Practical TELEVISION

OCTOBER 1963

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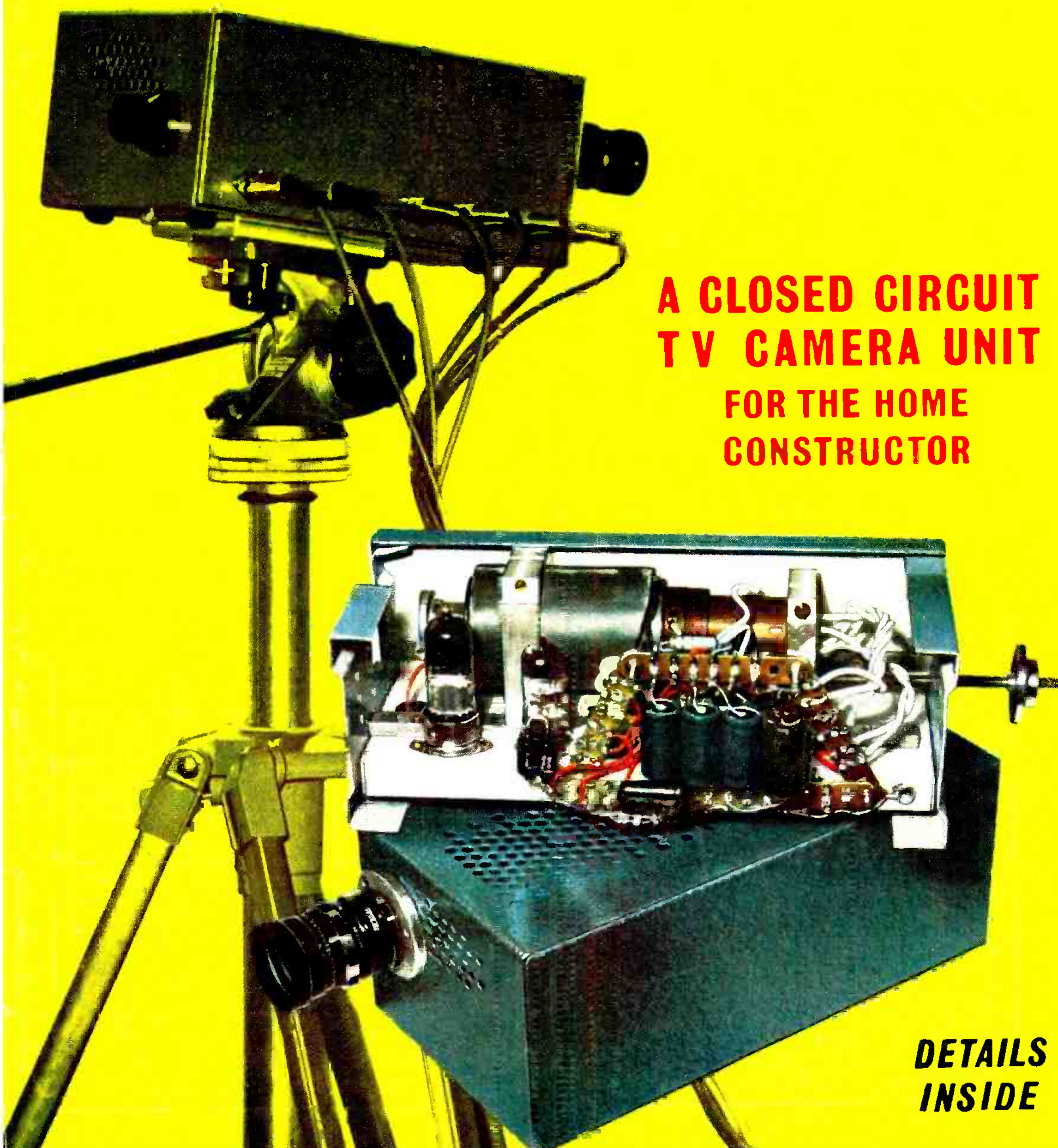

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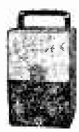

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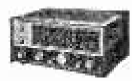

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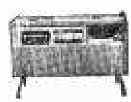

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Practical Television

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VOL. 14, No. 157, OCTOBER, 1963

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Contents

Our CCTV Camera

AS intimated in the June leader, we have for some time been observing the increasing activity among amateurs in the field of closed circuit TV work. It is now not only possible to buy relatively inexpensive assembled camera units but to obtain even more inexpensive kits of parts for building. And the now ready availability of moderately priced vidicon tubes has brought CCTV within the reach of many more enthusiasts.

The time is ripe, in fact, for *Practical Television* to venture into the CCTV field. And it gives us a good deal of pleasure to begin, in this issue, a series of articles describing the construction of our first CCTV camera and its control unit.

We make our debut with a well tried and tested piece of equipment, a design that will stand comparison with anything in a similar category. Moreover, with a little care and planning, it can be built for a comparatively modest outlay.

The CCTV camera unit to be described in this and the next few issues is not, perhaps, the simplest that could be devised, but it should not prove too difficult for the constructor with a reasonable amount of practical experience. And it will produce results to satisfy all but the extremely critical.

Even though the design is not prejudiced by economies, the question of cost has been one of the factors we have constantly borne in mind. Apart from the unavoidable special components, standard parts are used throughout. And the prospective builder will find some very helpful notes in the first article on how economies can be made when it comes to the gathering together of the parts required to construct the equipment.

Our CCTV camera is simple to use and easy to rig up. It involves no modifications to the ordinary home TV set which can be used to display the pictures. The camera unit simply plugs into the aerial socket of the receiver.

In view of the TV broadcasting situation as it is to develop in the immediate future, it was considered desirable to design the camera basically for 625-line operation. When the new u.h.f. service begins next April, many homes will already be equipped to receive 625-line signals and more will follow in due course. And it was thought logical that we should take advantage of the improved definition possible with a 625-line signal.

However, those that do not have dual-standard receivers need not despair for we will be giving parallel information where applicable for those who wish to build their camera to operate in conjunction with a 405-line receiver.

We are very enthusiastic about the possibilities of CCTV for the amateur and hope that even readers who do not build our camera unit will be stimulated to thinking about trying their hand in the future. For if the response is sufficiently encouraging we will go ahead with plans to bring you more practical articles on home constructed CCTV equipment and its use.

Our next issue dated November, will be published on October 22nd.

TELETOPICS

Electronic Standards Converter Demonstrated

THE Engineering Designs Department of the BBC, recently demonstrated a standards converter based purely on electronic principles. Previously, standards converters used to change European and North American television pictures to 405-line standards for retransmission, relied on the image transfer principle. This involved a television camera working on 405 lines, viewing the 625- or 525-line picture on a high-quality receiver.

Although this system of conversion has been developed considerably since its inception, the results obtained are always susceptible to variation at any slight alteration of contrast, focus, etc. A design that would obviate the need for an optical stage in the process of conversion was obviously necessary, and the BBC's demonstration introduced such equipment.

Between 2,000 and 3.000 transistors are employed in the equipment to carry out the high-speed switching on which this new design is based. The processes involved are in many ways similar to those used in modern computers, and the time lag between incoming and outgoing signals is only slightly more than 60μsec.

Although in principle it will be possible to convert any two-line standards using the equipment demonstrated, the technique cannot yet be applied to changes in field rate such as exists between American and European transmissions.

Large-screen Colour Television

CINEMA audiences all over the U.S.A. will soon be able to see colour television on full-size screens for the first time ever. A new development by the General Electric Corporation has made this possible, where before only black and white TV pictures of sufficient brightness, could be made suitable for the 25ft x 33ft cinema screens.

This new development—a large-screen colour television projector—is unique not only in its ability to produce colour images of suitable brightness and quality, but also in its use of only two light beams instead of the usual three. The new projector is named "Talaria" and with a simplified optical system, it requires only light beams of green and magenta to simulate a full three-colour picture.

"Talaria" equipment will be installed in a chain of theatres throughout the U.S.A., bringing shows, sport events, news items, etc. "live" to cinemas hundreds of miles away.

The projector itself is, in many respects, similar to a standard movie projector, except that the motion picture film is replaced by a transparent thin layer of viscous control fluid. An electron gun, operating as it does in a TV picture tube, scans the surface of the control layer. Instead of producing a picture directly on the layer however, as it does on the phosphor face of a TV picture tube, the electron beam causes the fluid layer to control the light so that the picture is projected on to the screen.

MOTORISED ZOOM LENS

MOTORISED zoom lenses, which can be fitted to closed circuit TV cameras and which are made by Voigtlander, are now available in this country from EMI Electronics Ltd., who have recently been appointed official U.K. agent. At the moment only one type is in stock but the range is to be extended.

This zoom lens simplifies remote control as a single nine-core cable can connect lens and control box over distances of up to 160ft.

CCTV For School Opening

RECENTLY when H.R.H. the Queen Mother opened the new Royal Caledonian School, more than 100 of the guests were unable to be accommodated in the main hall where the ceremony was to take place. However, in a large marquee that had been erected outside the building, these guests were able to see and hear the whole of the proceedings on three television monitors.

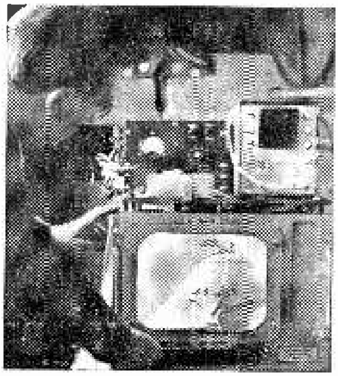
Inside the main hall, a closed circuit television camera mounted in the gallery, relayed pictures to the monitors in the marquee. The television equipment was installed by Automatic Information and Data Services Limited.

The school, which is sponsored by the various Scottish Clans, is for orphans and the children of broken homes and has been built at Bushey, Hertfordshire.

AIRBORNE TV AIDS RESEARCH

AT the College of Aeronautics, Cranfield, television is helping technologists study an experimental swept wing in actual flight. The wing, or aerofoil, is mounted vertically above the fuselage of a Lancaster bomber and is fitted with numerous devices to relay details of the airflow over the surface of the wing, to recording and measuring equipment inside the aircraft. This research work is contributing greatly towards the design of an aircraft wing surface which will provide a smooth airflow—known as laminar flow — as opposed to the turbulent flow of most present aircraft wings. Such a wing surface would result in considerable reduction in aircraft drag, leading to substantial gains in payload and fuel economy.

It was to enable observers inside the aircraft to watch the experimental wing during flight, that an EMI television camera was installed on the tip of the aircraft wing, facing inwards towards the centre of the fuselage, where the aerofoil is mounted. The leads and attachments on the aerofoil could cause considerable damage if they were to break away from the surface; but with the constant surveillance made possible by the TV camera, any such eventuality could be dealt with by the crew. To enable visual checks of the traversing gear mounted on the aerofoil, and of stages of a special chemical technique on the airflow, are also the objects of installing the airborne TV system.



An observer inside a Lancaster bomber, adjusts a monitor receiver which displays pictures of an aerofoil under test.

Observations are made on a receiver inside the fuselage and both the camera and receiver operate on 230V a.c. from a rotary converter which draws power from the aircraft's 24V d.c. supply.

900 Lectures Televised

WHEN the 19th International Congress of Pure and Applied Chemistry was held at University College, London, recently, a division of the Rank Organisation was called upon to install an exclusive closed circuit television system to link lecture halls and audiences in many parts of the building.

Over a mile of cables linked cameras, monitors and sound reproduction equipment in a number of separate camera channels.

Co-ordination between live shots and views of static material was necessary to provide a comprehensive presentation, and by the end of the Congress some 900 lectures had been televised.

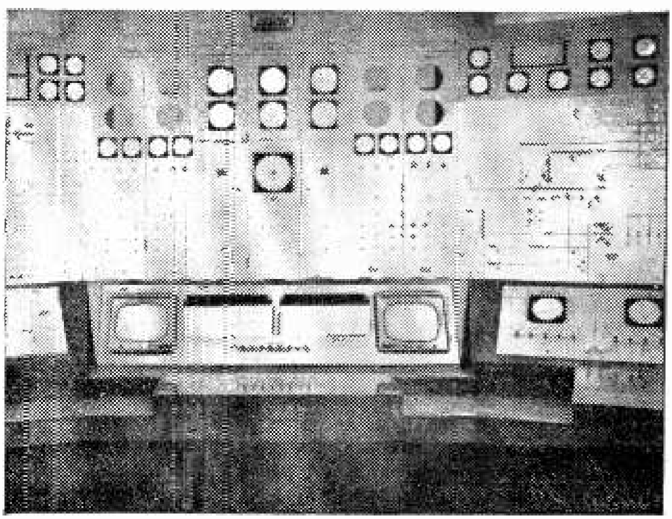
HUNGARY ORDERS A NEW O.B. UNIT

MAGYAR TELEVIZIO, the Hungarian broadcasting authority, has ordered a third outside broadcast unit from EMI Electronics Ltd.

The vehicle, which will be used for televising outdoor events from all over Hungary, will be equipped with four EMI 4½in. image orthicon cameras and a zoom lens. Like earlier units, the new vehicle will be mounted on a 7-ton Bedford chassis with a 168in. wheelbase.

