Practical TELEVISION

JULY 1965

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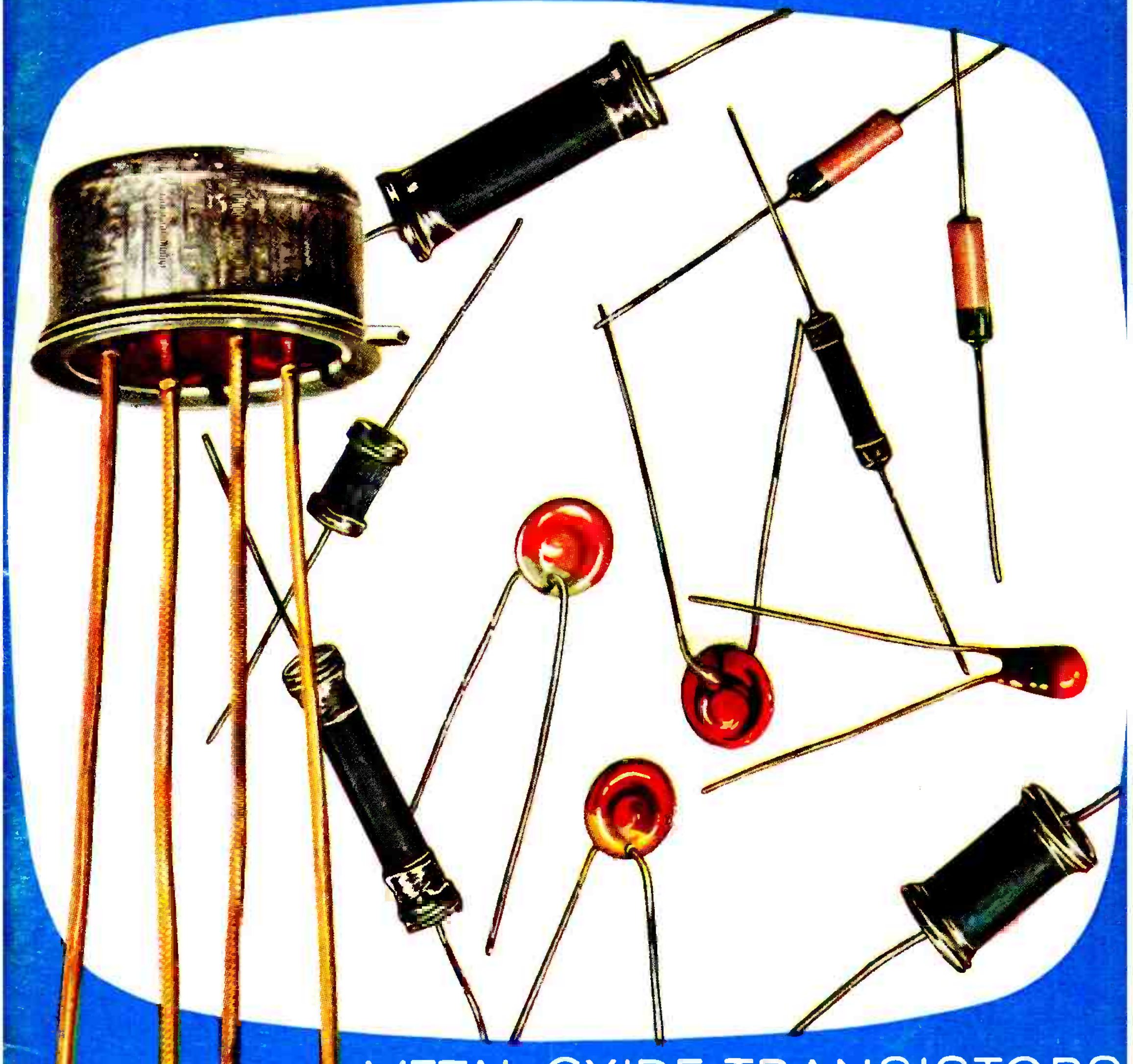

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E83F	24/-	ECL86	8/-	EM85	8/9	N108	26/2
E88CC	10/-	EF22	6/6	EM87	7/6	P2	10/-
E180F	19/6	EF36	3/3	EN31	10/-	PABC80	6/9
EA50	1/6	EF37A	7/-	EY51	5/6	P61	2/6
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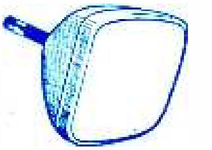

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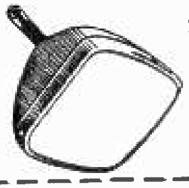

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Practical Television

JULY 1965

VOL. 15 No. 178

COLOUR PREJUDICE

We have recently spoken of the political pressures which have befogged the European colour TV problem. It is sad to see that even the domestic colour scene is being injected with political prejudice and muddled thinking well in advance.

In a recent statement by the PMG, it is suggested that since many people will not wish to see, or be able to afford, colour TV, then it would be wrong to expect the main body of licence payers to subsidise such services. The introduction of a separate colour receiver licence is put forward.

Now we have always been under the impression that a TV or a radio licence is not issued to permit the holder to tune into one station or another but conveys the right to *operate* a receiver. A radio licence is still necessary even if the holder listens only to Luxembourg, a pirate pop station or Radio Pekin. The BBC does not enter directly into the contract. Similarly, the TV licence holder does not pay to watch BBC or ITA programmes. He pays to operate his receiver.

If not, how about the ITA fan who seldom watches BBC? How about the viewer who does not want BBC-2—or does not even have a local u.h.f. service? These people subscribe through their licence fee to these services. So why should a colour TV viewer pay extra when the BBC-2 fan does not?

Mr. Wedgwood Benn, we feel, is on a sticky wicket. If, as suggested, the "wealthy few" must pay extra, then it is logical to project the idea if the intention is equity and not political doctrine.

This would mean a lower fee for those not using BBC-2, a reduction for those willing to forgo BBC altogether, a different fee for those who dislike ITA and a system of rebates for moderate viewers based on how many hours the set had been used and what programmes had been seen!

No, it is not feasible or desirable to separate viewers into such narrow statistical compartments. Nor, as the present law stands, is it legal.

In short, there is no case for colour prejudice in television!

THIS MONTH

OUR NEXT ISSUE DATED AUGUST WILL BE PUBLISHED ON JULY 22nd

TELETOPICS

Cancelled—The '65 Show

THE National Television and Radio Show's successor, "The '65 Show", which was to open in August, has been cancelled.

The show was to have provided a fresh approach by covering all aspects of the radio, television and entertainment industry and by including foreign exhibitors for the first time.

The organisers of the new Show were Industrial and Trade Fairs Ltd. Lack of support is the reason behind the cancellation; most of the larger television manufacturers had refused to take space as had the commercial TV companies.

First British Transmitters Sold to US

FOR the first time British television transmitters have been sold to the USA. A new u.h.f. station being built in Chicago will be equipped with Marconi transmitters and studio cameras.

Six of the new Marconi mark V 4½in. image orthicon cameras are included in the order and the two 25kW transmitters ordered are similar to those specified for BBC-2.

Call for Colour Decision after Show

Attendance at the Radio and Electronic Component Show held recently in London was up 16% on last year's figures.

Commenting on the show's success, Mr. A. F. Bulgin, president of the Radio and Electronic Component Manufacturers' Federation, called on the Government to encourage Britain's electronics firms and to decide now on the standards for British colour television.

A general view of the exhibition is shown above.

NEW SCIENCE TV PROGRAMME AWARD

EACH year for three years a new award will be made to the producer or editor of the programme judged to have made the most significant contribution on television to the wider understanding and appreciation of science.

The award has been instituted by Mullard Ltd. in co-operation with the Guild of Television Producers and Directors. It will consist of a plaque plus 200 guineas and will be first presented on November 11th this year.

TV TRANSMISSIONS BEGIN IN BERMUDA

A NEW TV station will soon begin operations on the British Atlantic island of Bermuda.

The Atlantic Broadcasting Co. Ltd.—ZFB TV—will operate the station, which will come into service on July 1st. Transmissions will be on channel 8.

VTR EQUIPMENT FOR AIRLINERS

NINE-INCH television receivers are being installed by an American airline in 45 of its jet liners to show passengers full-length videotaped movies, programmes from local ground channels, or recordings of take-offs and landings.

The equipment, made by the Sony Corporation, includes their new video tape recorder, the PV-100, and a TV camera in the nose of the plane which will televise terrain beneath the aircraft during flight and landing and take-off periods.

Now a COAL-powered TV Set

AT the Westinghouse research laboratories in Pittsburg, USA, a television receiver is being used to demonstrate an experimental fuel cell system which converts gases obtained from *coal* directly into electricity.

The system consists of a fuel cell battery plus a chemical reactor. The reactor produces the gases from coal fed into it which flow to the fuel cell battery. The battery contains 400 thimble-size ceramic cylinders, which are the fuel cells, and here the upward flowing gases make contact with negative electrical terminals (cathodes). At the same time heated air passes around the outside of the battery where a positive terminal (anode) is located. Electrons are removed from the anode surface by the oxygen in the air which attach themselves to the atoms of the oxygen molecules, forming negatively charged ions.

The ions move through the electrolyte of the fuel cells and collect at the negative electrode. Here they combine with atoms of the fuel gases, freeing the electrons that were picked up at the anode terminal of the cell. It is this movement of electrons, constituting an electric current, which provides the 100W to power the TV receiver.

SCHOLAR RECEIVES BAIRD AWARD

AT the annual dinner of the Television Society on 14th May, Mr Bruno John Vieri, aged 24, of Reading, was presented with the John Logie Baird Travelling Scholarship for 1965.

This scholarship is awarded annually by Baird Television Ltd. and enables a student engaged in television research to undertake travel abroad.

Mr. Vieri, who is currently carrying out research into television bandwidth compression, acquired his first-class B.Sc. in engineering at Birmingham University and subsequently joined Imperial College, where he has just completed his Ph.D.

BBC BEGIN COLOUR TESTS WITH GERMAN SYSTEM

ON Monday, May 24th, the BBC began a new series of experimental transmissions of colour TV using the German PAL system. These tests replace the 625-line American NTSC transmissions which the corporation had been radiating prior to this.

Initially the transmissions are being made during the BBC-2 trade test periods between 1200 and 1300, and 1500 and 1600 on Mondays to Fridays, from the Crystal Palace station on channel 33. Each one-hour transmission consists of a trade test card in black and white for 15 minutes, ten minutes of colour bars and colour slides for the remainder of the time.

Paint Stops Trade Tests

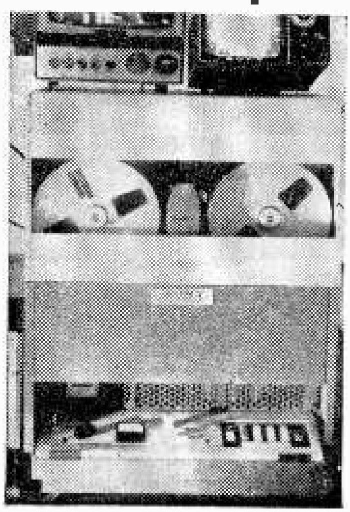
TRADE test transmissions from two ITA stations were subject to interruptions for a month recently while the masts were painted. Both Croydon and Presely stations cancelled their regular trade transmissions for four weeks.

TV EXPANSION IN RUSSIA

THE Soviet Union's television receiver population stands today at 15 million, whereas ten years ago it was only 820,000.

Providing programmes transmissions for these receivers are the USSR's 500 TV stations whose combined output reach about half the population. In 1970 there will be a further 300 stations transmitting.

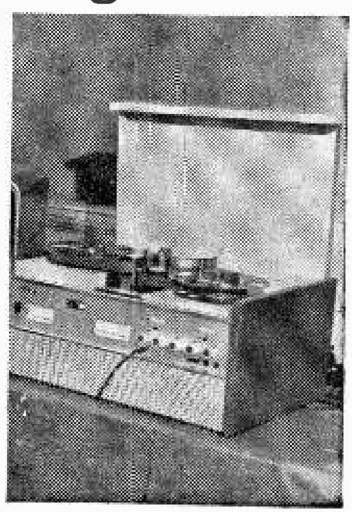
Video Tape Recorders Getting Smaller



As the demand for video tape recording equipment grows, the competition among the world's manufacturers to provide less expensive and smaller machines intensifies.

Two of the latest introductions come from Sony and Philips. The Sony "Videocorder", on the left, weighs only 130lb and has a base area of only 324 sq. in. The 7in. reel of tape accommodates a full hour's recording which can be replayed immediately or stored for replay later. The tape used is 50·8mm wide and runs at the low speed of 12·6cm/s.

The Philips machine, shown right, uses a 25·4mm-wide tape running at 19cm/s. Programmes of up to 45 minutes' duration can be recorded on this machine, which sells for less than £1,000.



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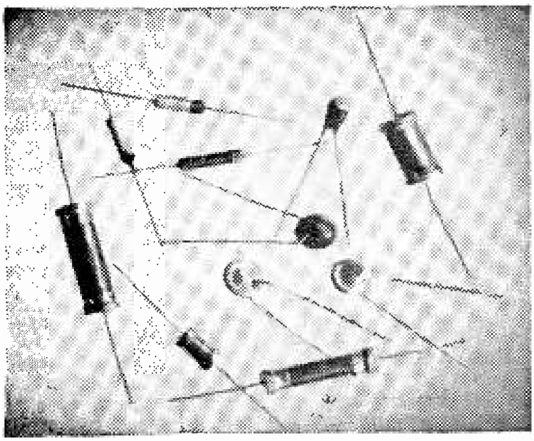

Non-linear Resistors

by G. J. King

AN electrical resistance is a property which hinders the flow of electricity. The higher the value of the resistance the greater is the hindrance to the flow of electricity. Electrical resistance can be considered as the counterpart of mechanical friction. Heat is developed in both cases.

Under normal conditions all electrical conductors possess resistance. Even very good conductors such as silver and copper have a very small value of resistance and other materials have a higher value per unit size.

However, certain metals can be caused to lose most of their resistance when lowered to a temperature of approximately 4°K, that of liquid helium. This is called "superconductivity". Unfortunately a great deal of use has not been made of this to date for the reason that the strong magnetic field resulting from almost zero resistance to a flow of current tends to neutralise the superconductivity effect.

Nevertheless work is in hand to produce hard superconductors which can be put to practical use, but as they rely on extremely low temperatures they have no immediate application in domestic television. It is likely, though, that they will eventually find use in high-speed computer switching systems. But this is a different story.

Most conductors exhibit a linear resistance characteristic under normal conditions where the flow of current does not cause a rise in temperature. This means that a graph of current plotted against voltage takes the form of a straight line passing through the origin as shown in Fig. 1. This characteristic applies to ordinary resistors as well as to conductors.

However, should the conductor (or ordinary resistor) increase in temperature the resistance would also normally increase. This results from the *positive* temperature coefficient which is possessed by the majority of conductors. The degree of such coefficient of temperature is determined by the nature of the conductor.

Positive Temperature Coefficient

A practical demonstration of positive temperature coefficient is given by comparing the cold resistance of a picture tube or valve heater with the resistance of the same heater when hot. A considerable increase in resistance will be noted if the heater resistance is measured immediately after a valve or tube is switched off. Conversely the resistance is very low when the heater is cold, which is the reason for the heavy flow of current in a heater chain when it is first switched on.

Resistors with a high positive temperature coefficient are not normally used in television

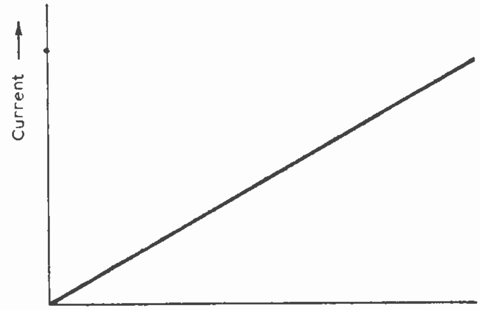

Fig. 1: Linear resistance gives a straight-line current/voltage characteristic.

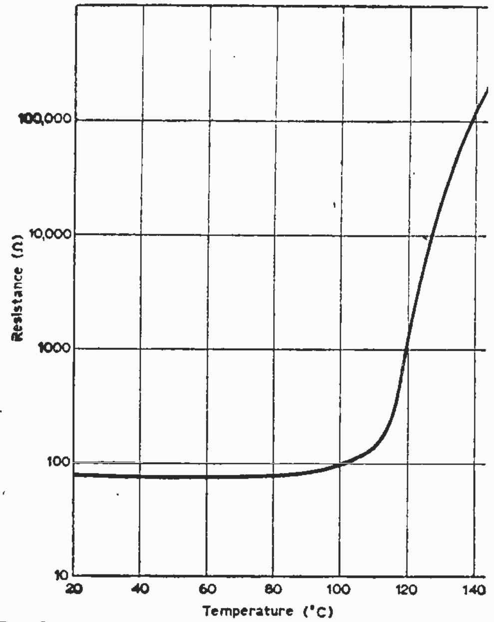

Fig. 2: Positive temperature characteristic of a Mullard P80/110/33/01 resistor. Note the relatively low temperature coefficient up to about 120°C.

circuits, though of recent months they have been made available for the control and protection of electric motors in critical applications. Such a resistor is the Mullard P80/110/33/01, the characteristic of which is given in Fig. 2. This curve clearly shows how the resistance rises rapidly beyond a certain temperature value. Resistors of this kind are designed for mounting in the winding of a motor.

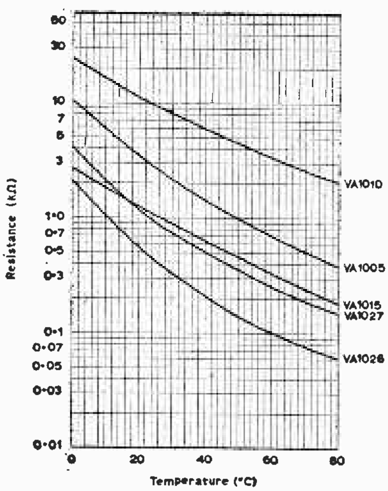

Fig. 3: Negative temperature coefficient of five Mullard thermistors. Note the decrease in resistance with increase in temperature, opposite to the curve in Fig. 2.

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Negative Temperature Coefficient

Of far greater application in television receiver circuits are resistors possessing a high *negative* temperature coefficient. As would be expected, such a resistor has the property of decreasing in resistance with increase in temperature. Curves of resistance against temperature for five Mullard negative temperature coefficient resistors are given in Fig. 3. Here is shown the relatively high cold resistance and the progressively falling resistance as the temperature rises.

Resistors whose value is designed purposely to be affected by temperature are called "thermistors". Sometimes a trade name such as *Brimistor* is used.

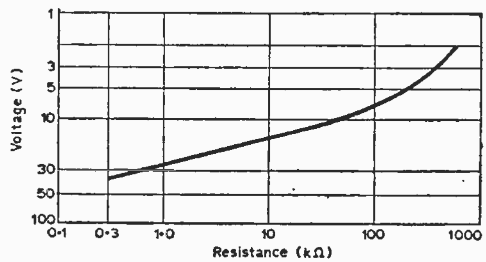

Fig. 4: This curve shows how the value of a VDR decreases as the voltage across it is increased.

Thermistors are made in various shapes, sizes, ratings and characteristics. The positive temperature coefficient component referred to above is made of "doped" barium titanate ceramic. Components with a negative temperature coefficient are composed of specially selected oxides to provide not only the requirements for temperature coefficient and specific resistance but also to give constant life characteristics, remembering the high temperature at which they may operate, and mechanical strength for ease of fitting and handling.

Voltage Dependent Resistor

There is also another type of resistor which fails to obey the ordinary law depicted in Fig. 1 and this is called a "voltage dependent resistor". With an ordinary resistor the value remains substantially constant with changes in voltage across it. With a VDR, however, the resistance value decreases as the voltage across it increases. Fig. 4 shows how the resistance of a VDR drops as the voltage across it rises.

As with thermistors VDRs have a diversity of ratings to suit specific applications. However, the curve in Fig. 4 shows the characteristic of one particular component where the value changes from about 700,000Ω with 2V across it to about 600Ω with 30V across it.

The thermistor and the VDR then represent the two major non-linear resistors encountered in television receivers and associated equipment. The resistance is said to be non-linear, of course, since the current through it does not follow linearly the

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voltage across it. Non-linear resistors are really a form of semiconductor, for it may be recalled that a semiconductor such as a diode—or even a transistor—does not possess a linear current/voltage characteristic.

Now let us see how thermistors and VDRs are used in television receivers, starting with the former. The classic application of the thermistor is for the protection of series connected valve and tube heater chains. When such a circuit is switched on the voltage across the heater with the least thermal capacity may rise above the voltage rating of the heater and cause an overload.

This is revealed by the affected heater (or heaters) lighting up abnormally bright when the set is first switched on and then gradually dimming as the other heaters in the chain warm up and increase in resistance themselves, having in mind the positive temperature coefficient of heaters.

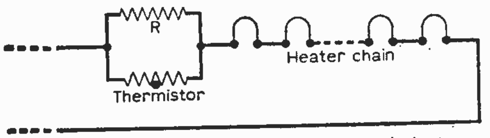

Fig. 5: A thermistor connected for heater-chain protection. The shunt resistor R is not always necessary.

