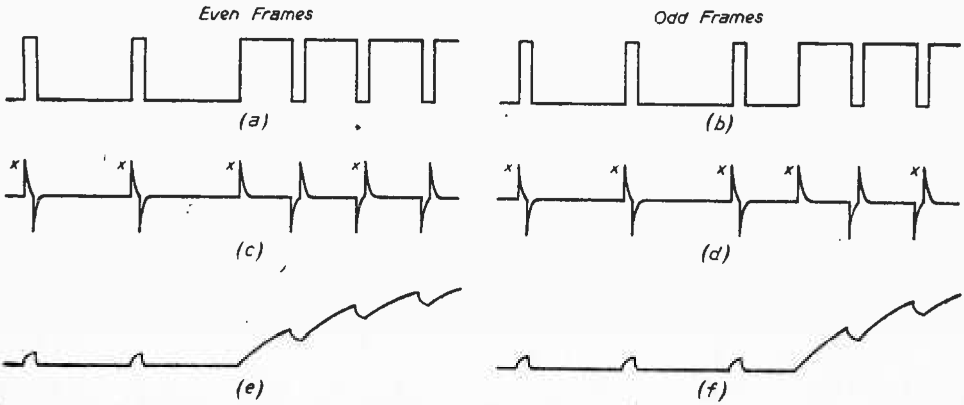


Fig. 1.—A train of line and frame sync pulses for even and odd frames (a) and (b), differentiated pulses (c) and (d), integrated pulses (e) and (f).

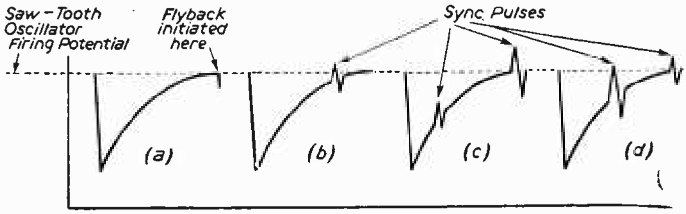


Fig. 3.—Firing points of a saw-tooth oscillator (a) free-running, (b) during a normal line scan, (c) during a frame pulse, and (d) fired prematurely in the middle of a line scan during a frame pulse.

which is followed by an exponential return to zero.

Output wave-forms where CR is much larger than, and equal to the pulse duration are illustrated by Fig. 2 (c) and (d) respectively.

From the foregoing it will be obvious that if CR is smaller than the pulse duration, C will acquire a maximum charge before the trailing edge of the pulse is reached. Therefore, eR will rise to a maximum positive value; reduce exponentially to zero; rise to a maximum negative value and again exponentially return to zero. Fig. 2 (e) illustrates the resultant differentiated square waveform.

Actually this operational mode indicates that CR must be appreciably smaller than the pulse duration since C charges fully. Theoretically a capacitor will reach nearly full charge in a period equal to 4CR seconds. Therefore, for true differentiating action T should not exceed one quarter of the pulse duration, or in the case of a line pulse, $10/4\mu s$ equal CR.

Usually, in practice, C is about 50pF. Thus:— $2{\cdot}5 \times 10^{-6}$ equals 50×10^{-6}R (it should be noted that C and R are expressed in microfarads and megohms respectively).

Therefore, $R = 2{\cdot}5 \times 10^{-6}/50 \times 10^{-6}, = 50$k.

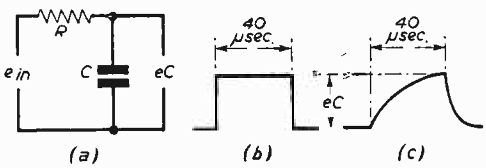


Fig. 4.—A basic integrator circuit is shown at (a) and a frame sync pulse at (b). (c) is the output waveform across C.

The Principle of Synchronisation

The effect of feeding the mixed pulse train of Fig. 1 (a) and (b) into the differentiating circuit is shown diagrammatically in Fig. 1 (c) and (d). It will be seen that the frame pulses when passed through the circuit lose their identity and are also differentiated to form a set of short duration peaked pulses, which keep the line oscillator in synchronism during the frame sync pulse.

This will be better understood in relation to the general operation of a saw-tooth oscillator. The potential on the grid of the oscillator valve increases exponentially until it reaches a value which "fires" the valve (flyback). In the unsynchronised (free-running) condition this potential build up is determined by the circuit constants (Fig. 3 (a)).

The oscillator is synchronised by the application to the valve grid of a differentiated positive-going sync pulse. The effect being that just before flyback conditions are reached, a sync pulse arrives and the valve is immediately "fired", thereby exercising complete control on the repetition frequency of the line saw-tooth oscillator (Fig. 3 (b)). This means then, that the line hold control should be so adjusted that the oscillator is running very slightly on the slow side.

The pulses employed for line synchronism are marked "x" in Fig. 1 (c) and (d). Therefore, it can be seen that during the frame pulses the line oscillator remains synchronised due to the differentiated leading edge of every other frame pulse; the sync pulse for the half line during odd frames being clearly indicated.

A condition may arise where the pulse which occurs in the middle of a line scan during a frame pulse "fires" the oscillator prematurely (Fig. 3 (d)). This will have the effect of causing the top of the picture to be tilted over to the right-hand side. Usually, such a fault indicates that the sync pulses fed to the oscillator are too large and steps should, therefore, be taken to reduce their magnitude.

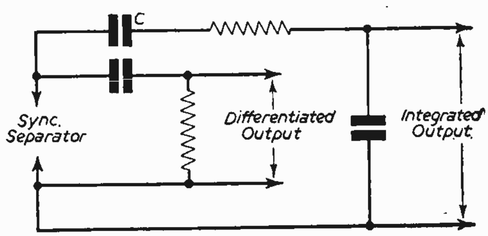


Fig. 5.—A combined differentiator and integrator circuit. The inclusion of C is for D.C. isolation only.

The Integrator

The integrator circuit is also formed by an RC combination but with a modified time constant. The basic circuit is shown in Fig. 4 (a), and in this case it will be observed that the integrated sync pulses are developed across the capacitor.

Unlike the differentiator, however, this circuit responds only slowly to steep-fronted waveforms, which is rather obvious when it is considered that an integrated pulse is nothing more than the exponential rise and fall in potential across C due to its charge and discharge.

Fig. 4 (c) shows the waveform across the capacitor due to an input pulse such as (b). From this it will be seen that the amplitude of the integrated pulse is proportional to the duration of the applied pulse; since a longer pulse allows the capacitor to charge to a higher value. This feature enables discrimination to be made between the $10\mu s$ line sync pulses and the $40\mu s$ frame sync pulses.

The effect of feeding both line and frame sync pulses into the integrating circuit is shown diagrammatically at (e) and (f) in Fig. 1. The short duration line pulses are distorted and greatly reduced in amplitude, since they have little effect on charging C. However the first of the series of frame pulses, due to its longer duration, charges C to an appreciable value, and it discharges only slightly before the next pulse arrives. Thus, the next frame pulse charges C to an even higher value and so on, resulting in a build up of potential across C, which at some critical value "fires" the frame saw-tooth oscillator. It is necessary, of course, for the frame oscillator to be arranged to "fire" at a higher level than the peak output on a line pulse.

The values for C and R are larger than those forming a line pulse differentiating circuit, and it is usually found satisfactory to make T about 5 times the frame pulse duration, typical values being: R 20k and C 1,000pF.

Interlace Problems

From the waveforms of (e) and (f) Fig. 1, it can be seen that the first pulse following an "even" frame is only displaced half a line from the first

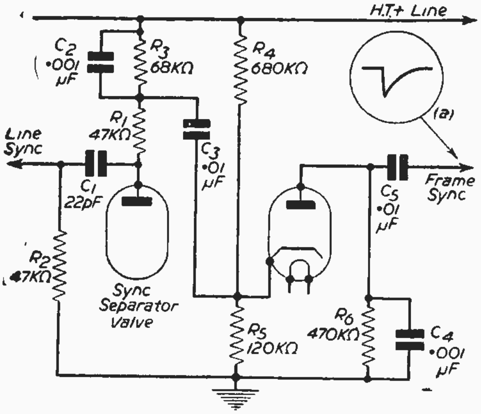


Fig. 6.—A frame pulse shaper circuit showing the waveform output at (a).

pulse following an "odd" frame. This means that to secure a good interlace between successive frames the start of a frame scan must coincide with the start of a line scan every other frame only. Such conditions are difficult to achieve with the simple differentiator/integrator circuit of Fig. 5 and by its use a stable interlace is very rare.

The limitations offered by this simple arrangement may be better understood when it is considered that the frame timebase has to be pulled only half a line at the end of an "odd" frame and the beginning of an "even" frame to impair the interlace severely. This means, that for proper interlacing, the frame timebase will need to "fire" on exactly the some serrations of the integrated waveform of Fig. 1 (e) and (f) every "even" and "odd" frame. In practice minor circuit disturbances, such as fluctuation of signal or mains voltage, prevent this happening and, therefore, noticeably impair interlacing.

Furthermore, matters are made worse since no protection from the line pulse is offered; for it must be remembered that during the line flyback high peak voltages are developed which cause quite a disturbance in the receiver and are liable to "fire" the frame timebase, resulting in non-interlace.

A Frame Pulse Shaper Circuit

Usually, in order to prevent line pulses effecting the "firing" of the frame generator the integrator circuit is followed by a further circuit which eliminates the line pulses and shapes the train of eight frame pulses to form a single steep-fronted pulse. A pulse shaping circuit of similar function is shown by Fig. 6.

Line sync pulses developed across R1 are differentiated by the action C1, R2 and are applied to the line generator in the usual way. The frame pulses, however are mainly developed across R3 and C2. These components form a time constant such that the line pulses are severely attenuated. The thus modified sync signals are conveyed, via C3, to the cathode of a diode which is positively biased by a potentiometer comprising R4 and R5. Bias magnitude is arranged so the diode conducts during the negatively-going pulses only, resulting in a rise of potential across R6 and the charging of C4. Since these components form a relatively large time constant the 10µs interval between successive frame pulses has little effect on the discharge of C4. A single clean-cut frame pulse (Fig. 6 (a), is thus produced and is transmitted via C5, to the frame generator.

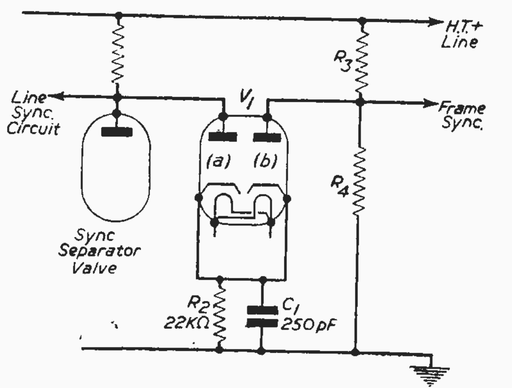


Fig. 7.—A frame pulse separator circuit.

Another Method

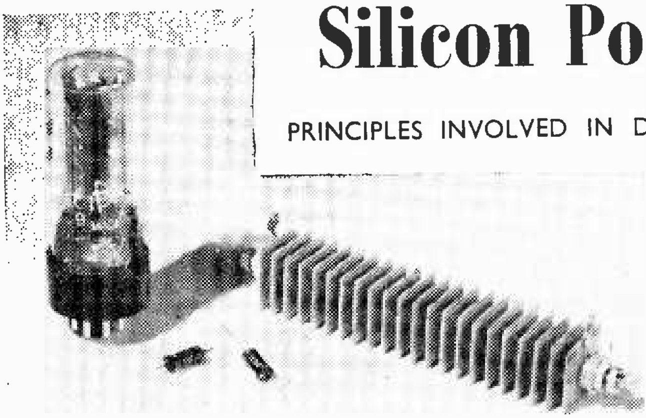
Another popular circuit is shown by Fig. 7. Both line and frame sync pulses are developed across the sync separator load resistor R1, which is in direct connection with the diode anode of VL (a).

In conclusion, it should be remembered that interlacing may be considerably impaired if stray capacitive couplings exist between the time bases. The line flyback pulse may also be radiated from a lead or component within the circuit to any of the post-detector circuits with similar results. It is worthy to note that unless a receiver is interlacing correctly 50 per cent of the transmitted picture may be lost.

Silicon Power Diodes

PRINCIPLES INVOLVED IN DESIGNING SUITABLE CIRCUITS

By "Electron"



Two modern silicon diodes compared with a conventional rectifying valve and metal rectifier.

THE majority of modern television sets employ A.C./D.C. technique. One reason for this is that the sets are then dual purpose and can be operated on D.C. mains with only an alteration to the plug and socket arrangements at the rear of the set. The technique also obviates the use of a mains transformer but gives rise to a "live" chassis. The heaters of the sets are wired in series and the H.T. is obtained direct from the mains via a suitable rectifier. The rectifiers employed have previously been of two types: valve and metal. The metal variety are generally of the selenium type and are familiar to most servicemen. Both sorts of rectifier, valve and metal, are not everlasting. The valve tends to lose its emission and the H.T. voltage drops. When the metal rectifier ages, the same effect is observed, but it is caused by the forward resistance of the rectifier increasing. However, a new rectifier for H.T. supply which is suitable for use with TV receivers has recently made its appearance although prototypes have been in development for some time. The units employ silicon and are little bigger than a conventional metal or glass encased "crystal" diode. These silicon power diodes have an extremely high inverse resistance (of many megohms) and an extremely low forward resistance. Provided the ratings of these rectifiers are carefully observed they age very little.

Circuit Problems

Although the rectifiers have high inverse resistance, for high current types, the reverse voltage rating tends at present to be less than that required for use on mains H.T. supply circuits in this country. When assessing the peak reverse voltage encountered it must be remembered that the quoted figure for the mains supply voltage is the r.m.s value. Therefore it is recommended that two of the new silicon rectifiers are employed in series in H.T. rectification circuits.