CCTV FOR ROAD TUNNEL TRAFFIC CONTROL

TRAFFIC conditions in, and on the approaches to the Dartford-Purfleet road tunnel will be under constant observation over closed circuit television from when the first vehicles enter this new link between the Essex and Kent road ways. The new tunnel, which runs under the Thames, will be tended by an administration block on the Dartford side of the river, where attendants in a control room will regulate such functions as ventilation of the tunnel, and will watch on monitor screens, the traffic flowing through. Five TV cameras inside the tunnel and two covering the approach roads, will immediately show any hold-ups or emergencies which develop.



This illustration shows the control room of the new Dartford-Purfleet road tunnel with the two TV monitors mounted on the instrument panel.

TOWARDS 625

A Guide to TV Conversion

THE FINAL PART OF A SERIES DESCRIBING THE CONVERSION OF VINTAGE 405-LINE SETS TO RECEIVE 625-LINE PROGRAMMES

CONTINUED FROM PAGE 561 OF THE SEPTEMBER ISSUE

by D. ELLIOTT

SO far in this short series of articles we have seen how a 405-line receiver can be modified and rebuilt in certain sections to respond to the new 625-line signals. Past articles have dealt with (i) conversion of the vision i.f. stages, (ii) conversion of the vision detector and video amplifier stages, (iii) conversion of the line timebase, (iv) modifications in the sync separator stage, (v) conversion of the sound i.f. channel and (vi) conversion of the sound detector stage.

Two major considerations thus remain. These are (a) how to align the rebuilt and converted stages for optimum response of the 625-line signals and (b) the u.h.f. front-end requirements. This final article gives full information on (a) and useful notes on (b).

If it is assumed that a commercial u.h.f. tuner is to be employed (which is undoubtedly the best idea as it is outside the scope of the average enthusiast to build his own unit of this nature) we will want to know how to connect it to the set and, in any case, it is desirable to have a tuner connected before undertaking the alignment.

A typical u.h.f. tuner designed by Mullard Limited is shown in Fig. 14. This model features an 0·3A heater chain for connecting into the series valve heater circuit of the set in place of the original v.h.f. tuner. If a v.h.f. tuner was not used with the set chosen for the experiments, then the heaters of the tuner valves should be introduced into the heater chain directly before V3 (see Fig. 4 in Part 1), ensuring that heater chain continuity and balance is maintained, as considered in Part 2.

The Mullard circuit has two h.t. inputs. The 160V input can be fed via a 1kΩ resistor and the 175V input from a 500Ω resistor, both from the h.t. line of the set. The tuner side of each resistor should be decoupled by a 0·001μF capacitor. Most u.h.f. tuners feature two h.t. input points.

In common with v.h.f. tuners, u.h.f. tuners have an i.f. Test Point into which may be injected a signal for the alignment of the i.f. stages.

I.F. CHANNEL ALIGNMENT

For the alignment of the converted i.f. channel (see Fig. 4 in Part 1) the generator signal should be applied, via an 0·005μF isolating capacitor, to the tuner Test Point (see Fig. 14). The braid of the generator signal lead should be connected to receiver chassis. As a safety measure, it is desirable to isolate the receiver wholly from the mains supply by connecting a 100W 1 : 1 ratio isolating transformer between the mains and the set; but if such a transformer is not available, care must be taken to ensure that on a.c./d.c. receivers the mains supply is connected so that the chassis is on the "neutral" circuit.

The signal generator should tune between 37 and 42Mc/s, but the signal need not be modulated. The output is indicated on a valve voltmeter or high resistance voltmeter connected across the load of the vision detector, positive to chassis (see Fig. 6 in Part 2). Increase in output will be signified by an increase in the negative d.c. voltage across the load.

When aligning transformers T1, T2 and T3 a 330Ω non-inductive (carbon) resistor must be connected across the primary when the secondary is tuned and across the secondary when the primary is tuned.

Tune generator to 37·3Mc/s and tune T3 secondary for maximum output. Change to 37Mc/s and tune T3 primary for maximum output. Change to 37·3Mc/s and tune T2 secondary for maximum output. Change to 37Mc/s and tune T2 primary for maximum output.

Tune generator to 37·3Mc/s and tune T1 secsecondary for maximum output. Change to 37Mc/s and tune T1 primary for maximum output.

Detune the i.f. transformer or coil in the tuner, inject a 37Mc/s signal and tune L5 for maximum output. Change to 37·5Mc/s, damp L5 with a 330Ω resistor and tune the i.f. transformer or the coil in the tuner for maximum output. Remove the damping resistor.

REJECTORS

Inject 41·5Mc/s and tune L2 for *minimum* output. Change to 31·5Mc/s and tune L4 for *minimum* output. Change to 33·5Mc/s and tune L3 for *minimum* output. Repeat all operations until further improvement is impossible.

The coils and transformers should reach their maximum or minimum peak with the cores just arriving towards the centre of the winding. If a coil rises to a peak with the core almost out or leaving the winding, there are too many turns and one or more (or less than one) should be removed as required to achieve the tuning peak as indicated above.

Conversely, if a coil goes towards maximum peak with the core in the centre of the length of the winding, then there are insufficient turns and one or so should be added until the correct tuning balance is secured. It is important not to alter the spacing between the two windings on the transformers.

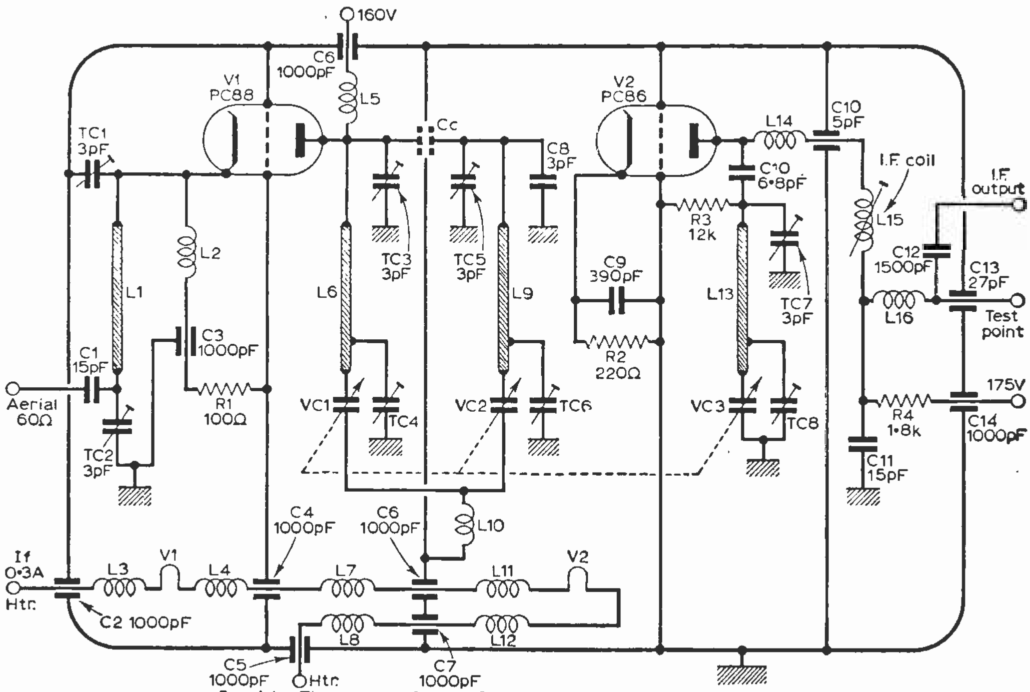


Fig. 14—The circuit of a u.h.f. tuner, designed by Mullard Limited.

INTERCARRIER SOUND CHANNEL ALIGNMENT

Disconnect the screened link from T4 to T5 (see Fig. 10 in Part 3), detune the secondary of T6, connect high resistance voltmeter across the 25μF electrolytic capacitor in the ratio detector circuit, observing polarity, connect signal generator across the primary (link) winding of T5, tune to 6Mc/s and adjust T5 secondary and T6 primary for maximum reading on the voltmeter.

Connect two 10kΩ resistors in series and temporarily connect the series combination across the 25μF ratio detector electrolytic. Connect a valve voltmeter or sensitive voltmeter between the junction of the two 10kΩ resistors and the bottom of the 100Ω resistor connected to the tap of T6 secondary winding. Adjust the "zero set" screw on the meter to displace the pointer away from the zero mark on the scale so a positive and negative reading can be indicated, inject 6Mc/s and adjust the secondary of T6 for zero voltage on the meter. Note that the pointer will deflect positive or negative depending upon the extent and direction by which T6 secondary is detuned. At this stage it may be necessary to adjust the secondary winding of T6 a little up or down the primary winding to secure the best discriminator balance and bandwidth (e.g. coupling co-efficient). Once the best position has been established, the card former of the secondary winding should be fixed with a low-loss cement. After these adjustments remove the two temporary 10kΩ resistors and the voltmeter.

ADJUSTMENT OF T4

It will be recalled that T4 performs the dual function of sound i.f. rejector, to prevent a 6Mc/s pattern on the picture, and sound take-off coupling (see Fig. 7 in Part 2). Adjustment of T4 is best adjusted on an actual 625-line transmission for maximum sound output consistent with minimum patterning on the picture. Inherent unbalance in the ratio detector will produce vision buzz on sound. Correction is possible by turning up the volume control to maximum during a period of sound silence and then adjusting the "balance control" of the ratio detector for minimum buzz (see Fig. 10 of Part 3).

Remember that an efficient Band IV aerial system, fed to the u.h.f. tuner through super low-loss coaxial cable, will be required in most areas (see The Principles and Practice of Television, *Practical Television* April, 1963). Tests are being made (at the time of writing) on Channels 34 and 44 in both monochrome and colour.

After alignment as detailed in the foregoing a fairly good 625-line picture should be obtainable on the majority of converted sets. If at this time, it is found that the line is not locking adequately and that the line hold control is at the end of its range, then the preset R1 (see Fig. 11 in Part 3) can be adjusted for the best lock with the main control at range centre.

U.H.F. TUNERS

Of past months most commercially made u.h.f. tuners were directed into new dual standard sets and few were available to the enthusiast. However, it is expected that this state of affairs will soon alter. The tuner selected should, of course, give a 39·5Mc/s vision i.f. on the British 625-line system. In practice, it will be found that the u.h.f. tuner i.f. coil or transformer will require adjustment on an actual transmission for the best picture quality and sound balance. ■

building SET TOP AERIALS

By K. Royal

MOST parts of Great Britain are now within range of both BBC and ITA television transmitters and in many areas the complicated outdoor aerial can be dispensed with and its place taken by a relatively simple set-top aerial. One has become used to having chimney-mounted arrays—often relics of past days of fringe area reception—and it comes as a surprise to find that good reception is possible with a well-made, though simple aerial designed for standing either on top of the set or on a shelf or ledge a little distance away from the set.

Redundant Ironmongery

Soon we shall be faced with the problems of picking up the "third" television programme to be composed of 625 lines and transmitted in the ultra high-frequency bands (Bands IV and V). Some of the problems will be associated with aerials and in many areas to start with quite complicated outside arrays will be required, as in the early days of Band I and Band III television.

Now is the time, then, to rid the roof and chimney stack of redundant ironmongery to make room for the new aerials of the future. Let us see whether it is possible to bring the BBC and ITA aerials indoors!

Plastic Case

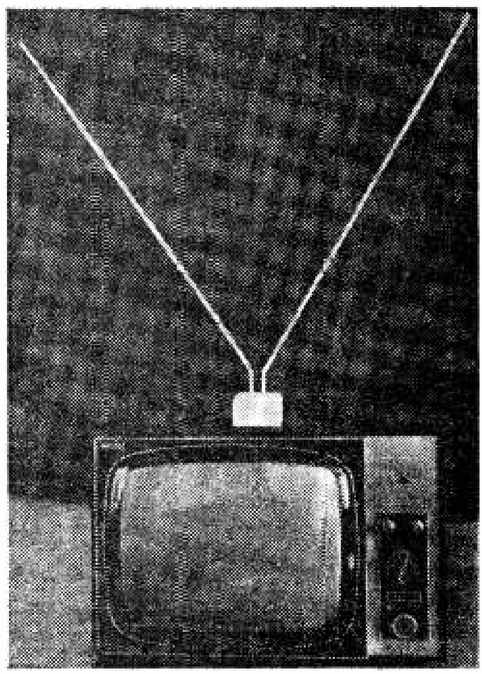
This article describes designs for set-top aerials and if the details of construction are carefully followed good reception is possible at distances as high as 30 miles from a main station. The aerials are built upon an electrical switch box and top plate marketed by M-K Electric Limited (available from any electrical dealer). This accessory is made in plastic—ivory and brown—and the ivory version was chosen for the prototypes. The box proper has a List No. 2031, and the matching top plate 3830, the latter being supplied complete with 4B.A. plated fixing screws.