Heater Chain Protection

Now with a thermistor connected in the series circuit, as shown in Fig. 5, its value is high to start with, but as current passes through it so its temperature rises and its resistance falls in accordance with the characteristics in Fig. 3. This effect causes a gradual rise in current through the heater chain and thus avoids overheating of a valve whose heater is of a small thermal capacity.

The type of thermistor used for this application has the appearance of a black carbon rod or a resistor which is burnt out! Indeed some beginners incorrectly interpret a thermistor as a failing resistor, especially in view of the high operating temperature of the component in a heater chain.

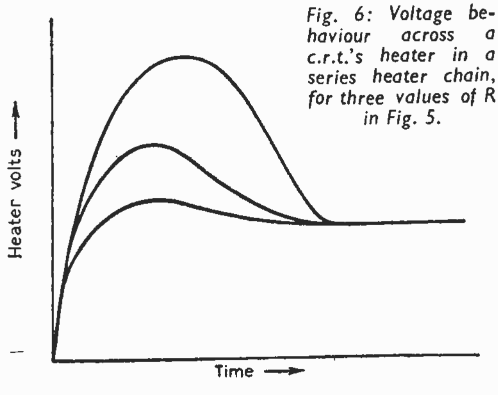

Fig. 6: Voltage behaviour across a c.r.t.'s heater in a series heater chain, for three values of R in Fig. 5.

After years of use thermistors do tend to become a little brittle and the connections at the wire ends may become impaired, causing local hot spots and sparking.

The correct replacement should always be made, for the component was selected originally with a sufficiently high cold resistance to protect the heaters immediately after switching on and a change in resistance which is sufficiently slow to facilitate the correct warm-up period. This latter condition is often adjusted by the use of an ordinary wire-wound resistor in shunt with the thermistor.

The importance of a shunt resistor is revealed in Fig. 6, which shows the voltage across the heater of the picture tube which, incidentally, usually has the smallest thermal capacity, plotted for three R values.

A resistor of too small a value will tend to neutralise the compensating effect of the thermistor and give too great a rise in voltage across the affected heater. It should be noted that many heater chain thermistors in use are designed for a 300mA heater current without the need for resistive shunting.

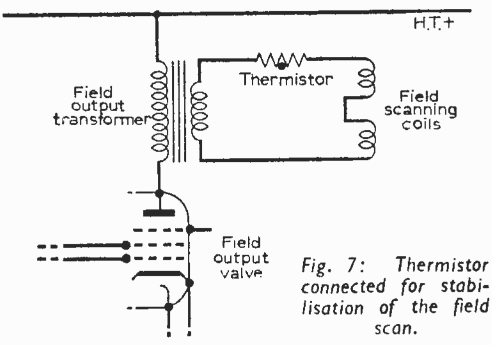

Fig. 7: Thermistor connected for stabilisation of the field scan.

Field Scan Compensation

Another thermistor application is shown in Fig. 7. Here the thermistor is connected in series with the field scanning coils to compensate for their positive temperature coefficient. It may not be known but the compression of the field scan (e.g. reduction in height) after a television set has been running for a while is often caused by the increase in resistance of the field scanning coils. This pulls down the scanning current and thus reduces the scan amplitude.

The problem is overcome by the value of the thermistor falling as the value of the coils rise. The curves in Fig. 8 show these effects and also how when they are correctly combined the overall resistance remains substantially constant over the normal operating temperature of the set.

For this application the thermistor characteristics are chosen in conjunction with the resistance of the field scanning coils and the thermistor is located in thermal contact with the coils so as to respond to their temperature change. The scheme ensures that the load on the field output valve remains constant in spite of change in resistance of the scanning coils.

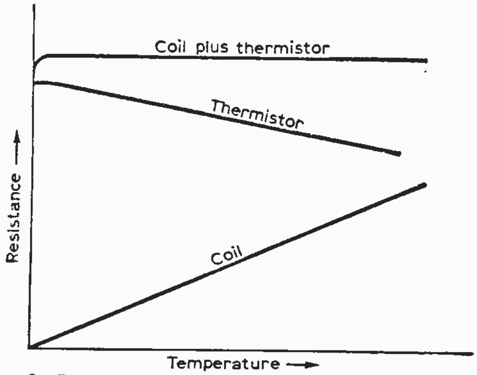

Fig. 8: These curves show how the negative temperature coefficient of a thermistor neutralises the positive temperature coefficient of a coil of wire.

So far we have seen how the thermistor can be applied relative to its own thermal inertia (e.g. time taken for the thermistor to reach equilibrium as in the heater chain) and relative to its own negative temperature coefficient as in the television field timebase circuit.

Another application uses the dependency of the resistance of a thermistor on temperature. Such applications, however, fall outside the scope of this article since they concern the direct measurement of temperature, temperature control, the indirect measurement of current and so forth.

Temperature Control

When transistor television sets become more popular thermistors will be observed applied directly in terms of resistance and temperature. Fig. 9 shows one application in this respect. Here the thermistor causes the base current of the p-n-p transistor to reduce as the ambient temperature increases, thereby offsetting the increase in collector current with increase in temperature. In other words, the thermistor is caused to "sample" the ambient temperature around the transistor itself and to adjust the transistor biasing accordingly.

Applications of the VDR are also diverse. These components are not unlike black ceramic to look at. They are made in the form of rods and discs of various dimensions, depending upon dissipation and characteristic requirements. The current carrying capacity (for a particular material) is directly proportional to the cross-sectional area, while the voltage rating is a function of the length of the rod-type component.

The current rating can range from a few microamperes to thousands of amperes and the voltage rating from a few volts to thousands of volts.

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Surge Suppression

A VDR is ideal for the suppression of surge voltage and is sometimes so applied in television circuits. In this application a VDR may be seen across the primary winding of the field output transformer as shown in Fig. 10, the idea being to damp or suppress voltage pulses resulting from the field flyback.

These pulses can under certain conditions put undue strain on the transformer and field output valve and they can also very quickly ruin a transistor when such is used as a field amplifier.

The back e.m.f. developed across the primary of the field output transformer is normally very small during the field scanning stroke. However, as the flyback occurs much more rapidly a far greater back e.m.f. is developed. Now at the small normal scan e.m.f. the resistance of the VDR remains high and consequently has zero effect on the operation of the circuit, but on the higher flyback e.m.f. the resistance falls considerably and as a result damps the circuit, thereby suppressing the peaks of voltage as shown in Fig. 11.

VDR as Voltage Regulator

A VDR can also be employed to regulate the voltage across high impedance and high voltage supply circuits. Typical in this respect are the e.h.t. voltage circuits of television sets. The component is found connected between the final anode of the picture tube and the metal chassis as shown in Fig. 12. It works as follows:

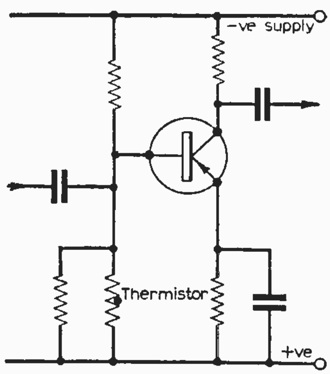

Fig. 9: Here a thermistor is used to back-bias a transistor to combat rise in collector current.

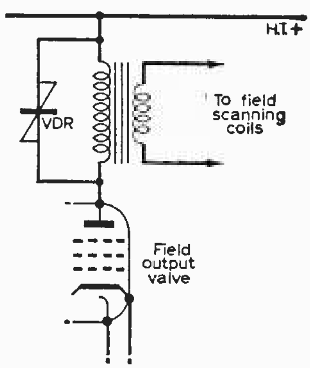

Fig. 10: The use of a VDR as a voltage surge suppressor.

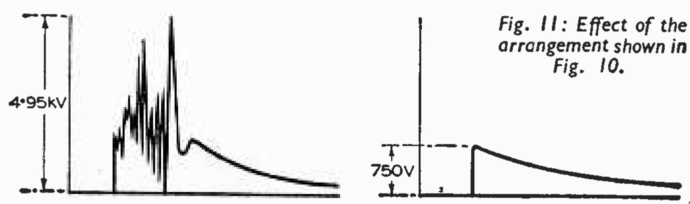

Fig. 11: Effect of the arrangement shown in Fig. 10.

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If the e.h.t. voltage tends to rise due to a fall in tube beam current the voltage across the VDR will rise likewise and the resulting drop in resistance will automatically increase the e.h.t. current, the net result of which is a constant load presented to the e.h.t. supply irrespective of variations in picture tube beam current. The voltage at the tube final anode thus remains constant.

The VDR in this application is sometimes known as Metrosil, being the trade name of Metropolitan-Vickers Electrical Co. Ltd.

A VDR connected in the cathode circuit of the video amplifier valve can increase the contrast range of the picture. This happens because the cathode current of the video amplifier valve is dependent on the picture brightness, and when the picture signal is at black the cathode current is minimum, as also is the voltage across the VDR. Under this condition, therefore, the degree of negative feedback is at a maximum.

However, as the picture goes towards white the cathode current, and hence the voltage across the VDR, increases. This results in a decrease of cathode resistance and a consequent reduction of negative feedback. A kind of "contrast expansion" effect is thereby given.

through a non-linear VDR, as in Fig. 13b, the capacitor will charge to a somewhat greater value because only a small discharge current will flow between the pulses. This is due, of course, to the smaller voltage across the VDR between pulses and the considerable increase in resistance of the VDR under this condition.

Line Timebase Stabilisation

To stabilise the line timebase a VDR is used to rectify a pulse sampled from the line output stage. The amplitude of such a pulse is governed by the load presented to the line amplifier, by the power supply voltage and so forth, and any variation in line scan amplitude is reflected as a variation in pulse amplitude.

Thus by feeding back to the line amplifier valve as a bias voltage the d.c. resulting from rectification of the flyback pulses a sort of automatic gain control effect results. If the pulses are of small amplitude, meaning that the line scan is insufficient for optimum performance, less negative bias is applied to the amplifier valve control grid and the gain of the valve is increased, an effect which turns up the overall operating efficiency of the stage to combat the tendency for scan and e.h.t. voltage reduction.

Conversely, if the amplitude of the pulses tends to rise a greater negative bias is applied to the

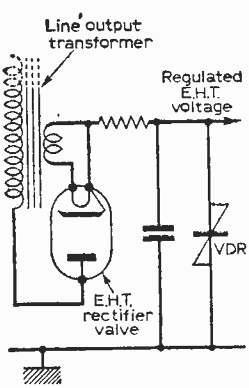


Fig. 12: A VDR used to regulate the e.h.t. voltage in television sets.

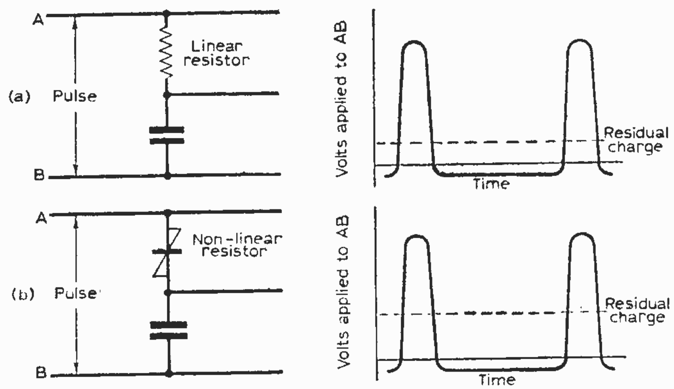


Fig. 13: This diagram shows at (a) the small residual charge resulting from feeding pulses to a capacitor via ordinary resistance, and at (b) the greater charge resulting from the use of VDR.

VDR as Pulse Rectifier

Owing to the non-linearity of a VDR it can act as a rectifier of pulse voltage. This property is exploited for the stabilisation of the line timebase. It is also sometimes used to produce a first anode voltage for the picture tube. In both cases the pulses used are those which are generated by the line flyback.

If these pulses are used to charge a capacitor through an ordinary linear resistor the charge will be approximately equal to the mean of the waveform. The d.c. voltage will thus be low since the duration time of each pulse is very small. This is shown in Fig. 13a.

However, if the pulses are fed to the capacitor

amplifier valve and its gain is reduced, as also is the e.h.t. voltage and scan amplitude. In that manner, therefore, the line timebase is stabilised against any variations which are reflected back as amplitude changes of the flyback pulses. A basic circuit of this kind is shown in Fig. 14.

A positive potential is also applied to the VDR via a preset resistor as shown in the circuit. This potential fixes the operating bias and is adjusted in practice for the correct boost potential.

Testing VDRs

Now we come to ways of testing VDRs and thermistors. So far as VDRs are concerned the best way of testing is by the use of two meters as shown in Fig 15. Here a mA meter is used to measure the current flowing in the component, while a voltmeter is used to measure the voltage across the component at any current within the component's rating and as set by P1.

Whether the voltage developed across the component at a particular current is correct can be ascertained by reference to the voltage/current curve of the component under test. Fig 16 gives such curves of six popular Mullard VDRs and for other components reference must be made to the appropriate data sheet.

Care must be taken not to exceed the maximum power dissipation of the devices and the value of P1 and the voltage required for the test will depend upon the type of component being tested. For instance, a current of 200μA in a Mullard E299DC/P338 should result in a voltage in the order of 50V across it as shown by the appropriate curve.

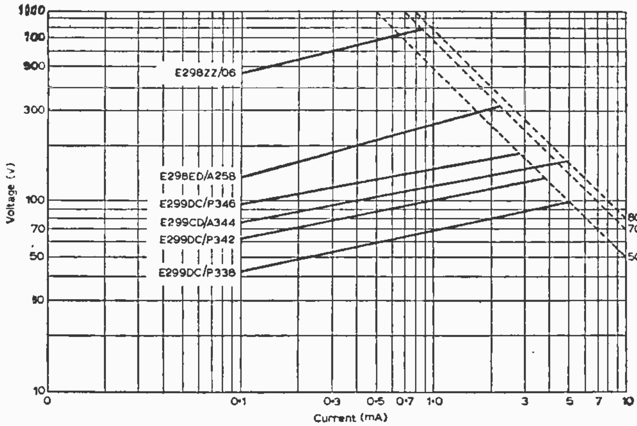


Fig. 16: Voltage/current characteristics of a range of Mullard VDRs.

Testing Thermistors

One of the best and easiest ways of checking a thermistor is to measure its resistance at a particular temperature and then compare the values obtained with the resistance/temperature curve of the appropriate thermistor. Fig. 3, for instance, gives five such curves for well-known Mullard thermistors.

At 20°C the VA1026 should have a resistance of about 550Ω. When making this kind of test the thermometer should be held close to the component under test as shown in Fig. 17. ■

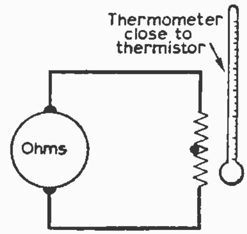


Fig. 17: The set-up required for testing thermistors.

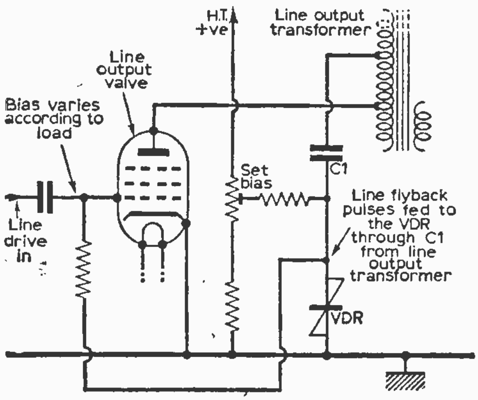


Fig. 14: A VDR connected for stabilisation of the line timebase, as described in the text.

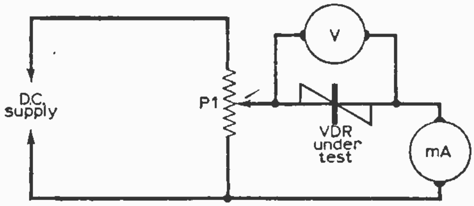
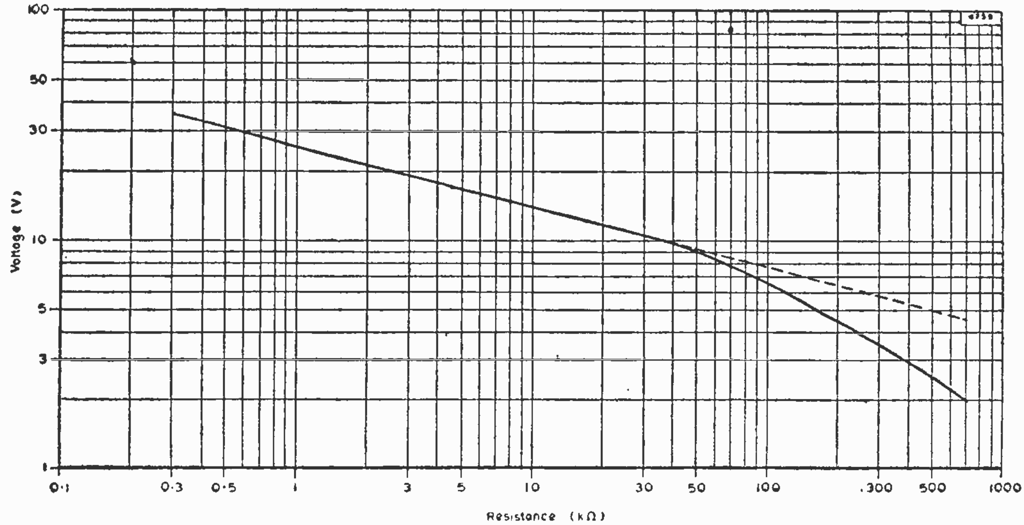


Fig. 15: The set-up required for testing VDRs.



Timebase Stabilisation

by G. R. Wilding

The graph above shows change of resistance with applied voltage of a Mullard voltage dependent resistor. This article outlines the role played by v.d.r.'s in the stabilisation of raster width and height in current television receivers.

IT is becoming increasingly the practice in current TV design to include means for stabilising raster width and height so that variations in mains voltage do not affect picture size.

Invariably such designs make use of the unique properties of voltage dependent resistors (v.d.r.).

These components, as the name implies, have a resistance that varies with the applied voltage, decreasing rapidly as the voltage is increased.

As an example, one v.d.r. in the Mullard range has a resistance of about 350kΩ at 1V but which drops to only 300Ω when 35V is applied.

However, as well as providing simple means for timebase stabilisation the v.d.r. can be used for preventing spot burns at switch-off, obtaining extra boost voltage from the line output circuit, limiting peak flyback voltages in the frame circuit, a.g.c. voltages in negative modulation receivers and most uniquely adapting meter sensitivity.

But to turn first to current receiver practice. The latest dual-standard Ferguson 900 series of models employs three v.d.r.s, one for width stabilisation, one for height stabilisation and one to limit the peak voltages developed across the frame output transformer.

The action of the width stabiliser is based on the fact that a constant relation exists between the deflector coil scan current and the flyback voltage, so that if the latter is kept fixed, the scan current and hence the width must also stay constant.

Secondly, the v.d.r., being a non-linear device, performs as a sort of rectifier if an asymmetric voltage of sufficient amplitude is applied.

As a v.d.r. has no differing forward and back resistance characteristics like a germanium or silicon diode this may seem somewhat difficult to appreciate, but this rectification occurs only if an asymmetric waveform is applied.

Therefore if the voltage in one direction differs from that in the reverse the resistance offered by the v.d.r. must be different also and will develop a differing voltage to the positive and negative waveforms, producing a d.c. bias one way or the other.

As the voltage variation between the positive and negative waveforms becomes greater, so the more marked becomes the v.d.r.s' varying resistance characteristics and it becomes now obvious why the applied voltage must be of sufficient amplitude so that there is a clear-cut difference between the two peaks.

In Fig. 1 it will be seen that a 100pF capacitor feeds the v.d.r. with a flyback pulse and a negative potential is developed across it proportional to the pulse amplitude.

This negative potential is then fed to the grid of the PL36 via the 2·2mΩ grid leak and thus controls its peak current.

To determine the desired width a positive bias to partially offset the negative control bias is tapped from a 1mΩ pot in series with a 330kΩ limiter connected across the h.t. line.

It will be seen that this control system bears a similarity to the mean value a.g.c. circuit, where a negative control voltage (taken from the grid of the sync separator) is modified by a positive

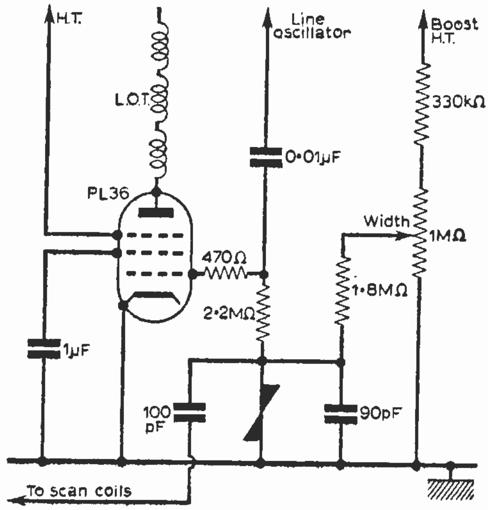


Fig. 1 (left)—The stabilised line output circuit of Ferguson 900 series receivers. Negative voltage developed across the v.d.r. is fed back to the PL36 as control voltage. Width control is effected by tapping positive voltage to off-set this bias.