Although the reverse resistance of each of the two diodes is high, the reverse resistances are not likely to be equal, particularly as they are dependent to some extent on the reverse voltage. It was mentioned earlier that the reverse voltage ratings of devices currently available are not high enough for the devices to be operated singly. It should therefore be clear that, when two of these devices are used in series, it will be necessary to ensure that the reverse potentials across each of the diodes are equal. The reverse resistances are so high that they can effectively be swamped by a resistor of a value of about 470k. The circuitry involved is shown in Fig. 1 where the characteristics of each diode are enclosed in a

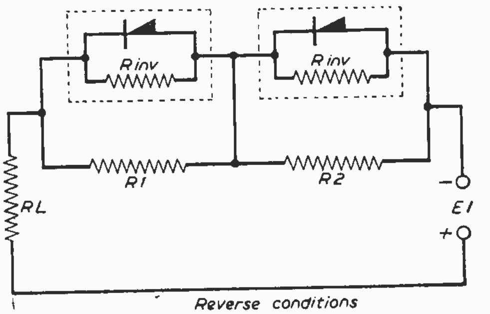


Fig. 1.—Reverse voltage conditions for two diodes in series. R1 and R2 are the equalising resistors.

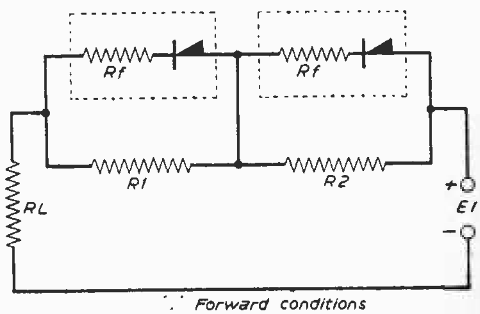


Fig. 2.—Forward conditions for two diodes in series.

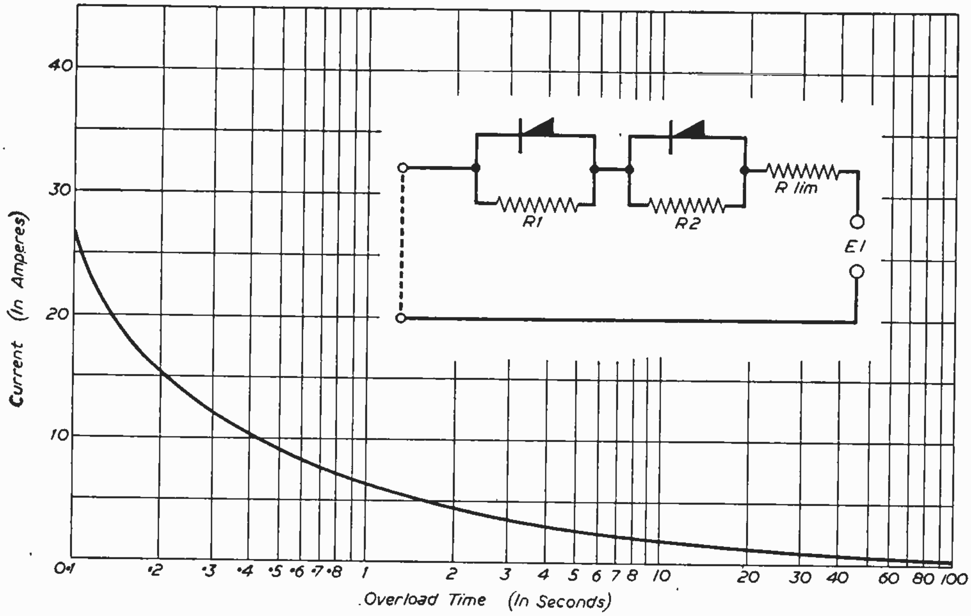


Fig. 3.—Typical curve giving overload current related to overload time. Fig. 4 (inset) Initial current surge when switching on the receiver is limited by the resistor Rlim in series with the rectifying system.

dotted line box. Resistors R1 and R2 are each 470k and effectively swamp the reverse resistances of each diode so that, by application of Ohm's Law, it is evident that the reverse voltages will be equal within the limits required.

The forward conditions for the circuit of Fig. 1 are given in Fig. 2. The forward resistance of each diode is extremely low and although a certain current flows through R1 and R2 it is negligible in comparison with the current through the diodes.

In some instances with diodes of certain manufacture it must be noted that the manufacturers sometimes state that equalising resistors are unnecessary, but many amateurs using the devices would no doubt wish to include them.

Current Limitations

Manufacturers of the devices are generally pleased to provide comprehensive literature giving full details of the ratings. From this data another factor can be taken into account in the design of the circuit and this concerns the maximum allowable output current of the rectifier. Generally the information is given in the form of a curve relating maximum permissible current to the time of overload. Such a curve is given in Fig. 3. When these rectifiers are employed they are generally used in half-wave circuits and therefore large reservoir and smoothing capacitors are necessary. These must needs be of the electrolytic variety. These condensers require the normal H.T. potential to be across them before they are effectively capacitors. When the circuit is first switched on and the mains applied to the rectifier system the electrolytic condensers are in effect low value resistors connected across the H.T. output. Naturally this state does not persist, the condensers soon polarise and the leakage current is reduced to negligible proportions. However, the initial surge of current when first switching on may be of very large magnitude and could damage the rectifier unless it were limited. This limiting is carried out by the insertion of a resistor R lim as shown in the diagram Fig. 4 above. The value of this resistor needs to be as high as possible to limit the surge current but not so high that an appreciable voltage drop appears across it when the normal operating current flows through it. In practice the value of this resistance tends to be about 10-20Ω.

Silicon power diodes tend to be more efficient than their conventional counterparts as the forward resistance is so low that the I^2/R losses give rise to such a small amount of heat that they can be air-cooled. The small size of the device is also an advantage and will enable reductions in receiver size to be made.

Provided the ratings of these diodes are observed they should have a very long life and in this connection it is worthwhile to note that, as previously stated, manufacturers are generally very willing to supply users with comprehensive data. From this, it is possible to design all kinds of TV receiver power supplies.

VIDEO AND SYNC AMPLIFIER

SP61 VALVES ARE USED FOR ECONOMY

By B. Osborne

THE most common picture defects met with in fringe areas, apart from fading signals, are "snow", line tearing and poor resolution—the latter usually being excused (or considered necessary) to minimise the former.

Line tearing is a fault which should only be met in weak signal areas, as its primary cause is random "noise" pulses which erratically trigger the line timebase.

With a low signal this triggering can be caused by valve "noise" alone—as distinct from outside electrical disturbances—and in a poorly designed receiver can make an otherwise usable signal of poor entertainment value.

Sheer gain—as the user of converted "surplus" equipment will be well aware—is not the answer to this problem. The remedy—assuming an efficient aerial array and low-noise pre-amplifier stages are already in use—lies in the careful design of the synchronising circuits themselves.

If one is just starting to build completely new equipment, some form of "fly-wheel" synchronisation would be the obvious choice, but there are many improvements which can be made to the ordinary triggered timebase—the more advanced circuits to be described—comparing very favourably with the best "fly-wheel" type.

Many keen amateur enthusiasts receiving pictures well outside the accepted range of the TV transmitter will protest that they do very well without the need for fancy circuits, but—in many cases—it is merely the *distance* that seems impressive; the measured signal strength may be well in excess of that met with in the poorer reception areas within 30 or so miles of the transmitter.

In undulating country—south-west England for example—as distinct from predominately flat areas, distance bears little relationship to the prevailing signal strength, and the terms "fringe area" and "long-distance reception" can be very misleading.

The increasing popularity of "fly-wheel" sync in commercial "fringe area" receivers and their inherent immunity from line tearing has "laid by the heels" the generally accepted belief that a restricted band-width in the vision channel was beneficial in reducing picture "noise" or "snow." Anyone who has seen the very much finer textures of the picture "snow" prevalent with a normal band-width, and how much less noticeable it is at the correct viewing distance, will be very dissatisfied with the "smeary" picture inevitable with a reduced response.

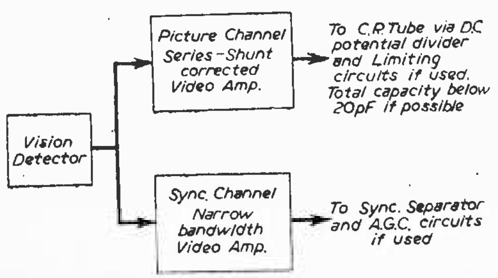


Fig. 1 (a).—Block diagram of picture and sync channels.

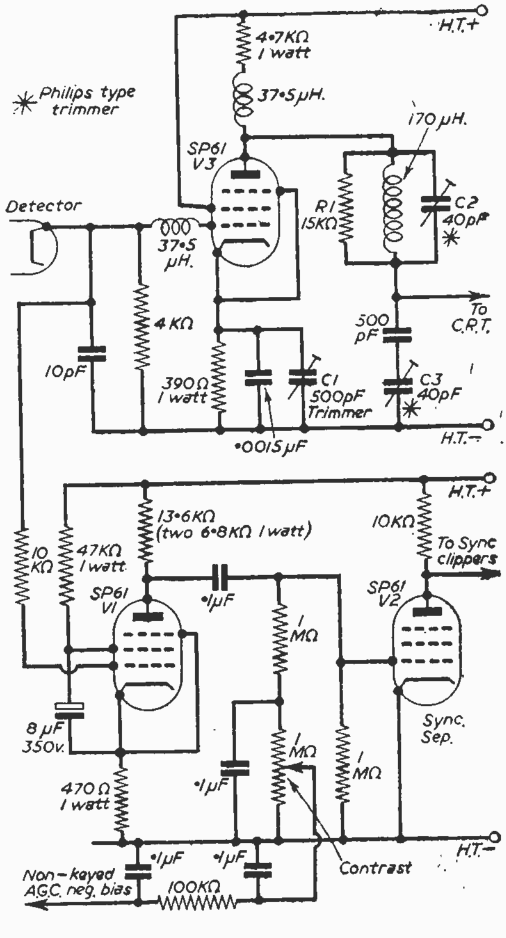


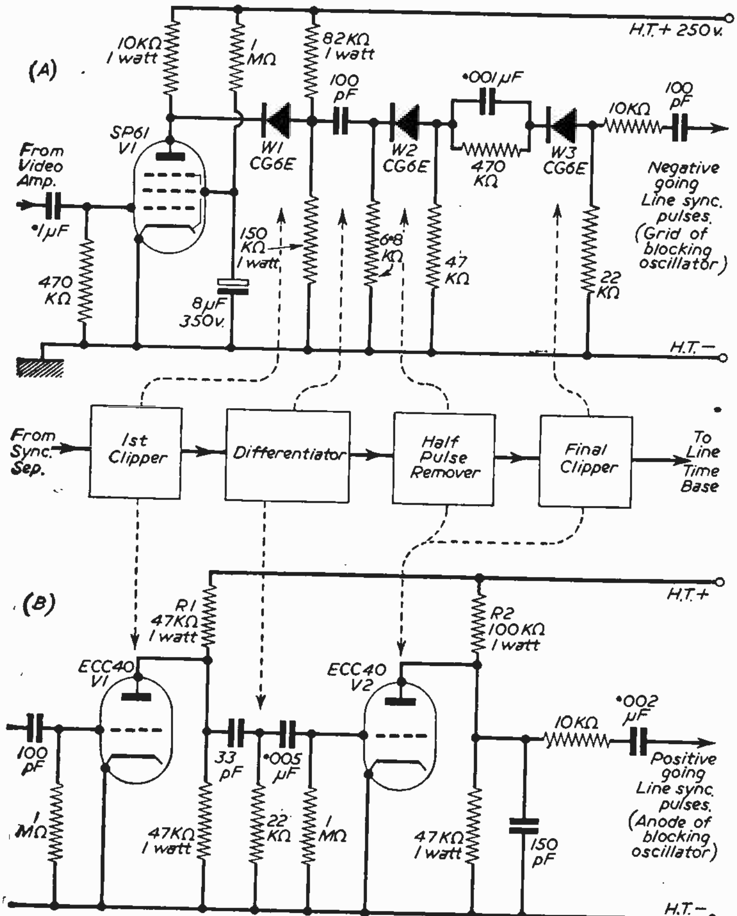
Fig. 1(b).—Theoretical circuits of the scheme in Fig. 1(a).

C1.—Adjust to reduce smearing with minimum overshoot.

C2.—Turn C3 to minimum capacity then adjust for maximum response on highest frequency grating visible, i.e., 3 or 2·5Mc/s.

R1.—Reduce value to 6·8k if excessive "ringing" experienced.

C3.—Increase to maximum value possible without visible response cutting—this trimmer is useful to eliminate any 3·5Mc/s patterning which may be present.



Note: If a sufficiently hard lock is obtained more efficient limiting is possible by doubling the values of R1 and R2

Fig. 2.—Two methods of line-pulse shaping.

Of course, the reduced band-width enthusiast (who may regard sound rejectors as an unnecessary encumbrance) will insist that response cutting is still essential to minimise line tearing; but the band-width can be narrowed in or to the sync circuits themselves, where it is unquestionably beneficial with the triggered type timebase.

For the effective sync separation—and to avoid that annoying fault "pulling on whites"—a response of $1\frac{1}{2}$Mc/s is required, so a separate narrow band-width channel to the sync circuits is quite practicable.

A Simple Scheme

One of the easiest methods of adapting an existing receiver chassis is simply to add an extra narrow response amplifier stage for the sync pulses, and utilise the existing video amplifier for picture signals only.

In this way both functions can be carried out separately and, consequently, with greater efficiency, with the additional advantage that there is now unlimited scope for experiment with the video amplifier (a much neglected field among amateurs) there being no longer the danger of interfering with picture synchronisation.

A practical circuit for experimental video and sync amplifiers is shown in Fig. 1, with several variable components which can be adjusted for optimum performance, under the varying conditions that are met with in fringe areas.