Elements

The aerial elements are made of aluminium-silicon welding rod of ⅛in. diameter, designated 5-S1-A. This welding rod is available from almost any garage. There are two versions of aerial, one of "rabbit ears" design, so called because of its "V" shape—rather like the ears of a rabbit, and the other of circular loop design. Both aerials are directional, but the rabbit ears type has slightly more gain than the loop type, though the latter is a little more directional than the former which gives it some advantage in discriminating against interference.

Rabbits Ears Construction

The construction of the rabbit ears aerial is illustrated in Fig. 1, while Fig. 2 shows where to drill the two holes in the top plate of the switch box to take the elements. This type of aerial needs to have each of its elements movable so that the position for maximum signal pickup can easily be obtained in conjunction with orientating the complete aerial on top of the set.



One of the author's prototype aerials.

It will be seen from Fig. 1 that the "V" shape is given by bending each rod at a point 1½in. above the surface of the lid of the box, and the angle at the base of the "V" should be arranged to measure 55° by bending each rod equally. Each rod is designed to rotate so that the "V"-angle can be adjusted (reduced) and the relative positions of the rods altered for the best results.

Spring-loaded Elements

This facility is provided by spring-loading, as shown in greater detail in Fig. 3 The bottom of each element is threaded to 4B.A. over a length of about 1in. A 4B.A. nut is screwed on right up to the end of the thread and the element inserted in the hole. A coiled spring is then clamped between two washers and tensioned by a second 4B.A. nut. A third nut is used to lock the second and to secure a 4B.A. solder tag, as the diagram shows.

A ½in. heavy-wood block is cut and pushed into the bottom of the plastic box, and can be secured by plastic cement if necessary. This serves both to weight the box to prevent the aerial from toppling over and to give a base upon which a simple tag board may be screwed. Two free tags of the four-tag strip are used to terminate the elements and two lengths of flexible wire are connected between the two pairs of tags. The two outside tags of the strip are connected to their adjacent tags through 1,000pF isolating capacitors (250V a.c. test). The outside tags are then soldered to the inner and outer conductors of the coaxial lead-out cable. Capacitor isolation is required to avoid the user getting an electric shock on touching the metal elements in the event of the isolating components in the set itself failing. Though this possibility is remote it is as well to be on the safe side for the sake of a few pence.

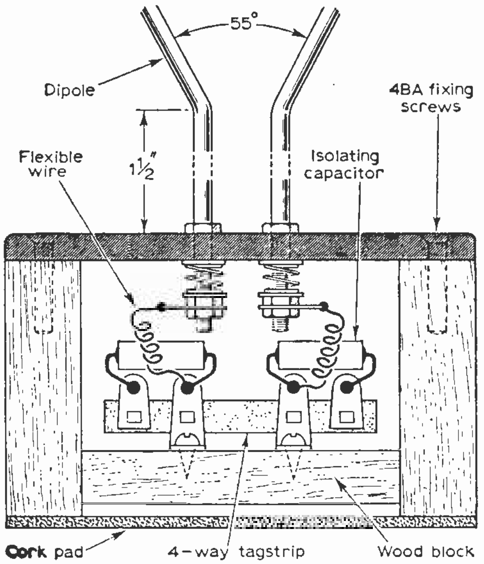


Fig. 1—The basic construction of the "rabbit ears" aerial.

The coaxial cable should be just about long enough to connect to the aerial socket of the receiver without pulling. If the cable is too long and is hanging at the rear of the set, poor picture definition and ghosting effects could be troublesome due to the cable itself as well as the elements picking up signal.

The flexible wire soldered to the aerial tags should be of sufficient length to allow the elements to be rotated without impediment, but no longer. The outer braid pulled from a piece of coaxial cable and then stretched and twisted makes an ideal flexible connection.

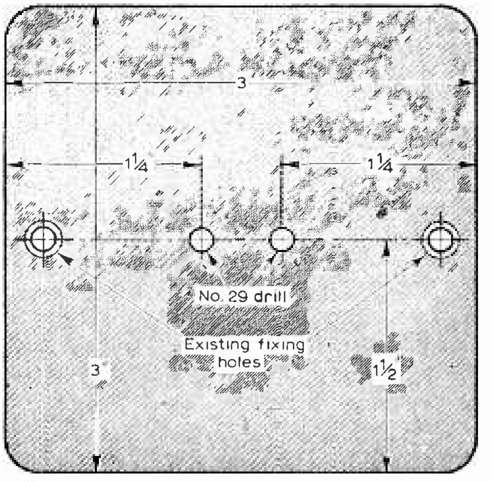


Fig. 2—Details of the top plate of the aerial base.

Loop Aerial

Fig. 4 shows the basic construction of the circular loop aerial. The base is of the same type of plastic box and top plate as recommended for the rabbit ears aerial. This time, however, both ends of each element are threaded to 4B.A. over a length of about ½in. After threading, each end should be bent in accordance with the dimensions given in the drawing and at this time each element should be shaped so that together they form an almost complete circle. This is best accomplished by using a cylinder of some kind as a jig. A large paint tin or basin is often suitable for this operation, the size, of course, depending upon the channel (see later).

Again, the elements should be connected to the coaxial lead-out cable via 1,000pF isolating capacitors, but there is no need this time to spring-load the elements. A wood block can be fitted into the base of the plastic box, as in the previous example, and upon this can be secured a tag strip to retain the capacitors.

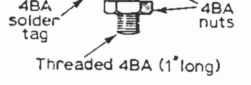


Fig. 3—Details of the spring-loading device for the elements.

To prevent the box scratching the top of the set or any other polished surface upon which it may stand, a thin piece of cork should be cut to the shape of the box and cemented on to the bottom with a plastic adhesive. The cork should be about ⅛in. thick and if any difficulty is experienced in obtaining a small piece for this purpose a cork table-mat can be purchased from a popular store for a few pence. Alternatively, a piece of felt can be glued to the bottom, but cork is best as it tends to hold to a polished surface better than felt.

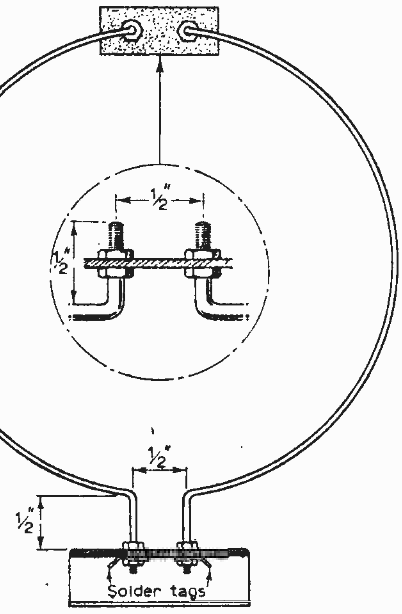


Fig. 4—A "circular" aerial.

The finished aerials look quite professional and can be made even prettier by buffing the elements or polishing with a metal polish.

Element Size

Table 1 gives the lengths of each element for the five channels in Band I, the eight channels in Band III and for Bands IV and V (e.g., the u.h.f. channels). Table 2 gives compromise lengths to suit Band I and Band III channels in any specific reception area. Note that the lengths are from tip-to-tip of *each* element.

TABLE 1

Channel	*Length Each Element Inches*
1	64
2	56
3	51
4	46
5	43
6	16
7	15·5
8	15
9	14·5
10	14
11	13·5
12	13
13	12·5
BAND II	31
BAND IV	6
BAND V	4·5

Element lengths for optimum results on any one channel. Note that for horizontally polarised signals the elements will need to be horizontally disposed.

Adjustments

Once the size of the elements has been established, the aerial should be connected to the set through the shortest possible length of coaxial cable, making sure that the soldered connections within the box and those at the set coaxial plug are adequately performed. With the rabbit ears aerial, the elements should be adjusted symmetrically as shown in Fig. 1 and then the whole aerial should be turned through 360° to find the best orientation. After this each element should be adjusted in turn for the best possible results—it may then be necessary to finalise the orientation.

TABLE 2

Main Co-channels	*Length Each Element Inches*
1/9	58
2/9	58
2/10	57
3/11	55
4/8	60
5/10	57

Element lengths for co-channel working.

If results are poor with the aerial on top of the set it should be tried on a nearby shelf or ledge, for it is surprising how the signal conditions can vary from one part of the room to another, especially on Band III and Bands IV and V. As modern sets usually feature an efficient vision automatic gain control system, the aerial should not particularly be adjusted for the best contrast (black and white) ratio, but for the least display of " snow " or grain behind the picture. The idea being to establish the best possible signal-noise ratio.

With the loop aerial it is just the matter of turning the whole loop on top of the set for the best results. If local interference or ghosting is bad, then this aerial may well give better pictures than the rabbit ears version.

B-K Oscillation

It sometimes happens that Barkhausen oscillation shows up on the pictures when a set-top aerial is employed (even though the pictures may be otherwise good) and yet is absent when the signal is from an outside aerial. The reason for this is that nearly all sets produce B-K oscillation to some extent and when the aerial is on the roof it is too far away from the set to receive the interference, and even if a little interference is picked up then the signal from the roof aerial is much stronger so that the interference is completely outweighed.

B-K oscillation looks like a ragged, vertical line (or two lines) down one side of the picture, but this can often be cleared by replacing the line output valve in the set, by adjusting an ion trap magnet on the envelope of the line output valve or by moving the aerial from the top of the set to a nearby table or shelf. ■

CIRCUIT PRACTICE AND DESIGN PRINCIPLES FOR

OSCILLOSCOPE TIMEBASES

CONTINUED FROM PAGE 551 OF THE SEPTEMBER ISSUE.

BY
M. L. MICHAELIS

FOLLOWING on the discussion of last month, Fig. 10 shows some other methods of arriving at square waves and square pulses, which require a different drive-signal in turn, in the simplest case a sine wave from a conventional oscillator. Fig. 10(a) shows two biased diodes of opposite polarity which short-circuit the output whenever the input voltage goes beyond the bias-limits in either polarity. If the bias-limits are small in comparison with the total amplitude of a sine wave input the curved upper parts of the sine wave are clipped off, leaving quite a good square wave. There is necessarily a considerable loss of amplitude which must, if necessary, be made good by a subsequent amplifier.

Fig. 10(b) performs an identical function but avoids the need for bias supplies by using a pair of Zener diodes back-to-back. A Zener diode behaves as a normal diode when anode is positive to cathode but is cut off in the reverse direction only as long as the inverse voltage does not exceed the characteristic " Zener " voltage.

Fig. 10(c) is a more efficient circuit for " squaring a sine wave ". It is simply an amplifier which can withstand enormous overdrive without damage. The grid stopper of unusually high value prevents grid current rectification blockage on the powerful drive signal whose amplitude is many times as great as the grid-base of the valve. The small portion of an input sine wave around the zero voltage points thus swings the pentode alternatively between cut-off and bottoming, giving a very good square wave output of high amplitude across the anode load. This arrangement can be driven from the output of the signal amplifier of the oscilloscope (Y-amplifier), where the necessary high ampli-

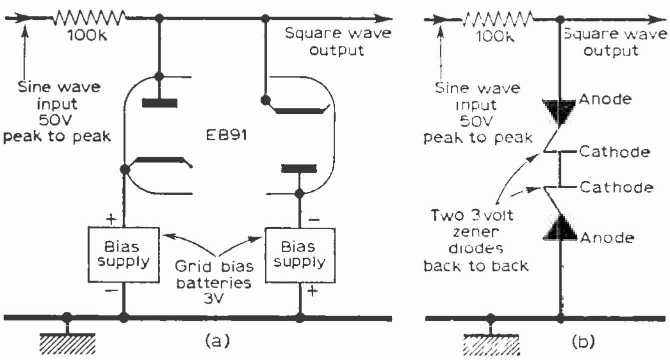
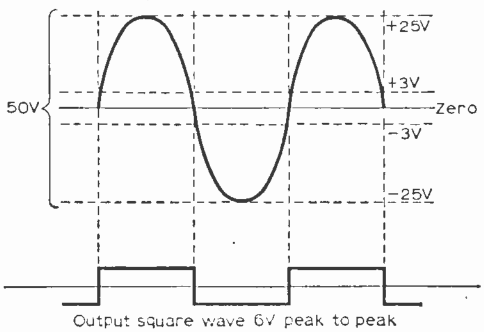
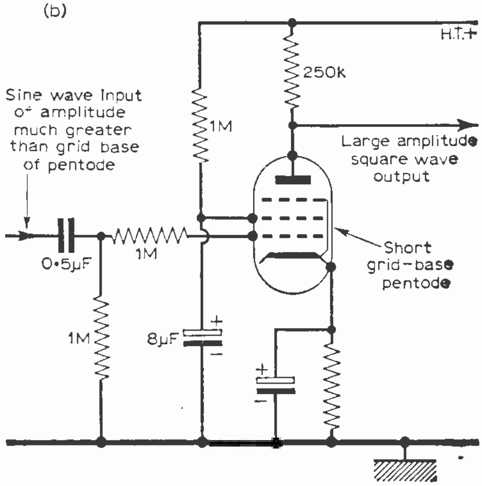


Fig. 10—Methods of producing square waves from arbitrary input signals: a—biased diode clipper pair; b—modern version of a, using backed zener diodes; c (below)—producing square waves by heavy clipping of a sine wave; d (right)—an improved "squarer" using a pentode.





tude is present for the c.r.t. deflection-plates anyway. The output of Fig. 10(c) would then be a sequence of square pulses corresponding to the signal frequency. The circuits of Figs. 10(a) and 10(b) could also have been used at lower efficiency.