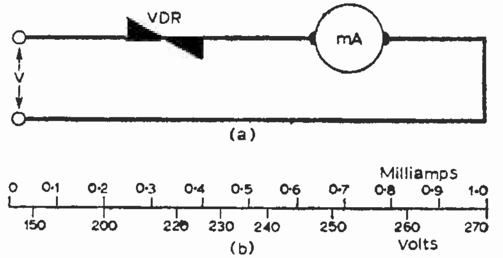


Fig. 4(a)—Converting a milliammeter to a voltmeter by placing a Mullard v.d.r. in series with it; (b)—comparison of original milliammeter scale with the voltmeter scale.

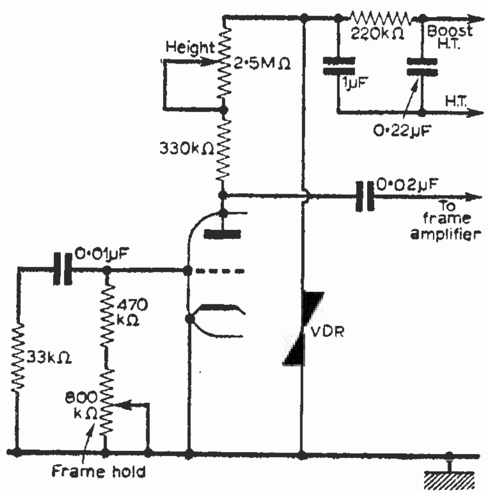


Fig. 2—The stabilised height control circuit of 900 receivers. Increasing boost rail voltage reduces the v.d.r. resistance which then takes a bigger current and increases the I.R drop across the 220kΩ resistor, leaving the original voltage. The valve is half a PCL85.

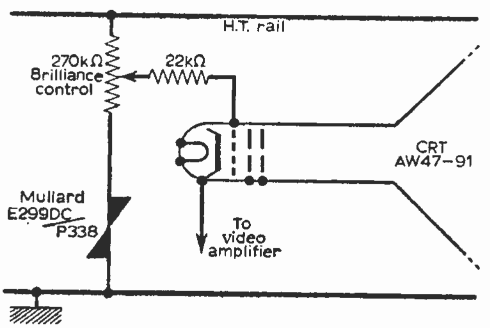


Fig. 3—A circuit to eliminate the switch-off spot, as used in Bush TV115L receivers.

potential similarly obtained from a high-value pot shunted across the h.t. line and chassis.

In the same Ferguson receiver Fig. 2 shows how the frame height is kept constant despite varying mains voltage.

As is normal practice, the anode of the frame generator is fed from the boost h.t. rail, in this instance via a 220kΩ resistor, and at the junction of this component and the height control a Mullard v.d.r.-type E298CD/A258 is connected to chassis. Should the boost h.t. voltage rise, thus applying a higher voltage to the v.d.r., its internal resistance would fall and the resulting higher current would increase the I.R drop across the 220kΩ resistor and bring back voltage to the original value.

The third v.d.r. used in this circuit is simply shunted across the primary of the frame output transformer.

During scan the regular increase in current through the primary develops only a relatively low voltage but at flyback the sudden current change produces a high e.m.f. to which the v.d.r. presents only a low resistance, thus effectively limiting this voltage peak and effectively damping any oscillation that may be instigated.

The method used by Bush for preventing spot burn at switch-off with a v.d.r. is also very simple and effective and is shown in Fig. 3.

The tube is cathode modulated in the usual manner but with the lower end of the 270kΩ brightness control connected to the top of a Mullard E299DC/P338 instead of being earthed directly.

On switch-off as the h.t. collapses the v.d.r.

—continued on page 447

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

IN the last two issues we have dealt with DX-TV stations that can and have been received in Bands I and III, so to complete the picture we are dealing this month with reception in the u.h.f. Bands IV and V.

It was originally imagined that the u.h.f. bands would not provide any real DX reception and as I recall various statements were made in the non-technical Press and elsewhere that the new BBC-2 service would be free from the patterned interference experienced by so many domestic viewers.

This is, however, not the case and at the risk of being lynched by the average domestic viewer I am delighted to tell you that the patterns on local TV pictures so appreciated by DX'ers are also well in evidence in the u.h.f. bands. I would even go so far as to say that DX/u.h.f. reception is comparable with, and possibly even better than, that in Band III.

The type of reception is similar to that in Band III, i.e. tropospheric, with long duration, reasonably steady pictures as opposed to the fast-fading Sporadic E signal encountered in Band I during certain times of the year.

The "ceiling" for distance is similar to Band III and is probably usually about 500 miles maximum. This is, of course, dependent on prevailing weather conditions and the efficiency of the receiving installation.

In order to encourage "would-be" DX-ers in u.h.f. work we are publishing this month a list of stations received by one of our very experienced readers, I. C. Beckett, of Twyford, near Buckingham. It should be noted that Mr. (Beckett's location is not in the south-east coastal area where u.h.f./DX is comparatively easy. He is situated well inland but this has not prevented him from producing a really first class log, including Dequede (East Germany).

Reception Reports

Saturday, May 8th, was a notable Sporadic E opening applicable throughout the British Isles, according to readers' reports, and at my own place the reception was available from 1400 until 2000 GMT and included West Germany, Poland, Austria, Spain, Norway and Sweden. Since that date we have had no comparable repeat performance.

I regret that I shall have to hold over a large number of readers' reports and in some cases even omit them where the stations received are largely duplicated by others. One of the most interesting letters comes from **F. C. Griffiths,** of Te Awamutu, New Zealand, covering reception from November, 1964/March, 1965 (midsummer in New Zealand). He reports excellent Band I reception from Australia with six stations received, probably Sporadic E reception. The most outstanding report, however, is of very strong signals from Sydney in Band III, 1,350 miles away, and lasting for three days during Christmas week, 1964.

This exceptional type of reception may make it necessary for us to revise all our ideas on the

U.H.F. STATIONS RECEIVED

Station	Channel	Country
Gottingen	21	W. Germany
Munster	21	W. Germany
Paris	22	France
Wuppertal	22	W. Germany
Bremen	22	W. Germany
Torfhaus	23	W. Germany
Aachen	24	W. Germany
Lingen	24	W. Germany
Dortmund	25	W. Germany
Caen Mt. Pincon	25	France
Minden	26	W. Germany
Lille Bouvigny	27	France
Lopik	27	Holland
Uelzen	27	W. Germany
Unidentified	28	France
Dusseldorf	29	W. Germany
Hamburg	30	W. Germany
Dequede	31	E. Germany
Koblenz	31	W. Germany
Baden Baden	31	W. Germany
Bremen	32	W. Germany
Munster Baumberge	32	W. Germany
Sarrbrucken	32	W. Germany
Crystal Palace	33	England
Bielefeld	33	W. Germany
Gr. Feldberg	34	W. Germany
Crystal Palace	34	England
Hardtkopf	35	W. Germany
Aachen	37	W. Germany
Hamburg	40	W. Germany
Sutton Coldfield	40	England
Lingen	41	W. Germany
Wuppertal	42	W. Germany
Dannenberg	43	W. Germany
Gr. Feldberg	54	W. Germany
Rimberg	57	W. Germany
Frankfurt	??	W. Germany
Brest Roc Treduoon	21	France

limitation of distance to about 500 miles for Band III tropospheric signals or the impossibility of Sporadic E reflections in this band. It is difficult to deduce which type of propagation applied in this case but Band III reception in excess of 1,000 miles was obtained and this in itself is a terrific achievement. And to make our mouths water even more he also reports reception of Samoa on Band I.

W. M. N. Burridge (Totnes, Devon) is delighted, and so are we, that he has had u.h.f. successes from Lille Ch 27, BBC-2 London, Caen Ch 25 and Rouen Ch 28, so even in the West Country u.h.f./DX is possible on good home constructed equipment.

J. Cribbon (Athlone, Eire) found the opening of May 8th extended as far as his home and we confirm from details given that he received Sweden on channel E3 (Skovde-Sveg).

D. J. Kelleher (Macroom, Cork) sends in a good log for May, 1965, including Spain, West Germany, Czechoslovakia, France, Sweden, Denmark and East Germany, all identified by test card sketches supplied by him. (If other readers would provide photographs or sketches of test cards it would help us considerably in identifying them.)

Many readers have been kind enough to send test card photographs for intended publication in the new monthly item on test cards and I hope to acknowledge all in due course. I have also been circularising all Continental TV services to try and obtain original test cards. However, please continue to send in test card photographs and in particular any details you have of times of transmission of test card and programme; this will apply particularly to East Europe as well as West Europe.

TIMEBASE STABILISATION

—continued from page 445

resistance rises rapidly, thus tending to keep the potential tapped off at the potentiometer nearer to that of the h.t. line and thus keeps the c.r.t. grid positive with respect to the cathode.

The resulting heavy momentary tube current rapidly discharges the e.h.t. circuit so that even before the raster collapses completely the e.h.t. potential is of no significant value.

The bright spot therefore fails to materialise.

Finally the effect of putting a v.d.r. in series with a milliameter is graphically shown by the two meter scales in Fig. 4 where a Mullard v.d.r.-type E299DG/P354 has been placed in series with a 0—1mA movement.

It will be noted that the 200V indication requires little more than 10% of the scale, the remaining part being wholly devoted to 200-270V, thus enabling small deviations from a 240V centre to produce meter movements that normally could only be registered on a scale very many times bigger.

However, as v.d.r.s have a tolerance of 20% it would be necessary to calibrate such a meter against a standard type to preserve accuracy.

For the amateur constructor nothing could be simpler to make than this interesting unit, for which we are indebted to the Mullard Laboratories. ■

30 YEARS BACK

(From "Practical Television", July '35)

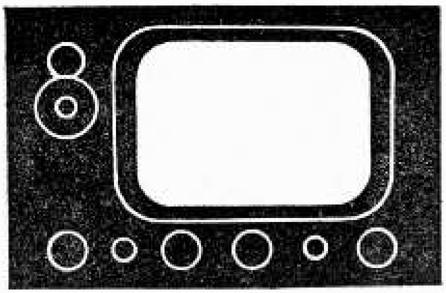
THE Editorial comment page waxes strong and stern on the subject of the forthcoming Radiolympia Exhibition. It seems that no television apparatus is to be on show, the ban being imposed because featuring TV would probably have a deleterious effect on the sale of radio sets. "*It seems a great pity*", says the Editor, "*that the Press, no doubt guided by certain trade interests, should have been distributing anti-television propaganda during the past three months*".

None the less the situation is saved because on the (presumably) later news pages it is announced that there is, after all, to be a large-scale demonstration of high definition television.

News from abroad: SAFAR, of Milan, starts regular experimental 240-line/25-frame transmissions and a suitable receiver, giving a picture of 18 x 21cm, costs £40. The French 30-line system is to be changed to 60 lines and within three months to 90 lines and 180 or 240 lines. First TV studio equipped at Montreal, for demonstration purposes.

Snippets: An article describes "Television from Gramophone Discs", using the new records "now on sale". Sir Oswald Stoll says he is firmly convinced that television in full colour and stereoscopic relief will be possible; quite correct, but here we are 30 years later and still not even colour! Despite the obvious adoption of the c.r.t. for display an optimistic company announces it has placed its faith in a mirror drum system.

Nothing-New-Under-the-Sun-Department: How about this? "*A television receiver that can be carried in the pocket*"! About the size of a pocket camera, this set was being developed in Birmingham. It used a miniature c.r.t. with a 1in.-square reflector screen which projected pictures 12 times larger on to a folding screen. We quote: "*The secret of the system is the mechanical part which enables intense shadows to be projected on the screen and so reveal a television picture that would otherwise be invisible . . . Careful attention has been given to possible television improvements such as stereoscopic and colour pictures. The inventor has been developing cathode ray tubes since 1929*". Who this inventor was we do not know. The only clue is that he was awarded the Sir Grey-Wilson prize in 1930 at the International Exhibition of Inventions. It was, no doubt, all done by mirrors!



THE OLYMPIC II Transistor TV

by D. R. Bowman

Part Four Line Time-base and E.H.T. Unit

THE design of both line and frame scan generators is in practice dependent on what is commercially available by way of the scanning yoke, since this is a highly specialised component whose construction is beyond the scope of the average constructor. Fortunately a suitable yoke is obtainable from Electronic Components Ltd. (Elac), 33 The Hale, Tottenham, N.17. This consists of a finite ring wound with 37Ω frame scan coils and nominally 140μH line scan coils. With this can be obtained a suitable e.h.t. transformer and a frame output choke. These components will also be required and their use will be described in this article.

The line scan circuit is shown in Fig. 19 and it will be seen that the output device is a power transistor arranged as a switching device; in the collector circuit the line scan coils are connected and in parallel with these the e.h.t. transformer primary. How current divides between the e.h.t. transformer and the scan coils depends partly on their relative resistances but much more on their relative inductances. The e.h.t. transformer inductance is nominally 1·5mH and thus the parallel total inductance is 125μH approximately. The scan coils thus get very nearly 90% of the collector current, while the transformer receives 10%—quite sufficient for the needs of the cathode ray tube and the video amplifying stage when transformed to the appropriate voltages. The d.c. resistances of both yoke and transformer are very small and can be neglected in calculating feed currents and voltages, although the resistance of the yoke—and the output transistor—introduces a small non-linearity into the scan which has to be corrected.

LINE TIME BASE LIST OF COMPONENTS

Resistors:

R64	2·2k Ω	R71	4·7k Ω
R65	3·9k Ω	R72	22 Ω
R66	2·2k Ω	R73	33 Ω
R67	2·2k Ω	R74	0·5 Ω*
R68	2 Ω	R75	10k Ω
R69	390 Ω	R76	100 Ω
R70	180 Ω	R77	10k Ω

All 10% ½W * see text
VR4 10kΩ wirewound ½W

Capacitors:

C69 0·01μF paper
C70 0·05μF paper
C71 0·5μF paper
C72 1000pF 10% silver mica
C73 0·03μF paper
C74 0·005μF paper
C75 100μF electrolytic 15V
C76 0·1μF paper
C77 0·5μF paper
C78 0·1μF paper
C79 0·17μF paper 350V 5%
C80 0·1μF paper 750V
C81 8μF electrolytic 150V
C82 100μF electrolytic 15V
C83 0·5μF paper
C84 330pF silver mica 10%

Transistors:

Tr15 2S301	Tr17 OC81
Tr16 2G382	Tr18 2N1908

Diodes:

D4	OA81	D7	1S411
D5	OA81	D8	BY100
D6	1S020	D9	OA202

Miscellaneous:

L25 See text
T5 Blocking oscillator transformer (see text), 2-FX1238 cores required—Mullard Ltd.
T6 Driver transformer (see text), 2-FX1239 cores required—Mullard Ltd.
T7 E.H.T. transformer LOP/4188 Elac Ltd.
Scanning coils: Line coils 140μH, Frame coils 37Ω, Elac Ltd.
V1 DY86 Mullard Ltd.
Aluminium sheet, 16 s.w.g. 7 x 4 in. (chassis 'C'), 7 x 4¾ in. (metal panel "B"). 18 s.w.g. two pieces 2½ x 2 in. for heat sinks. PC4—copper clad laminate 4 x 3¾ in. Polythene sheet, perforated zinc sheet, transistor mounting clips—2. Quantity of 4BA bolts, nuts, solder tags and washers, 4BA studding, ⅜ in. coil former fitted standard dust core (L25), quantity of 24, 26 and 32 s.w.g. enamelled copper wire (for L25, T5 and T6 windings). 1½ in. length of 34 s.w.g. bare eureka wire (for R74).

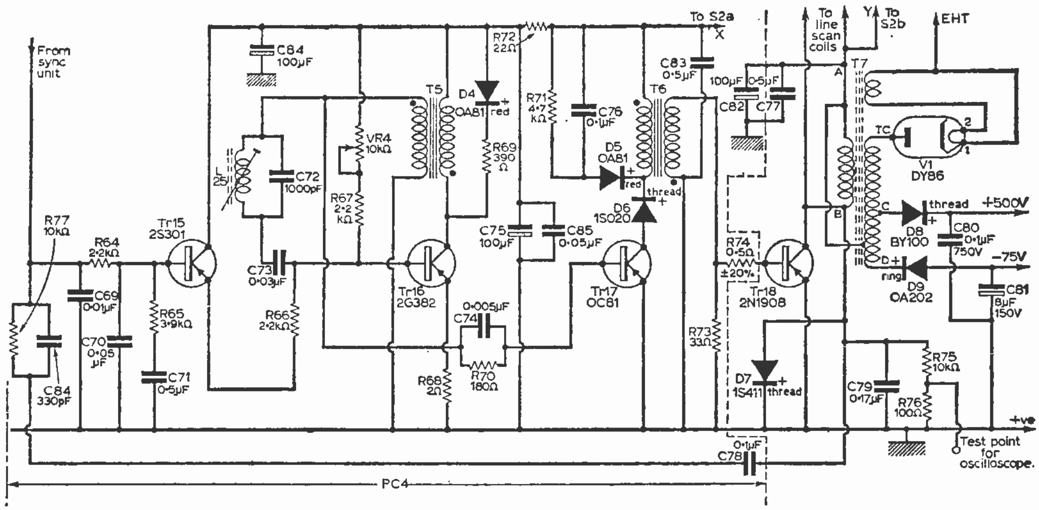


Fig. 19—The line timebase and associated circuitry. The dots on T5 and T6 windings indicate the start of each winding. C79 is a close tolerance component and may be made up of 0·15μF and 0·02μF capacitors in parallel.

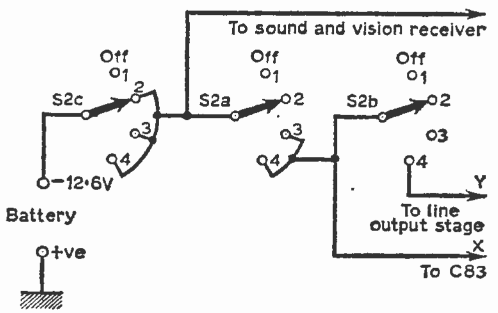
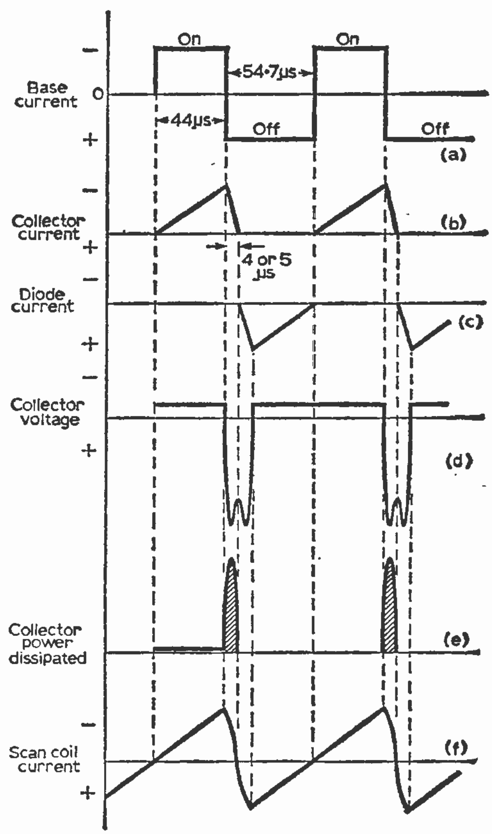


Fig. 20—The function switch, S2. This is shown now only to help illustrate the operation of the line timebase. Full details of S2 will appear later.

Fig. 21 (right)—Waveforms for the line output stage.



The output transistor Tr18 is a Texas Instruments pnp power device capable of switching up to 20A collector current. Its collector—base breakdown voltage rating is −130V and its frequency—handling capacity extends to several Mc/s. The type is 2N1908 and may be had on order with a delivery delay of a week or two. As might be expected, this very high quality transistor is somewhat expensive, but this need occasion no alarm, since under normal working should outlast scores, if not hundreds, of line output vacuum tubes. However, it is most important that this transistor should be worked within—if close to—its limits as all transistors are readily destroyed by improper use. The makers do not specify an absolute maximum voltage rating because exceeding breakdown voltages does not permanently damage transistors as long as other maximum ratings are not exceeded. In particular the instantaneous current rating is important because if this is exceeded and the voltage is high the power dissipation may be very great locally within the transistor. Suppose while the collector-emitter voltage were momentarily at 100V the emitter-collector current were 20A, this would mean that 2,000V would be produced, which is well above the transistor rating of 150W maximum. Even though this lasted for only 1% of the "duty cycle"—giving an average dissipation of 20W—the heavy current produced instantaneously would cause a large local magnetic field within the transistor; and this, in a semiconductor material, would be likely to result in a "pinch" effect, constraining the current to flow in a very narrow channel. The result might well be to increase the *local* dissipation within the germanium slice to destruction point.

It may be remarked that no experiments have been carried out on these lines and care has been taken that ratings are not exceeded. If this article is followed with care no harm is likely to come to the transistor, but the constructor must always be aware of the physical nature of the situation and will do well to remind himself of the mathematics, too, if possible. Several pounds per microsecond is above most people's income!