The line sync pulse can also be much improved after the sync separator by adopting the technique shown in Fig. 2 (a) and (b). Basically both these circuits work on the principle that better results should be obtained by removing from the sync pulse all that is not wanted, and improving what is left.

With this in mind the first step is to clip the negative going line sync pulse as it appears at the anode of the sync separator. Then it is differentiated, and the positive-going half so produced, removed; finally the negative-going pulse remaining is again clipped and fed to the line timebase.

In the second circuit, Fig. 2 (b), using triode valves, it is of course, the negative-going trailing edge which is removed, the output pulse, being positive-going, should be fed to the anode if a blocking oscillator is used, the necessary negative pulse on the grid being obtained by reversal action in the transformer.

Having reduced line tearing and made an improved video response possible, it may be necessary to widen the vision channel bandwidth to obtain full advantage of the modification. If no signal generator is available this is best accomplished by using Test Card "C", and, as the most favoured I.F. strips among amateurs seem to be "stagger tuned anode or grid circuits" broadening the response curve by "trial and error" requires only a little patience. Contrary to many articles published on converting surplus I.F. strips, it is virtually impossible for the amateur to use a receiver with a 3Mc/s bandwidth without the aid of sound rejectors.

For the other channels—even by using band-pass coupling transformers throughout—it is exceedingly doubtful whether a response up to 3Mc/s could be obtained with the necessary drop of 35dB at 3·5Mc/s.

Making TV Tubes

THE MANUFACTURING PROCESSES AT MULLARD SIMONSTONE WORKS

THE production of television tubes at Simonstone begins with the component parts of the glass bulb; the cylindrical neck, the flared cone, and the rectangular faceplate.

Assembly

After the parts have been checked for accurate dimensions and inspected for blemishes the process of assembling them into the complete bulb begins. First, the neck is welded to the cone. This operation is performed by automatic rotary machines, of which there are six in the Plant each having twelve stations. The two parts are first pre-heated by radiant cup gas burners and gas-air burners to bring them to the correct temperature for welding and the weld is then made by oxy-coal gas jets. Following this, the bulbs are transferred to a side sealing machine where the metal EHT connection is fused into the side of the cone. The region of the seal is pre-heated by radiant cup burners and gas-air jets, and the seal is made by oxy-coal gas jets. To remove any strains in the glass, the neck and cone assembly is annealed in an oven, which also serves to pre-heat the assembly ready for the faceplate to be joined on. Meanwhile, the faceplate is pre-heated to the same temperature in another oven. The twenty-four automatic machines for welding the faceplate to the neck and cone assembly are among the most ingenious in the Plant. Gas-air jets pre-heat the two component parts and cross-fires of oxy-coal gas jets further raise the temperature of the welding region. The actual weld is accomplished by an electric arc struck through gas flames which brings the edges of the two components up to melting point when a perfect seal takes place. With the thick glass necessary for television tubes it is essential to heat the two components evenly to avoid strains or cracks and to ensure this the gas jets automatically follow the contour of the faceplate keeping a constant distance from the glass as it rotates.

Annealing

The complete bulb is annealed by raising it to a certain temperature and allowing it to cool slowly. This removes any stresses which would be potential weaknesses in the finished tube. The bulbs are now introduced to the extensive and elaborate overhead conveyor system that runs through the entire plant, and around which all the subsequent processes are planned. Almost two miles in length, the conveyor is laid in over 30 separate sections for flexibility. Besides carrying the tubes from one process to the next, it is actually involved in many of the operations. By arranging journeys of suitable length between processes, the conveyor is used for operations like slow cooling and drying; and it can also act as a store between processes, reducing handling costs and the possibility of damage. Furthermore, it is designed so that many operations can be performed without removing the bulbs or tubes.

The cooled bulbs are thoroughly washed with different solutions, finishing with purified water, to make ready for the vital process of laying the fluorescent screen.

The screens are laid by means of specially designed rotary mills. These are fitted with dispensers which automatically deliver the correct amount of buffer solution, water glass and fluorescent powder. As the bulbs travel round the mill the fluorescent powder gradually settles down through the buffer solution evenly on to the surface of the glass, where it is held by a gel-like formation produced from the different solutions. As they complete their journey the bulbs are automatically tilted to remove the liquid, leaving the screen deposit undisturbed. The bulbs are dried by infra-red lamps and filtered air and are then given internal coatings of lacquer and graphite, the latter to form an electrical connection between the final anode and the EHT connector.

Aluminising

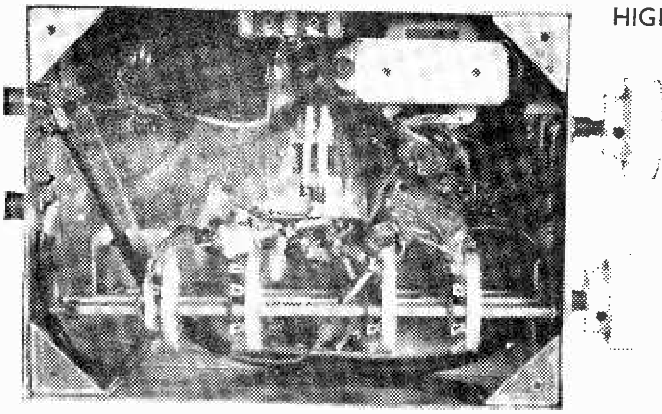
The bulb is then ready for laying a film of aluminium on the inside of the screen and cone. The film acts as a mirror behind the fluorescent screen, increasing the brightness of the picture. It also prevents the screen being damaged by heavy ions during the tube's working life. To form the mirror a small pellet of aluminium is attached to a wire filament and inserted in the bulb. Air is then removed from the bulb, and the filament heated by an electric current: the aluminium pellet evaporates in the vacuum and spreads evenly, and microscopically thin, over the inside surface of the screen and cone.

The bulbs are next passed slowly through one of two continuously operated 100ft long Lehr furnaces to drive off all moisture and to bake out the unwanted constituents of the various coatings, which would otherwise make it impossible to maintain the necessary vacuum in the finished tube. This baking process also fixes the fluorescent screen firmly to the glass face. The Lehr furnaces are indirectly heated by gas fired tubes and are the biggest single gas consuming units in the entire Plant. They each have a starting consumption of 6,000cu. ft of gas an hour and an average hourly running load of 4,000cu. ft. The bulbs travel through the furnaces on a 12ft wide conveyor belt and the whole process takes 125 minutes. The temperature through the furnaces is zoned automatically at 7 points rising from 20deg. C through 420deg. C and back to 25deg. C.

Now, after a thorough inspection of the screen, using ultra-violet light, the bulb is ready to receive the electron gun. The guns are assembled in a separate part of the factory by highly trained female operators. The component parts (over 60 to each gun) are manufactured to extremely high standards of accuracy and a system of statistical quality control is applied throughout so that there is no possibility of faulty parts reaching the assembly operation. Oxy-coal gas jets are used in the assembly of the guns, to weld the glass support rods in the electrode assembly.

(Continued on page 476)

A Two-Band Pre-An



HIGH GAIN, LOW NOISE CASCOD CIRCUIT

By R. E. F. Street

THE coverage of the television services in Great Britain has been extended greatly in recent years; in fact, many areas which were originally thought to be too remote are now within reach of television. The stage has now virtually been reached, however, where further large extensions in the coverage cannot be made. Although there are many areas where reception is very difficult, at present there is no economic means of providing, for instance, local transmitters of very low power. Therefore, the only method available to achieve reception is to use the existing signals to best advantage. At first sight, it would seem necessary only to amplify the signals to a sufficient degree. It is not usually realised that the limit to amplification is set by the signal-to-noise ratio; "noise" in this context refers to any unwanted signals which are picked up with the television signals and amplified with them. These noise signals may proceed through the ether or be caused by the random movement of electrons in the first valve of the receiver. The current flow from the cathode of this valve to the anode and any other electrodes is not steady because it is composed of negative charges (electrons) and the quantity of electrons emitted from the cathode in a given time is not constant. The effect is a change in anode current and this gives rise to spurious signals in the output. The noise voltages are only of appreciable magnitude in the first stage where they can become comparable with the signal voltages. It can therefore be seen that one of the limiting factors in the amplification is the choice of a low noise valve for the first stage in the receiver.

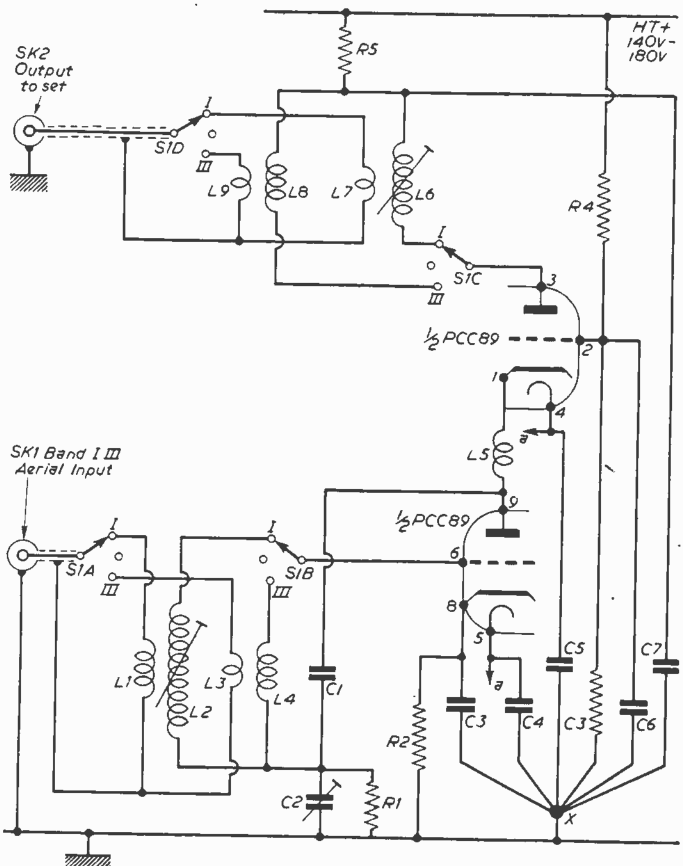
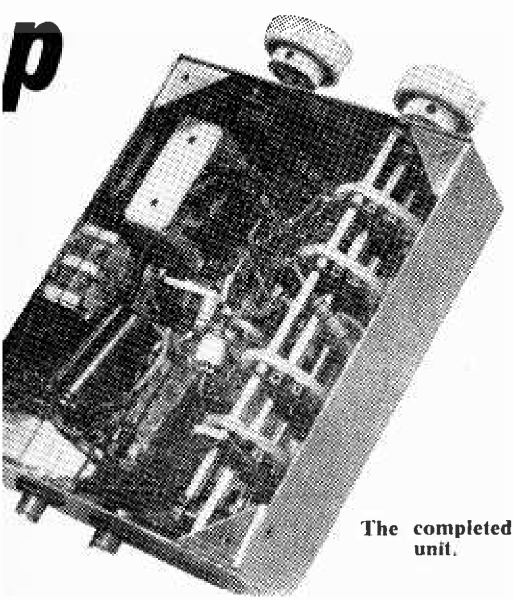


Fig. 1.—The circuit diagram.



The completed unit.

Cascode Circuit

The standard input circuit which is employed is the "cascode" and this consists of two triode valves in series. The first triode operates as a neutralised, grounded cathode, amplifier and the second as a grounded grid amplifier. Triodes are used to reduce the number of active electrodes and thereby reduce noise and, as the same H.T. current flows through both of them, noise is still further reduced. In this pre-amplifier the cascode valve used is the PCC89, a comparatively recent introduction. This valve has a very high slope and was described with other frame grid valves in the article on page 172 in the January issue.

Of course, the use of high gain, low noise valves must be accompanied by the use of the optimum aerials for the particular site: a signal must be present at the input of the receiver before it can be amplified. As we have stated many times in these pages, the best aerial for a particular location is not always the most complicated array; much depends on local conditions, particularly upon the incidence of reflections which give rise to in-phase and out-of-phase effects. Thus, in fringe areas, it is extremely important to test out various aerial arrays, or at least, move the available one around until a comparatively strong signal is found. The use of a low loss downlead is also a necessity which is seldom appreciated; the normal downlead can give rise to sufficient losses to reduce the signal reaching the set to negligible proportions. A low loss downlead, while more expensive, is essential.

General Design

When designing this pre-amplifier various circuits and valve types were reviewed but as previously stated a cascode circuit was chosen with a frame grid valve for low noise and high gain. As this pre-amplifier is intended to cover both a channel on Band I and a channel and Band III some form of coil switching was obviously required and although the arrangement shown in Fig. 1 may appear over complicated it does permit the circuitry used for each valve to be altered to match both the receiver and the downlead (and aerial assembly) with which the unit is to be used. This was one of the problems in the design. Whilst it is possible to design a circuit and unit which will give some improvement in most locations it is virtually impossible to make a design to give optimum results with *every* receiver and aerial system. Naturally, the input circuit of the pre-amp tends to be the most critical as regards losses and therefore some alternatives will be given later.

Circuit Analysis

Apart from the switching the circuit employed is conventional. The input is designed for 75Ω coaxial cable but cables of other impedance or balanced cables could, no doubt, be employed with suitable alterations to the input circuit. For coil switching, a four-wafer switch is used and can be seen clearly in the illustrations. The first wafer is used to switch the aerial coupling circuit and is S1A in the circuit diagram (Fig. 1). The second wafer, S1B, switches the tuned coils associated with the grid of V1. Coils L2 and L4 are the tuned windings for Bands I and III respectively and the associated coupling windings are L1 and L3.