D.C. Restorers or "Clamps"

Having obtained a square wave of the desired frequency and symmetry, either from a multivibrator or from one of the circuits of Fig. 10 from a different input waveform, and wishing to use it as relaxation-drive for a Miller-Timebase, it is necessary to clamp it to a definite d.c. reference-voltage so that positive and negative peaks represent some definite voltage. For example, in Fig. 7(a) the requirement was that the negative peaks of the square wave represent chassis-potential, and the wave goes entirely positive from this. Fulfilment of this function is called "negative-peak clamping to chassis-potential" or "positive d.c. restoration", because the mean level is thereby made positive.

Fig. 11 shows the extremely simple arrangements sufficing for the performance of these clamping functions in practice. The waveform whose shape and amplitude is as desired but which is now to be d.c. clamped is coupled through to its point of requirement by means of a conventional coupling capacitor and leak resistor. The leak resistor is not returned to chassis unless we desire to clamp to chassis potential. It is, in general, returned to whatever d.c. level we desire to clamp on to, whether positive or negative. A suitable supply or bleeder must be available from the power pack or a battery of the required voltage may be used or any other source of the desired d.c. voltage.

The only further measure is to shunt a small diode across the leak resistor. If we wish to clamp the positive peaks of the signal waveform to the reference voltage then the cathode of the diode must be at the reference voltage end of the leak resistor; for clamping the negative peaks of the waveform to the reference voltage the anode of the diode must go to the reference.

The action is very simple. The value of the coupling capacitor is chosen such that its time constant with the forward resistance of the diode is very short compared to one cycle of the waveform to be handled. But the leak R is so large that the time constant with the coupling capacitor is very large compared to a signal cycle.

Under these circumstances the arrangement behaves as a peak rectifier in the usual fashion, with R as load resistor across which the d.c. rectified signal voltage is developed. Now, there being no smoothing, the d.c. across R is pulsating with the full signal waveform, i.e. the signal is shifted to excursions of entirely one polarity in relation to the bottom end of R, which is taken to the desired reference voltage.

Another way of looking at it is that, on account of the short forward time constant, the coupling capacitor charges up to the signal peak through the diode, with polarity dictated by the diode, very rapidly. Whenever the signal differs from the peak voltage C tries to discharge the relevant amount but cannot do so because the diode is cut off except at the peaks of correct polarity and R is too high. Thus the signal voltage appears across R entirely of one polarity.

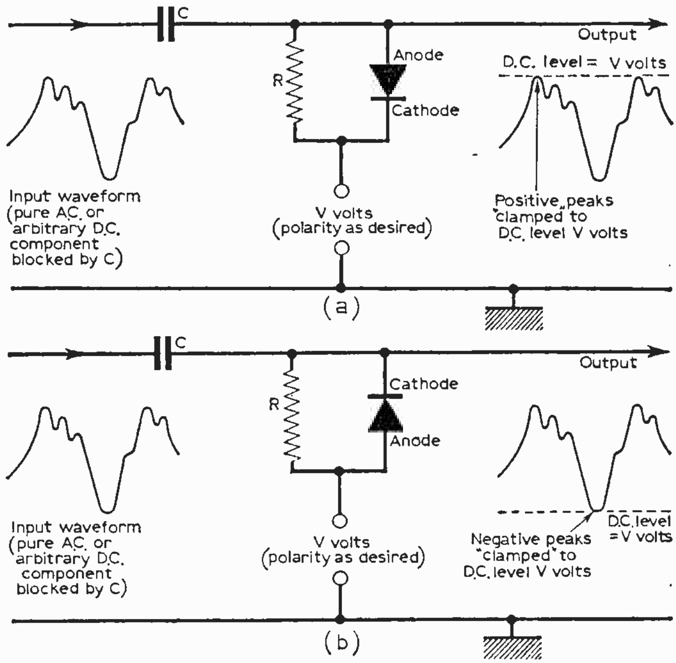


Fig. 11—Clamps or d.c. restorers: a—positive peak clamp or negative d.c. restorer; b—negative peak clamp or positive d.c. restorer.

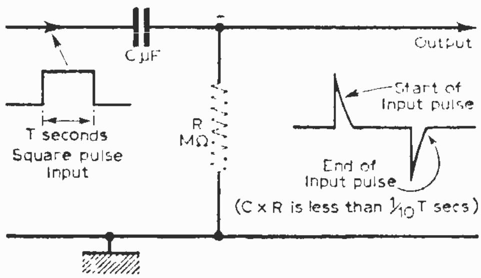
Sync and Trigger "Spike" Production

If we do not wish to use the square wave as direct relaxation drive for a timebase (because, as we shall see below, some Miller-Arrangements provide their own relaxation drive square wave) but rather wish to produce trigger or sync "spikes", then the simple circuits of Fig. 12 may be used for this purpose.

If we feed the square wave through a conventional resistance capacity coupling whose time constant CR is very short compared to the duration of the square wave pulse, then C charges up to the impressed voltage long before it terminates at the end of the pulse, so that output across R is present only for a brief time. The initial output is the full square-pulse amplitude, with the same polarity, but this falls exponentially to zero in a very short time. When the pulse terminates, the charged capacitor can discharge again and thus gives a brief spike of opposite polarity to the square pulse as far as the output is concerned.

Fig. 12(b) shows how the simple clippers of Fig. 10(a) may be used to select only the desired polarity of spikes and remove the others. A difficulty is here that the clipper circuit must be of much higher impedance than the differentiator (as Fig. 12(a) is called) preceding it to avoid interference with the differentiating function. Thus R1 should be at least five times as great as R. The output must then be used in turn in a circuit whose impedance is very much greater than the clipper, otherwise the latter is disturbed. If this leads to impossible restrictions on the minimum impedance of the final consumer a cathode-follower may be interposed at any stage of the chain to step-down impedance.

Fig. 12(c) shows a typical example of an oscilloscope sync generator embodying all these features. The high-amplitude signal from the Y-amplifier is taken to a pentode-squarer of the Fig. 10(c) variety, giving square pulses in rhythm



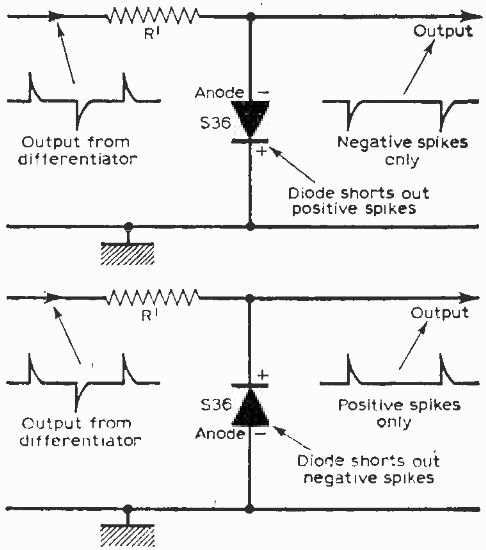
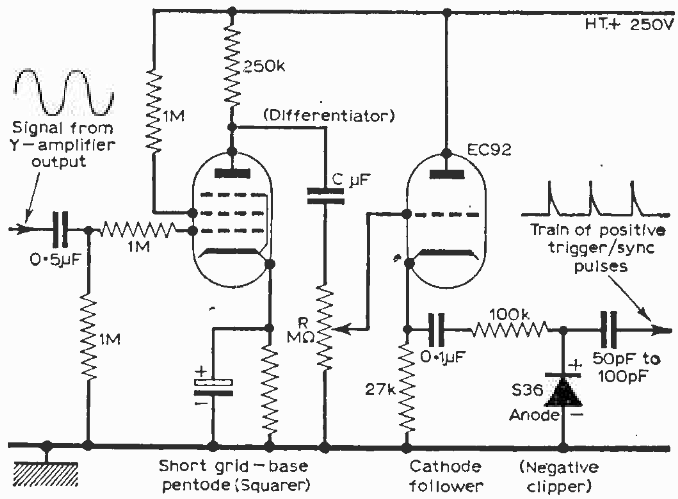


Fig. 12—Methods of producing voltage spikes for synchronising or triggering a timebase circuit: a (left)—square pulse differentiator; b (above)—diodes as polarity selectors; c (below)—complete trigger/sync generator for timebase.

with the signal frequency. These are differentiated to alternate-polarity spikes in the coupling to a cathode-follower where a sync-amplitude control is also situated. The fact that the cathode-follower is operated near cut-off (self-bias on high cathode resistor) means that positive spikes are passed preferentially a n y w a y. The remaining negative spikes are removed by the diode clipper in the output, leaving a pure train of positive spikes for synchronising the timebase in rhythm with the Y-signal to be displayed on the oscilloscope. A trigger generator operating off the Y-signal, or off any other control-waveform, would be identical in appearance; the difference is merely the application in controlling the timebase.



The Sanatron Timebase

It may justifiably be said that the Sanatron and the Miller-Transitron are the two Miller arrangements which are found in the majority of modern oscilloscopes. The Sanatron, described in this section, is useful where both synchronised and triggered operations are desired in the final oscilloscope, whereas the simpler Miller-Transitron, to be described in the next section, synchronises excellently but is not suitable for stable triggered operation.

Fig. 13(a) shows a basic multivibrator supplying the relaxation drive squarewave for a basic Miller-Integrator. The drive is here to the pentode suppressor, just to illustrate this variant frequently found. It does not really matter at what additional electrode a Miller-Timebase is driven provided that no conflicting circumstances are generated.

For drive at the suppressor the valve must rest cut off at the suppressor, a sawtooth-run being initiated by lifting the suppressor to its normal level of zero volts. The coupling from the multivibrator is thus a positive-peak clamp to chassis-potential accordingly; compare with Fig. 11(a). It is important that the suppressor does not go positive, as this could cause erratic behaviour, hence the clamp. Note that the arrangement is *not* suitable for

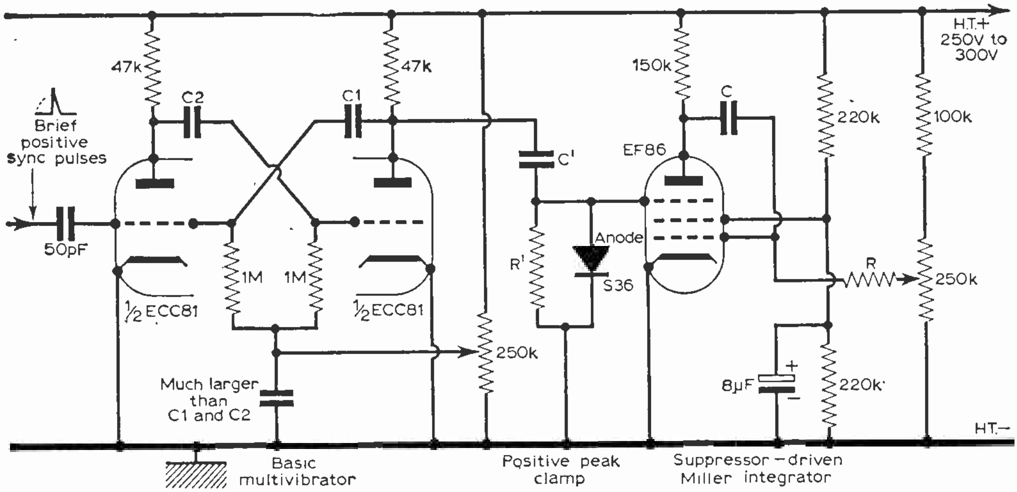


Fig. 13a—Miller integrator timebase with fully external drive from a basic multivibrator. Notes on this diagram should be co-ordinated with the relative text.

triggering, by using a univibrator instead of a multivibrator, because the *continuous* signal for proper operation of the suppressor-clamp would then be absent. But the circuit can certainly be synchronised by applying spikes in the usual way. The same synchronisation can be achieved by applying negative spikes, from a low-impedance source such as a cathode-follower, to a small cathode-resistor in the same multivibrator triode. Applying negative spikes to the grid of the other valve is much less effective unless their amplitude is considerable.

Popular Form of the Circuit

Now the circuit of Fig. 13(a) can be simplified in a very elegant way to give the Sanatron arrangement of Fig. 13(b), which is extremely popular. The Miller valve itself is used simultaneously as one half of the multivibrator, by employing cathode, suppressor and anode as a triode. The Miller capacitor is not taken from anode to grid but from a tap on the anode-load to grid. The normal Miller-step of grid-base amplitude is thus present at the tap and is consequently much greater at the anode, sufficient then to give a transition great enough to cut the other triode sharply off, giving the proper multivibrator-transition turning the Miller valve hard on for a sawtooth run. The diode prevents the suppressor going positive, which would cause undesirable secondary-emission effects otherwise. Apart from this the multivibrator action is normal; when the left-hand triode reaches cut-on again the usual switch-over takes place, cutting the Miller valve off again and causing a flyback.