The design problem included the assessment not only of the scan coil current required (which is just over 7A) but also of the flyback characteristics of the assembly on which depends the power dissipated both instantaneously and by way of steady battery supply as well as the peak voltage developed across the transistor. If a battery of fixed voltage is connected in series with the scan coil inductance to the collector circuit nothing happens until the transistor is switched on by a

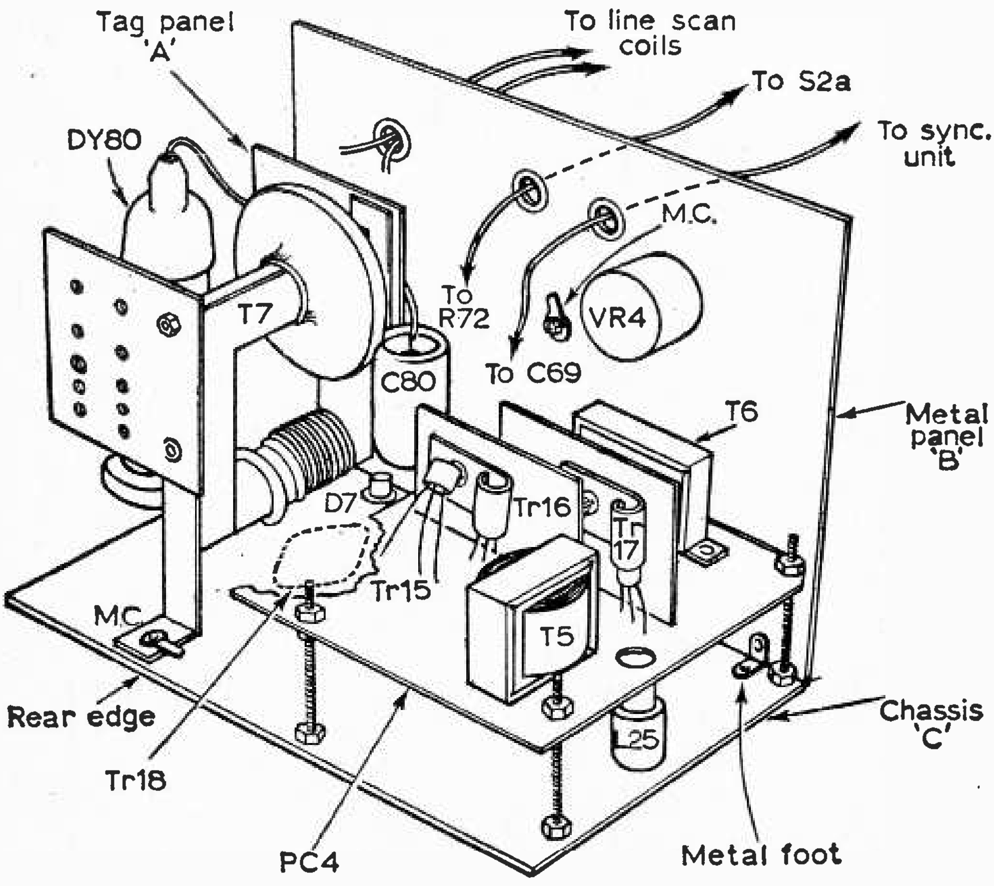


Fig. 22—The complete line timebase unit. This shows how the component parts—the line output transformer, PC4 board, chassis "C", etc.—are related when the unit is made up. Note the mounting arrangement of Tr18 (see also Fig. 26) beneath chassis "C" which acts as its heat sink.

negative supply of current to the transistor base. If this current is large enough the forward resistance from collector to emitter becomes very low—a fraction of an ohm—and current begins to flow in the collector circuit. Because of the inductance of the scan coils the current rises linearly with time until either the transistor is switched off—by means of a heavy positive current in the base circuit—or the transistor is destroyed. The trick is to switch off in good time! At this point the capacitance across the scan coils, together with their inductance, form a tuned circuit and this begins to oscillate. At the end of the scan, when switch-off occurs, there is a very considerable amount of energy stored in the magnetic field of the yoke, and as this collapses a reverse current is driven into the capacitor, charging it up. The transistor collector now becomes the emitter, since the polarity of the applied voltage is reversed, and is not very efficient at this. Consequently a power diode is connected in parallel with the transistor to pass the reverse current. The end point is reached when the flyback finishes with the collector positive and the parallel capacitor fully charged. Then current again begins to flow into the scan coils as before.

If nothing more were done several cycles of oscillation would virtually put an end to scanning because of losses. However, if the transistor is switched on by a further negative current in the base circuit the losses are automatically made up by the battery and if this is done regularly each cycle (by a driving waveform) the process repeats indefinitely. Clearly the transistor only needs switching on each cycle when the *reverse* collector current reaches zero (from a positive value) and begins to go negative again. The first portion of the scan is then due to current passing through the diode—usually about 45% of scan—and the transistor is switched on to provide the remaining 55% of the scan.

Since the capacitor in parallel with the transistor and diode forms part of the oscillatory circuit the flyback period is just half a cycle of the natural frequency of this circuit. The flyback peak voltage produced depends directly on the speed of flyback and therefore the value of the capacitor is critical. Too low a value causes a higher peak voltage to be developed, while too high a value lengthens the flyback period and some of the picture is lost. In order to keep the peak voltage to a safe value it is

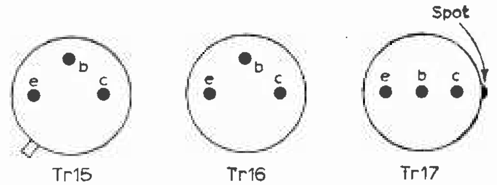


Fig. 23—Base connections of transistors used in the line timebase.

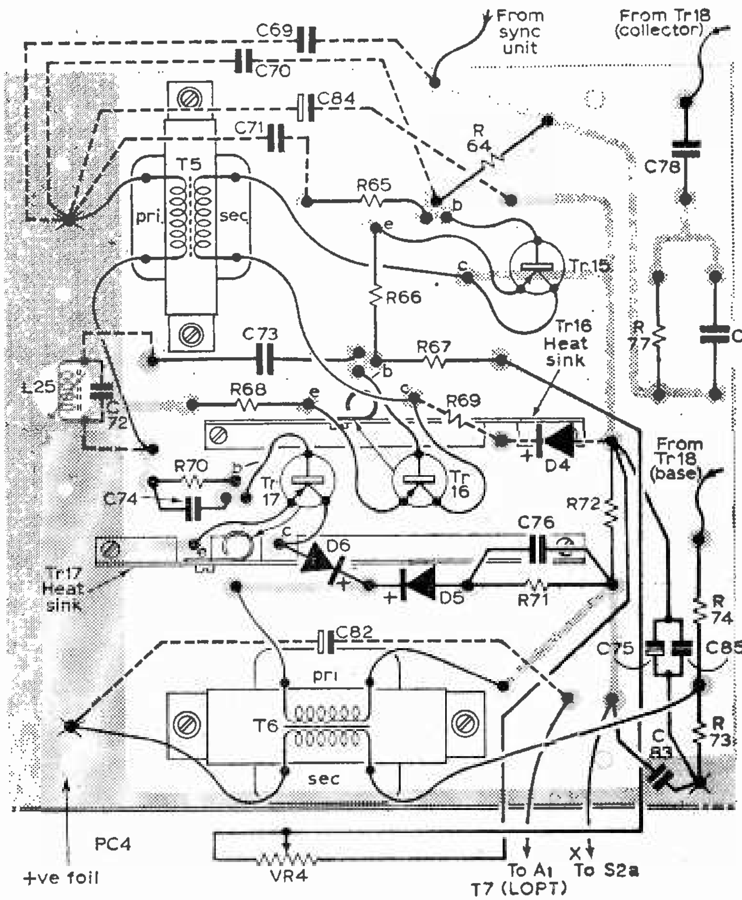


Fig. 24—The line timebase printed circuit board, PC4. This is drawn full size with copper parts shaded. Dotted components are mounted on the underside.

necessary to sacrifice part of the picture, since the line blanking period transmitted is too short. The lost portion is equal to the width of the black-and-white border on the test card and may be neglected. Visible fold-over does not occur because the flyback pulse is used to blank the cathode ray tube and all that is noticed is that a half-inch of picture disappears. Full scan—even a little overscan—is, however, available.

Study of Fig. 21 will reveal that the collector dissipation is limited to a very short period of time, while collector current is falling to zero and the flyback voltage is high. The time the collector current takes to fall to zero (as distinct from the time taken for flyback current to flow into the parallel capacitor) depends on the rate at which the base drive can attract "holes" from the transistor base. To minimise this time a high-frequency transistor is essential. This is the reason for choosing the 2N1908 device; there are transistors whose voltage rating is higher—much higher—but these are usually relatively low-frequency transistors with a cut-off frequency which is measured only in kc/s. It will be seen also that the "economy diode" also dissipates because of the flyback voltage and the current flowing at the same time. For this reason the diode must also have a high voltage rating and be capable of passing a heavy pulse current. The collector-base diode of another 2N1908 would, of course, be ideal but the cost would be prohibitive. Instead a cheap but efficient silicon rectifier diode is needed, Texas Instruments type 1S411, which has a voltage rating of 200V and a pulse current carrying capacity of 15A.

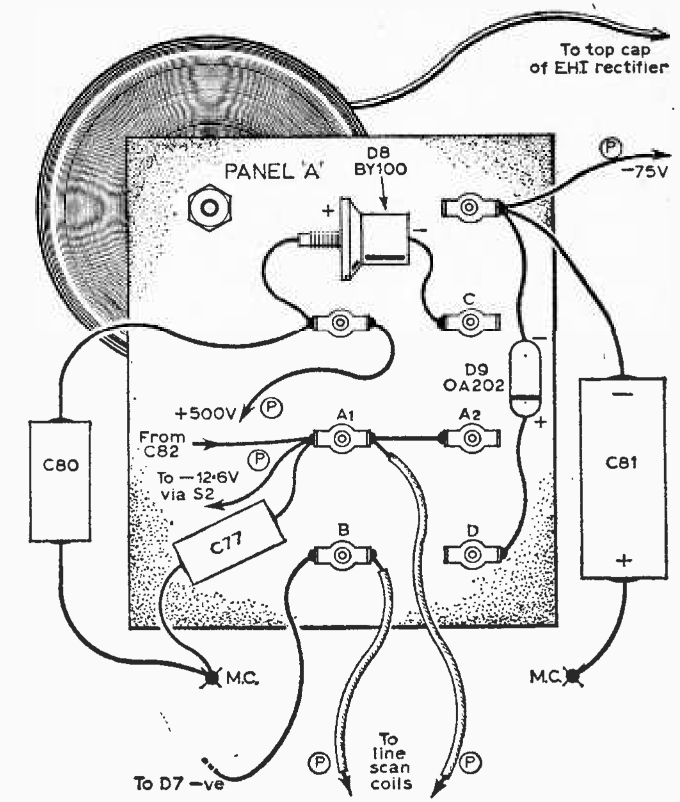


Fig. 25—Component wiring and connections on panel "A" of the transformer, T7.

The base drive switching waveform does not need to be the precise rectangular wave shown in Fig. 21(a). As long as at any moment it is capable of supplying enough current to the base to sustain the collector current required at that same moment the stage will work satisfactorily. With an output transistor of minimum current gain (15) the peak current of, say, 4A can be ensured with base current of 4/15 or, say, 0·3A. This is the minimum base drive needed at the end of scan. To switch off the transistor, however, all the stored base charge has to be extracted in about 4μS and this may need as much as 1A reverse drive at the beginning of flyback. Also, since the stored base charge acts as a kind of tank, base drive pulses of less than 4μS duration are unlikely to cause the transistor either to switch on or off (depending on diode polarity). Thus it may be seen that a quite irregular base switching waveform may do the right job provided the irregularities do not exceed certain limits. This is made use of in the generation of the switching waveform.

The switching waveform can be obtained in a number of ways, among them multivibrators and blocking oscillators. The choice of a blocking oscillator for this application was governed by practical considerations, chiefly the need for simplification of the conversion needed when the time came to change to 625-line standards. The largest change likely with this circuit is to replace one capacitor and even this may not be necessary.

On general grounds it would be expected that a buffer amplifier between oscillator and output transistor would be necessary. It would be economical to drive the output transistor direct from a low-power oscillator stage but, as input and output characteristics of transistors are by no means independent, changes of loading on the output stage (consequent upon the changes in picture brightness inseparable from reception of actual programmes) might be expected to be reflected into the oscillator, causing variation in its operating frequency. This might be correctible if an effective method of automatic frequency control were incorporated. This latter is in any case necessary, since it is not possible with available transistors to effect direct locking with the transmitted pulse. The reason for this is the finite time taken, from the application of a turn-off pulse, to extract stored holes from the base. Over two or more transistors this causes sufficient delay to displace the flyback so that it does not coincide even roughly with the line-suppression period at the cathode ray tube.

The buffer amplifier or driver stage (Tr17) consists of a low-power transistor switched by the oscillator (Tr16), the transformer in whose collector circuit is designed to give the correct drive to the output transistor base. A series resistor of $0{\cdot}5\Omega$ (R74) made of a 1½in. length of No. 34s.w.g. eureka wire limits the base current, but if a particularly "low" output transistor is supplied this may be reduced or omitted. The parallel resistor of 33Ω (R73) is introduced to damp the transformer "ringing" which takes place on switch-off when no further current flows into the base-emitter diode.

The oscillator (Tr16) is a conventional blocking oscillator but this does not of itself produce the waveform needed to switch the output transistor on for $44\mu S$ and off for about $55\mu S$. This is arranged by including at a convenient point a parallel-timed LC circuit resonating at about 200kc/s. When the blocking oscillator transistor (Tr16) is cut off by the feedback pulse from its collector nothing happens. When the timing capacitor C73 discharges and the transistor base goes negative the oscillator cuts on and a pulse appears at its collector. This pulse stores energy in the inductance L25 and L25/C72 then rings at its own frequency. As it rings the voltage peaks produced cut the transistor on and off alternately. Each "on" period is associated with a further feedback transient; in time these charge up C73 to transistor cut-off voltage and the "off" period begins. The action is not unlike that of a squegging oscillator. The combination continues to ring but these damped oscillations soon die out, since they cause no further transients in the feedback circuit. Eventually the charge on C73 decays through VR4/R67 and the process is repeated.

These ringing transients cause spikes on the generated waveform but even though they get through the buffer amplifier to the output stage they do not affect its working, since their width is considerably less than $4\mu S$.

Adjustment of L25 affords a means of varying the "on" period of the oscillator between reasonable limits. The adjustment is not, of course, a continuous one, since an integral number of oscillator pulses must occur during the "active" ringing period of L25/C1. However, both 405 and 625 line standards can be covered effectively.

Part of the line-sync circuit is included on the etched circuit board for the line scan generator, since the flyback pulse is used as a sync gate. Also the timing LC circuit radiates badly and so screening is provided which also serves to screen the main portion of the sync separation circuit from unwanted pulses. The extra components are shown in the diagram but properly belong to the sync circuit. The need for effective screening also dictates the use, as a panel control, of the d.c. control of line speed available in the sync circuit. The variable resistor VR4 is then used only as a setting up and temperature adjusting control.

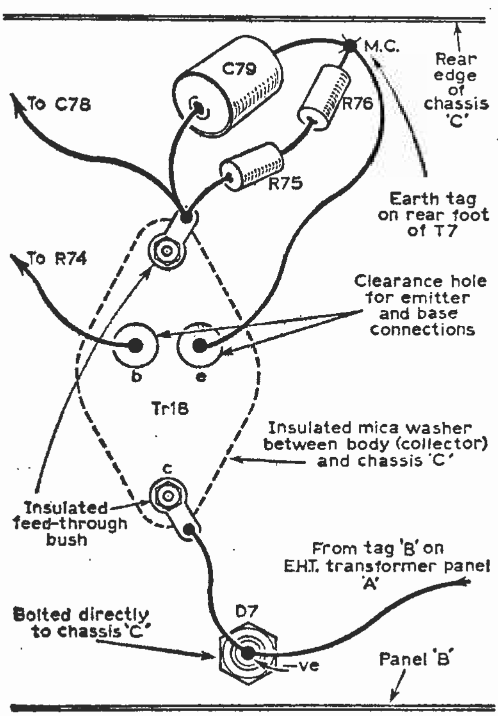


Fig. 26—Details of the wiring of Tr18 and D7.

Constructional Notes

For mechanical stability it is probable that it will be desired to mount all the units on a metal chassis. If this is done the best heat sink for the line output transistor is the chassis itself, on which it may be mounted, using the insulating kit to be ordered with the transistor. The etched circuit board (PC4) for the associated components would then be mounted at a convenient distance above the chassis, using screwed rod, nuts and washers for the purpose, while the e.h.t. transformer T7 would be mounted on the chassis close by, not too far for the e.h.t. lead to reach the c.r.t. in its desired position. The whole assembly would then be covered with a perforated zinc screen secured to the chassis with nuts and bolts.

Layout is entirely non-critical except that the connection from Tr18 to D7 (economy diode) and e.h.t. transformer must be kept as short as possible. The leads to the scan coils must be of copper braid or 10A flex as they carry heavy currents and negligible resistance must be introduced into the circuit.

Fig. 24 shows a suggested etched circuit board and Fig. 25 the connections to the e.h.t. transformer.

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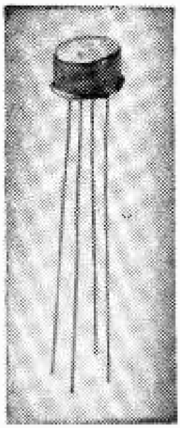

Metal Oxide Transistors

by J. F. Miles

THE conventional bipolar transistor, from the viewpoint of the signal source or previous stage, appears as a forward biased diode, and the output current is controlled by the current flowing into the input of the device.

The Field Effect Transistor (FET) was developed about five years ago to remove the disadvantage of having to supply an input current. The output is controlled by the field across a p-n junction. This appears from the source as a reverse biased diode with very high resistance ($10^{10}\Omega$) but it has a leakage current of a few nanoamps which is exceptionally dependent on temperature.

The Metal Oxide Semiconductor Transistor (MOST) is a further development of this principle, in which the controlling field is developed across a capacitor, (approximately 4pF) with a parallel resistor of the order of $10^{12}\Omega$ (1MΩ) and a leakage current of hundredths of a picoamp. This is, for almost all practical cases, an open circuit, hence the device is sometimes known as the Insulated Gate Field Effect Transistor (IGFET).

When using the device it is easier to compare it with a valve than a transistor as the very high input resistance makes it a voltage controlled device. Two polarities of device are possible, the n-most and the p-most, corresponding to n-p-n and p-n-p transistors. The more common is the n-most, which requires a positive supply. The Mullard type 95BFY is an n-most and the principal parameters of this device are:

r in $=10^{12}\Omega$, gm = 1mA/V, r out = 50kΩ, C in = 4pF, C out = 3pF,

Miller capacitance = 0·7pF.

These figures show its similarity to a pentode. The maximum voltage between terminals is, however, 35V.

The terminals of the MOST and the FET are known as the drain, source and gate, corresponding to anode, cathode and grid. A further terminal, the substrate, is available on the MOST and will be discussed later.

The phasing of the n-most is as in a valve—that is a positive gate voltage increment will increase the drain current. In the MOST the gate voltage may be positive (the enhancement mode) or negative (the depletion mode) with respect to the source and a combination of the two modes may be used by C-R coupling the input to earth potential and allowing the signal to swing the gate positive and negative (Fig. 1).

If lower drain currents are required to obtain high voltage gain autobias may be used (Fig. 2) or if high output currents are required (to give the maximum mutual conductance) a positive bias is possible (Fig. 3).

The gate voltage required to cut the device off is known as the pinch-off voltage $V_{GS(p)}$ or threshold voltage V_{GST} (Fig. 4) and is analogous to the cut-off voltage of a pentode.

The obvious application of the device is as an impedance converter. Fig. 5 shows the source follower configuration, analogous to the cathode follower. The magnitude of the gate resistor R_G is limited only by the requirement of providing a shunting path for the leakage current, which is a fraction of a picoamp; a several kilomegohm resistor may be used if it is available or a more commonly available value, say 56MΩ, may be used and boot-strapped to give an input resistance of 1,000MΩ (Fig. 5). The output resistance approximates to $\frac{1}{gm}$—about 1·2kΩ with R_B = 10kΩ.

The common source configuration (anode follower) as in figures 1 to 3 may be used as the first stage in a transducer amplifier where the high input resistance is required to prevent loading on the transducer. It is also useful in a "hybrid" amplifier, alternating MOSTs with conventional transistors, when the high input resistance allows a high collector load to be used in the previous stage and the full voltage gain of the stage to be achieved.

When the device is used as an i.f. amplifier the high input resistance and low input capacitance prevent loading on the previous tuned circuit.

The frequency response of the stage is determined solely by the terminal capacitance, the intrinsic cut-off frequency being so high as to be of academic interest only. Experiments have shown the device to be usable as a power amplifier at 100Mc/s and as an oscillator at several hundred megacycles.

The noise has been found to be less than that of a low-noise conventional transistor when used with a source resistance of several megohms, though much higher when used with low-source resistances.

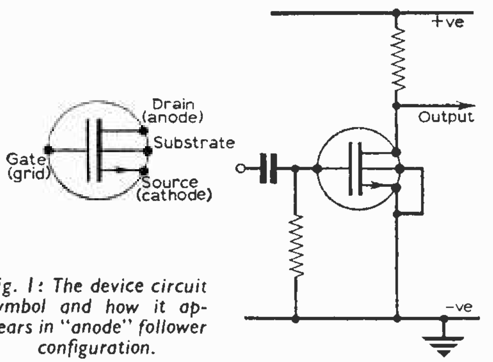

Fig. 1: The device circuit symbol and how it appears in "anode" follower configuration.