Bias for the first triode is provided by R2 in the cathode circuit and this triode is neutralised by the two capacitors C1 and C2. These two capacitors form two arms of a bridge circuit, the other two arms being the inter-electrode capacitances of V1. Capacitor C2 is made variable so that the bridge circuit can be balanced to give lowest noise. From the anode of V1 the signal passes to the cathode of V2 via the inductance L5 which is adjusted for

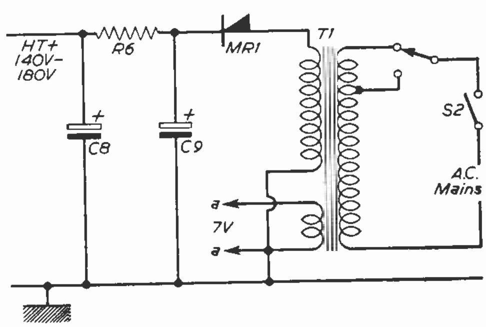
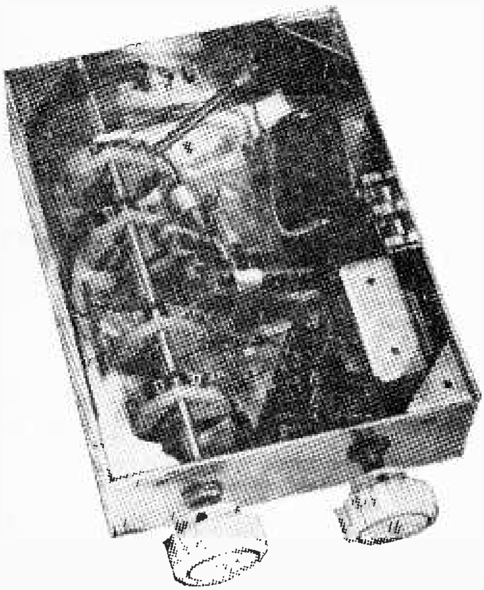


Fig. 2.—The circuit diagram of a simple power supply.

best results. As previously mentioned the grid of V2 is earthed but only so far as R.F. is concerned and this decoupling is achieved by capacitor C6. Resistors R4 and R3 form a potential divider across the H.T. supply to the valve for biasing purposes. It must be emphasised here that the capacitor C6 must be wired with short leads otherwise the combination of capacity and inductance may give a resonance resulting in ineffective decoupling.

The output from the anode of V2 is taken to S1C which is used to switch in the Band I coil L6 and the Band III coil L8. The other ends of these two coils are common and decoupled by C7. The H.T. feeder resistor to this point is R5 which gives a measure of decoupling. The Band I and Band III output coupling coils are switched by S1D and are L7 and L9.



Another view of the unit.

The H.T. used is not critical and can have a voltage of about 140-180; for highest gain the voltage should be in the region of 180. As might be expected, the decoupling capacitors used in the circuit and their wiring have a large bearing upon the results obtained. The associated leads *must* be made as short as possible and it is best if the "earthy" leads of these capacitors are taken to a common point as indicated at X on the circuit diagram. This common point can be the metal spigot of the valveholder. The spigot is then wired to chassis by the shortest route, probably to a soldering tag underneath a bolt used to secure the valveholder.

Constructional Details

The construction of this pre-amplifier is not unduly critical but the layout given in the diagrams has been proved to give good results and should be used. The chassis is a box type about 10in. x 6in. x 2in. but these dimensions are not critical and will depend to some extent on the parts employed and on the chassis available. In the prototype the valve is mounted on a bracket inside the chassis (as can be seen from the illustrations) and this means that the unit must be operated with the open side of the chassis upwards to secure good ventilation. However, the valve could be mounted more conventionally—through the chassis—but this might cause wiring difficulties as all of the wiring to the switch must be very short.

The coils for the station in Band I (L1 and L6) are wound on small polystyrene formers with purple coded dust cores. No spacing is employed between turns and the ends of the winding are fixed to the formers with cellulose cement. The coupling windings are wound on a suitable former slightly larger in diameter than the tuned windings so that they may be slipped over them before the tuned windings are soldered into circuit. The ends of the coupling winding are taken to the switches S1A and S1C, spare tags on these switches being used as anchoring points if required. When final adjustments are made, and the optimum positions of the coupling coils have been found, they may be cemented lightly in position. The wire used for L1, L2 and L6, L7 can be D.C.C. or enamelled 22-26s.w.g. and is not unduly critical.

The Band III tuned coils are wound with 18-22s.w.g. bare copper or tinned copper wire and are self-supporting —are not wound on formers. The coupling coils L4 and L9 are wound with PVC-insulated wire and, like the Band I coupling coils, are supported by the switch wafers S1A and S1D. Inductance L5 is wound with the same wire as L1 and L6 and on an $\frac{1}{8}$in. diameter former. It is wired between pins 9 and 1 on the valveholder.

Switch

It is obvious from the description and the circuit diagram, that the construction of this pre-amplifier depends to a large extent on the switch employed. In the prototype, this switch was a long, four-wafer type. To reduce the losses, a ceramic switch was used. Unfortunately such switches are not a standard item and the best use must be made of the type available. The main requirements are that the switch should have four wafers approximately equally spaced along its length. The valve can then be positioned between the middle two which makes for short wiring. Each wafer must have at least a one-pole two-way switch on it but it is likely that the types encountered will have more poles on each wafer and probably more ways per pole. Thus if each wafer had three poles, each having four ways, one pole and two ways only would be used on each wafer. Any remaining tags could be used as anchoring points for the various other components provided that the spare ways on the poles in use are left vacant. If the local "surplus" dealer does not have a suitable ceramic switch in stock then it may be possible to adapt or construct one from spare wafers. Alternatively, a suitable switch could be purchased from several of the advertisers in this magazine who deal in government surplus.

Power Supply

The H.T. circuits of the power supply employ half-wave rectification for convenience. The transformer used is of the type commonly sold for converters. A tapped primary is not essential

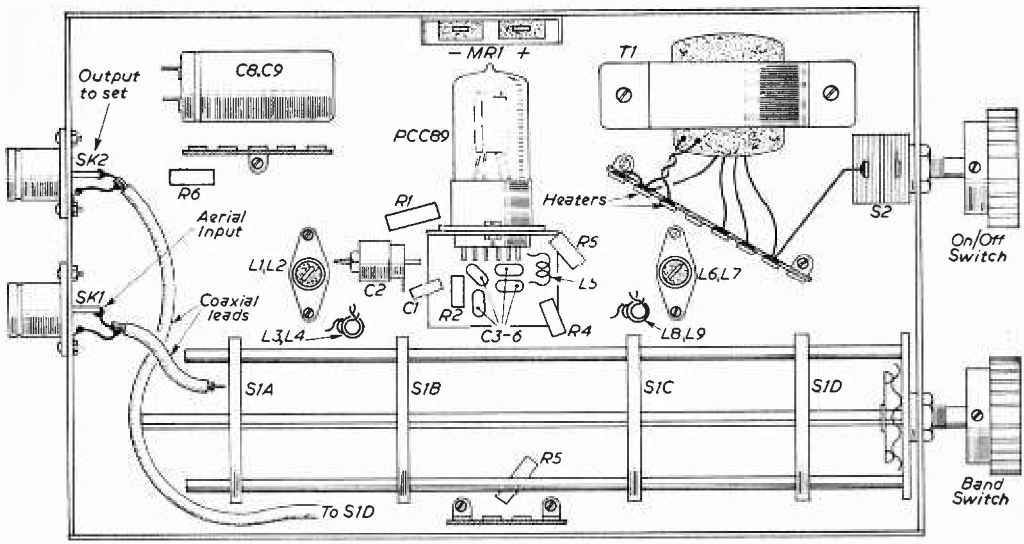


Fig. 3.—Layout of the pre-amp. (As the layout naturally depends to some extent on the parts employed, no detailed wiring has been given.)

provided the correct rating is obtained for the local mains voltage. The H.T. secondary winding should be rated at about 150-200V r.m.s at 30mA. The heater winding should give 7·2V at 0·3A if the valve heater is to be run correctly. However if it is difficult to obtain a transformer with a suitable heater winding rating is should be remembered that many converter transformers rated at 6·3V at 1 or 2A give about 7V when that total load is only 0·3A—the winding resistance is comparatively high. The H.T. smoothing is by R6, C8 and C9. The value of R6 is not critical and may be adjusted when tests are made to give the optimum H.T. voltage. The values of C8 and C9 are also not critical but should be at least 8μF. As the H.T. consumption is low, a small metal rectifier can conveniently be used and a contact-cooled type is ideal. The rectifier should be rated at about 30mA.

Wiring

As already stated, the aim in wiring is to keep all "hot" leads short, particularly those associated with the grid of V1 and the anode of V2. It will be noticed in the circuit diagram that these two leads are wired to poles on S1B and S1C respectively. In order to reduce the effective inductance of these two leads it is worth while to employ two separate leads in parallel (the inductance of two inductors in parallel is less than the inductance of the smaller—compare resistors in parallel).

(To be continued)

COMPONENTS LIST.

Resistors:
R1—82k.
R2—82Ω
R3—100k 10 per cent.
R4—100k 10 per cent.
R5—180Ω.

Capacitors:
C1—2·2pF.
C2—2 to 10pF, bee-hive type (or similar).
C3, C4, C5, C6, C7, 1000pF, min. ceramic.

Valve: PCC89.

Coils: (see text).

Switch: (see text).

Power Unit Components:
Resistor, R6, 1k or to suit H.T. voltage.
Capacitors, C8 and C9, 8 to 32μF, 350VW.
Rectifier, miniature contact-cooled type for 200V r.m.s. input and rated at about 30mA.
Transformer—type used for converters, with tapped primary and 7V, secondary.

Chassis: approximately 6 x 8 x 2½in.
Solder, wire, wooden case, etc.

COIL WINDING DETAILS.

Band I	Channels 1—3	Channels 4—5
L1 (over L2)	3 turns	3 turns
L2	17 turns	15 turns
L6 (over L7)	3 turns	3 turns
L7	14 turns	12 turns

Band I coils are wound on ¼in. small Polystyrene coil formers with purple coded dust cores. No spacing is used between turns—the coils are closewound.

Band III	All channels (8—12)
L3 (over L4)	1 turn
L4	3 turns
L8 (over L9)	1 turn
L9	2½ turns

Band III coils are wound on an ⅛in. former which is then removed and turns are spaced by the diameter of the wire. Coil details for Band III are necessarily approximate and dependent to some extent on the layout and components employed (see text).

Aerial Input Balancing

A NOVEL USE FOR A DIPLEXER

By L. E. Jones

THERE is no need to adjust your sensitivity control each time the channel is changed. Using a diplexer and an odd resistor the levelling of signal inputs can be exactly controlled without recourse to climbing up the chimney stack and trial and error attenuating in the teeth of a biting north-easter. This method can match up inputs without spoiling either band, and in the comfort of the living room at the back of your set.

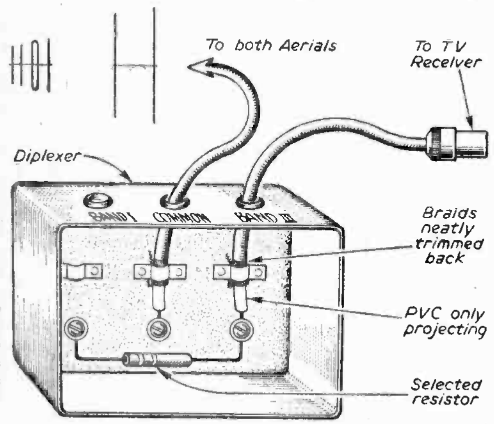


Fig. 1.—The necessary wiring.

The printed circuit diplexer is an accurate frequency discriminating filter, allowing only one band through one output terminal, and the other band through to its associated terminal, each strongly rejecting signals of the opposite band. Use is made of this.

Cut the aerial coaxial cable at some convenient point a few inches from the TV aerial plug (see Fig. 1). To the end coming from the aerial connect the common, or output, terminal of the diplexer, making sure that no whiskers of wire touch any other part. Twist the strands well before joining.

Strip and prepare the set end of the cut cable, carefully joining it to the diplexer terminals of the weakest channel. This is important. The makers give instructions identifying the band terminals and the way to prepare and connect the cable.

Now test the work so far by switching on the TV and receiving the weakest channel, setting the sensitivity and contrast for best results. This should be as good as it was before inserting the diplexer. If not check the work and clear the fault.

Switch to the strongest channel and if the diplexer is accurate the received station will be weak and grainy—this is what is wanted.

From a selection of $\frac{1}{4}$ or $\frac{1}{2}$W resistors, pick one that when connected from the vacant strong band terminal in the diplexer to the weak band terminal going to the TV gives the best balanced results when switching from channel to channel. This can vary between ten to one thousand ohms, according to the aerial, cable and signal strength. The small resistor can then be fitted in the diplexer case, and the whole tied or hung on the back of the set to take the weight off the coax plug.

With a good quality diplexer, and care in selecting the resistor, perfect matching is possible.

MAKING TV TUBES

(Continued from page 471)

The assembled guns are checked by microscope to ensure that the spacing of the electrodes is correct. They are then washed to remove contamination before passing to the rotary sealing machines, which seal the gun, mounted on its glass base, into the neck of the bulb. Each sealing machine has 12 stations and employs radiant cup gas burners for pre-heating the region of the join and oxy-coal gas jets for the actual seal. The positioning of the gun in the neck is critical and everything depends on the accuracy of the machine and the correct adjustment of the gas flames.

From this operation the tubes are transferred to the pumping machines where air is withdrawn from the bulbs and the internal components degassed to create the necessary very high vacuum. Each tube is pumped by an individual pumping trolley and while the air is being removed the trolley carries the tube through a long heated tunnel. This heating process drives off any gasses present in the metal electrodes, the glass bulb, or the screen materials. At the same time, an electric current is passed through the heater to give the cathode the necessary emissive properties. These operations completed, the getter is "fired" by induced high frequency currents. (The getter is necessary to trap the last traces of gas remaining in the tube and any which may be released during its working life—so maintaining the vacuum at a high standard.)