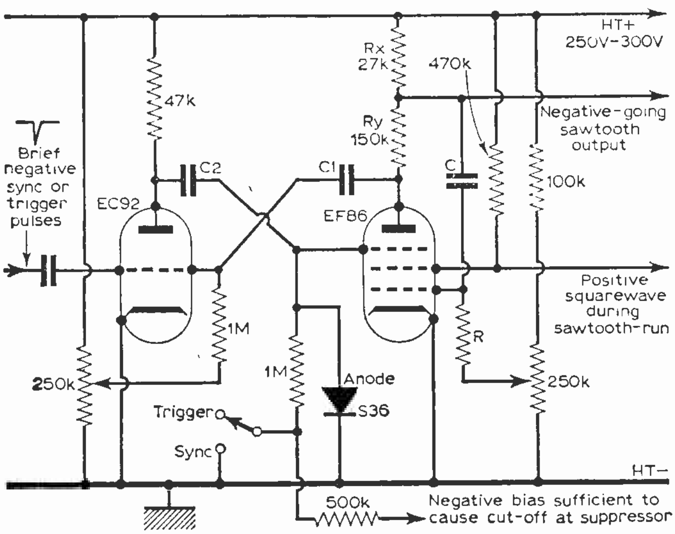


Fig. 13b—The popular Sanatron circuit.

Timebase-amplitude Control

The 250kΩ potentiometer in the left-hand triode grid circuit controls the time that triode is cut off, i.e. the time the Miller is operative, as this functions as timebase-amplitude control in the manner already described. The potentiometer in the Miller valve grid circuit fuctions as time-base-speed fine-control. A switch should select various capacitors for C as coarse speed control, and a second wafer on this switch must select various values for C1 to suit C, so that the time that the Miller valve is cut-on at the suppressor does not exceed the bottoming time. It is common practice to select about equal values for C and C1.

—continued on page 45

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

BEFORE getting down to DX reception, the beginner should first of all gain a basic knowledge of the propagation problems involved. The signal may arrive by one of several means of propagation:

Local Reception

(1) *"Local" Reception* 0—50 miles approx. As is now known this is not exclusively "line of sight" propagation, needing a clear visual path between the transmitting and receiving aerials. In fact the signal tends to follow the earth's contours to some extent so that it can be received beyond the horizon distance and even fairly successfully under the shadow of intervening high ground, although very close proximity of such obstructions is extremely troublesome.

Tropospheric Reception

(2) *Tropospheric Propagation* 50—500 miles approx. Strange as it may at first appear the greatest DX skill lies in the reception of stations at distances of 250—500 miles by this means. In fact reception at distances of 500—2,000 miles by ionospheric propagation (see below) is a much easier proposition.

Firstly let us consider what happens during tropospheric propagation of a signal. Tropospheric propagation is made possible because of *refraction* of the path of the transmitted signal. Refraction implies bending of the path of the signal because of transition from a medium of one density into another of a different density.

Certain atmospheric conditions near the earth's surface can meet these requirements.

In order to bend our required signal away from its tangential path at the horizon, and down towards our receiving aerial, the intervening atmosphere must be composed of layers of air at different densities. When we have this condition the path of the wave is progressively bent down to reach us at distances greatly beyond the horizon.

Stratification

These layers of different density can arise when changes of atmospheric temperature occur at different heights above ground level in still air. Under these conditions the air becomes "stratified" into layers in the required manner.

This stratification occurs most effectively when we have a hot, still, sunny day followed by a sharp fall in evening temperature, i.e. summer conditions, or even much later in the year (October to December) when a fairly warm day is followed by a very cold evening. These conditions are also conducive to fog, and a foggy evening is a good indication of possible tropospheric DX reception.

Tropospheric propagation is applicable to both Bands I and III and also to u.h.f. Bands IV and V. Reception conditions by this method are largely predictable if we study prevailing weather conditions.

The characteristics of tropospheric signals are long duration, and slow fading reception.

Sporadic "E" Reception

(3) *Ionospheric—Sporadic "E" Propagation* 500—2,000 miles approx. This is by far the most spectacular from the point of view of results, but it is in fact much more easily attained. Ionospheric propagation is made possible by ***reflection*** of the required signal during its path from the transmitter to our receiver.

As before, the signal tends to leave the earth's surface at a tangent, but if somewhere in the upper atmosphere at a distance between 50 miles and 150 miles there is some medium capable of reflecting the signal down again, then following optical laws the angle of incidence will equal the angle of reflection, and the signal will return to ground at a distant point from the transmitter. This "skip distance" will depend on the distance of the reflecting layer above the earth's surface, and the ground area of the reflected signal will depend on the surface area of the reflecting medium.

"Mirror In the Sky"

This "mirror in the sky" for our ionospheric reception is in fact provided by clouds of ionised gas which occasionally float at random in the upper atmosphere. The heights, surface areas, speeds of movement and efficiency as reflectors of these clouds are subject to random changes, and it is these that give rise to the sporadic aspect of reception by this method.

The characteristics of "sporadic E" reception are very strong signals at times, but prone to rapid fading and to ghosting due to reflection from more than one reflecting area.

While it may be infuriating to lose a beautiful USSR picture just at the moment the neighbours have arrived to gaze in wonderment, the chances

—continued on the next page

Improving TUNER UNIT Gain

By A. E. J. Simons

THERE are many television receivers with turret tuners using the PCC84 double triode valve as a cascode r.f. amplifier. The gain of such tuners can be increased by replacing the PCC84 with the more modern PCC89 frame-grid valve. In many areas the extra gain obtained on Band III will be well worth the small modification necessary.

Component Changes

First change the bias resistor R5 from 100Ω to 82Ω. Fit the PCC89 valve and allow the receiver to warm up before re-tuning.

Re-tuning

Switch receiver to a Band III programme and re-tune anode trimmer, C2, and aerial coil L1 for maximum vision consistent with good sound. This tuning is best carried out on the ITA test card. The circuit (Fig. 1) shows R6 and R7 as gain controls—in some receivers R5 is connected to the a.g.c. line, and R6 and R7 omitted. Also, in some receivers C2 may be a fixed capacitor and the inductance L3 is tunable by the core.

Characteristics and Operation Conditions

PCC84		PCC89	
Ia	12mA	Ia	15mA
gm	6mA/V	gm	12·3mA/V
mu	24	mu	28
Vgl	−1·5V	Vgl	1·23V
Va	200V	Va	200V

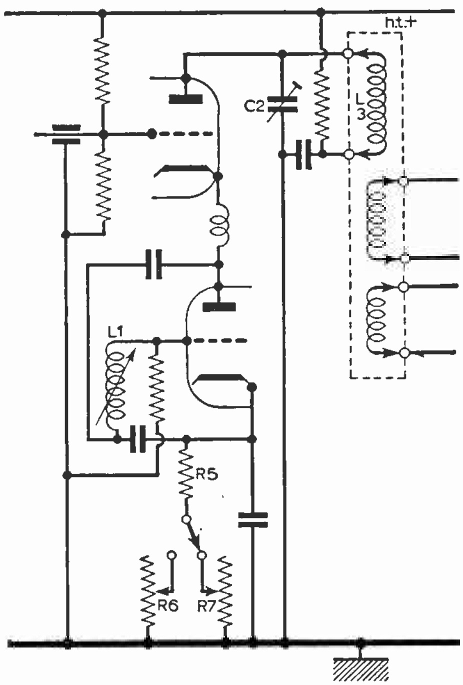


Fig. 1—The basic circuit of a cascode r.f. amplifier.

DX-TV

—continued from the previous page

are that the fade-out of the Russian will be superseded by the resolution of, say, the Hungarian signal because of change in skip distance.

With patience this phenomenon allows us to receive many stations in Europe at different times although they use the same channel at the same time.

"Sporadic E" reception is best attempted during the months of May to September, this being the most active period of the year. Reception is, however, possible on occasions throughout the year. "Sporadic E" conditions are not easily predictable but tend to arise during unsettled and changing weather.

Duration of reception of any one station can be from only a few seconds to several hours and is normally confined to Band I, although it can very occasionally arise on Band III.

The F2 Layer

There is a fourth type of reception: by reflection from the much higher F2 layer. This is only possible in periods near the maximum sunspot activity. So patience until 1967 onwards for this, when we may get transatlantic TV again. But take heart—the current sunspot minimum is not closely linked with either tropospheric or "Sporadic E" propagation.

Next month we will deal with reception techniques for each method.

To conclude here are some news shorts for established DX viewers.

(1) *Norway* is for the first time operating on Channel E3 from Lillehammer. "Norge" test card has been received here.

(2) Late news shows a change in plan for *Bulgaria*. No Band I station for Sofia after all but Band III operation in two years time.

(3) U.H.F. reception at over 200 miles! *West German* TV received in Belgium. So there is hope yet!

SERVICING TELEVISION RECEIVERS

By L. Lawry-Johns

No. 94: PHILCO 1,000

ALSO known as the "Slender Seventeener" the Philco 1,000 was the first of a series of models constructed along the same basic lines of separate panels and boards, some printed, some wired.

Servicing of the upper panel is made very simple as it can be removed from the cabinet and stood on end on the bench with the receiver still working. To release this upper assembly it is only necessary to remove the two screws at the top of the cabinet, at the same time supporting the assembling to prevent it dropping. The knobs do not have to be removed.

The lower deck (power and timebase chassis) is just as simple to remove. This is done by removing the octal plug (top chassis supply leads), releasing the screws at either side, pulling the chassis back and lifting clear.

The c.r.t. is secured to the cabinet shell. The scan coils on the neck of the tube can be freed by removing the five-pin plug from the lower deck.

Tube Mounting

The tube fixings are exposed when the front frame and window is removed. This is held by four screws, one at each side and two at the bottom. It is only necessary to remove this frame when it is desired to clean the tube face and the inside of the window (with anti-static polish).

To remove the tube completely, disconnect the e.h.t. lead from the side of the tube, remove the scan coils, base socket and ion trap magnet from the rear and then slacken the top two fixing nuts securing the tube mounting straps to the cabinet. Slacken rather more the two screws securing the tube straps. Note the position of the straps around the plastic collar and the distance of the collar from the front of the tube. Remove by lifting forward out of the tube strap.

Fit the plastic collar to the tube to be fitted, ensuring that it occupies the exact position as it did previously, then assemble tube into position in its straps, making sure that the tube is quite square

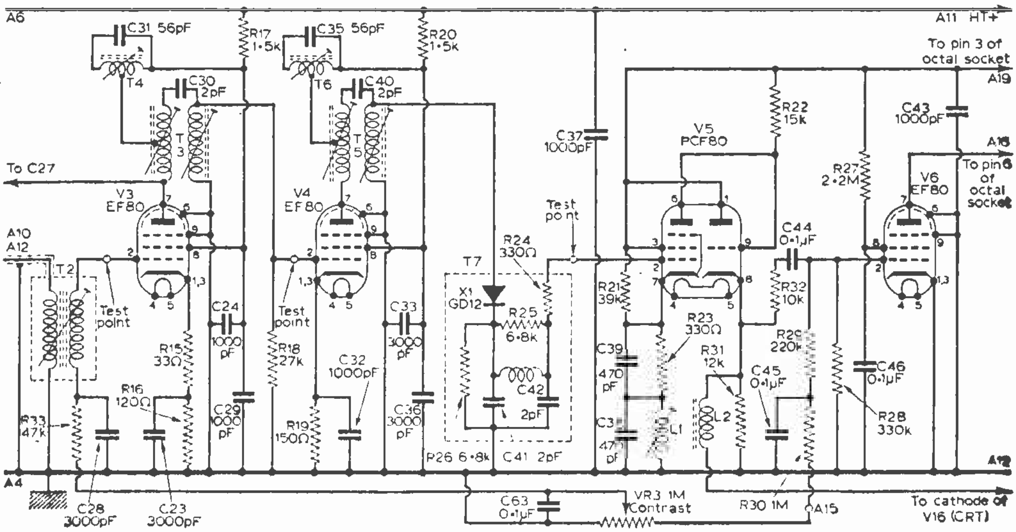


Fig. 1—The vision i.f. strip.

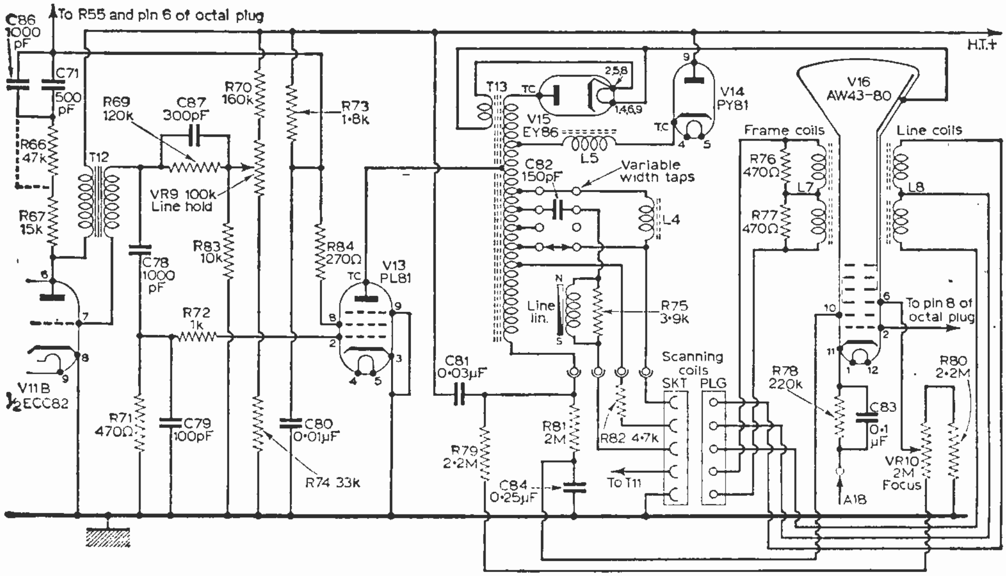


Fig. 2—The line timebase and c.r.t. circuit.

before tightening screws and nuts. The tube used is a 90° Mullard AW43-80 which is, of course, electrostatically focused.