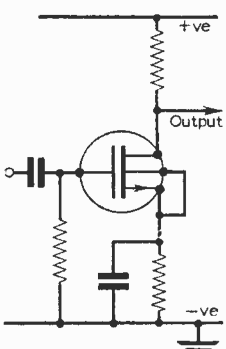

Fig. 2: The circuit arrangement to provide autobias for the device.

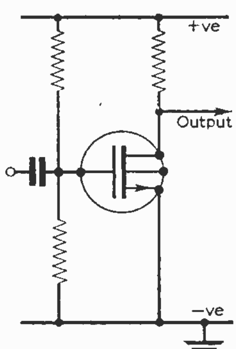

Fig. 3: This positive bias arrangement provides for high output currents.

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Finally the most interesting applications of the device are perhaps the less conventional ones and two examples will be given.

Although the relationship of I_{out} (I_D) and V_{in} (V_{GS}) has been quoted as a mutual conductance the relationship is not in fact linear (Fig. 4) but an accurate square law $I_D = \frac{\beta}{2}(V_{GS} - V_{GST})^2$ where β is a constant of the device. If two signals are added and amplified in the device a square law mixer is obtained which is superior to other devices in its rejection of unwanted modulation products.

The availability of the substrate connection has been mentioned. This acts as a second gate of the field effect rather than MOST type with the same phasing as the first gate. If signals are applied simultaneously to the two gates multiplication occurs.

A self-oscillating mixer has been made using a single device and other possible uses of the substrate are variable gain amplifiers, including a.g.c., and analogue multipliers as d.c. inputs are permissible.

From this brief outline of the device it is evident that when the device becomes available in quantity at low price experimenters will find it a most intriguing and useful transistor. ■

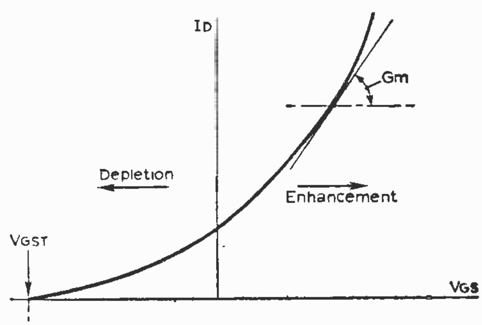


Fig. 4 (above): The transfer characteristic curve of a metal oxide semiconductor transistor.

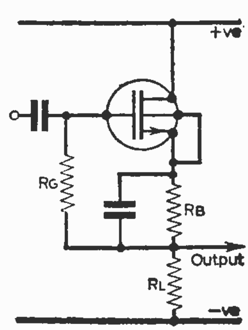


Fig. 5: The MOST arranged in source follower configuration.

MEASUREMENT OF INDUCTANCE

IT has been the author's experience to find that many people regard the measurement of inductance as an impossibility for the home-constructor; as something only to be done with complicated and expensive apparatus.

This is an entirely false impression. There is no more difficulty in measuring inductance than there is in measuring any other sort of impedance, and the whole business is well within the power of anyone who has a normal amateur's equipment.

The inductances of coils in general use lie mainly in the range 1μH to 100H. Resistances which lie in a similar range (0·1Ω to 10MΩ) may be determined with a simple Wheatstone bridge which can be constructed to cover such a range.

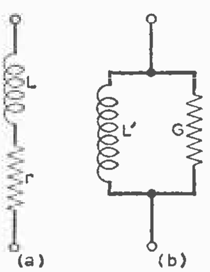


Fig. 1 (left)—Pure inductance (L) in series with pure resistance (r) and in parallel with conductance (G).

Fig. 2 (right)—Measuring series L and r (a) and shunt L- and G (b).

An inductance bridge to cover a comparable range would be a formidably cumbersome and expensive device, but if we have two overlapping ranges of inductance, thus:

Range 1—1μH to 1H

Range 2—1mH to 100H

we may deal with each range separately, and the problem is very much simplified. The accuracy of measurement will depend on the accuracy of the calibration of the components used in the measuring devices. Resistors should be of the non-inductive wirewound card-type (Muirhead) with 0·1% tolerances.

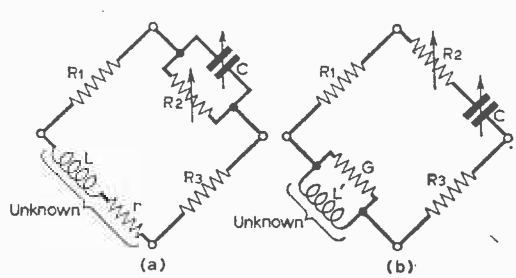
If these are unavailable then surface-type high-stability carbon resistors (Welwyn) of 1% tolerance will serve. An accurately calibrated 1000pF variable air capacitor is a necessity and may be made up by mounting a 0·0005μF two-gang tuning capacitor, with both sections connected in parallel, in a metal box, which serves as a screen. A simple and accurate method of calibration will be described later.

A calibrated wide-range audio frequency oscillator and a detector of some kind are also necessary. The former should be part of any amateur's equipment and almost any sensitive a.f. amplifier will serve as a detector.

INDUCTANCE AND LOSSES

It has been said that it is quite easy to make a measurement, but that it is not always a simple matter to know what we have measured. This is particularly true in the case of inductance.

A coil may be represented in two ways, either as a



pure inductance (L) in series with a pure resistance (r) which represents the losses due to the wire resistance, eddy-current effects in the core, hysteresis loss, etc. (Fig. 1a), or as a pure inductance L′ in parallel with a conductance G, which represents the losses.

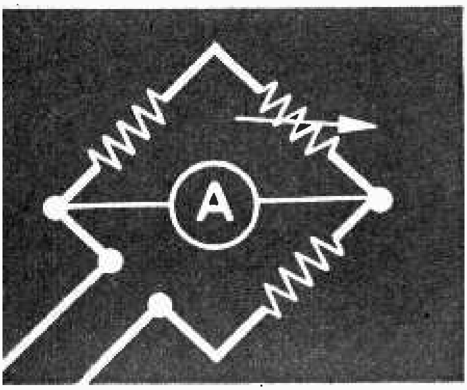
Where r and G are not negligible, L is not the same as L′; but where losses are small they approach each other in value, for it is easy to show that

$$L' = L + \frac{R^2}{\omega^2 L}$$

This distinction between L and L′, r and G is of importance in deciding what type of bridge is to be used.

RANGE 1: 1μH TO 1H

Inductors in the lower part of this range are, for the most part, either air or powder cored and their



PETER C. JONES

losses are comparatively small. They may be conveniently measured on a simple Maxwell bridge. This bridge may be arranged to measure either series L and r, or shunt L′ and G. (Fig. 2a and b.)

The solutions to these circuits are:

$$\text{(a) } L = C\,R_1R_3 \text{ and } r = \frac{R_1R_3}{R_3}$$

$$\text{and (b) } L' = C\,R_1R_3 \text{ and } G = \frac{R_2}{R_1R_3}$$

Now in a low-loss coil, G will be small; so R2 will be small, and the resistance of connecting leads etc., may make itself a nuisance. It is therefore more convenient to measure series values L and r.

At this stage a few comments on the construction of a.c. bridges are necessary. The circuit of a bridge suitable for measuring inductances between 1μH and 1mH is given in Fig. 3.

It does not much matter whether the bridge is made up in a box, mounted on a metal panel or just screwed down to a breadboard. The really important points are these:

(1) The four bridge points, A, B, C, and D should be kept close together, not more than a few inches apart.

(2) All components should be connected directly to these points *only*, for reasons which will be given.

(3) Only one earth must be used, preferably applied at C, for if another earth were applied at say, the oscillator end of the earthy supply line, a loop would be formed, which could give rise to hum and other more insidious troubles.

The reason why (2) is important will be clear if we consider a bridge wired up as in Fig. 4.

In the arm AB, the impedance of the lead Aa is common to both R2 and C, and the impedance of the lead Bb is in series with R3, which is relatively small.

If we redraw the circuit as shown in Fig. 5, the effect of the two strays RS1, RS2 in the arms AB, BC, is apparent.

As the bridge is a low-impedance device, the oscillator should have a cathode follower output, or the bridge should be fed through a suitable step-down transformer.

Similarly, the detector should be fed through a step-up transformer; a 15Ω output transformer

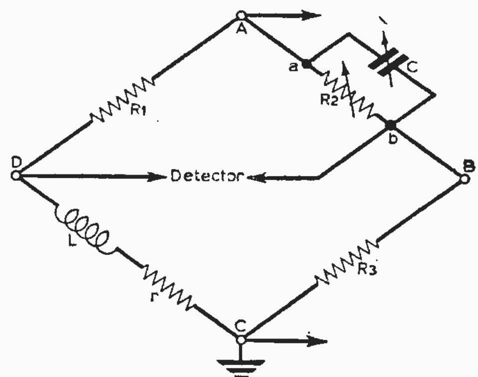


Fig. 4—The basic arrangement of the circuit of Fig. 3.

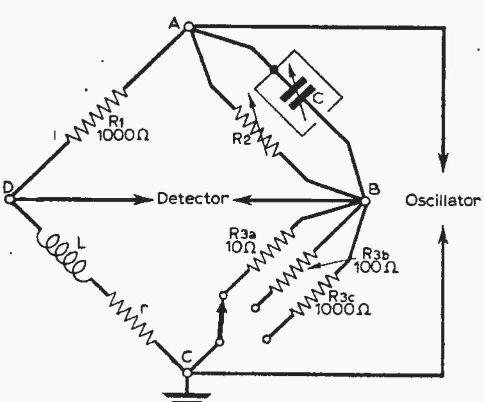


Fig. 3—This a.c. bridge circuit is suitable for measurements between 1μH and 1mH.

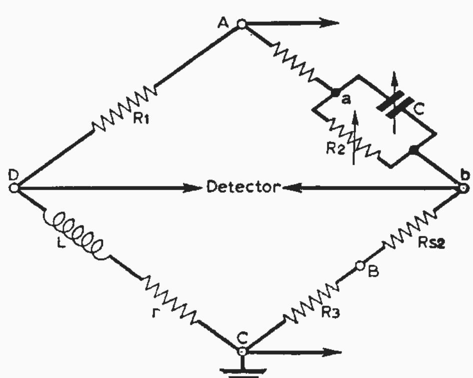


Fig. 5—The basic circuit with the addition of the two "strays" RS1 and RS2. (RS1 is the unmarked componua between A and a.)

would be suitable, although mismatches into and out of the bridge are of little consequence. The current in the bridge, most of which flows through the arms AD and DC, should not be so high as to cause heating either of the specimen or of R1.

The supply and detector leads should be screened; 80 Ω television feeder is quite suitable. If the step-up transformer to the detector is close to the terminals D and B, the leads from these points to the transformer need not be screened. Stray capacitance across the specimen or across R3 (when R3 is small, 10 Ω or 100 Ω) is not important, however.

Leads to the capacitor C and to R2 may be screened, but the total capacitance of the screened leads must be added to the capacitance of C. The screen of C may be connected to A. (Capacitance across the supply or detector leads has no effect on the balance.)

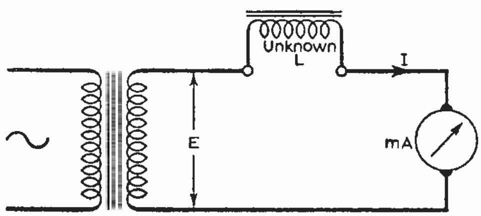


Fig. 6 (above)—Arrangement for determining the unknown inductor L.

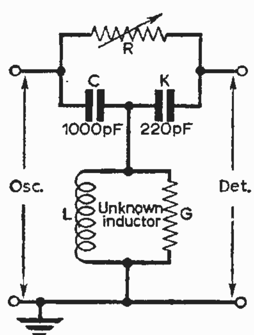


Fig. 7 (right)—A bridged-T network suitable for measurements over a wide range.

The bridge shown in Fig. 3 will measure inductances from 1μH to 1mH with fair degree of accuracy. To extend the range upwards we should have to increase C (by means of additional fixed capacitors), or increase the value of the product arms R1 and R3.

It would not be difficult to extend the range to 1H in this way, although small errors might creep in.

The bridge may be used at any suitable frequency; 2kc/s is ideal for use with headphones, a method which the author recommends, as the ear is capable of distinguishing the balance-point by the disappearance of the fundamental, and ignores harmonics.

A magic eye or similar device would be incapable of this. (The bridge may be used at frequencies up to 100kc/s with careful construction. It is independent of frequency). The variable components are independent of each other, which makes the circuit very easy to use.

For those who are interested, the mathematical solution of the circuit is given in Appendix 1.

RANGE 2: 1mH TO 100H

Inductors in the upper part of this range are nearly always chokes and transformer windings. The simplest way of measuring inductances of this type is to put a known alternating voltage across the unknown inductor and to measure the current flowing with an a.c. milliammeter, as shown in Fig. 6, when

$$L = \frac{E}{\omega I}$$

This method is quite suitable for finding whether a choke is say, 10H or 50H; but it will give no indication of the presence of shorted turns or similar faults.

A bridge to cover this range would have unwieldy components, so another method must be used. The bridged-T network shown in Fig. 7 is an extremely flexible circuit, and may be used for measuring inductances over a wide range, by varying any two of C, K and R and by varying the frequency of the applied signal, as the circuit is frequency-sensitive.

An advantage is that one side of the source, detector and unknown are earthed. This is impossible in a Maxwell bridge measuring self inductance. L and G represent the unknown inductance and its associated losses. C is a 1000pF variable air capacitor and K is a fixed capacitor of known capacitance. (This may be calibrated from C.)

The solution to this circuit is

$$L = \frac{1}{\omega^2(C+K)} \quad \text{and } G = \omega^2 CKR$$

The complete analysis of the circuit is given in Appendix 2.

R should be a 1M Ω or 2M Ω non-inductive linear resistor. It may be necessary to use a lower value (say 0·1M Ω) if losses are unduly high. A high degree of accuracy in the calibration of this component is unnecessary, as we are not concerned with precise loss measurements, but only with knowing whether losses are about normal or unduly high (in which case R will be very low).

The variable controls are not independent of each other, as they are in the Maxwell bridge; they have to be operated simultaneously so that they converge to a balance. If the waveform of the applied signal is reasonably sinusoidal the balance point is completely silent; if a poor waveform is applied, harmonics will be clearly audible, as the circuit balances *at one frequency only.*

Table 1

Frequency Kc/s	Inductance Range
1	100H — 20H
2	20H — 5H
3	10H — 2·3H
4	5H — 1H
10	1H — 0·2H

For this reason headphones and not a magic eye should be used as a detector (as already mentioned in connection with the Maxwell bridge).

Using the values of C and K shown in Fig. 7, the approximate ranges covered by the network are given in Table 1.

Table 2

f. kc/s	ω^2	(C + K)					
		100H	10H	1H	0·1H	10mH	1mH
1	4×10^7	250pF	0·0025μF	0·025μF	0·25μF	—	—
3	$3{\cdot}6 \times 10^8$	28pF	280pF	0·0028μF	0·028μF	0·28μF	—
10	4×10^9	—	25pF	250pF	0·0025μF	0·025μF	0·25μF
30	$3{\cdot}6 \times 10^{10}$	—	—	28pF	220pF	0·0028μF	0·028μF
100	4×10^{11}	—	—	—	25pF	250pF	0·0025μF
300	$3{\cdot}6 \times 10^{12}$	—	—	—	—	28pF	280pF
1000	4×10^{13}	—	—	—	—	—	25pF

Table 2 may be found useful for determining the most convenient operating frequency and component values (for K can be varied as well as C, if desired).

If the circuit is used at frequencies of 10kc/s and above a heterodyne detector is used; a suitable circuit is given in Fig. 8. The heterodyning oscillator-ing need not be calibrated; it is only needed to produce an audible beat note.

The author has used this circuit at frequencies of 10Mc/s and above, although at such frequencies the accuracy of measurement will easily be impaired by strays (such as the inductance inherent in the variable capacitance).

There is little to be said about the construction. The variables R and C should be close together, joined by a very short wire. K should be connected directly to the high potential side of C (the fixed plates). The screen round C should be taken to the high potential side of the input, as capacitance across the supply and detector leads has no effect on the balance conditions.

The screen round R may be similarly connected, or earthed. Input and output leads should be screened. It is advisable, when using the circuit for the first time, to measure a few inductors of known properties in order to get the feel of the controls; thereafter no difficulty should be experienced in making a measurement. Fig. 9 shows the final arrangement.

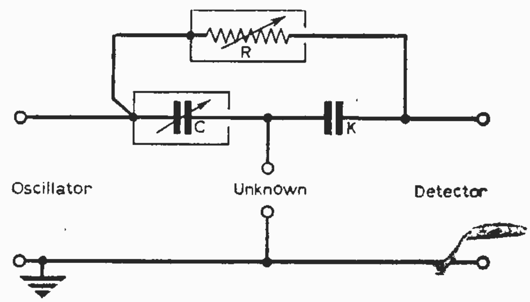


Fig. 9—The circuit arrangement between circuit oscillator and detector.

CALIBRATING AN AIR CAPACITOR

Set up a simple de Sauty bridge, as shown in Fig. 10. The arms R1 and R2 are equal; their value is not important; anything between 10kΩ and 100kΩ would be suitable.

Calibration is performed by balancing C against fixed capacitors of various values S, from about 50pF to 1000pF (e.g. 50, 100, 150, 220, 330, 470, etc. pF) and recording the scale reading of C.

Each reading should be made twice, once with the circuit as shown, and once with R1 and R2 inter-

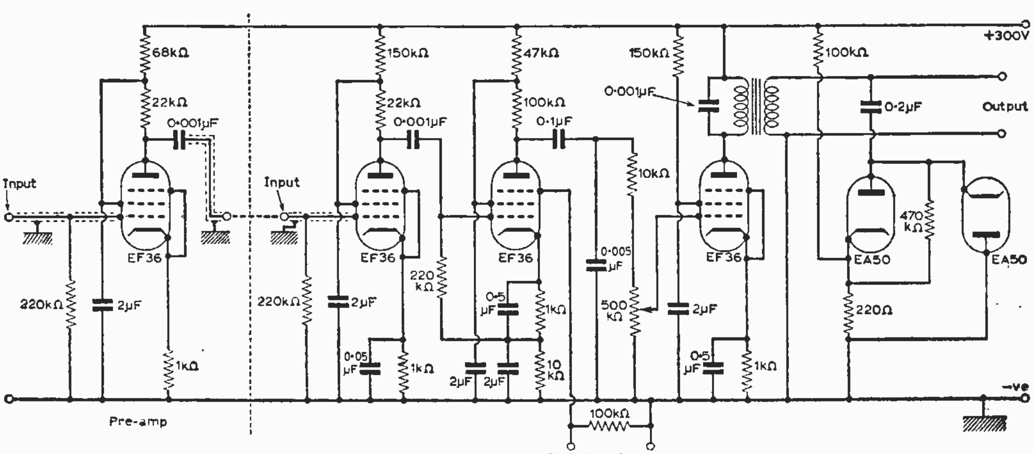


Fig. 8—The circuit of a heterodyne detector for use with bridges at frequencies of 10kc/s and above.

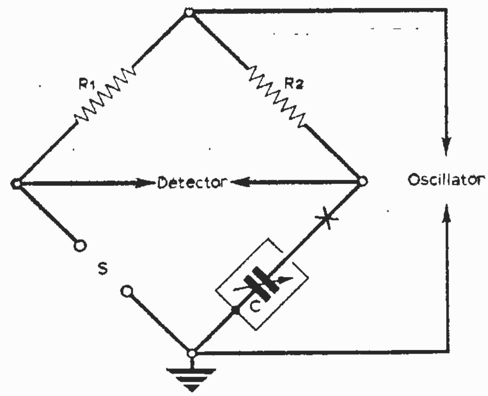


Fig. 10—A simple de Sauty bridge arrangement.

changed. The mean of these readings should be plotted against the values of S. Errors due to the difference between R1 and R2 are thus eliminated. If the calibrating capacitors S are accurate to within 1% or 2% the resulting smooth curve will be surprisingly accurate.

It may be found necessary to introduce a small variable resistor at the point X (1 Ω or 10 Ω) to balance any losses in S, although this is unlikely to be needed.

A HETERODYNE DETECTOR

There are few points that need to be explained in the circuit. The two diodes are provided to prevent the user being deafened by a very loud signal. The output transformer can be an intervalve transformer with the secondary winding used as a primary, stepping down into headphones. A 3:1 or 5:1 would be suitable.

A pre-amplifier stage is shown, in case the measuring network is being used at very low currents (to prevent hysteresis loss from being objectionable for example, or in the event of the initial permeability of the core of the specimen being measured). The circuit is quite easy to build and consumes very little h.t. current.

APPENDIX 1

In the net shown in Fig. 11 R1R3=R2R4. Any bridge circuit can be solved by treating the impedances of the arms in this way after the net has been transformed into one similar to Fig. 11.

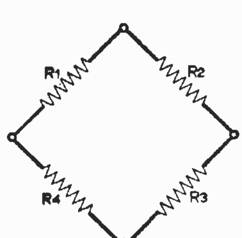


Fig. 11—A basic network of resistors.

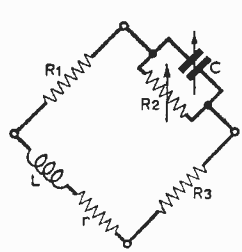


Fig. 12—Circuit of a Maxwell bridge.