The tube is now connected to power supplies and its internal metal components are bombarded by electrons from the cathode to establish its performance. It is then subjected to a series of rigorous tests under working conditions to ensure its high performance and reliability; and at this stage the quality control department selects batches of finished tubes at regular intervals and subjects them to extensive tests. By comparing the results of successive tests, any trend away from the high standard of performance required can be quickly detected and rectified before quality is adversely affected.

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1D5	9/6	6BA6	6/-	6K8G	5/6	7B7	7/3	12SJ7	5/6	54KU	8/9	DH76	5/6	ECC85	8/3	EM84	9/9	P61	2/3	U18	8/6	UF42	6/9
1D6	9/9	6BE6	6/-	6K8GT	10/-	7C5	7/6	12SK7	5/6	61SPT	11/-	DH77	7/-	ECF80	9/9	EM85	10/6	PABC80	11/-	U22	6/9	UF80	9/-
1H5GT	9/9	6BG6G	12/6	6K25	7/6	7C6	7/3	12SN7GT	8/6	75	8/-	DK32	11/9	ECF82	9/9	EN31	16/-	PCC84	7/6	U24	15/-	UF85	9/-
1L4	3/6	6BH6	6/-	6L1	12/6	7E7	9/6	12Y4	9/6	77	6/6	DK91	6/-	ECH21	14/-	EY51		PCC85	9/3	U25	13/6	UF86	14/6
1LD5	3/6	6BJ6	6/-	6L6	9/9	7H7	7/6	14S7	14/9	78	7/6	DK92	8/6	ECH35	9/9	SMALL	8/9	PCC88	19/-	U26	11/-	UF89	7/3
1LN5	4/6	6BR7	9/3	6L6G	7/6	7K7	8/-	19AQ5	7/6	80	6/6	DK96	7/9	ECH42	8/6	EY86	8/-	PCC89	13/9	U31	7/3	UL41	7/6
1N5GT	9/9	6BW6	7/9	6L7	9/-	7R7	10/6	19BG6G	15/-	83	9/6	DL33	8/9	ECH81	8/3	EZ35	6/-	PCF80	7/6	U33	13/-	UL44	12/6
1R5	6/-	6BW7	6/6	6L7G	7/6	7S7	9/6	20D1	9/6	90AV	4/6	DL35	9/9	ECL80	7/6	EZ40	6/9	PCF82	7/6	U35	8/9	UL46	9/9
1S4	8/6	6BX6	5/3	6L18	9/-	7V7	7/9	20F2	9/6	117Z7	10/6	DL82	9/6	ECL82	10/-	EZ41	7/3	PCL82	8/6	U37	26/6	UL84	7/9
1S5	5/3	6C4	3/6	6L19	12/6	7Y4	7/-	20L1	13/6	185BT	16/-	DL91	8/9	ECL83	14/6	EZ80	6/3	PCL83	11/6	U43	8/9	UM80	9/6
1T4	4/-	6C5	5/6	6LD3	8/6	7Z4	7/6	20P1	11/6	723A	29/-	DL92	6/-	EF22	12/-	EZ81	7/-	PCL84	9/9	U50	6/-	UU6	12/6
2D21	4/6	6C6	4/9	6LD12	7/6	8D3	3/6	20P3	12/6	807A	5/-	DL94	7/-	EF36	3/3	GT1C	7/-	PEN25	4/6	U52	5/-	UU7	9/6
3A4	5/6	6C9	9/6	6LD20	8/6	10C1	11/-	20P4	17/-	807E	3/9	DL96	7/9	EF39	4/3	GZ32	8/9	PEN45	7/3	U76	5/6	UU8	16/6
3Q4	7/3	6CD6G	18/6	6N7	6/6	10C2	13/6	20P5	16/-	808	15/-	EA50	9d.	EF40	13/6	GZ34	12/6	PEN46	5/3	U78	5/6	UY1N	11/-
3Q5GT	8/9	6CH6	9/3	6P1	14/-	10C14	9/-	25A6G	8/-	955	3/9	EABC80	7/6	EF41	8/6	GZ37	10/6	PL33	9/-	U191	9/6	UY21	11/6
3S4	6/-	6D1	9d.	6P25	9/-	10F1	6/9	25L6G	6/9	956	2/9	EAC91	4/9	EF42	7/6	HABC80	9/6	PL36	11/-	U281	9/6	UY41	6/6
3V4	7/-	6D2	3/9	6P28	12/6	10F9	10/3	25L6GT	9/-	2050	3/6	EAF42	8/6	EF50-BR	2/-	HL41DD	9/6	PL38	14/6	U282	15/-	UY85	6/9
5R4G	9/6	6D3	12/6	6Q7G	6/9	10L14	8/-	25Y5G	9/-	5763	10/-	EB34	1/6	EF50-USA		HVR2	7/6	PL81	9/9	U301	14/-	VR150/30	
5U4G	5/-	6D6	4/9	6Q7GT	9/3	10LD3	8/3	25Z4G	7/3	9001	4/-	EB41	7/-		2/6	KL35	7/9	PL82	7/6	U309	12/6		5/6
5V4G	9/6	6F1	5/9	6R7G	7/6	10LD12	8/9	25Z5	8/-	9003	4/-	EB91	3/9	EF54	3/3	KT32	6/9	PL83	7/6	U329	12/6	W61M	11/-
5Y3G	6/-	6F6G	6/3	6SA7	5/9	10P13	9/6	25Z6	9/-	ATP4	2/9	EBC3	9/-	EF80	5/3	KT33C	6/6	PL84	11/-	U339	11/-	W76	5/6
5Y3GT	6/6	6F6M	7/-	6SG7	4/9	10P14	9/6	27SU	16/-	AZ31	9/-	EBC33	5/-	EF85	7/-	KT36	9/-	PX25	16/-	U403	9/6	W77	4/9
5Z4G	8/6	6F12	3/6	6SH7	4/6	10P18	8/-	30C1	7/6	B36	8/6	EBC41	8/6	EF86	10/3	KT44	9/6	PY31	8/3	U404	6/6	W81	5/9
5Z4GT	11/-	6F13	6/9	6SJ5	5/-	12A6	5/3	30F5	7/-	B65	4/9	EBC81	7/9	EF89	8/-	KT45	8/6	PY32	10/6	U801	19/-	X61M	12/6
6A7	10/-	6F14	9/6	6SK7	5/3	12AH7	6/9	30FL1	9/6	CBL31	21/-	EBF80	8/6	EF91	3/6	KT61	9/-	PY80	7/-	UABC80	8/9	X63	9/6
6A8G	9/6	6F15	9/6	6SL7GT	6/-	12AH8	9/9	30L1	7/9	CCH35	7/6	EBF89	8/6	EF92	4/9	KT63	6/6	PY81	6/6	UAF42	9/-	X65	11/-
6A8GT	13/6	6F16	8/9	6SN7GT	4/9	12AT6	7/9	30P4	12/6	CL33	13/-	EBL21	14/-	EF95	6/9	KT66	12/6	PY82	6/9	UB41	8/-	X66	11/-
6AB8	8/3	6F33	6/9	6SQ7	6/3	12AT7	5/9	30P12	8/-	CY31	9/9	EBL31	21/-	EK32	7/9	KT81	14/-	PY83	8/-	UBC41	8/3	X76M	9/6
6AC7	4/3	6H6	2/-	6SS7	5/-	12AU7	6/6	30P16	7/9	D63	1/6	EC52	3/9	EL32	4/6	KTW61	5/6	PZ30	12/-	UBC81	10/-	X78	14/6
6AG5	4/3	6J5	4/3	6U4GT	10/6	12AX7	7/-	30PL1	10/6	D77	3/9	EC90	3/6	EL33	9/-	KTW63	4/9	R18	12/6	UBF89	8/6	X79	16/6
6AG7	8/-	6J5G	2/9	6U5G	6/3	12BA6	8/-	35L6GT	9/-	D152	6/6	EC91	4/6	EL35	11/6	KTZ63	5/6	R19	12/6	UBL21	14/6	Y63	6/3
6AK5	6/9	6J5GT	3/9	6V6G	5/6	12BE6	8/9	35W4	6/9	DA30	12/6	ECC31	9/6	EL37	11/6	L63	2/9	SD6	9/-	UCC84	14/6	Z63	5/3
6AL5	3/9	6J6	4/-	6V6GT	6/6	12BH7	10/6	35Z4GT	5/6	DA90	2/6	ECC32	4/-	EL38	12/6	LN152	7/6	SP6	3/9	UCC85	8/-	Z66	9/6
6AM5	4/6	6J7	7/9	6X2	8/9	12C8	8/6	35Z5GT	8/6	DAC32	9/9	ECC33	4/9	EL41	8/6	LZ319	7/6	SP41	2/6	UCF80	16/-	Z77	3/6
6AM6	3/6	6J7G	5/6	6X4	5/6	12E1	12/6	42	7/6	DAF91	5/3	ECC34	9/-	EL42	9/6	MU14	8/-	SP61	2/6	UCH21	14/6	Z152	5/3
6AQ5	6/-	6J7GT	7/9	6X5G	5/6	12J5GT	3/6	43	7/6	DAF96	7/9	ECC35	6/9	EL84	7/-	N37	11/-	8U25	15/-	UCH42	7/9	Z719	5/3

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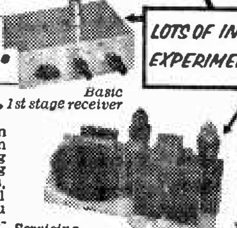

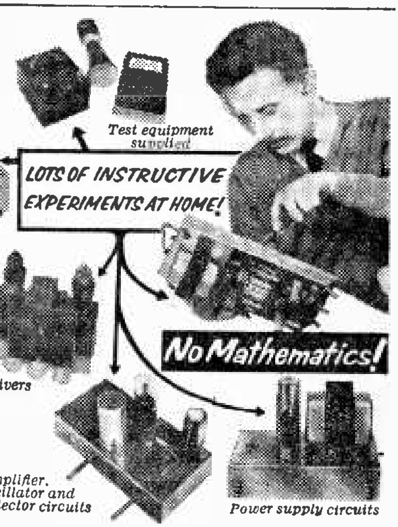

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Curing Difficult Faults

SHORT CUTS IN SERVICING

By L. E. Higgs

ONCE every now and again, the odd technical trouble crops up in our TV experience, which seems to defy solution. Everyone comes up against it, a blank wall that will not yield to any of the many rule of thumb solutions, or past successful methods. Valves all tested, hours spent tracing and trying, no obvious clue and having tried each of the many different approaches we are forced to admit to reaching a particular limit in our knowledge. What can we do?

Methods

The challenge of overcoming the baffling defect, gives us an opportunity to develop improved diagnostic methods, compels a closer examination of that which we thought was familiar, and becomes a valuable exercise in our thinking and leads to more flexible procedure. There follows, too, the exhilaration when finally the trouble is located and solved.

Lack of information is the main cause, and many who say they do not need a circuit diagram really mean that they carry a good approximation in their head. The problem therefore, is to obtain the required extra information whether it be a service manual, circuit diagram, or comments of an expert on the particular model.

Manufacturers generally are not helpful and refer enquiries to the nearest local dealer, but some of the smaller makers may send data if a postal order and stamped envelope are enclosed, especially for persons far from a dealer, or off the beaten track. However, the maker's service department can be most helpful on the phone. Usually a technician answers, and if you take the trouble to have a table of measured voltages and all available symptoms, model number, etc., he will most likely provide a clue or new line of thought. Purchasers of Radio and TV servicing books such as Newnes' "Radio and Television Servicing" will have all the data they require. Readers of this periodical also have a postal service but must always remember the stamped and addressed envelope and queries coupon. It is a good idea for those who are frequently repairing TV sets of different makes to collect any data published in magazines and compile a scrap book. You never know when this information will be needed.

Tracing the Circuit

All of this takes time, and while waiting for something to come through the post, try to make up a circuit diagram by tracing out the details in that part of the set that is suspected. Starting from the valve base, trace and list the components, voltages, and valve pins, by searching through the section with a bright light and an insulated dental mirror. Fill in the diagram with the resistance of windings as you measure them and note the effects of altering controls. This systematic checking often takes us to parts of the receiver that formerly we overlooked and quite likely this new objective task will show up the defect, or give a clue to it, before the postman calls. If it does not, then at least you have a circuit diagram and a better knowledge of the set. Commonly this method will show up dry joints, concealed damaged resistors and shorts to chassis. As a quick aid, a circuit of another set with similar timebases and circuit can be consulted, mainly as a guide to the kind of voltages to expect, but care must be taken not to rely on it.

New thinking, when "going stale" on a hard fault can be stimulated by recalling each action taken since starting on the job. Perhaps the present trouble is not the original fault but has an extra defect caused while working on it, such as a wire broken or shorting as the chassis was removed from the cabinet, or two valves accidentally transposed—even a bent valve pin suffered when refitting. One case of crackling starting up since working on a set was traced to a thin line made by a pencil on a capacitor while probing about on another fault. If the trouble arose since, say, replacing a brightness control—then checking around that quarter is obviously going to be the most profitable.

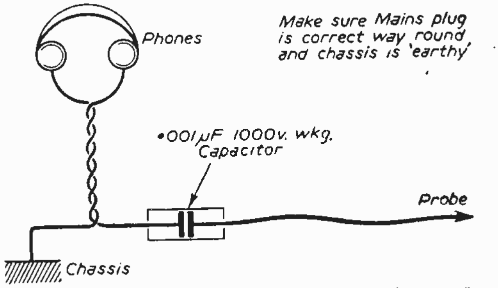

Fig. 1.—Using earphones with a condenser for signal tracing.