The mains lead is of the three-core type with the green lead connecting to the earthing spring shown in Fig. 2. This spring connects to the top of cabinet and it is stressed therefore that when the top deck is fitted, the cabinet is at earth potential which is, of course, what is required when the receiver is normally used from a safety point of view.

However, when the rear cover is removed for servicing purposes, an earthed cabinet can be awkward since the chassis frame is (or should be) connected to the black lead and, apart from R50 (2.2MΩ), the chassis and the cabinet are insulated from each other. When servicing therefore, it is suggested that if a mains isolating transformer cannot be used the green lead be disconnected from the mains plug to reduce the possibility of the handler putting himself across the mains accidentally due to a wrongly wired plug or socket.

Faults to be Expected

The usual PY32 faults can be expected and these normally are that the valve becomes partially gassed, showing as a blue glow inside the envelope which may clear after some time when the getter is still able to cope.

This period becomes longer and longer however and it may be half an hour or more before operating voltage is reached and a picture appears. Occasionally the valve flashes over inside blowing the fuse, and where the fuse rating has been exceeded, the choke L3 to the on/off switch may become open-circuited and when there is no supply to the fuse holder this possibility should be checked.

TO BE CONTINUED

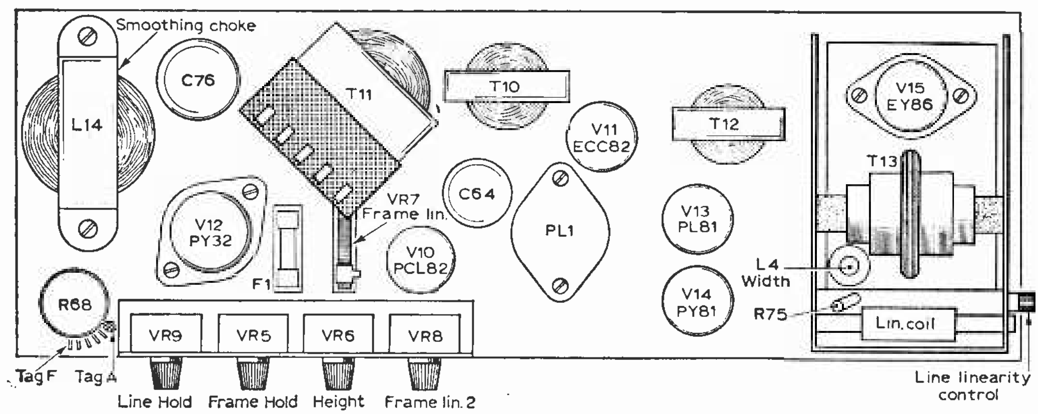


Fig. 3—An above-chassis view of the lower deck.

PRINCIPLES AND PRACTICE OF COLOUR TELEVISION

PART 4

BY G. J. KING

CONTINUED FROM PAGE 564 OF THE SEPTEMBER ISSUE

IN past articles in this series we have seen how a complete picture in full colour can be built up by the use of three separate picture tubes, producing picture separation in red, green and blue—the three television primary colours.

Each picture, of course, is composed of the colour components of the televised scene corresponding to the colour output of the tube. For instance, on the blue tube is displayed all the blue parts of the picture, while the red and green tubes display the red and green parts of the picture.

The three colour-separated pictures are then projected optically onto a common viewing screen. Now, if all the pictures fall accurately on top of each other—to give good registration—and the brightness of each colour separation is carefully adjusted—to give the correct hues—then a very good colour picture results. That is, of course, provided the colour signals are accurately derived either simultaneously or sequentially, depending upon the type of system (see last month's article).

An optically integrated three picture tube display system can thus be used with either a simultaneous or sequential system, and it makes no difference whether the transmission is via wire (closed-circuit) or a radio circuit.

Optical Problems

There are many optical problems associated with the three-tube display system, and readers who have had experience of a single-tube monochrome projection set will probably appreciate just how many problems could arise from the use of three tubes and three optical systems—in trying to get them all to focus together over the entire screen area without distortion, while at the same time maintaining accurate colour registration over the full area of scan.

For these reasons the three-tube projection colour display system is rarely used domestically, though it may sometimes be found in large screen colour systems. The colour display device is the weakest link in the colour television chain to date, and it is this which keeps the price of colour sets at a high level. There have been numerous and interesting developments in this field aimed not only at getting a single tube to respond to three primary colours but also at reducing production costs.

Single-gun Colour Tubes

Among these recent developments are the Philco "Apple" tube, the Sylvania-Thorn "Zebra" tube and the Mullard "Banana" tube. There are others with the common factor of just a single gun assembly, some of which automatically "switch" the electron beam from one colour phosphor to another as required by the signal (these are sometimes called "switching tubes") and others called "beam indexing tubes" in which the modulation is altered to suit the colour which is lit at the time. These are sometimes called "sensing tubes", since there is a sensing device which produces a pulse related to the lit colour.

Shadow Mask Colour Tube

None of the tubes above is in mass production and the single tube system which is featured in all contemporary colour television systems is the "shadow mask" tube. This uses three electron guns, as distinct from the single-gun assembly of the switching and beam indexing tubes. Even though the shadow mask tube is in mass production, the output is limited and the price is still very high compared with a monochrome tube of similar dimensions. Nevertheless, with a boost in colour television in Great Britain it is expected that the price of the shadow mask will fall considerably; that is, unless some other—possibly less inherently expensive—method is not evolved in the meantime.

Fortunately, almost any type of colour display device can be used with either the NTSC or SECAM colour system, so even if a new tube is invented there is every reason to expect that the remainder of the colour system (transmitter and receiver) will remain unchanged. This is one big factor in favour of an almost immediate launching of a British colour system.

The shadow mask tube translates the three signals corresponding to the primary colours red, blue and green into a complete and seemingly coincident picture in full colour. The basic structure is revealed in Fig. 19. From this it will be seen that the basic principles of operation closely follow those of the relatively simple monochrome tube.

However, there are two chief points of difference. Three electron gun assemblies—one for each primary colour—are used to produce a triple electron beam converging onto the screen; and the screen itself differs widely from that of a black and white tube. Further, a perforated metal plate—called the "shadow mask"—is located directly behind the screen.

Tricolour Dots

The screen is composed of a regular mosaic of extremely small phosphor dots which are grouped in adjacent triangles of three dots. Each triangle contains a dot of three different colour-emitting phosphors—blue, green and red. The electron gun which "fires" its beam onto, say, the phosphors which glow red when bombarded is called the "red gun", and likewise we have blue and green guns.

The shadow mask ensures that the electron beam from the red gun always strikes the red-glowing phosphors and that the beams from the blue and green guns always strike the blue- and green-glowing phosphors respectively. The shadow mask geometry is such that the beam from, say, the blue gun can never strike the green- and red-glowing dot phosphors, the beam from the red gun can never strike the blue- and green-glowing phosphors and the beam from the green gun can never strike the red- and blue-glowing phosphors.

In practice not all the electrons from the beams get through the appropriate apertures in the shadow mask to strike the dot phosphors, and it has been calculated that about three-quarters of the total number of electrons are absorbed by the metal

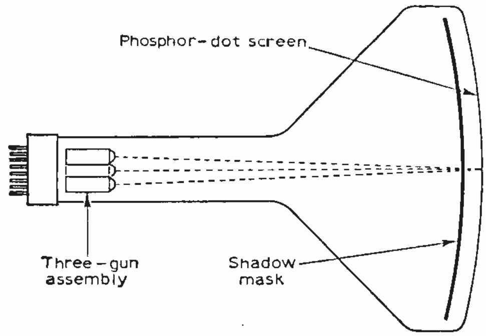
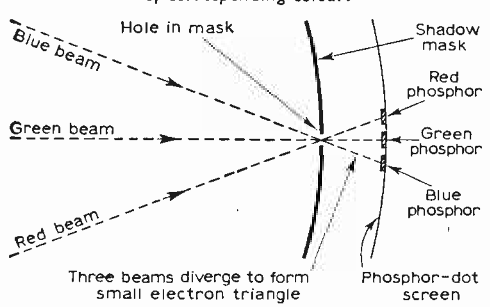


Fig. 19a (above)—Basic structure of the shadow mask colour c.r.t., showing the three-gun assembly. Each tetrode gun is similar to a monochrome counterpart with electrostatic focusing. The three focusing electrodes and final anodes are brought out to common connectors, while the cathodes, grids and first anodes are brought out to separate connectors.

Fig. 19b (right)—Adjacent triangular pattern of the dot phosphors.

Fig. 19c (below)—The metal shadow mask is positioned a little under 1in. from the screen, and the geometry is cleverly arranged so that the three beams pass through a single hole in the mask and diverge to strike their corresponding colour phosphors. The three beams are deflected together and at any part of the screen, a beam can strike only the phosphor of corresponding colour.



shadow mask. This, of course, means that the tube is running well below maximum efficiency and is one of the shortcomings sometimes levied against the shadow mask technique.

If all the phosphors are bombarded simultaneously, the result is an admixture of red, green and blue lights, and at the correct viewing distance the dots do not appear as separate colours. If the separate colours are balanced correctly in terms of relative brightness, then a white raster is produced (see Fig. 1 in Part 1 of this series). This means that the shadow mask tube can be used for displaying a picture in monochrome as well as in colour.

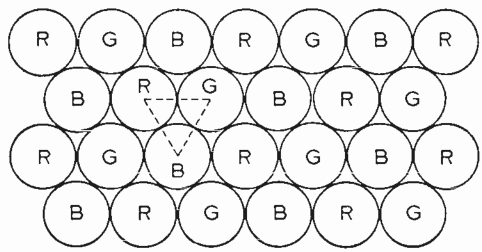
By adjusting the relative brightness of each dot in each trio the creation of almost any colour in the spectrum is possible, as will be understood from the earlier articles in this series dealing with colours. It is noteworthy that in excess of one million phosphor dots are contained on the screen of a typical 19in. shadow mask picture tube, giving a total number of trio groups in the region of 342,000.

In effect, then, the shadow mask is rather similar to a three-tube display device, but all in a single tube and devoid of the optics. The three electron guns are each modulated by one of the three primary colour signals. The triple electron beam converging on the screen thus embodies all the colour information necessary to "energise" any trio of phosphor dots in the correct colour balance.

Although we are not bothered with complicated optical problems on the shadow mask tube, as we are with three separate tubes in optical coupling, there are, nevertheless, other rather critical factors which need to be adequately satisfied before successful colour rendering is possible.

Purity Adjustment

A colour picture is said to be "pure" when a red signal only produces a red raster without any



spurious display of other colours—and likewise with blue and green signals. Owing to shortcomings in the manufacture of the tube and the close tolerances that are essential for correct operation, any standard tube without some form of correction would not produce pure colours as described above. On a red only signal, for example, there would be displayed on the screen a red raster distorted by other spurious hues, and likewise with displays due to blue and green signals.

This is because the red beam, say, strikes not only the red-glowing dots, but also a little of the blue and green ones, and so with the beams of the other two colours.

The "purity adjustment", consisting of two ring magnets on the tube neck, adequately resolves these problems without too much trouble. The magnet assembly is rather like that employed for picture shift on the neck of a monochrome tube, and by adjusting the magnets together or separately a transverse field across the neck can be changed in direction of strength. The three beams can thus be adjusted so that they appear to emanate from somewhere along the tube neck which coincides with the holes in the shadow mask.

Static Convergence

To make the three colour separation pictures overlap and be perfectly coincident a convergence adjustment is incorporated on the tube neck. The "static convergence" applies to the centre of the screen and it is made so that the three focused beams coincide exactly. However, though they may coincide here, they may well fall out of step as the three beams are scanned towards the edges of the picture. This is corrected by a "dynamic" convergence yoke on the tube neck. This yoke features three windings (Fig. 20), one for each gun, and the windings are fed with current waveforms at the line and field frequencies. Thus, the varying magnetic fields resulting from the waveforms correct the position of the three scanning spots as they are scanned from top to bottom and from left to right of the screen.

The static convergence field may be produced by passing d.c. through the windings of the convergence yoke or it may be obtained from a separate permanent magnet.

A further adjustment for shifting the blue beam horizontally is also provided. This allows the blue beam to be shifted relative to the red and green beams. Again, the adjustment is in the form of a small permanent magnet on the tube neck, and it is called the "blue lateral shift magnet".