In the Maxwell bridge shown in Fig. 12:

$$R_1R_3 = (j\omega L + r)\left\{\frac{1}{\frac{1}{R_2} + j\omega C}\right\}$$

$$= (j\omega L + r)\left\{\frac{R_2}{1 + j\omega CR_2}\right\}$$

$$= \frac{j\omega LR_2 + R_2 r}{1 + j\omega CR_2}$$

whence $R_1R_3 + j\omega CR_1R_2R_3 = j\omega LR_2 + R_2r$

Equating real and complex quantities, we get

$$R_1R_3 = R_2r \text{ or } r = \frac{R_1R_3}{R_2}$$

and $j\omega CR_1R_2R_3 = j\omega LR_2$; or $L = CR_1R_3$

APPENDIX 2

Fig. 13(a) shows the bridged-T network described earlier. To solve this, transform the C, K and (L + G) arms into a mesh, as shown in Figs. 13(a) and (b); calculate the impedance of the portion from A to B:

$$\frac{Z_1R}{Z_1 + R}$$

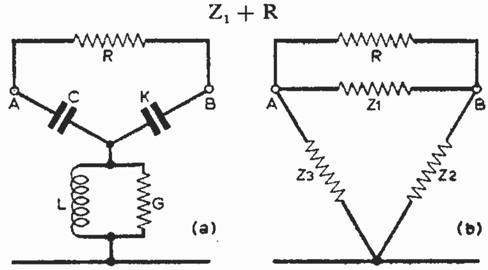


Fig. 13—The bridged-T circuit of (a) is solved by transforming it into the network of (b).

At balance this impedance is infinite.

$$\frac{1}{j\omega C} + \frac{1}{j\omega K} + \frac{\left(\frac{1}{j\omega C} \cdot \frac{1}{j\omega K}\right)}{\left(\frac{jL}{1 + j\omega LG}\right)} \text{ (Star)}$$

$$= \frac{C + K}{j\omega CK} - \frac{1 + j\omega LG}{j\omega^3 CKL}$$

$$= \frac{\omega^2 L(C + K) - j\omega LG - 1}{j\omega^3 CKL} \text{ (mesh)}$$

Then, at balance, the admittance between A and B is:

$$\frac{1}{R} + \frac{j\omega^3 CKL}{\omega^2 L(C + K) - j\omega LG - 1} = 0$$

or

$$\frac{j\omega^3 CKLR + \omega^2 L(C + K) - j\omega LG - 1}{R\{\omega^2 L(C + K) - j\omega LG - 1\}} = 0$$

Hence the numerator = 0

Equating real and complex parts we get:

$\omega^2 L(C+K) = 1$ and $j\omega^3 CKLR = j\omega LG$,

or $L = \frac{1}{\omega^2(C+K)}$ and $G = \omega^2 CKR$.

Additional (or stray) capacitance S, across the specimen gives:

$$L = \frac{1}{\omega^2(C+K+S)}$$

G remains unchanged.

The effect of stray capacitance, S′, across R may be calculated by replacing R and S by the equivalent series resistance and capacitance ρ and σ, where

$$\rho = \frac{R}{(\omega S'R)^2 + 1} \text{ and } \sigma = S'\left\{\frac{(\omega S'R)^2 + 1}{(\omega S'R)^2}\right\}$$

Whence $$L = \frac{1}{\omega^2\left(C + K + \frac{CK}{\rho}\right)}$$

and $$G = \omega^2 CK\rho.$$

The direct calculation G and L, using R and S, is exceedingly laborious.

NEXT MONTH THE CONSTRUCTION OF A MUTUAL AND SELF-INDUCTANCE BRIDGE.

THE OLYMPIC II

—*continued from page 453*

The two tags A1/A2 are connected by a piece of 18s.w.g. wire, well soldered, and this is the −12·6V connection also. No component should be allowed to come close to the e.h.t. winding or corona discharge is likely; the same applies to the screening box. When the box is fitted a wise precaution is to fold in some sheet polythene, not too tightly, to ensure that corona discharge is avoided.

Where the −ve lead enters the screening box a 0·5μF capacitor (C77) should be connected by the shortest path to chassis to assist in minimising radiation from the line oscillator.

THE MULLARD PICTURE TUBE

Many readers have experienced difficulty in obtaining this tube (the M36-11W) originally specified for the Olympic, and Mullard Limited have asked that it be pointed out that the M36-11W is not now available, except for industrial purposes, but the AW36-11 can be used as a substitute. This will not affect any of the circuitry so far published in the present series of articles, and the slight design alterations necessary will be incorporated in the relevant sections to be described later. Retail price for the tube is £14.

NEXT MONTH

TRANSFORMER WINDING DETAILS—SETTING-UP AND ADJUSTING THE LINE TIMEBASE—THE FIELD (FRAME) TIMEBASE

NEXT MONTH IN Practical TELEVISION

VALVES AND THEIR HABITS

An up-to-the-minute review of the modern TV valve, packed with practical advice on typical faults and troubles and how to remedy them.

RECORD PLAYER CONVERSION

How to use the audio section of an old television set to build a record player unit, complete with microphone pre-amplifier.

IMPROVING SYNC

Methods of obviating the effect of interference on time-base circuits, with particular reference to fringe areas.

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UNDERNEATH

THE DIPOLE

SHOW business is always on the move. Fashions and trends change in the story-lines of all staged entertainments whether in the theatre, steam radio or television. "Playing Safe" by repeating ad infinitum war stories, kitchen-sink epics, situation comedies, Westerns or the modernistic unpredictables all have their days until the general public tires of them. This especially applies to full-length dramas which are not part of a series.

Title Music

With a TV series, anticipation of the familiar and predictable characterisations of the leading actors provides a short cut for viewers to get down to story values. There is no need for the usual preliminaries, introductions and atmosphere. Yet the stories themselves are often unpredictable. Steptoe, the Coronation Street cast, Dr. Finlay and—for that matter, Laurel and Hardy—all start off their stories with the goodwill or forebodings of viewers. The title music of the very old Laurel and Hardy film comedies induced laughs even before these comics appeared on the screen and Steptoe's music does the same. We look forward to the familiar tune again in the autumn.

The Ad Hoc Drama

Writers of ad hoc dramas for television have a harder nut to crack and no amount of preliminary trailers or publicity blurbs in radio programme magazines can induce viewers to take them for granted apart from the name values of a few outstanding stars. This, I feel, is one of the reasons for the drop in popularity of lengthy television plays. You won't find many of them in the TAM ratings with the availability of alternative programmes from the three networks in Britain. The scripts so often lack real meaty stories and have endings vague and unsatisfactory. After staying the course through an hour or so's meandering dialogue the viewer feels cheated when the rising credit titles put an end to the evening's problem drama. Fortunately the viewers who detect the ditherings of dramatic dross can provide their own "curtain" after a very few minutes by reaching for the "off" switch or turning over to another station. It is also unfortunate that a few of the really good complete television plays aren't even switched on for the same reason.

Vintage Years of Hollywood

You can't keep a good film down! There are pre-releases, general releases, re-releases and reissues of good films in the cinema and now they get a new lease of life in television. Some of the television critics of newspapers take a poor view of these old films but in the main they just ignore them. Nevertheless some of the films retain worthwhile entertainment values and seem to be age-proof. The BBC's "Vintage Years of Hollywood" has taken us back to Hollywood's boom years with films made as far back as 1932 to 1934 in the Paramount Studio, when stars included Bing Crosby, W. C. Fields, Mae West, Dorothy Lamour, Clive Brook, Marlene Dietrich and the Marx Brothers. In a few cases smallish part players have developed into big stars, even retaining their star rank in elderly parts. Though films have progressed a great deal technically in the last 30 years it was surprising how good both the sound and photography seemed to be. Lenses have been improved to cope with the huge screens and all master tracks recorded in film studios are on sprocketted magnetic film on tape. Yet in many cases the hazards of photographic sound track from the original studio recording, re-recording, dubbing and release printing seem to have been overcome.

The Golden Rose

The Montreux Festival with its Golden Rose awards was again the centre of television programme competition from all over the world. It was no surprise to me that one of the Continental television networks won the first prize. This seems to be a trophy which has a world significance, giving an opportunity to smaller nations to make their mark. Finland won the Golden Rose with *The Cold Old Days*, a title which in the Finnish language sounds more like Welsh. This is, I am told, a delightful fantasy of castles and fairy-tale characters which received the unanimous vote of the "jury". Frankly I am not surprised that Finland has won the award—not because I have seen the film—which was a film and not a telerecording—but because I have recently visited the studio at Helsinki and was very impressed indeed with the organisation and its equipment. It is with the latter with which I was mainly concerned and on which in due course I will report separately. Generally speaking, I find that films made specially for television are finding great favour on the Continent, enabling dedicated people to stand (or fall) by a subject to which they are devoted (without public poll advice), able to prune (by film editing) or add (by additional film sequences) as they think fit.

"Poor Man's" VTR

The Audio Fair is an annual event which appeals to hi-fi enthusiasts, who turn up in their thousands in search of the latest developments in turntables, microphones, pick-ups, stereo sound and tape recorders. And as usual there are one or two items of special interest to devotees of quality television, amateur and professional.

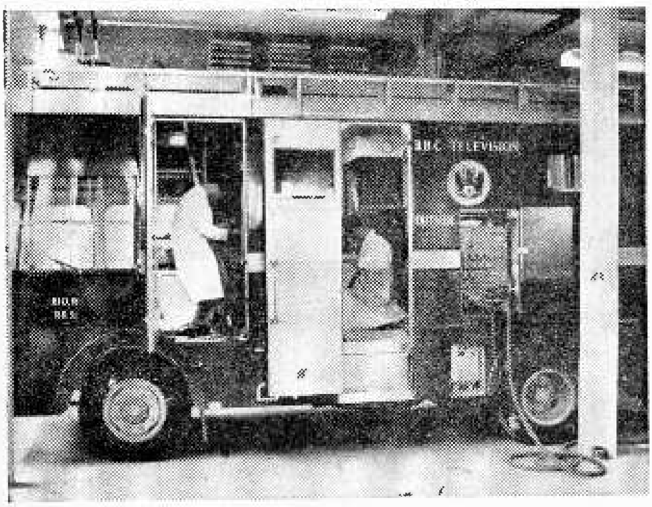
Tape recording of sound and vision has been in use at television studios for some years and has now become an essential part of the equipment, operation and techniques of all but the smallest television stations. The equipmet is complicated and expensive but over the years it has decreased in size, improved with refinements and reduced—slightly—in cost.

Attempts have been made to develop really cheap magnetic television tape machines suitable for the pockets of the amateur but few have reached a consistent and reliable stage. The cost of a broadcast quality VTR machine approaches £20,000, which is quite a sizeable capital expenditure even for large television stations, especially when two or more VTR equipments are necessary, plus their spare parts, all compatible for the interchange of tapes on different play-off machines of their own and other studios. The use of the helical method of transporting 1in. wide magnetic tape across a single rotating magnetic video head has been attributed to the Japanese but has also reached an acceptable standard of performance in USA, Holland and elsewhere. Referred to as a "poor man's VTR" the price range varies from about £5,000 down to less than £1,000, depending upon the refinements such as ability to run forwards or backwards at slow motion or variable speeds or even holding the tape stationary for a stop frame while the magnetic video head whizzes round at 50 revolutions a second.

"Regional" Activity

Viewers who live in the four major ITV areas catered for by Rediffusion, ATV, Granada and ABC-TV are familiar with the programmes of all of these companies—and their trade marks. The inverted dipole (which appropriately looks like an umbrella) heralds the polished productions from Granada's studios at Manchester and is just as well known in the South as it is in Scotland, Northern Ireland or Lancashire. The individual styles and tastes of each of the major companies have resulted in points of view and presentation which are varied and refreshing. The smaller regional companies are all required by the Independent Television Authority to originate a proportion of their own programmes which are mainly of a local magazine type. They are rarely seen in other ITV regions and hardly ever on the main network excepting as small news items for the IT News. Not all regional programmes are of a parochial type, however. Anglia, Southern and TWW have occasionally videotaped plays and series which have managed to find "slots" in the main network.

One of the difficulties with many of the regional stations has been that they have been fed from the main network—at least partly—by microwave links in one direction only.



BBC technicians fitting out a new "roving eye" outside broadcast unit at the Corporation's recently opened Kendal Avenue transport base.

Two-way Programme Lines

The Regional Television Companies Association has been in existence for some years in dealing with problems of the member companies. One of its objectives has been to assist in the exchange of regional station programme items. Practical difficulties of non-reversible lines or microwave links are likely to be overcome shortly when two-way facilities are completed by ITA.

The regional companies have already had some success in linking up their own special programmes independent of the major companies. Tyne-Tees bought the TV rights of an American television series, "Peyton Place", which was transmitted by the regionals with great success. An unexpected result of this was the recent reissue by the cinemas in South Wales and elsewhere of the original full-length feature film of the same name which attracted audiences larger than when it was first released about five years ago.

Iconos

Servicing TELEVISION Receivers

No. 115: Ekco T381, TC383 and Ferranti T1058 series

by L. Lawry-Johns

A COMMON fault with these and a large number of similar receivers is the breakdown of the video amplifier h.t. to cathode bias loading resistor in this model designated R51 (27kΩ). After a period of use the resistor changes value, passing more and more current as it falls in value until it constitutes a virtual short in series with R49 across the h.t. line.

In some cases R51 burns out completely, in others it may remain a virtual short, persistently blowing fuses and burning the panel. As well as R51, R49 should also be changed as it always suffers in some way which may not show up immediately.

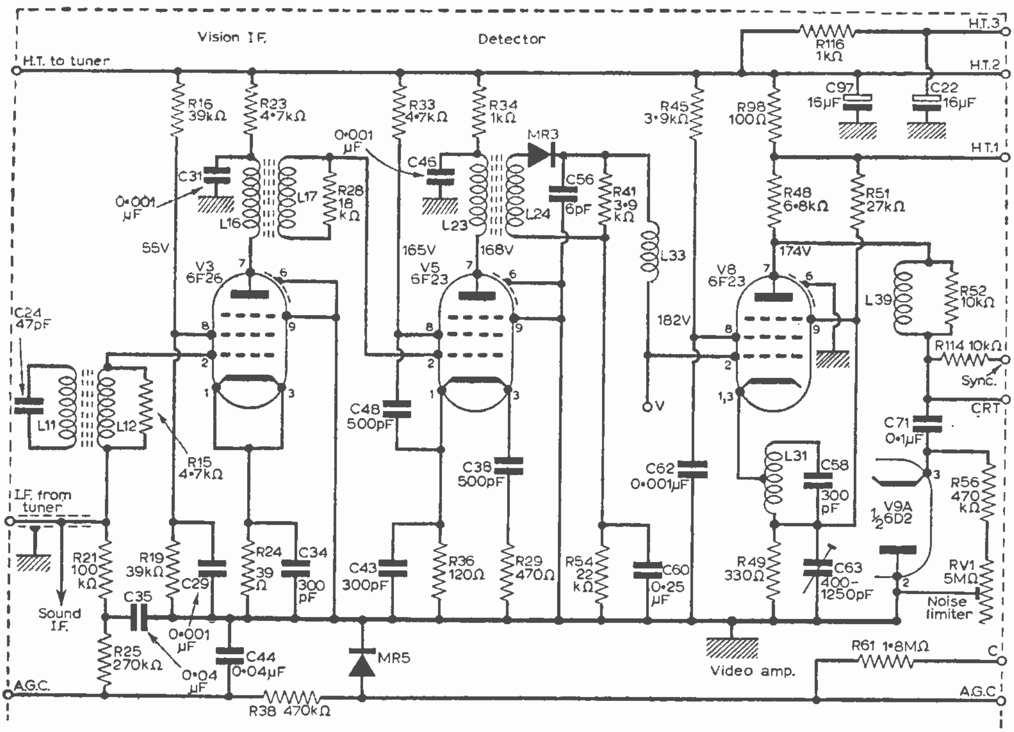


Fig. 4: The circuit for part of the i.f. panel. Shown here are the vision i.f., detector and video amplifier stages.

No F.M. Radio

Another fairly common failure is that of R119 (300Ω) which is in series with the h.t. supply and is switched out on TV.

The symptoms here are that the sound is perfectly in order on TV but fails as soon as FM is selected. Check R103, R104 and R105 if R119 is not at fault.

PY32

The symptoms given in previous articles in this series concerning this type of valve rectifier apply to these receivers, including slow warming up, gassed envelope and internal arcing.

It is not proposed to go into detail of these symptoms as they have been given so many times before and the writer has no wish to bore the reader as well as himself.

Lack of Width

Notwithstanding the above remarks, check the PY32! If the h.t. is well up, say not much under 190V at C124, the PY32 can be assumed in order and the 30P19 should be checked. Check V17 (30FL1) and the U193 if necessary. R79 should not be a lot under 4·7kΩ. Check R92 in stubborn cases.

No E.H.T.

If the sound is in order but there is complete absence of life on the right side—no line whistle, no life from the top caps of the line output valves, check the resistors associated with the width taps. These are R81, R83 and R87.

If some whistle is present, check the boost line voltage and if this is low check C85 (0·15μF) which is the boost line capacitor. Check valves in all cases.

Where there is plenty of life on the right side but no sign of life in the U26, check this one first. This also applies if there is a blue glow in the envelope.

Picture Fades and Blurs

If the picture swells and defocuses on bright scenes, completely fading as the brilliance is advanced, change the U26.

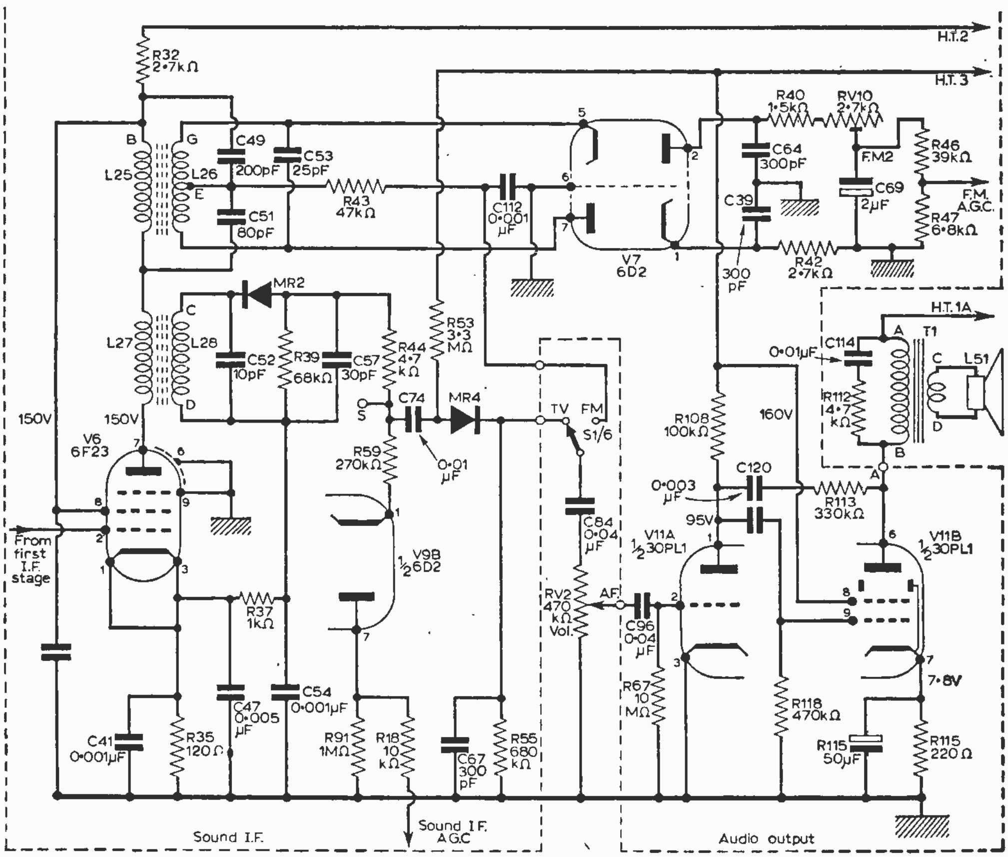


Fig. 5: The remainder of the i.f. panel circuitry—the sound i.f. and audio output.