Assumptions

Quite often an incorrect recognition of the symptom leads one up the wrong track, and it is not until a tip to look elsewhere is received and followed that a prompt solution is found. Many are deceived into thinking a picture tube has failed because no light can be raised on the screen, yet EHT is present. Sometimes a bias fault or displaced ion trap magnet or missing accelerator anode voltage is the cause. Very often the telltale spot of light appearing when switched off is unnoticed. It is worth questioning assumptions again on these faults: we may be looking in the wrong place. Time spent trying to improve low EHT in flyback systems finishes up with replacing the H.T. rectifier to the whole set. Just one simple voltage test before starting could save this.

"Intermittents" are a big headache, in annoyance, time testing and waiting. But here a methodical approach can be made, usually in causing the set to perform its tricks to order. The formula to apply that covers most eventualities is

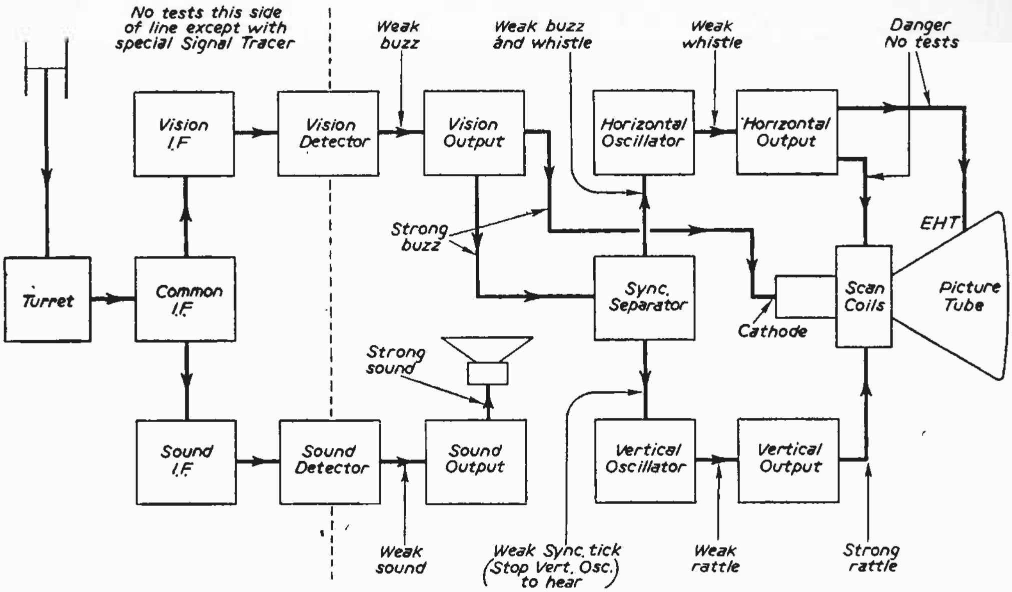

Fig. 2.—Sounds to be heard at various points in the circuit.

heat, time, vibration, interference, position, and mains fluctuation.

Heat

Effects of heat may be speeded by covering up with a cloth but care should be taken not to overdo it as the temperature can rise high enough to soften plastic parts such as channel knobs. Remember to test sets with their backs in position—the increased cabinet heat may be warping a speaker cone, and distortion caused: not fitting the back on will improve the ventilation, and the speaker will not become warm enough to show the fault.

Time has to be allowed for with many intermittents, possibly resistors dropping in value with time or temperature, or gas in valves blocking grids in time, so a wait is required here. Yet others show up in the first warming-up period only, so switching off to cool takes up most time.

Vibration

Vibration of the receiver affecting valve electrodes, poor connections on controls and dry joints can be simulated by gently probing the wiring and components during examination with the set on. Much vibration comes from the speaker shaking the chassis and will not show up outside the cabinet. This is one form of sound on vision. Position of the set can mislead: and some oil-filled line transformers, with arcing taking place above the oil level, will work well on their side on the bench when the oil slopes upwards and quenches the breakdown. Other outside effects such as mains variations and sporadic interference can give rise to effects that are blamed on the receiver and take a long time to prove otherwise. The aerial, too, must be considered.

Complete breakdown of the receiver or part of it, however, does allow some form of fault procedure to be attempted, and unlike the intermittent we do know that the trouble is cleared when the normal operation is restored. Strange to say, "tracing" is not the most often used or quickest way of clearing trouble. "Probability" is often best used first, such as trying the valves in a section, or testing fuses, or perhaps trying the control of a section through its full extent in the case of an open circuit. After this, "trial and error" is often quicker than tracing (and what else can be done if there is no diagram handy?). The most easily checked parts may be checked by substitution, or measured with the set off, and the working voltage checked with the set switched on. Some tracing can take place once a missing voltage or waveform is proved.

Listening to Waveforms

Knowing the sound to be expected at key parts of the set, and listening to them with a pair of phones and capacitor speeds up diagnosis greatly (see Fig. 1). In the case of timebases, the driven type, coupled from an oscillator, the buzz from the vertical, or whistle from the horizontal can be checked first to see if it is arriving at the grid of the output valve. If it is not, try working backwards to the oscillator. If it is, then examine the output stage. Unfortunately, the output multivibrator cannot be checked this way, as these circuits are two valves see-sawing together (the output and a section of another small valve). If any part fails, the whole circuit fails. Video waveforms can be traced from the detector to the tube this way, as can the sync from the video valve anode to the sync separator, and off to each of the timebases. It is necessary to stop the timebase for a short while for this check as the noise from it drowns the sync signal, so turn down the brilliance to avoid burning the screen, or take out the EHT connector.

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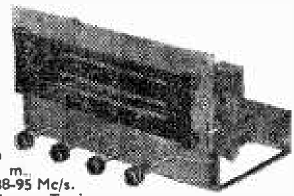

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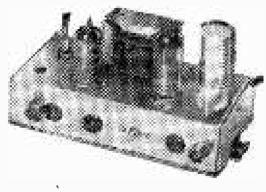

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Improving Performance

SET ADJUSTMENT FOR THE BEGINNER

By J. Kingdon

MANY constructors find themselves responsible for keeping the family's TV receiver in good order. One common fault which may be difficult to clear without sufficient information is an out-of-centre raster; that is to say, large corner shadows appear to give the raster, or the diffused patch of light, a new moon effect. Such a combination of easily remedied defects can be extremely disconcerting to the constructor, especially if he is new to the art of TV construction.

Centring

The constructor should take heart, for the cause of the deranged raster is not often as bad as the picture-tube first shows it. It is advisable, first of all, to get the raster in some sort of order, after which the constructor can then concentrate on improving sound and vision. The aerial should be taken out, and the contrast control turned to minimum. Next, the raster should be brought to some form of focus; this will give it a clear edge, and indicate its boundaries so that centring is facilitated.

Receivers may employ either electro-magnetic focusing or, as is more usual, a focusing magnet. In the former case, alteration of the external focusing control should do as it indicates—it may to a degree, but more than likely hard over on one of its "stops," the raster just starts to focus. Should this occur, all is well, for it simply means that the focus coil is not quite correctly positioned on the tube neck.

With electro-magnetic focusing we energise the focus coil by passing a certain current through it as determined by the setting of the focusing control. This allows the focus coil to behave with an electron beam as a lens does with light rays; the electron beam is brought to a point of focus on the screen by modifying the *focal length* of the coil. Clearly, then, the coil must be correctly positioned on the tube neck in the first place so that the approximate midway setting of the focusing control will effect a perfect focus of the electron beam.

Fig. 1(a) and (b) illustrates the general method of focus coil mounting; a circular bracket drilled to take the neck of the picture-tube is secured to the chassis. The bracket carries three threaded bolts, which line up with holes drilled in the focus coil cowling. Three compression springs provide loading for the coil, and three nuts allow its axial movement. With the focusing control set to its midway position, and the coil set as far as possible towards the tube base, the three adjusting nuts should be given equal clockwise turns (about one complete turn at a time) and the position of the raster noted. A point will be reached where the horizontal scanning lines are clearly defined on the tube face, although it is possible that the raster may be well out of centre with its corners cut off.

At this point the picture width and height controls should be adjusted so that the raster occupies about two-thirds of the screen area. It is then an easy matter to centre the raster by slight readjustment of individual nuts, the correct nuts and direction of adjustment being readily found by trial and error. Should it be found that, instead of the raster being wholly in focus, the centre is very sharp, and focus deteriorates towards the side and corners, correction may be effected by moving the coil very slightly along the neck of the tube towards the screen. The final centring and focusing must be carried out with the aid of test card "C" in conjunction with the settings of the horizontal and vertical linearity controls.

With permanent magnet focusing, the field strength along the tube neck, and thus the virtual focal length is adjustable by means of a soft iron sleeve, which can be made to traverse the tube neck in such a way that it gradually by-passes the focusing field as it enters the magnet. The magnetic gap is sometimes adjustable by three screws, which, apart from focusing the raster, also act as a picture shift. Adjustment of this arrangement may be followed by the method recommended for the focus coil, althought the optimum focus adjustment must be performed by this means as no external focusing control is available to facilitate this function.

Finally, it should be remembered that it is pointless to perform these adjustments, to an optimum limit, if the picture tube is not securely fixed to the chassis, for only a slight alteration in the position of the tube when it is fitted into the cabinet will be sufficient to necessitate further adjustment.

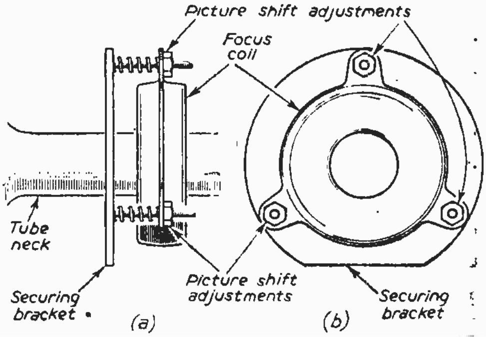

Fig. 1.— A method of focus-coil mounting.

Shadowing

This fault has several variations, since the shadows may be no more than slight shadings at one or more of the corners; or there may be complete blackout of the corners with clearly defined edges. Adjustment of picture shift screws or nuts probably tends to prevent shadowing, but only when the raster is well out of centre. In the end the exasperated constructor realises that it appears impossible to have it both ways—no shadowing and a perfectly centred raster—by the mere adjustment of the picture shift screws, so a compromise is usually aimed at.

Little is said in construction manuals about this type of fault, although it can present quite a headache to the builder. The fault is, of course, produced by an obstruction of the electron beam, where the deflection is greatest, by the glass envelope of the tube. Fig. 2(a) clearly illustrates

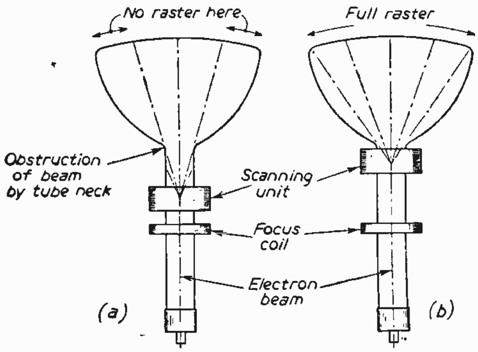

Fig. 2.—Showing how a wrongly positioned scanning unit can cause corner shadow.

how such a fault could occur. The scanning unit, as will be noticed, is not as far as possible up the tube neck, and deflection is taking place about one-third of the way down, resulting in sharply-defined corner shadows. It is, therefore, essential that the scanning unit be well up to the top of the neck of the tube as shown by Fig. 2(b).

Sometimes the corner shadows are less clearly defined, which generally means that the electron beam is not coming up to centre of the tube. This fault is usually indicative of bad alignment of the tube in relation to the focus unit. The mechanical mounting of the tube should be such that the tube axis passes centrally through both the scanning and focus units. With home-constructed equipment special attention should be given to this very important point.

Slight misplacement of the gun electrodes in the tube itself can be responsible for corner shadowing, and more than one such instance can be remembered by the author. It is frequently possible to avoid shadowing by rotating the tube into a different position, and then re-setting the shift adjustments. Apart from changing the tube —if it is still under guarantee return it to the dealer—little more can be done. Care should be taken if the tube is rotated, to provide adequate clearance between the EHT connector and chassis.

External fields, either electrostatic or electromagnetic, can distort a raster and give rise to corner shadowing. The electrostatic charges develop on the tube and associated mask; usually due to slight dampness. A complete dry-out is the answer coupled with a coating of anti-static tube polisher.

Instability can be very difficult to trace, but it must be rectified before further alignment is attempted. Special attention should be given to the screening between coils or stages. Mechanically it may be perfectly sound, but from the R.F. point of view, probably, sadly lacking. Frequently, screens and shields of this nature are secured to the main chassis by B.A. nuts and bolts, and so far as R.F. is concerned this method of fixing is totally inadequate. In fact, in certain cases, where the screen is also employed to earth decoupling capacitors, etc., the receiver would probably behave better if the screen were omitted altogether!

This is because R.F. voltages induced into the badly-secured screen are fed back again, via the capacitors, to the valves, and if these voltages are of the right phase conditions for positive feedback are developed. First of all, then, make absolutely certain that any R.F. shielding is really doing its job—and where possible solder all round any mechanical joint, especially where the shield is making contact with the main chassis—dozens of cases of tricky instability problems have been so cured by the author.

Decoupling capacitors must be returned direct to a common point, for the stage in question, and not to random sections of the chassis as is unfortunately very common practice. The circuit of Fig. 3 illustrates the arrangement which should be adopted. Grid and anode leads must be kept as short as absolutely possible, and it is essential to earth the metal centre portion of the valve base, since this acts as a screen between grid and anode pins of the valve.