Although the foregoing adjustments corresponding to the shadow mask tube may seem, on the face of it, somewhat formidable, it is, at least, nice to know that the adjustments on recent tubes are fewer and less complex than those necessary on the earlier tubes for accurate colour rendering. In the early days even the earth's magnetic field had an influence on the purity and the constancy of the colour rendering over the screen area. Now all that is required is the simple demagnetisation of the whole receiver should it be subjected to a very strong magnetic field or if it has undergone a major move in location.

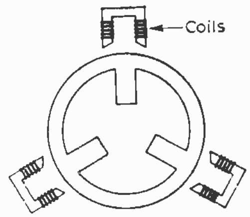


Fig. 20—The basic arrangement of the dynamic convergence coils used on the neck of a shadow mask picture tube. There is a coil for each gun and they are fed from signals associated with the line and field waveforms.

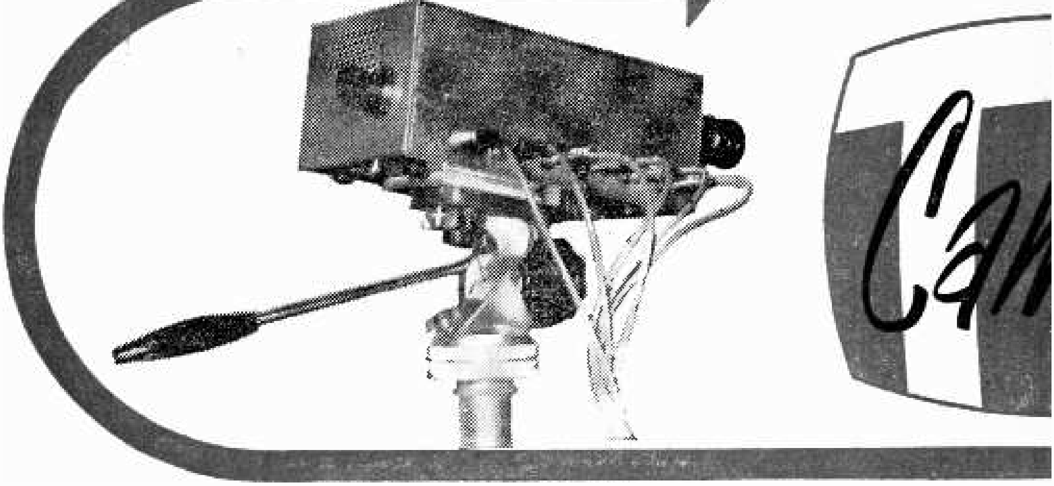
Nevertheless, the shadow mask tube is still influenced by strong external magnetic fields much more than a monochrome set, and a recent case of picture disturbance on a colour set was traced to the wires in a piano which had undergone slight magnetisation. The cure in having the piano completely demagnetised.

In spite of the electron loss in the shadow mask itself, recent tubes give a far greater light output than the early specimens, resulting in part from the use of a new red phosphor. Indeed, the shadow mask tube is capable of giving some very fine colour pictures as those readers who studied the colour sets at the last Radio Show will agree.

Next month we will see what the colour signal looks like and how it compares with the monochrome television signal.

PART 5 APPEARS IN THE NEXT ISSUE

A CLOSE



PART ONE: THE SYSTEM OUTLINED

THE purpose of this first article is to acquaint the reader with the items of equipment he will need in order to feed good pictures into his domestic television receiver. The equipment to be described is so designed that no modifications whatsoever are required to the domestic television receiver, the signal being fed in at the aerial socket just as if it were a broadcast signal received on an aerial.

Some discussion will be given of conditions of operation where they affect the choice and design of components, but no discussion of operation of equipment from the standpoint of programme production will be given, as this has already been well covered by Mr. H. Peters in the November/December 1962 issues of this magazine.

The basic purpose of each component and circuit stage will also be described, and estimates of the probable prices involved. Detailed circuit descriptions will follow in the two constructional follow-up articles in the next months; these will deal with the camera head unit and the camera control unit respectively, and will include the full theoretical circuits and layout diagrams.

The present article presents block diagrams of all equipment, to give the reader a clear grasp of what is involved and enable him to make the decision whether to build this apparatus. If so, he should set about ordering the vidicon camera tube and accessories (focus coils, scan coils, line and frame transformers) as soon as possible, also the optical items, so that these essential components are in his possession by the time publication of constructional details commences next month.

Estimate of Total Cost of Equipment

The basic set of equipment to be described in these articles involves an optical lens system on a home built vidicon camera head unit with built-in head amplifier, a nine-valve control unit containing entirely standard receiving valves and ordinary components to be found in any advertiser's lists, and a good camera-tripod. The only expensive and unusual items in the control unit are the special set of four transformers obtainable from Messrs. EMI, which form the line and frame oscillator and output transformers.

If one wishes to obtain the best quality and sensitivity, it is necessary to obtain a really good optical system and tripod, and these two items will then cost about the same as all the rest of the equipment. A good precision lens conforming to optimum specifications discussed later in this article can cost up to 30 guineas, or even more, and a precision tripod with pan/tilt head can cost about the same.

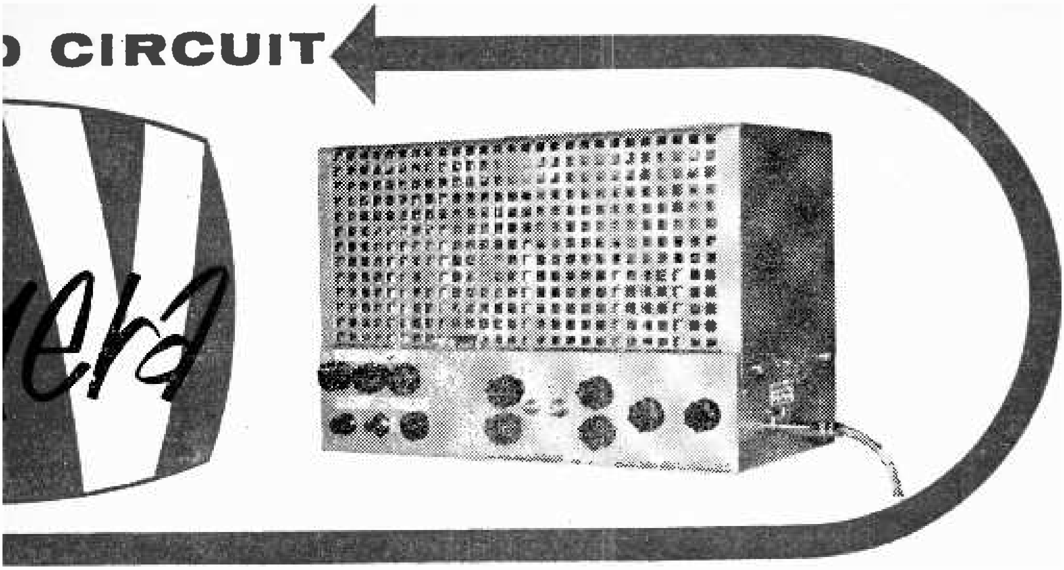
However, if the reader intending to build this CCTV equipment is already a keen 35mm camera photographer and 16mm cine-film photographer, he will very likely already possess the necessary optical items and tripod so that these then play no role in determining the price of his contemplated CCTV equipment. Or, if he does not already possess the exact items needed, he may now consider their purchase doubly justified because they can be used for his photographic hobby too, when not in use for the CCTV equipment.

Another method which can achieve drastic cuts in the price of optical equipment is to use lenses from government surplus equipment, some of which can give very good results and are quite cheap. However, simple magnifying glasses or other primitive "toy" arrangements can not be used. The definition of images from such lenses is very poor, the focal length generally too long and the aperture too small, so that high illumination would be required for even moderate sensitivity.

Readers with experience in metalwork can also design and build their own tripod with pan/tilt head, probably at very low cost in material.

The Tube and Coils

The EMI 10667 vidicon tube, together with a set of focus and scan coils and transformers, is now



marketed by EMI and by various advertisers at prices between 20 and 60 guineas. The general tendency in recent times seems to be for these prices to decrease, so that amateur constructions have now become definitely feasible projects as far as the financial side is concerned. This was in fact formerly the main barrier, not any particular technical difficulty. However, it must here be stressed that the vidicon camera tubes in these "amateur component sets" often have some slight blemish making them unsuitable for high-class broadcasting, and this often accounts for their cheap release for amateur experiments. The blemishes are mainly in the form of small dead spots in some position of the scanned target area, or slight non-uniformities of the target. A first-class tube free of all blemishes is more expensive, costing up to £50 alone, without coils and transformers.

The remaining circuitry comprising video amplifiers, scan and sync generators, r.f. oscillator and modulator is straightforward and uses only standard receiver components. The entire 11-valve circuitry in camera head and control unit should not cost more than about £20, probably less if judicious use is made of surplus items.

Summing-up, it may thus be said that, at the one extreme, if a first-class lens, first-class tripod and top quality vidicon tube are purchased, and the circuitry built entirely with new components, an outlay somewhat over £150 could turn out to be necessary. At the other extreme, if judicious use of surplus equipment is made, existing or home-made (or surplus) optical equipment employed, and "amateur quality" vidicon tube with accessories obtained, the total outlay for the whole project can be as low as £50, i.e. comparable to the purchase of a domestic television receiver. Naturally, such a TV receiver will have to be either available or purchased in addition.

405 or 625 Lines?

The equipment as described in these articles is laid out for 625 lines, with an output signal according to the CCIR-standard, i.e. black is high carrier

BY E. McLOUGHLIN

amplitude, white is low carrier amplitude, and sync pulses represent full carrier amplitude.

The reason for this choice is solely that the effective pick-up sensitivity increases with the number of lines used, because the raster is then "read-off" more often, and this can just make the difference between having to use photographic floodlights with short life or being able to manage with two or three ordinary 100W or 150W bulbs for lighting interior scenes.

No gain in definition is possible with the specified vidicon and accessories when changing from 405 to 625 line operation; in fact, the obtainable resolution is only in the region of a poorly interlaced 405-line broadcast signal anyway. However, it is very acceptable for amateur use, and definition in the shadows is better than in highlights, so that general picture appearance is good.

It may justifiably be assumed that the practical television enthusiast who builds this equipment will certainly be keeping up with the times in other respects, and thus will be modifying his 405-line receiver for dual-standard operation, or purchasing a new dual-standard receiver. However, for those who wish to keep to 405 lines, parallel additional instructions will be given throughout the constructional articles wherever differences arise.

Monitor Equipment

The camera operator should ideally be able to see the televised picture from his camera on a small local receiver serving as monitor. This function corresponds more or less to the viewfinder on an ordinary camera, and serves the additional purpose here of checking for correct setting of all electrical controls.

No specific monitor is involved in this article, because any second television receiver may obviously be used. There are many offers of second-hand TV sets on the advertisers pages, at extremely low prices.

Choice of a receiver with small c.r.t. is of great advantage for monitor use, as it enhances portability, and this is fortunately also the factor which makes these sets very cheap. A TV receiver purchased for conversion to a monitor may have a defective tuner and i.f. strip, and also the sound channel may be inoperative. All these items are not essentially required in the basic system, as a video output for a monitor without r.f. section is provided on the control unit. However, if the r.f. section is working on the receiver to be used as monitor, it is as well to use it, feeding both monitor and main receiver(s) off the modulated r.f. output of the control unit. This then gives the additional check at the camera that the modulator and r.f. oscillator are working properly in the control unit, and that the oscillator is tuned correctly to the selected channel.

A word of warning here! This being a closed-circuit TV system employing not plain video but modulated r.f. on the distribution cable, it is essential to pay proper attention to screening. The signal must not be allowed to radiate, as this is forbidden by G.P.O. regulations.

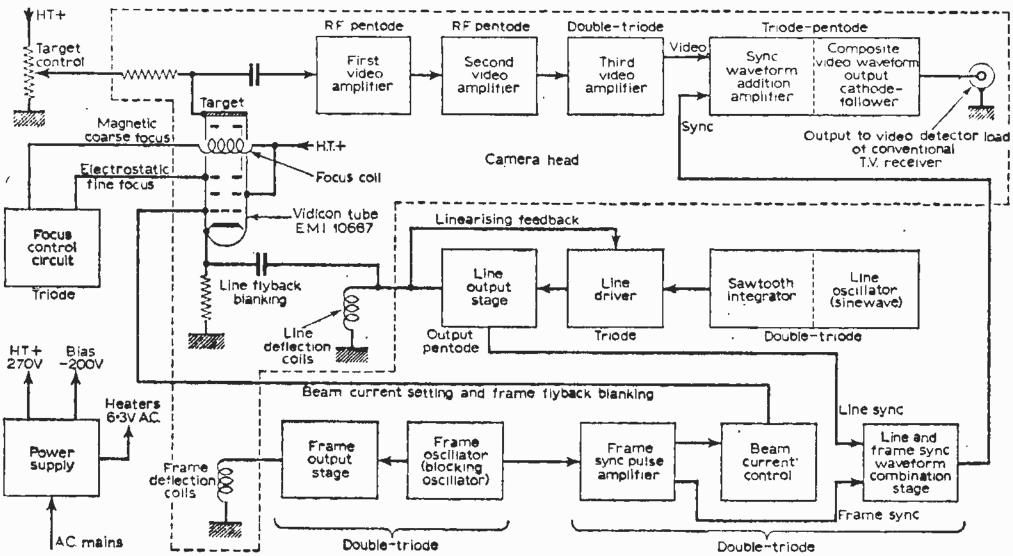


Fig. 1—Basic arrangement of EMI TV-Camera Head for CCTV.