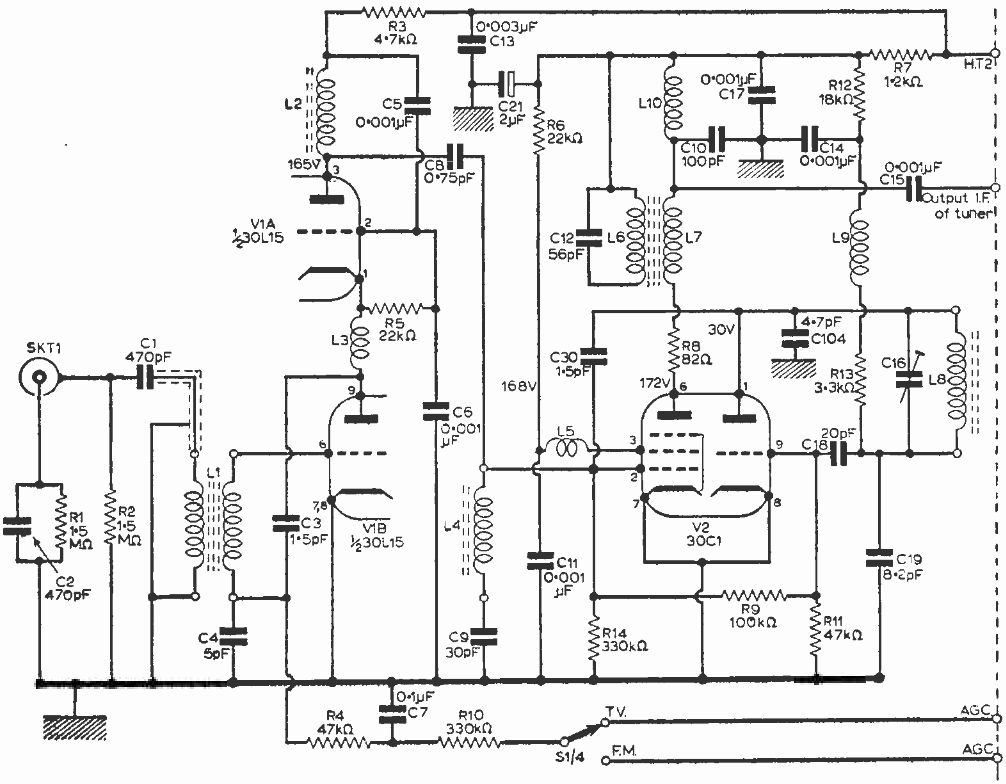


Fig. 6: The circuit of the tuner unit.

Poor Field (Frame) Sync

If the picture rolls up or down but will not lock reliably, check the Q3/4 interlace diode and if necessary the 2μF electrolytic capacitor decoupling pin 7 of V17 30FL1 (C101).

This capacitor often goes o/c, leading to much weakened sync pulses. This symptom should not be confused with erratic loss of hold which is often due to a faulty V13 30PL13.

If a PCL82 is found in this position it should be taken out and the correct 30PL13 fitted.

Bottom Compression

The 30PL13 is often responsible for bottom compression, i.e. gap at the bottom, short legs, etc. When the valve is not at fault, the 500μF cathode electrolytic should be checked (C78). Also check R72 240Ω.

No or Intermittent Sound

Check V11 (30PL1). Tapping this valve will often temporarily restore sound or cause it to fail. A PCL83 may be used in this position if a 30PL1 is not available.

If, however, some background is audible it is likely that the fault is further back. If the picture is normal and the f.m. radio functions, attention should be concentrated on the TV sound detector diode and limiter, and associated circuit.

Distorted TV Sound

Check R53 (3·3MΩ) to MR4 and associated capacitors.

Picture Absent, Sound in Order

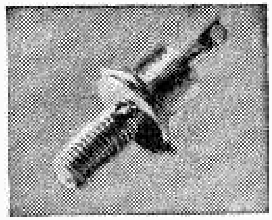
If on advancing the brilliance a normal blank raster is displayed with little or no modulation, the sound however remaining normal, it is prudent to check the video amplifier and the vision detector diode.

The 6F23 V8 sometimes develops a screen to grid short. This not only necessitates replacement of the valve and probably R45 (3·9kΩ), but if the repair ends here vision signals are hardly likely to be restored. The detector diode MR3 (CG64) will almost certainly have been damaged by the excess current flow, although in this circuit it can escape damage due to the limiting action of R54.

If the video circuit appears to be in order, check back to the V3 (6F26) and V5 (6F23) stages, the expected voltages will be found in the Panel A diagram. About 50V at pin 8 of V3 should not be considered low.

—continued on page 468

SEMICONDUCTORS '65



Silicon Rectifier Replacements

by T. D. Williams

IT has been my experience that PY32 and PY33 type mains rectifiers in domestic receivers are very much more prone to failure than the dual PY82 arrangement which was used successfully for many years in a large range of receivers. If my experience is typical their successors, the PY32 and PY33, suffer not only earlier loss of emission, to an extent sufficient to stop the line timebase operating, but also have a very unhappy tendency to "blow" their cathode connection at the slightest flash over in the circuit. The endurance of the two PY82s is understandable since each is rated to supply 180mA so that a total—under actual working conditions—of probably well over the rated 360mA is available to the receiver, whereas the PY32 is designed to deliver only 325mA and this is probably a little too near the knuckle to allow for uneven cathode coating and an over-thin connection between the cathode pin and the actual cathode.

With the arrival of the silicon rectifier, which is a very compact device, it is a reasonably simple process to make a plug-in replacement for PY32 and PY33 valves which should provide for a far longer life than the valve rectifier. Additionally, for the serviceman, it can be a useful test replacement, particularly as it is mechanically stronger and more easily carried than a valve the size of a PY32, which can so easily come to grief in a service bag.

It can be made up on an international octal plug, but if such is not to hand the plinth of an i.o. valve having pins 2, 3, 5, 7 and 8 intact will serve equally as well and in fact has the advantage of providing a better grip when inserting and withdrawing the device. The old valve will need to be broken away from the base and the cement cleaned out. The old connecting wires into the pins can be removed fairly easily with a soldering iron and pliers. Make certain the holes through the pins are nice and clear as it makes the insertion of the new wires much simpler. The silicon rectifier is inserted between pins 3 and 8, the "a.c. in" lead going to pin 3 and h.t.+ side to pin 8. Where the polarity is not marked on the rectifier it is usual with these devices for the metal casing to form the d.c.+, whilst the a.c. connection is formed by the wire which enters the rectifier through the plastic seal. A jumper lead should next be inserted between pins 3 and 5. This is needed to ensure the rectifier draws its current through both the surge limiter resistors, one of which is connected to each anode pin after being fed from a common mains point. Fig. 1 shows a typical circuit for a PY32. In order to take up the voltage normally dropped by the heater of the valve a wire-wound resistor of 100Ω 10W is fitted between pins 2 and 7. Slip short lengths of insulated sleeving over the wire ends of the components before fitting them in place.

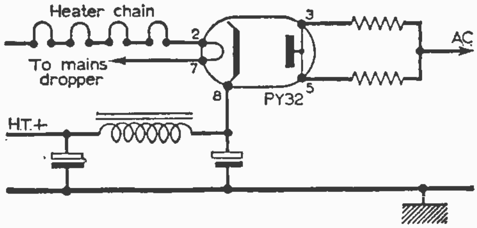


Fig. 1: A typical PY32 rectifier circuit for a TV receiver.

In certain cases it has been found a silicon rectifier tends to supply too high a voltage to the receiver and in one case, a 14in. HMV portable, it caused a narrowing of the picture due to the high h.t. creating an excessive e.h.t. voltage. It is as well therefore to measure the on load h.t. voltage to ensure it is not in excess of 200-220V. In the event of it being found to be on the high side a 10W wire-wound resistor of suitable value—from 25 to 100Ω—depending on the voltage to be dropped should be wired in series with the negative side of the rectifier. Do this by unsoldering the a.c. in lead from pin 3 of the valve base and solder in its place one end of the wire-wound resistor, the other end being attached neatly to the "a.c. in" lead of the rectifier.

The general circuit layout showing the modified circuit with the silicon rectifier is shown in Fig. 2. A typical silicon rectifier is illustrated in Fig. 3.

SEMICONDUCTORS '65

Mullard's BY100 rectifier is entirely suitable for this job but any unit rated at 250V 400mA (r.m.s.) or more will do equally as well and in fact the writer has successfully made several of these little gadgets with surplus silicon rectifiers rated at 250V 750mA costing as little as 3s. each. A drawing of the completed unit is shown in Fig. 4.

Purists might suggest that by replacing a valve rectifier with a silicon type, h.t. is being supplied to the receiver much more quickly than would normally be the case, but this has never been observed to have a detrimental effect on any set and

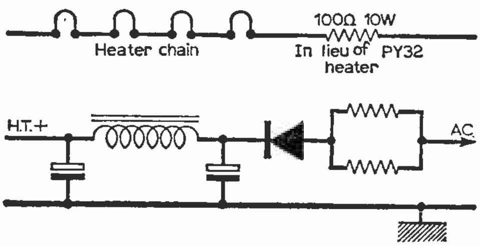


Fig. 2 (above): The circuit of Fig. 1 modified to use a silicon rectifier.

Fig. 3 (right): The appearance of a typical silicon rectifier.

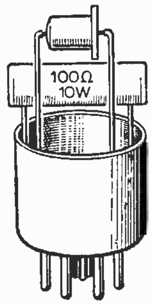


Fig. 4 (far right): The complete unit built into an i.o. valve base.

in any case practically all the valves—which are the components most likely to suffer damage by premature application of h.t. to them—appear quite indiscriminately in both metal rectifier and valve rectifier supplied h.t. circuits and therefore must be capable of dealing quite happily with the arrival of h.t. before the cathode is fully heated.

In addition to using silicon rectifiers in this application, sets having the old fin-type metal rectifiers or contact cooled types also can be serviced with advantage by the use of silicon rectifiers. All such old type rectifiers whether fin or contact cooled are, of course, supplied with a.c. via a surge limiter resistor which makes the circuit ideal for the insertion of a silicon rectifier. It is usually only necessary to wire the silicon type across the one already in the receiver, and in this direction it has never been found necessary to wire in an additional resistor to reduce the h.t. supply to the set in such circumstances as is occasionally the case when replacing a PY32 or PY33.

These little devices can be obtained cheaply from a number of advertisers in this magazine so it is well worth while to try one in any set that perhaps doesn't warrant the expense of a new metal or contact cooled type but might well considerably improve in performance if its h.t. is raised to the maker's original ideas on the subject.

If one undertakes any sort of servicing, even if only as part of a hobby, a small stock of these extremely compact devices is a must. They prove very useful when a new line output valve doesn't cure that narrow picture, for they can be clipped into the circuit across an existing valve or other type rectifier without any need to disturb the wiring or withdraw the existing valve rectifier and it will quickly be clear whether the line timebase circuit is being starved of current by a tired rectifier. Carrying metal or valve rectifiers in the service kit is a nuisance but a couple of the silicon type will keep quite well among the small change in one's pocket and be always there when required. ■

SERVICING TELEVISION RECEIVERS

—continued from page 466

Raster in Order, No Vision or Sound Signals

This is usually a tuner unit fault and either the 30C1 or the 30L15 could well be at fault. Substitution is the best check. A PCF80 can be tried in place of the 30C1 and a PCC84 in place of the 30L15, although there will be a difference in performance.

Adjustment of L8 oscillator coil core is through the side of the tuner, roughly in line with and at an angle to the base of the 30C1. Use a very fine tool and do not use undue pressure as the former can easily be pushed out of position.

The Tube

The CME1901 tube is a little sensitive to excess heater current and for a normal life it is essential that the voltage adjustment should be set correctly or preferably to a higher setting.

If the average mains input is 230V a setting for 250V would ensure maximum life. Low tube emission is shown by the inability to maintain correct focus and highlights on the brighter parts of the picture.

Maker's Notes

When the receiver leaves the factory the frame (field) linearity is correctly set and the range of the vertical linearity control is sufficient to cover all necessary adjustments.

If, however, difficulty is experienced and the control operates near one end of its travel, the correct setting can be achieved by breaking the shorting link across R102 or disconnecting one end of R77.

In extreme cases it may be necessary to carry out both operations.

Mains Input Lead

The input lead is terminated on the chassis at a pair of spike terminals which are covered by sleeves. As the mains are not controlled by the switch at this point it is essential that these sleeves are in position before handling a mains connected chassis.

The CATHODE RAY TUBE and its CIRCUITS

by J. McCarthy

CONTINUED FROM PAGE 419 OF THE JUNE ISSUE

IN most applications of c.r.t.s at least one time-base is required. There are two main types—straight line and circular. A straight line time-base is usually a saw-tooth oscillator, of which there are four common types. A table of these four types, and their advantages, is given in Table II.

A good time-base must have good linearity. The effects of good and poor linearity are given in Fig. 8.

TABLE II

Type	Frequency Range	Number of Valves	Linearity
Thyratron	V. Low—20 kc/s	One	Poor
Puckle	10 c/s —1 Mc/s	Three	Excellent
Miller-integrator	10 c/s—100 kc/s	One	Excellent except at l.f.
Blocking	Restricted	One	Poor

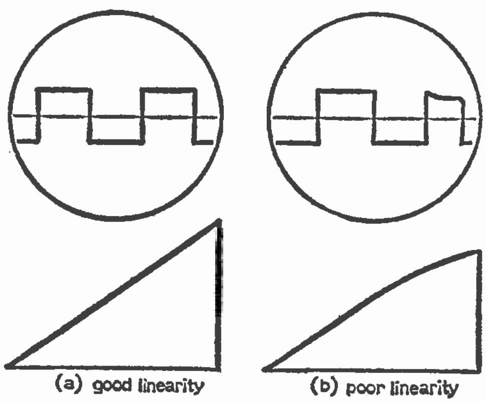


Fig. 8—Oscilloscope traces and waveforms of good (a): and poor (b) linearity.

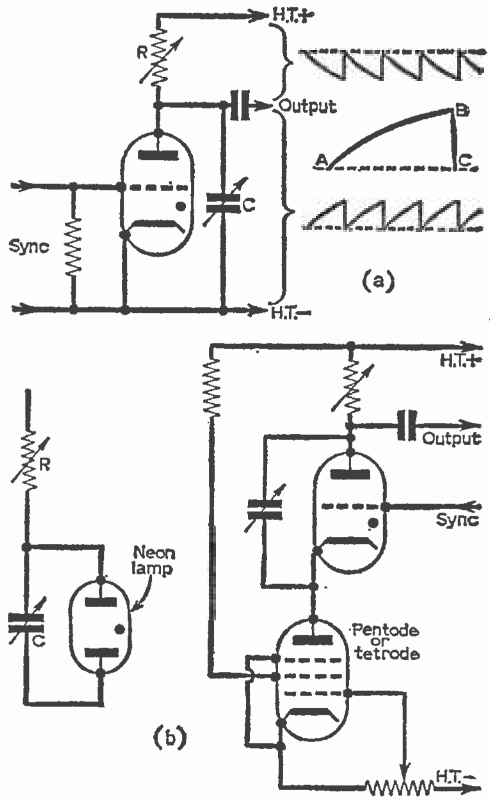


Fig. 9—(a) The thyratron timebase: (b)—the circuit with a current lineariser added.

It will be seen from the table that each kind of time-base has its own advantages and disadvantages when referring to the maximum and minimum frequency. If a really low frequency is required, a thyratron circuit is the best. A circuit is given in Fig. 9 and operates as follows:

The capacitor C is charged up through R at a rate depending on the values of C and R until the striking voltage of the thyratron is reached this slow charge up of C is the portion AB of the curve. When the thyratron strikes, the capacitor rapidly discharges causing a more or less invisible fly-back BC. The main disadvantages are:

(a) The non-linearity of the curve.
(b) The low maximum frequency.

(a) is due to the fact that a capacitor's charging curve is exponential. However, this may be corrected by making the maximum voltage possible across C (i.e. the h.t. voltage) far greater than the thyratron's firing voltage (a capacitor's charging curve is the most linear at the commencement of the charging action). Alternatively, a current lineariser may be employed in series with the whole oscillator, and a pentode valve is a useful device in this position (see Fig. 9b).

The same effect could be obtained using a neon-bulb, and a neon circuit is in fact used in some very early television receivers as a frame time-base. The advantages of thyratron over a neon is that synchronisation can be applied more readily. However, now for an explanation of the process of synchronisation and the reason for its use. This now will be explained using the thyratron time-base as its basis, although the explanation applies to all time-bases. Assume C to be slowly charging and its voltage to be below the striking voltage of the thyraton. Now assume that a small positive pulse is applied to the grid—the discharge will be initiated. Obviously if a series of positive pulses is applied to the grid the oscillator will operate at the frequency of the pulses as long as the natural frequency of the oscillator is less than the pulse frequency (see Fig. 10). The effects of sync pulses on the saw-tooth in (b) is shown in (a)—it may be seen that the generated frequency becomes that of the pulses, however, when the frequency of the sync pulses is less than the natural frequency, the natural frequency is maintained with an abrupt premature discharge at the point of the sync pulses, as in 10c and 10d.

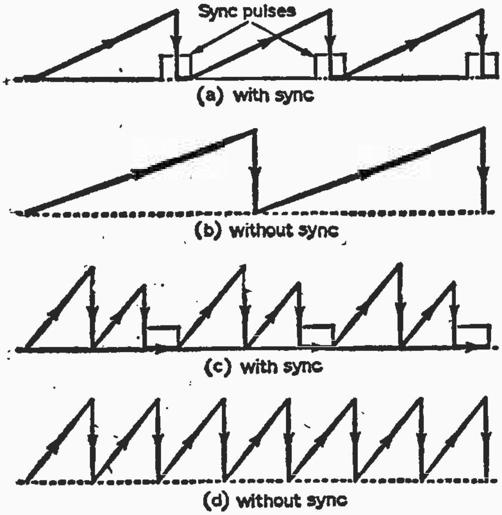


Fig. 10—Effects of sync pulses on saw-tooth waveforms

Next, the Puckle oscillator, Fig. 11. This is rather more involved as it requires three valves, however, the circuit functions very well, and in the following manner:

C1 charges through V1, a pentode valve, therefore C1 charges linearly. At the beginning of the charge, the anode and the cathode of V2 are at h.t. potential and its grid is negative. Eventually V2's cathode becomes sufficiently negative w.r.t. anode and the valve conducts and its anode potential will decrease, giving what is in effect a negative pulse on V3's grid via C2. This negative pulse cuts off V3 and raises its anode potential V2's grid positively, which will increase V2's anode current and V2 will discharge C1. The cycle will then be repeated.

The frequency depends upon the values of C1 and R—R varies the screen potential, and thus the charging current. If the sweep is not required to be very linear, the pentode can be replaced by a variable resistor. R is then not required.

Another kind of oscillator is the Miller-integrator. This has the advantage over the previous circuit of only requiring one valve—a pentode. A circuit is given in Fig. 12. Its operation can be described in two ways.

It can be described as a conventional multivibrator built around a pentode instead of around two triodes—the anode and suppressor grid form one triode, and the screen grid and control grid the other. The multivibrator of Fig. 13 is shown as having one grid leak connected to h.t.+. This is done to make the analogy between the two circuits clearer. Such a multivibrator would still function as normal, and grid current will prevent the grid from rising excessively positive. Interaction between the two electron streams distorts the square wave to saw-tooth.

The alternative description of its function will now be given: Assume that C1 is charged. It

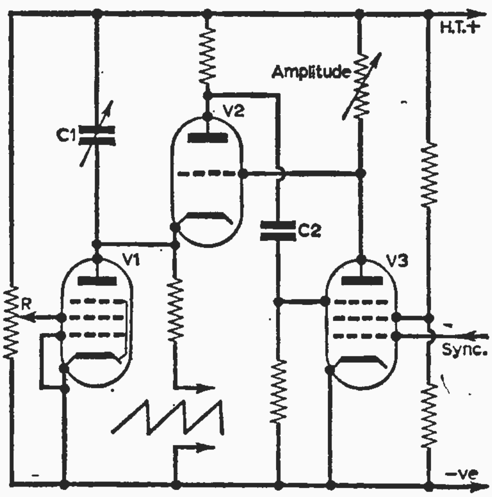


Fig. 11—Circuit of the Puckle timebase.

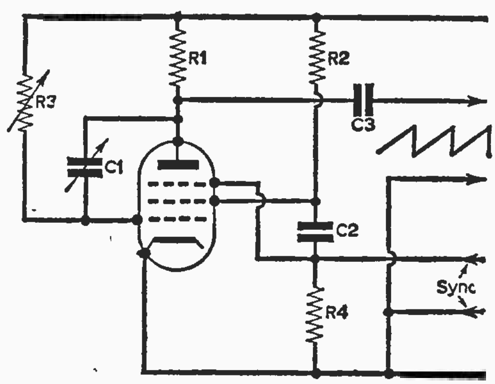


Fig. 12—Miller-integrator oscillator.

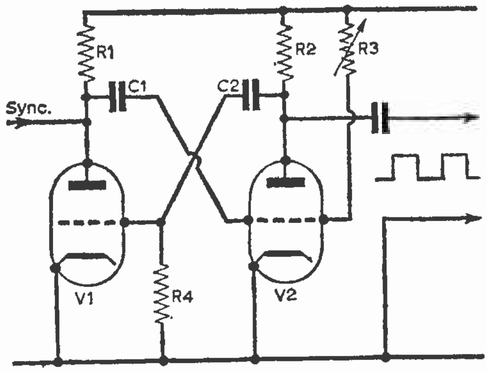


Fig. 13—The conventional multivibrator circuit.

discharges through R1 and R3 at a rate depending on the values of R3 and C1. This causes the valve's anode current to increase and its anode and screen voltages to decrease. Eventually, saturation (a condition in which the valve is conducting the maximum current possible, even with a positive grid) occurs and the screen grid's voltage drops suddenly because of R2. This negative pulse passes through C2 to the suppressor grid, which

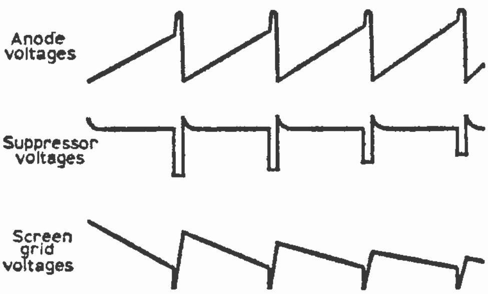


Fig. 14—The waveforms present at three of the electrodes of the Miller-integrator valve.

cuts off the anode and increases the screen current. The current through R1 ceases and the anode potential becomes that of the h.t.+ line and C1 again charges. The waveforms present at the various electrodes are given in Fig. 14. The negative pulses present at the suppressor grid are often connected to the cathode-ray tube's grid to cut the tube off during the flyback period. A Miller-integrator timebase has one minor disadvantage of being non-linear at low frequencies—to linearise, C1 may be split up into two capacitors in series, the centre-tap of which is earthed by a 0·5MΩ variable resistor.