The early stages common to both sound and vision channels are more likely to develop instability than later stages. Both loudspeaker and picture-tube will respond violently to instability here, and in extreme cases a microphonic howl

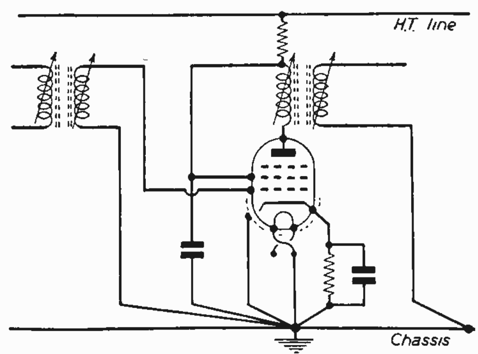

Fig. 3.—Single-point wiring is carried out as shown here.

may build up in the loudspeaker accompanied by an uncontrollable brilliant screen. In less severe cases the loudspeaker may go conspicuously quiet, and all valves appear microphonic if gently tapped; at the same time herring-bone or wire-netting patterns come and go on the screen, and alter in form as the contrast control is adjusted.

To determine quickly the actual stage which is unstable (oscillating) a valve current check can be taken. A voltmeter connected across the cathode resistor of each valve in turn will indicate an abnormal reading across the resistor of the valve which is oscillating. After locating the unstable stage attention should be focused on its associated wiring, decoupling, and shielding arrangements.

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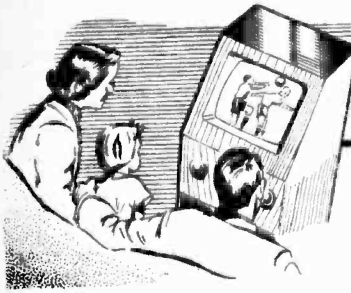


UNDERNEATH THE DIPOLE

A MONTHLY COMMENTARY

By Iconos

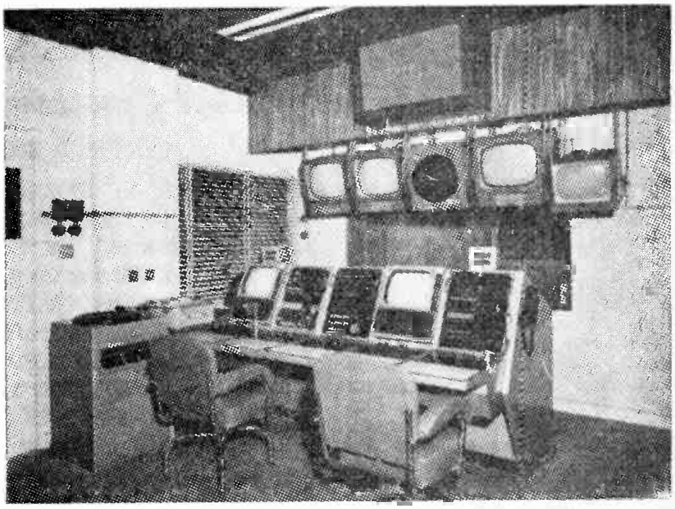
"HEY PRESTO!" are the magic words used by illusionists and conjurors to restore the two halves of a sawn-up woman—a trick they accomplish with incredible speed. Clever and amusing patter, diversionary actions, decoy lighting, mirrors and optical devices all play their part in creating the illusion. Interest and tension is retained not merely by the rapidity of the trick—but by the clever variations of the speed of the magician's actions and movements. *Timing* is the most important factor.

Electronic Legerdemain

I was reminded of these fundamental principles of *legerdemain* when I was watching the last episode of the "Black and White Minstrel Show", a swift-moving BBC musical series, recorded at the Hippodrome, Bristol. Here was the last instalment of a very good spectacular, which tried to beat its previous episodes—and I believe succeeded in doing so. Every technical trick in the pack was utilised to provide polish, slickness and speed, to exhibit the first-class cast, music and dancing at their best. Pre-recorded vocal and instrumental music was used for playback, scenery was moved in and out of shots and sometimes hoisted out of the picture, all to split second timing. Best of all was the variety of technical tricks used for continuity links and montages, particularly the liberal use of electronic "wipes"—the television equivalent of the optical effects seen in film trailers at the cinema, when one film scene appears to wipe the previous one off the screen. The whole production came over at a merry pace, with Penny Nicholls, Stan Stennett, the Television Toppers, the Jazzers and a very lively supporting cast under the able direction of George Inns. But the technical point which interested me was the generous use of the electronic optical wipe as a continuity device.

Special Effects

Electronic wipes, dissolves, inlay, overlay, zooms and superimpositions were considered to be near-miracles only a few years ago in the television field. The development of the inlay and overlay processes by the BBC frequently used in the BBC's David Nixon programme of magic, derived from the special effects device used in film studios known as "travelling matte". This process utilised photographic colour separation methods for securing such effective superimpositions as the flying carpet in "The Thief of Baghdad" film and the chase around the Eiffel Tower in "Lavender Hill Mob". Now, the electronic wipe and dissolve are standard special effects for television. The "special effects" panel is no longer *special*—a mysterious hay-wire device lashed together on a breadboard. It is an everyday piece of equipment which finds its place in the catalogues of several manufacturers. On a recent visit to the Pye factory at Cambridge I saw and operated without any difficulty several production model instruments which enable the most astounding montages to be undertaken with complete confidence. There is a caption machine which cuts, wipes or rolls in any direction from one caption card to another at the touch of a button. Contained entirely within a sleek-looking cupboard, it is a cleverly thought out arrangement of mirrors, flapping title-card holders, relays and pre-selectors surrounding one vidicon camera tube. Another Pye device, which can be used with the caption machine, is the special effects control panel, which enables the operator to wipe a picture horizontally, vertically, diagonally or in multiple sections. It



The ITV Master Control Room at Belfast, Ulster.

can be automatically or manually operated—thus giving a very flexible and wide selection of speeds. Several TV organisations have installed this type of panel, which is somewhat similar to an American special effects board made by R.C.A. T.W.W. at Cardiff have already made great use of it on their local programmes, including news items. Easier to operate than inlay or overlay, I expect that it will find its way in every master control room — and possibly every studio control room, too. Hey presto! It's practically there!

Natural Breaks

Do the "natural breaks" for advertising annoy viewers? And if they do, is it due to the length of the advertising breaks or to the number of separate advertisement items contained in any one break?

The answer may be found in the TAM ratings of BBC and ITV, which still give the commercial programmes a considerable lead. Probably most viewers do not resent the advertisements, particularly if they are amusing and well-made. But, here again, variation in presentation and timing can soften the blow and make the advertising easier on the eye and ear. Much can be learned of the art of advertising presentation by studying the format used in film trailers at the cinemas. Several times lately I have timed the length of the cinema advertising break. Never has it been less than eighteen minutes, and on one occasion it rose to twenty-six minutes! Just think of the ground that is covered: there is point-of-sale advertising for ice-cream in the cinema itself, followed by a number of short coloured advert filmlets. Then follows a longer advertising film sequence about cocoa, a holiday camp or a brand of cigarettes. Next comes the "promotion" film announcement of next week's first and second feature films, followed by a brief trailer of the Sunday evening's programme. Finally, the patrons are reminded that a weekly film magazine can be purchased from the usherettes! Quite a long advertising film session, I think, without benefit of a natural break! But the variation in the type and length of each filmlet helps to put them over with the public.

Educational Courses

I had heard quite a lot about the BBC training courses for sound and for television, but it was not until I heard BBC speakers explain the scope of the scheme and the facilities available that I realised just how far they had progressed. Strand Electric, makers of lighting control equipment for theatrical and television studios, enterprisingly held a conference in their private theatre recently, to which many television technicians were invited, and the BBC lecturers were the "stars" of both morning and afternoon sessions. Slides thrown on the screen revealed that the BBC television school was comprehensively fitted up with lighting, image orthicon and vidicon cameras and a lot of other equipment and test gear. The studio stage, where students are able to carry out practical work, seemed to be larger than many smaller stages in use at some British Regional Stations. The course is mainly a refresher, but the students undergo an examination after a few weeks of study. I should think that the BBC are ahead of any other organisation in the world in the practical completeness of their training scheme.

Echoes or Reverberation

I admit that I am a "square". I must be, because I have an aversion for the top-pop discs which have a superabundance of peculiar echoes. To my ear, some of the tinny echoes are completely phoney, with their flutters and wobbles, but there is no denying that they go down well in the juke box trade. Artificial echo was first used by the BBC at Savoy Hill, using the very first echo room ever, in the basement of that building. Music from any of the Savoy Hill studios was reproduced on a high-quality loudspeaker and reverberated around the bare concreted non-parallel walls. A microphone picked up the result and the echoes were added in any desired proportion to the direct sound from the rather dead studio. The result was a pleasant reverberant effect which added "roundness" to the original music. Since that time various acoustic tubes and magnetic delay devices, some of them very good, have been introduced. All of these systems have found their way into the facilities of television studios, and now we will soon be hearing the supplementary effects of superimposed vibro effects, oscillations and other gimmicks of the world of the golden disc. Fortunately, their weird resonances will be confined to the "top-pop" kind of programme. For me, they are tolerable when used by Jack Jackson in his bright but crazy play-back programmes, which are notable for slickness of cutting and the personality of Jack himself. But when used by anyone else, I can always switch over to the other channel like the other "squares"!

ACOS MICROPHONES

Acos Mic. 39/1. Crystal Stick Microphones for use as a hand, desk or floor stand unit for high quality recording, broadcasting and public address work. List Price £3.3.0.

OUR PRICE 39/6. With desk stand **47/6.** With floor stand adaptor **52/6.** Postage 1/6.

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Latest Collaro Studio Tape Transcriptor. 3 motors 3-speed. 1⅞, 3¾, 7½ i.p.s. takes 7in. spools. Push-button controls. Price **£15.15.0.** Tape extra. Carr. and Insur. 12/6.
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Letters to the Editor

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

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.

FRENCH TELEVISION

SIR,—I managed to pick up the French Television Service on Friday evening, the 8th April. I tuned in from about 9.30 p.m.—10.30 p.m. The programme included a violin and piano recital, a journalistic report, advertisements, and ending with news and weather, etc. I obtained two perfect pictures side by side, both identical and complete. This was obtained on Channel 7. Unfortunately, the sound could only be obtained on Channel 6 and I was unable to combine the two. The set is a Marconi BR217 model, the aerial was an ordinary BBC double dipole. This was obviously freak reception and this area is not noted for perfect reception, I.T.A. in particular.—E. W. EZZARD (Dorking).

TELEVISION COMPONENTS

SIR,—Being one of your latest readers of PRACTICAL TELEVISION, I think it would be a good idea to publish each month an article on television parts, taking a few of these parts and describing them fully and also describing their use. This would be of great help to many readers who do not have much knowledge on the subject.—B. LADYMAN (Boreham Wood).

[*We shall certainly bear your suggestion for a future series in mind.—Ed.*]

SOUND REPRODUCTION

SIR,—How refreshing to read your "exposé" of the deplorable "sound reproduction" of modern television sets—more so, since the advent of the 110deg. tube. It would seem the BBC is wasting equipment in transmitting a high-standard sound signal when its translation at the receiver end is, in many cases, bad. I can think of other adjectives more apt.

Who can press the manufacturers to do something about it? I would go so far as to suggest a 3 or 4 watt push-pull output—with a "jack-plug" for extension. I have a TV console with an 8in. speaker (the original was a very cheap unit), also a 12in. bass reflex extension. The difference in sound reproduction had to be heard to be really appreciated. Having carried the extension via a 7-watt push-pull amplifier, the results are most rewarding.

Thanks to your advice, all the proper precautions have been observed, which leads me to suggest, can your technical department give an article on this subject? I am sure many readers would be glad to have it detailed.—W. H. CHESTER (Barnsley).

[*We hope to publish an article on this subject shortly.—Ed.*]

BARKHAUSEN EFFECT

SIR,—On reading your May issue of PRACTICAL TELEVISION, I was interested in the letter from Mr. G. J. Wilde, of Stanmore. Although I have never come across this fault, I would like to point out that a frequency of approximately 101·25kc/s, getting to the cathode of the tube would cause (by beating with the line freq.) 10 vertical dark bars. This 101·25kc/s could be a beat frequency and could be caused by some frequency beating with the I.F. or oscillator frequency. With the latter the trouble would only be present on one channel. Although I have looked upon this from a theoretical point of view it is possible that it may help Mr. Wilde with his investigations.—A. KNOWLES (Co. Durham).

SIR,—In answer to Mr. Wilde, who is experiencing difficulty in removing lines on his picture (May issue), I would suggest that he first ascertains whether the lines are coming "in with the picture" or are introduced in the timebase or tube. To do this, simply earth the lead coming from the video stage to the tube cathode or grid. Alternatively a 1μF condenser connected from the tube input to ground may be used. This will effectively short-circuit all incoming pulses, and if the lines are carried by the picture intelligence the result will be a perfectly clean raster. (The brilliance control may need adjusting.) If, however, all the picture has gone, but the lines are still there, then they originate in the timebases or by induction in the leads feeding the rest of the tube base pins.—R. MORECAMBE (Portsmouth).

LENGTHENING TUBE LIFE

SIR,—Mr. Pearson is quite right in assuming that the idea mentioned in his letter (April issue) is a fallacy—with modern tubes. Before the general use of the ion trap, however, it was quite a good idea and many old receivers had a nasty ion burn due to the tube not having been moved around. This was avoided by the idea mentioned, but in these days of ion trap magnets there is nothing to be gained by turning the tube.—F. R. TURNBULL (Prestwich).

Your PROBLEMS Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 496 must be attached to all Queries, and if a postal reply is required a stamped and addressed envelope must be enclosed.

ALBA T.336

The picture just fills the screen during the day but shrinks 1¼in. each side during the evening, with the width control full on. I have fitted new PY32, EY86, PY81 and PL81 with slight improvement. The picture also fades badly after 6 p.m. each evening, sometimes preceded by horizontal lines appearing on the screen. Sometimes the picture fades altogether but it can be brought back by clicking the channel selection knob. The ITA fades so badly that it cannot be seen even with contrast at maximum. I have fitted EF85 with some improvement.—A. McGlen (Blyth).

You are apparently resident in an area severely affected by mains voltage variation. The voltage adjustment should be set at 216-230V unless it is known that the average voltage is much lower. Check the ECL80 line oscillator and the 2·2k resistor to pin 8 of the PL81. Clean the turret tuner (Cyldon) spring contacts and biscuit studs and smear with MS4 silicone grease to prevent further coating.

PYE 14in.

Sometimes on switching on the set no picture or raster appears. The sound is perfect and all valves light and EHT is in order. The set has been returned to the dealers twice but the picture has returned and no fault could be traced. The picture is fine for a few weeks and then fades again.—A. Cook (Culgaith, Penrith).

When the fault appears short a wire across the grid and cathode pins of the tube. This should flood the screen with light if the tube is O.K. If it does, suspect the brightness circuits and the video amplifier, but if it does not and there is a voltage on the A1 pin (10), suspect the tube itself.

PAM 500C

This set is about 2½ years old. Just recently the following fault has appeared; ragged black and white lines move across top half of the screen when contrast is turned up, more so when the background of the picture is all white. The only way I can stop this is to reduce contrast which spoils the quality of the picture.—G. O. Davies (Warwick).

Suspect the PCF80 at the back of the set near the mains dropper. If this is in order check the sync coupling condensers C23, C45 and C46. These are marked on the printed panel.

COSSOR 933

There is a black band approximately 1in. deep above and below the picture on this set. Some time ago a valve in the picture circuit was replaced and I was given to understand that there was also a fault in the height circuit, " probably a resistance gone high ".—J. M. Edmondson (Thorpe, Yorks).

Your fault is usually due to one or both of the 6AB8 frame timebase valves on the right hand side of the top deck as viewed from the back. If both of these valves are working suspect the 100μF electrolytic decoupling the cathode bias resistor (pins 3 to chassis) of the right hand one.

VIEWMASTER 12in.

I have the above set and also the PRACTICAL TELEVISION VM1 valve amplifier. I wish to alter the coils from Holme Moss to Sutton Coldfield. What number of turns is required for Sutton Coldfield? I note that in the 1-valve amplifier the damping resistances will have to be altered. I still have the circuit diagram of both VM and VM 1-valve amplifier. On my signal generator originally bought some years ago Sutton Coldfield's frequencies are given as sound 59·95Mc/s, vision 63·45Mc/s. When were these altered to the present sound 58·25Mc/s and vision 61·75Mc/s?—A. Hills (Harlington).

To modify your 1-valve pre-amp for Sutton Coldfield, it is only necessary to remove 2 turns from each tuning coil, then realign. It is not necessary to alter the damping resistors. So far as we are aware the Sutton Coldfield frequencies have not been changed at any time. They have always been 58·25Mc/s and 61·75Mc/s for sound and vision.

SOBELL T143

The width and height of the picture have decreased leaving ½in. of black around all four sides. I have changed PY81 and PL81, but only achieved slight improvement. The height control is fully turned clockwise and the vertical hold is very critical. Apart from this fault the picture is excellent.—C. A. Felstead (Leicester).

It sounds as if the metal rectifier is faulty and should be replaced. The height can be increased by replacing the 39k resistor in series with height control by a 27k. Frame hold could probably be improved by fitting new valve V7—ECL80, but H.T. should be checked first before a new rectifier is fitted, and make sure that H.T. is in region of 180V to 200V.

ULTRA 12in.

The trouble is insufficient height. The control will close it up to a thin line and open out to half a picture with a white line top and bottom. I have

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300-0-300 v 100 ma, 6.3 v 4 a, 5 v 3 a .. 23/9
350-0-350 v 100 ma, 6.3 v 4 a, 5 v 3 a .. 23/9
350-0-350 v 150 ma, 6.3 v 4 a, 5 v 3 a ... 29/9

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300-0-300 v 100 ma. 6.3 v 4 a, 5 v 3 a .. 27/9
350-0-350 v 100 ma. 6.3 v 4 a, 5 v 3 a .. 27/9
350-0-350 v 150 ma, 6.3 v 4 a, 5 v 3 a .. 35/9
425-0-425 v 200 ma, 6.3 v 4 a, C.T. 6.3 v 4 a, C.T. 5 v 3 a 49/9

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200-250 v 0-9-15v 1½ a, 12/9; 0-9-15 v 3 a, 16/9; 0-9-15 v 5 a, 19/9; 0-9-15 v 6 a, 23/9.

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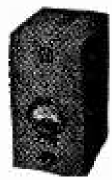

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had valves tested, 6L1, 6F1, UL46 and all are in order.—G. Hall (Wirral).

Your remarks suggest that if the front right side UL46 is in order, the 6K25 next to it is at fault or the 0.5μF capacitor coupling the 6K25 to the UL46 is leaky.

VIDOR CN4207

This set has given very little trouble despite its age, and it is still possible to enjoy the present quality of its definition. I should like to adapt it for reception of ITV (Lichfield). What kind of modification would you recommend? Would a turret tuner be satisfactory or do you think I could successfully achieve reception using a type of Band III converter advertised in the pages of your journal in the form of a kit. My location is about 15 miles from both BBC (Sutton Coldfield) and Lichfield.—T. Jones (Rolleston-on-Dove).

Conversion of the CN 4207 is a little difficult as the I.F. is low: sound 6.25Mc/s, vision 9.75Mc/s. This means that the most satisfactory type of tuner, Cyldon E101 or Brayhead 10P, will have to have its output I.F. coil tuned down as well as the oscillator coil. This is not too difficult and we could help you if you decide to use a turret tuner. The use of an add-on converter brings different problems the major one being BBC break-through on to the ITV reception resulting in severe patterning and perhaps audible BBC sound. The converter therefore must be carefully chosen, giving a high gain at low receiver sensitivity.

PHILIPS 1236U-15

This set is suffering from loss of frame and line sync. I have had the valves checked and I will soon be receiving a service sheet for the above.—R. L. Deveraux (Wokingham, Berks.).

You should check the ECL80 valve on the right side of the chassis (as viewed from the rear), the high value resistor associated with this valve base and the white cardboard-covered electrolytics associated with the video amplifiers under the rear of the same chassis.

BUSH TV22

Watery lines keep appearing at the top of the screen, and at the same time there is a continuous loud humming noise. I have noticed when the picture changes scene the watery lines clear for a second or so then reappear.—J. Trinder (Edmonton, N.9).

The described symptoms indicate incorrect tuning. Check knob to the right of aerial terminal and the inset brass cores (2) between. Tune knob for maximum sound, cores for optimum vision and sound.

MURPHY V150B

The trouble is a weak picture which cannot be seen in daylight or even at night if a light is on. I have had the V24, V801 and 20P1 tested and found to be in order. Do you suspect the 680pF condenser? If so, can this be replaced with any other as the makers say this is now unobtainable?—G. Wilson (Northwich, Cheshire).

There is no need to suspect the 680pF capacitor. The symptoms are of a weak tube which should either be replaced or boosted by means of a 2V boost transformer (of the isolating type).

REGENTONE BIG 12

The picture has lost definition and will not fill the screen at the top and bottom even with the height control at its maximum. The picture is dim and any attempt to brighten it merely increases the blurred effect and eventually leads to flaring of the white elements. I think the fault is in the 14A100 rectifier.—P. Harvey (Woolton, Liverpool).

The 14A100 should be replaced by a 14A100 or an Automat TV100. The symptoms cannot all be attributed to a low rectifier; the tube may well be failing and the 1·5 resistor (brown, green, green) to the 6SN7 may require renewal.

RAYMOND RF91T

The set is fitted with a turret tuner. The picture stretches at the top and seems to fold over at the bottom. Adjustment of the frame linearity control to bring the top half of the picture back again causes double images. Also the sides of the picture are now pulling in to the centre.—H. Mullen (Liverpool 11).

You should replace the ECL80 valve, next to the PY82 on the left-hand side. Also check the main smoothing capacitors of 60 + 100μF, the ECC82 line oscillator and the PL81 line amplifier valves.

DECCA DM41 C

There are horizontal black lines intermittently on the screen which become worse if the volume control is advanced. Sometimes the lines are so bad it is impossible to see the picture. I have fitted an isolation transformer to the CRT tube to cure a heater/cathode short, and I have tried all the usual "cures." This fault has only been present since the tube developed a short.—F. Breakwell (Kidderminster, Worcs.).

Check the H.T. smoothing 100 + 200μF capacitor and the 8μF sound section (EC80) decoupler. Ensure the oscillator cores are properly trimmed.

R.G.D. H1700

The level of the volume has dropped. By adjusting the oscillator trimmers the volume is higher but the sound on vision ruins the picture. I have replaced the 12AT7 and other valves which were low according to test, but it did not help. The picture also slips up and down, although it can be controlled by the frame hold which locks it for various lengths of time, from a few minutes to a few days. A slight movement of the control puts it right. I have replaced the 6K25 but it made no difference. The picture quality is perfect.—J. Borrill (Hull).

You should check the sound I.F. 6F13, the detector-amplifier 6LD20 and the output 6P25. If these are in order, check the resistors associated with the noise limiter (small metal rectifier) and the voltages to the above valves. Also check the components associated with the 6K25, particularly the 0·5μF and 50μF capacitors.

FERRANTI T1405

After switching on the picture is fair but focus is rather poor. After a short period the picture

darkens and I have to turn up the brightness control and the focus becomes worse. The height shrinks after half an hour or so although height control is at the limit of its travel. If I put mains selector to 200—210V position it improves the picture a little. All the valves have been in use since the set was new but appear O.K.—C. Patch (Grays, Essex).

The majority of your trouble is due to a failing metal rectifier. This is the grey finned object in the centre under the tube. A RM4, TV4 or equivalent rectifier may be used.

H.M.V. 1807

After repairing one of the wire-wound sliding resistors I have a good picture and loud sound. Trying out a converter for ITV I see there are no Band III results but still BBC very strong. Would it be because this is a straight set?—H. George (Shepherd's Bush, W.12).

An aerial will, of course, be required to produce ITV reception of any worth. The BBC reception is obtained on the coaxial connecting the receiver to the converter. The contrast must be kept well down, a strong ITV signal applied to the converter and this must, of course, be accurately tuned. If these conditions are met, reception is assured but patterning due to BBC pick-up may be too severe for satisfactory viewing.

PHILIPS 385U/15

This is a 9in. set which I would like to convert from channel 1 to channel 2 and, if possible, also be able to provide for the alternative programme from the ITA Dover Station. I want these two channels only, without the expense of a multi-channel tuner if possible.—A. Jones (Canterbury, Kent).

You cannot convert the 385U to dual band use without using a tuner unit or at least an add-on converter. It is fairly straightforward to realign the aerial, R.F. and oscillator circuits to channel 2. You will see a beehive type rotary trimmer next to the second UF42 from the far end (front) on the left. This should be unscrewed until sound is heard. Retune the coil cores of the far end aerial and R.F. coil cans on either side of the front UF42, also the front variable capacitor. Tune for optimum picture and sound and retrim the oscillator (next to V2) for best results. Do not alter any of the other coil cores. There is one core in the first can, two in the second (top and bottom).

ULTRA W.T.917

There is no sound or vision on this set. The U25 valve does not light. One FW10 valve is not lit. U801 valve burns with a bright blue glow at all four points. Will replacement of U25 and FW10 bring back the picture? The U25 valve is immersed in wax. Is it necessary to replace this after fitting a new valve? If the CRT requires boosting, can this be done?—W Ramsden (Sheffield 10).

There is no FW10 valve fitted in the WT917. The valve (10F1?) should be replaced, also the U801. not the U25. If the symptoms persist check the electrolytic capacitors and the H.T. line generally. The CRT can be boosted by wiring a 5k 10W resistor from the yellow lead on the mains dropper to pin 12 of the tube base socket.

SOBELL T145

The only way a picture can be obtained is to have the contrast fully advanced clockwise. Any attempt to adjust the control in the other direction causes the picture to cut out completely, although sound can still be heard faintly and a raster is still obtained. A visual check of components associated with this part of the circuit revealed nothing, but as the control did not seem in good condition I fitted a new one without any improvement. A slight drop in the local mains voltage seems to make the picture uncontrollable, i.e. the height falls and the picture revolves rapidly. Sometimes this can be checked by advancing the height and vertical hold fully clockwise. At times even this is not sufficient to correct it.—W. S. Jones (Wolverhampton).

First check that the H.T. is at the correct voltage, which should be in the region of 190 with 250V input. If not, metal rectifier is low. Failing that, check EHT rectifier EY51 for low emission. A small modification will improve the height situation however: R140. 39k in series with the height control, should be replaced by a 27k resistor.

FERGUSON 305T

Every so often there is a sharp click and the line hold is lost for a few seconds. It rights itself after this. Since the ITA transmissions started from Dover the set suffers badly from sound on vision and black lines running across the picture. Where is the oscillator core on the tuner? The interference is on Band III only.—F. Fagg (Ramsgate, Kent).

The click heard is probably a discharge of EHT which causes momentary loss of line hold. The source of this discharge may be in the top right hand EHT section or at the rear of this. We cannot suggest a remedy without knowing the exact point of discharge. The oscillator coil core is directly under the PCF80 valve and is adjusted by inserting a non-metallic screwdriver into the hole provided from beneath. If the sound on vision is caused by overloading adjust the local-distant control at the rear next to the aerial socket.

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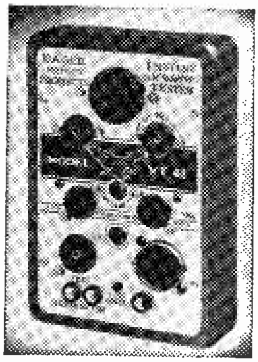

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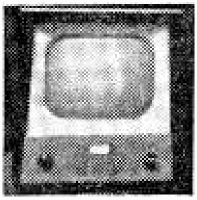

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