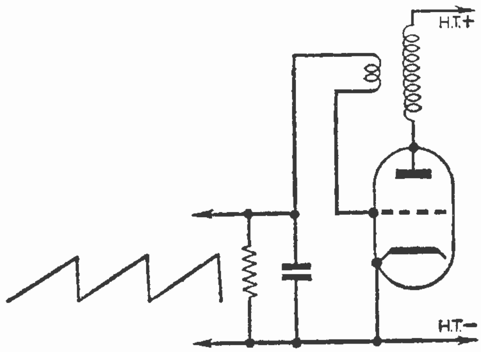


Fig. 15—A typical circuit of a blocking oscillator.

The last time-base to be described which is used sometimes in TV circuits is the blocking oscillator. The circuit oscillates in the normal manner because of positive feedback, and grid current rapidly charges up the capacitor C. Eventually, the capacitor is sufficiently charged up, and the grid is so negative that the valve is cut off. The capacitor now discharges through R, until the valve can conduct and oscillate again. A saw-tooth waveform is generated across the capacitor which can be used in the normal manner. A typical circuit is given in Fig. 15.

TO BE CONTINUED

LETTERS TO THE EDITOR

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

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

UNUSUAL FAULT

SIR,—Two German PY82s were purchased from a retailer for a TV set that used them both in the h.t. supply.

On insertion, however, they blew the set's h.t. fuse. After a thorough search for a fault none could be found until it was noticed that if one of the old valves was put in a certain valveholder the set worked but if the old and new valves were reversed in their holders the fuse would blow again. So the fault seemed to be in one of the valveholders and not in the valves.

There was another search of this holder and it was found that pin 3 of both valveholders was joined by a wire from one tag in the holder to an unused tag 7 in the other holder and also to its tag 3.

Therefore one valveholder had tags 3 and 7 strapped together by a printed circuit but the other had only tag 3 wired. One old and one new valve were inspected closely and the following noted:

British Valve.		German Valve.	
Pin 1	Not used.	Pin 1	Not used.
Pin 2	Not used.	Pin 2	Anode.
Pin 3	Cathode.	Pin 3	Cathode.
Pin 4	Heater.	Pin 4	Heater.
Pin 5	Heater.	Pin 5	Heater.
Pin 6	Not used.	Pin 6	Not used.
Pin 7	Not used.	Pin 7	Anode.
Pin 8	Not used.	Pin 8	Not used.
Pin 9	Anode.	Pin 9	Anode.

It can be seen from this list that on the insertion of the German valve in this valveholder pins 3 and 7 would be shorted, leaving a direct path for a.c. to flow from anode to cathode and on through both the main electrolytic capacitors.

Of course upon removal of the appropriate section of the printed circuit board from between pins 3 and 7 the set operated normally.—F. WALLACE (Corby, Northamptonshire).

GREAT LITTLE SET

SIR,—Recently a friend of mine was demonstrating the versatility of his "Sobell" transistor radio and he tuned in to about 15Mc/s on the short wave band. To my amazement and his delight there came across, loud and clear, not a "Ham", but BBC-1 sound in the form of "Temple Houston". The readability and strength were about QRK5 and QSA6 respectively.

Keeping in mind the fact that we get channel 10 from Emley Moor which broadcasts sound on 196·25Mc/s, I reckon that it's quite a good 16 guineas worth, don't you? — P. L. BALLANTYNE (Harrogate, Yorkshire).

FRONT END FOR VALVE RECEIVER

SIR,—Could the Olympic II tuner be used as the front end of a conventional valved chassis?—L. A. CHAPMAN (Chippenham, Wiltshire).

The Olympic tuner can be used as the "front end" of any TV. Note that the supply voltage must be −12V, well smoothed (preferably voltage-regulated, e.g. by means of a simple zener diode circuit). Four cycle headlamp batteries in series will give hundreds of hours of use as the tuner will work down to 7V.

If batteries are used, however, it will probably be necessary to fine-tune by variable capacitor, not electronically as the electronic tuner has not the same range of tuning.—Editor.

OLYMPIC COILS

SIR,—In the Olympic II article in the May issue of PRACTICAL TELEVISION the winding on T1 is not very clear and also the L9 coil is not shown. Are T1 and L9 to be wound clockwise or anticlockwise (looking from the top of the formers). Also could 18s.w.g. tinned copper wire be used for L9 as I cannot get the bare copper wire in 18s.w.g.?

I find that the diameter of the bakelite coils is not actually 3/10in. but just slightly under, about $\frac{9}{64}$in. Will this make any difference in performance?—J. REILLY (Birmingham 25).

It does not matter whether the winding is clockwise or anticlockwise on any coil unless (as in T2) there is a mechanical reason why it should go round one way, when the wire is rather thick, for example. Adjacent coupled coils should normally be wound in the same direction.

Regarding the oscillator coil L9, tinned 18s.w.g. copper wire will do very well.

The bakelite coils are not exactly 0·3in.—possibly $\frac{9}{64}$in. is a better estimate but the dimension gives the idea.—Editor.

LOG PERIODIC AERIALS

SIR,—I am interested in the articles on DX-TV, and I wondered if any of your readers have had any experience with Log Periodic Aerials as mentioned in some overseas journals.

The articles have been on using these aerials on horizontal polarisation, and I should be very interested to hear if anyone has used this type of aerial to receive British stations (TV and f.m. sound) on vertical polarisation. — L. KING (136 Ludwick Way, Welwyn Garden City, Hertfordshire).

NOTES FROM THE AUTHOR OF THE OLYMPIC II

SIR,—I have been receiving a large volume of correspondence from readers, much on the same subject, and trust that the following information will be of assistance to many of them:

The small components—resistors, diodes, capacitors and several of the transistors—may be bought quite cheaply from advertisers in *Practical Television*. Some firms advertise "bags" of capacitors and resistors and I took advantage of a "bargain offer" and found myself the possessor of about 40 small capacitors of 1,500pF, as well as some others, for 10s. Careful buying of these components can lessen the cost considerably. However, there are some transistors which one must buy direct from the manufacturer; with the exception of the line output transistor, which costs several pounds, these are all quite cheap—shillings each only.

The scanning components form another expensive item, since they *must* be according to specification. These will cost several pounds direct from Elac Ltd.

If pressed at least to hazard a guess my answer would be "around £60" for everything. Quite possibly some constructors could do better than this, nevertheless, especially if they are prepared to wind their own mains transformer, etch their own circuits and so on.

One correspondent was rather sad about the cabinet. Well, so am I; I never was very much good at carpentry and, to tell the truth, not much interested in it either! But I did point out that the cabinet was only one of the many possible ways the units could be assembled and I hope the reader concerned may be able to offer a really attractive design when he has got round to thinking about it. Maybe he would prefer just to have essential controls at the front. I fear the assembly I have shown in the article is an "engineer's" and not a "housewife's". Still, I know for a fact that many readers have their hi-fi in the nude, so to speak—including drainpipes set in concrete in the corner of the living-room (and often not even painted at that) to house their loudspeakers. Perhaps to have shown a bare chassis would have been best!

Another point mentioned in a letter was the fact that the printed circuit boards cannot be reproduced direct from the pages containing the article by a photographic method. Actually for one-off jobs it is easiest to put a resist direct on to laminate but NOT with a paint brush; ruling pen and ruling compass can be used very effectively as long as the resist is not too thick. *Practical Television* is, however, ready to supply photostats of the boards for a nominal sum to readers who want either a scale "blueprint" or a means of doing the job photographically.

Finally a word of caution to all intending constructors—test as you go along, especially in the timebase stages. When you are aware of the dangers it may be expensive to switch on hopefully. Switching circuits with inductance loaded transistors are especially tricky and it is always wise with them to start with 6V instead of 12V and a couple of ohms resistance in series with the scan coils—just in case.

I would like to thank correspondents for the letters so far received. I shall be glad to advise as necessary and will always be interested to hear how constructional projects are progressing.—D. R. BOWMAN (Henlow, Bedfordshire).

BLACK LEVEL EQUALISATION

The circuit of Fig. 6 in the above article, published in the March, 1965, issue, should show a 100kΩ resistor connected between the cathode of the picture tube and h.t. positive. Without this resistor the manual brightness control will fail to work correctly.

We are grateful to Mr. G. Naisby, of Co. Durham, for bringing this omission to our notice.—Editor.

TRADE NEWS

TV Tubes Give Better Picture Contrast

IMPROVED picture contrast with no increase in the price of the tube is the result of a decision made by Mullard in collaboration with leading set makers to deepen the tint of the faceplates of their current range of television picture tubes.

By tinting the glass of the tube faceplate the level of ambient room or window lighting normally reflected by the tube is attenuated by the tinted glass both on its way to the phosphor screen and after reflection. Such light has therefore less effect on the picture, with the result that the contrast ratio is improved.

Radiant screen mono-panel tubes with the deeper tinted faceplates will be marketed under the following type numbers: 19in. A47-14W (previously AW47-91) and 23in. A59-15W (previously AW59-91). *Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.*

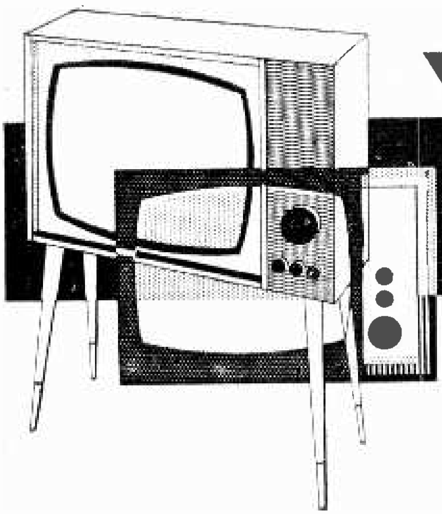
Mini Oscilloscopes

TELEQUIPMENT LIMITED have announced a small oscilloscope measuring 5¾ x 6 x 9in. and weighing only 5lbs. A 2¾in. c.r.t. operated at 600V provides a bright fine trace, and the green removable graticule has ten divisions, both horizontally and vertically, each division being 0·5cm. A moulded rubber light hood is standard.

The direct-coupled Y amplifier has a bandwidth of 30kc/s (−3dB) and has a continuously variable gain control giving a sensitivity range better than 100mV/division.

Any input signal of more than ½ division automatically triggers the timebase, thus eliminating the synchronising/triggering controls. Timebase speeds can be varied from approximately 100μsec/division to 100msec/division by a 3-position switch with a variable control providing continuous overlap between ranges. If the timebase is switched off, the undeflected spot will return to screen centre.

The list price is £23 10s., but by arrangement with the Association for Science Education, schools or colleges ordering six or more are to be allowed a 15% discount which will bring the price to below £20. *Telequipment Ltd., 313 Chase Road, Southgate, London, N.14.*



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

PAM 119A

There is no sound or vision. There is no h.t. voltage to the anode or screen on the EF85 (V3). The PCL83 sound output and PCL85 vertical osc. output valves are getting very hot.—J. Adams (Wednesfield, Staffordshire).

This set employs an automatic tuner (see August-September 1964 issues) with a switched h.t. supply to the tuner and i.f. stages. It would appear that either the switch contacts are not closing or R33 (470Ω 3W) has failed.

BUSH TV63

This set was switched off then switched on again within 30 seconds, now there is no sound or vision. The heater chain is in order.—E. Fitz (London, S.E.26).

You will find that the h.t. fuse has failed (the heater fuse must still be intact) due to an arc-over in one of the PY82 rectifiers. This often occurs when the receiver is switched on shortly after being switched off.

FERGUSON FR20

The trouble is lack of width and a broad line about 1in. wide down each side of the screen. Also, the faces of the people look very long.—C. Smith (Sheffield 9).

Lack of width may be caused by low h.t., loss of emission of the line output valve, or a fault in the associated circuitry.

The h.t. should be at least 180V. Lower than this should cause you to suspect the PY32 rectifier. If this is in order, check the PL36 and also the 1kΩ 2W resistor to the screen grid. Replace if necessary with a 3 or 5W wirewound component.

H.M.V. 1864

The trouble is poor sound. If I trim the turret tuner I can get good sound and vision on one channel only. If I adjust for the best picture on both channels, I get poor sound. I have changed the turret tuner valves but this has made no difference.—G. W. Lopping (Tredegar, Monmouthshire).

It is possible that the set is misaligned in the i.f. channels. This would give results mentioned if the tuner were trimmed. Realigning this model demands the use of test instruments and service manual for the best results. However, some improvement may be possible by tuning for the best vision on the affected channel and then carefully adjusting the sound i.f. cores for the strongest sound.

COSSOR 948

The picture has reduced top and bottom. Voltage readings on V5 are on the high side, but this is probably due to R89 being shorted out (it went O/C about a year ago).—R. Peacock (Islington, London, N1).

Your fault is probably due to a low emission PCL82, V5. Check also its cathode components R50 and C35.

PYE V210

There is a gap at the sides of the picture and the bottom. There is stretching at the top.—W. F. Bennet (Hull, E. Yorkshire).

The two most frequent causes of your trouble are low h.t. due to a faulty metal h.t. rectifier, and a decrease in value of the 2·2kΩ screen grid feed resistor to the PL81 line output valve.

McMICHAEL MP18

This set, when switched from ITV to BBC-1, has no sound with the volume control full on and the tuning pointer at the extreme of its travel, and the picture is faint. Touching the rod aerial with the hand improves sound and vision slightly.—F. Breese (Birmingham 20).

The BBC-1 oscillator coil core requires retuning. Remove side panel to reveal the holes in the front of the tuner. Set the fine tuner midway, inspect the holes to ensure at which the core is presented and insert a non-metallic tool, setting the core for maximum sound.

EKCO T205

The vertical hold is very critical. Could you tell me if the interlace diode is the usual cause of this? —P. Beatty (Lytham St Annes, Lancashire).

The usual cause of your trouble is a faulty interlace diode type Q 3/4. If a replacement is not readily available we suggest that you short this diode out as a quick check.

FERGUSON 546T

When first switched on the picture is perfect, but during the first hour, gradual picture shrinkage takes place at the bottom of the picture until it reaches approximately 1½in. This can be adjusted with the height control, but this results in the top of the picture being stretched very badly. Most of the components in the frame timebase have been renewed including the valves.—J. Evans (Northwich, Cheshire).

You should replace C97 0·01μF if the PCL82 and the bias components are in order.

PYE SP17

There is cramping at the bottom of the screen. I have changed PCL82 and PL81 valves but this has made no difference.

On switching on the picture fills the screen, and the cramping appears after about 15 minutes.—W. W. Gee (Solihull, Warwickshire).

Your symptoms suggest a fault in the cathode circuit of the PCL82. We suggest that you check the cathode bias resistor of the output stage, and also its decoupling capacitor, which is the 250μF of the adjacent secondary smoothing block.

H.M.V. 1871

I am unable to hold the line hold. I have changed the ECC81 and adjusted the two trimmers in the transformer without success.—A Hunt (Great Yarmouth).

The EF80 to the right of the ECC81 is the line reactance valve. This and the EB91 below must be in good order for reliable line locking. The 0·01μF capacitors across the transformer windings can also give trouble.

We presume the switch on the line hold control is functioning correctly.

BUSH TV62

There is frequent failure of the PCL83 sound output valve. Two valves have been used in nine months.—J. F. Grindley (Oswestry, Shropshire).

We do not suspect a circuit short and the valve itself is probably the only defect present. Check the 470kΩ bias resistor to pin 7 as this may have been damaged by excessive current flow.

EKCOVISION TC267/1

First of all there is a good picture, then the line whistle will slightly alter in pitch and the picture will become a mass of horizontal lines. The line hold control has no effect except when turned fully clockwise, when it produces three multiple pictures on the screen.—A. E. Card (Glamorgan, South Wales).

The symptoms you describe are due to a fault in the line oscillator or discriminator stages. These are the 6/30L2 and 6D2 valves just outside the e.h.t. box and we suggest that you try exchanging them with others of similar type inside the receiver as a quick check.

FERRANTI T4

The picture on this set is very good but the sound fades away after it has been on for about five minutes.—J. B. Guy (Southampton).

Since the picture remains the fault must lie in the sound channel. As it comes on progressively it is likely that a sound channel valve drops in emission as its temperature rises. Have the sound channel valves time-tested for emission and replace any in which the emission fails.

ULTRA VT917

The Band III failed and after difficulty I managed to get a weak picture, although the frame kept slipping, and after adjusting the contrast control there was a "plop" and the sound vanished. I can still get BBC and weak ITV but no sound. The output transformer to the speaker seems all right.

Could you please tell me how to boost the tube as this seems to be failing?—G. Scarborough (Streatham, S.W.16).

From your remarks it seems as though the set now has two faults. The original ITV fault and now the sound fault. First investigate for the missing sound. This could be caused by failure of a valve in the sound channel or by open-circuit of the speaker transformer primary winding. Check the wiring from this transformer to the speaker. Listen for trace of residual hum in the speaker. If there is no hum, the fault lies before the sound output valve. Check the feed from the sound detector to the volume control. Check the sound channel valves.

The weak ITV should lead to a check of the ITV aerial, diplexer if used and tuner. Since BBC is all right, it is likely that the fault lies prior to the i.f. channel. A defective decoupling capacitor in the tuner could be responsible.

A tube is boosted by raising its heater voltage by about 25%. This is not always successful and may result in burnout of the tube heater. Special transformers to lift the tube heater voltage are available.

FERRANTI T1215

I wish to remove the BBC signal from the top of the screen. I have changed V13 ECL80 also V8 EF80 sync separator.—J. Green (Bolton, Lancashire).

The picture interference is caused by test pulses radiated by the authority. They occur during the frame period. Their display therefore implies a slow frame retrace. This can be caused by the design of the frame circuits or by a fault in an associated component. In your set, the trouhle is sometimes promoted by a fault in the frame oscillator transformer. Also check the setting of the frame linearity control and check the negative feedback components.

PAGEANT 7P20

When first switched on there are gaps top and bottom of the picture which take about fifteen minutes to fill out. I have replaced the field oscillator/output valve 30PL13 and the line output valve PL81 without success.—L. F. Doran (Carlisle).

This is frame timebase trouble. If you are sure that the associated valve is in order (even a replacement may be out of tolerance), check that the mains voltage tapping is set to suit the mains in your area. If this is set above the mains voltage, then the set will be under-run and the trouble will be aggravated. Also check the thermister in the heater chain and the h.t. rectifier.

TEST CASE -32

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

? *The symptom on a Pye 17in. was a very much over-sized picture with normal sound. Although the picture was not of the maximum brightness expected for this type of set, it could not be termed as "dim". When the brightness control was turned up, the picture brightened normally and remained in focus. It did not "blow up" and disappear as generally occurs when the e.h.t. rectifier valve or line output valve is of low emission.*

An e.h.t. testmeter was not available, but to glean some idea of the amount of e.h.t. voltage present on the tube final anode, the e.h.t. connector was removed and held close to the chassis. This resulted in a violent discharge of blue light and when the connector was again applied to the tube it was noticed that between the earthing clip and the external conductive coating on the picture tube there occurred a discharge of very small blue sparks. This discharge ceased when the tube commenced to take current but it could be promoted by turning back the brightness control.

What was the most likely cause of this trouble?

See next month's PRACTICAL TELEVISION for the answer and for another problem.

SOLUTION TO TEST CASE 31
(Page 428, last month)

On 405 lines the field frequency can be exactly synchronised to the mains supply. This gives synchronous working. Such mains-field timebase synchronism is impossible on 625 lines, and for this reason the authority makes no provision for mains locking. This gives asynchronous working, as explained in Test Case 24.

However, apart from a high hum level, relatively poor field lock sometimes occurs on 625 lines owing to impulsive interference, especially in areas where traffic and electrical interference is high. On the 625-line standard the picture is negative-going. This means that the sync pulses are positive-going, and as impulsive interference is also positive-going on the video waveform, these are sometimes mistaken for sync pulses by the field timebase generator.

Mainly, however, the positive-going interference pulses tend to push the sync separator stage harder into grid current than is normal, thereby charging the grid capacitor to a value higher than normal. This holds the stage at anode current cut-off for an abnormally long period. That is, during the sync pulses. The effect can be "blocking" of the separator, so that there is no output from field pulses directly following a heavy burst of interference. Clearly, then, the field synchronising is badly affected.

Fortunately, the symptom from this cause is not widespread for two reasons. One, because impulsive interference is nowhere near so bad on the u.h.f. channels as it is on the v.h.f. channels (owing to the higher frequency), and two, because modern sets incorporate circuits to counter this blocking effect.

A BBC-2 viewer experiencing field slip due to interference should endeavour to secure an improved signal-to-interference ratio by paying extra special attention to the u.h.f. aerial system.

QUERIES COUPON

This coupon is available until JULY 22nd, 1965, and must accompany all Queries sent in accordance with the notice on page 475.

PRACTICAL TELEVISION, JULY, 1965

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