Both the camera head and control unit must be built in totally closed ventilated metal cabinets, and all cables screened. The mains input cable must embody TVI filters. The distribution cable *must* be coaxial aerial cable; twin feeder or flex are not permitted, as these can radiate appreciably when poorly installed. If the TV receivers used have aerial sockets for twin feeder, then the cable must be run coaxial right up to each receiver, and the necessary balancing transformer located right at the end, so that only an inch or two of twin feeder is still needed from its output to the receiver aerial sockets.

The Vidicon Camera Tube

A vidicon is essentially a low voltage cathode ray tube. It employs no voltage exceeding 300V in normal use, so that it may be run off conventional h.t. supplies. In size and in a number of other respects it is similar to a miniature oscilloscope c.r.t., and a practical description of its functioning may best be commenced by pointing out the differences in this comparison.

The vidicon contains the cathode, grid, first anode plate and electrostatic focus cylinder in much the same arrangement as an electrostatic oscilloscope c.r.t. However, the final anode plate beyond the electrostatic focus cylinder connected to the first anode plate in the oscilloscope tube, is here missing. Instead, a mesh-electrode is placed across the beam, close to the "screen" and connected to the focus cylinder which is here generally called the *wall anode*. This arrangement gives a strong decellerating field close to the "screen" (here called the *target*) and the beam stabilises the target potential at cathode potential.

It is clear that this arrangement alone is incapable of focusing the beam onto the target, because the necessary electrostatic focusing lens is only produced when a cylinder-electrode of somewhat lower potential is situated between two plate electrodes at higher potential, as in the conventional oscilloscope tube. Thus the vidicon requires an additional magnetic focus coil round its exterior, to exert the main beam focusing influence in the same way as in a TV receiver c.r.t. The potential of the wall anode, which influences the nature of the electrostatic decellerating field in front of the target, can then be varied to obtain fine focus control.

No electrostatic deflector plates are present, the line and frame scan of the target being performed by means of deflector coils exterior to the tube, in the same arrangement as for a TV receiver c.r.t. Also, scan circuits very similar to those found in TV receivers are used, except that everything operates at a lower voltage and power level here.

The Target

The target of the vidicon tube is the really new electrode, which cannot be likened to any

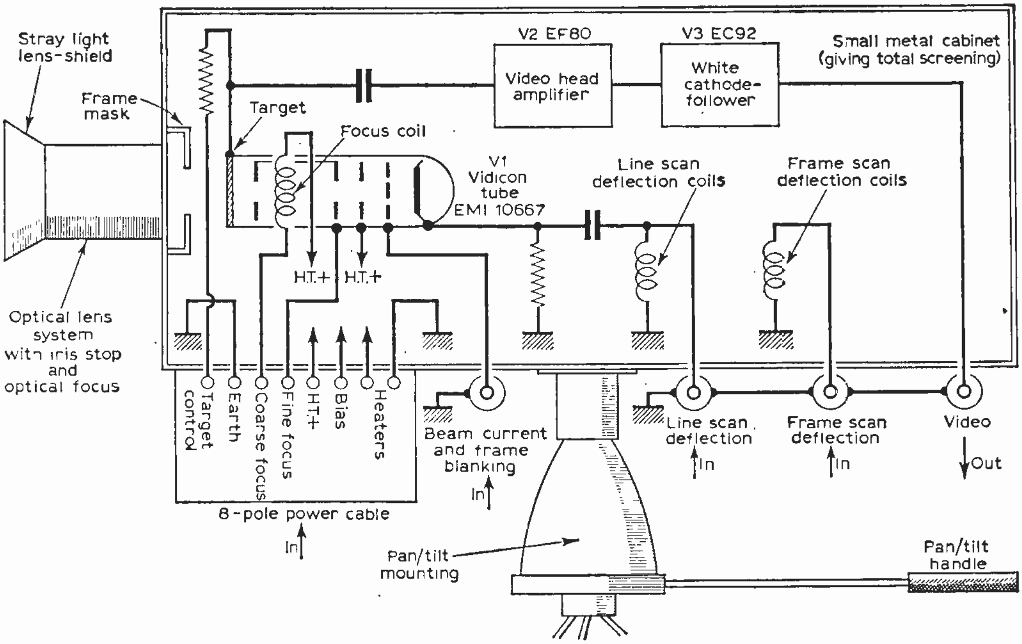


Fig. 2—Basic arrangement of CCTV Camera Head described in this series of articles. The next article will give full constructional details of this head unit. Four coaxial signal cables and one 8-pole screened power cable connect the camera head to the control unit shown in Fig. 3.

found in oscilloscope or TV receiver c.r.t. It is in place of the luminous coating, otherwise producing light wherever the electron beam strikes it in the other c.r.t. types.

The target of the vidicon consists of a layer of photoconductive material desposited on a transparent metallic coating functioning as common electrode. The photoconductive layer faces the internal electron beam and the common electrode, called the *signal electrode*, faces the optically flat window of the front end on the tube. This is about 1in. in diameter for the specific vidicon tube, and an area of 9·5 x 12·7mm on this is scanned by the raster.

The photoconductive layer has a high resistance at all points on it between front (electrode-beam impingement side) and back (signal electrode), when it is completely in the dark. Wherever a point on it is now illuminated however, the resistance drops in proportion to the intensity of illumination, so that beam current can flow across the layer to the signal electrode whenever the scanning beam passes the point(s) in question. The corresponding signal across the signal electrode load resistor is then the required video output, which represents the electrical conversion of the picture image projected onto the scanned area of the target by means of a conventional optical lens system (as in a photographic camera; the target is in this respect to be considered as the "photographic film").

Another way to describe events at the illuminated target: consider that, initially in the dark, the electron beam deposits sufficient electrons on the photoconductive layer to charge the front surface back to cathode potential. No further electrons can then be taken up on the target, and the beam current scatters back to the wall anode, chiefly. As soon as a target-point is illuminated, there is a conducting path through to the signal electrode at the rear and, because this signal electrode is given a judicious small positive potential (target bias control), it can draw off electrons from the front of the photoconductive layer at that point. When the scanning beam then next comes to that point, it finds it above cathode potential again, and can thus deposit the necessary quantity of electrons on it in passing, to restore it to cathode potential.

One operates the vidicon such that the mean target current is in the region of 0·25μA. The target load resistor is in the region of 4·7kΩ (largest value still allowing required video bandwidth in the presence of inevitable stray capacities), so that the resulting video signal output voltage is about 1mV. This is the sort of level obtained, say, from the playback head on a good tape recorder in the audio field, and one is familiar with the fact that good amplifier gain, but by no means excessive gain, is needed to amplify such signal levels to a usable final output. We may thus say that the sensitivity of the vidicon is very good.

Optimum Operating Voltage Settings

A detailed study of the actual behaviour of a vidicon target compared to the ideal behaviour just described shows certain side effects. Thus there are response lags involved.

The first of these represents a lag in the discharge process of the photoconductive elements, but this is generally negligible for beam currents less than one microamp, which is satisfied in practice.

LIST OF COMPONENTS TO ORDER IMMEDIATELY

(See text for discussion of prices and alternatives)

(1) EMI Vidicon Tube, Type 10667.
Specify: 10667S (perfect quality studio tube)
10667G (general use; slight blemishes)
10667M (setting-up and experimental; many blemishes)

(2) Focus Coil, Line Coil, Frame Coil, Tube base for 10667.

(3) Frame oscillator transformer 7AB/1005 }
Line oscillator coil PLC752 } For
Frame output transformer 7AB/1021 } 10667
Line output transformer 7AB/1013 }

(4) Lens: Schneider Cine-Xenon RX (Bolex) 1 : 1·4/f=25mm

(5) Linhof double-profile tripod, Type S248/SPD with pan/tilt head Linhof type 89.

Items 1–3 are obtainable from E.M.I. Electronics Ltd., Hayes, Middlesex.

Items 4, 5 are obtainable from photographic specialists.

All other components are *standard* valves, resistors, capacitors, etc., needing no special advance ordering; normal parts lists will be given in constructional articles.

The discharge lag is, of course, applicable to stationary optical images as well as moving ones, as it represents sluggishness in response on repeated scans of the same scene.

The second type of lag is more serious, and affects only moving scenes. It is called photoconductive lag, and produces much the same effects as excessive afterglow on a TV receiver or oscilloscope c.r.t. A moving object thus appears somewhat smeared and an object moving across a stationary background of high contrast appears to be slightly translucent like a ghost.

In the vidicon, the effect can be produced when the change of resistance of the photoconductive layer in response to change of point illumination in the optical image is not sufficiently rapid. The effect is not completely avoidable, and so it must be combated in practice by arranging operating conditions to minimise visibility of its consequences.

We can define errors due to photoconductive lag in terms of "echo percentage on successive frames". If a scene is suddenly switched off, e.g. by suddenly closing the stop of the optical lens, the impression on the conductivity of the target takes a certain lag time to decay away. For the next few frames the scanning beam will thus continue to produce a video signal of the former image, at successively weaker intensities. It is found that this "echo" on the first frame after switching off the optical scene can be reduced to some 15% of the original full signal, but a long tail of echoes then follows on successive frames, with much less rapid relative decay. It is thus generally required to concentrate only on reducing the first frame echo to as low a value as possible and the most vital influencing factor is here the target beam current. This should be set to about 0·25μA, by suitable adjustment of the target bias control.

Another useful aid is to use so-called *diffuse* "bias light" on the optical scene, to such an extent that a general background illumination amounting to about 20% of the peak illumination results. In other words, excessive contrasts in the televised scene should be avoided, indicating the need for the type of lighting photographers are familiar with for good colour photography. This then does not require sudden changes from full illumination state to total darkness state for elements of the vidicon target when objects in the televised scene move about, so that frame echoes are greatly reduced.

In practice, the first frame echo can be reduced by a factor of three compared to high-contrast conditions. Further flattening of scene contrasts brings no appreciable further improvement.

Illumination required

The specified EMI 10667 vidicon tube should ideally operate at a mean target illumination of 5ft candles, althought usable and safe operation is possible for mean target illuminations between 0·5 and 100ft candles.

The target bias must be adjusted in all cases for 0·25μA peak white current; correct values here lie between 10 and 20V for target illuminations 50—100ft candles, 25—60V for the optimum target illumination of 5ft candles and anything up to 100V for target illuminations of 0·5ft candles.

It is of advantage to use a video oscilloscope to check the beam signal current amplitude, until one has become accustomed to the relations between scene brightness and target bias setting. However, this matter is uncritical, because incorrect target bias in relation to illumination merely gives a bad picture and cannot in general damage the tube. The target is not burnt by either failure of one or both scan deflections or by excessive signal current. However, such damage can be produced by excessive dark current (non-signal component of target current present even in the dark), i.e. when this exceeds 0·8μA if the target bias is turned up too high. It is thus essential to insert resistors such that the top end of the target bias potentiometer does not exceed 100V—especially if non-technical operators are likely to use the equipment!

Let us now consider what the optimum target illumination of 5ft candles represents in terms of illumination for the televised scene and maximum aperture of optical lens system. A rough formula, applicable when the scene is situated many times the focal length in front of a lens so that the image is virtually in the rear focal plane, as will generally be the case for CCTV studio or outside work, states that:—

$$\frac{\text{Scene Brightness}}{\text{Image Brightness}} = 4A^2$$

Here A is the conventional stop-number or "f/—number" set on the lens. Its meaning is as follows: if the focal length of the lens used is divided by the number A, then the result is the diameter of the stop-hole being used (or the entire diameter of the lens, in simple cases using no stop).

If we now substitute the optimum target illumination of 5ft candles for the vidicon as image brightness in the formula given, we see that the optimum scene illumination is $20A^2$ft candles.

Now full summer sunshine outdoors represents an intensity of illumination around 15,000ft candles, so that the optimum stop-number according to the formula would come out as around f/27. The smallest stop available on good short focus cine lens is f/22; smaller stops approach the diffracting characteristics of a pin-hole too much, causing image-blurring. We see that, however, f/22 is suitable as the vidicon can tolerate considerably higher target illumination than the optimum.

Going to the other extreme, we may take a single 100W bulb in a reflector, some 1 to 3yd distant. We can expect scene illuminations of around 5ft candles from this arrangement. Exploiting the absolute minimum target illumination quoted as usable for the vidicon, i.e. 0·5ft candles, the formula shows that a scene illumination of $2A^2$ is needed. If this is to be 5ft candles as here, we see that A will need to be about f/1·4.

Now, as all these values are quoted for 405-line operation of the vidicon, change to 625 lines will just make the difference to enable satisfactory pictures to be got at full-aperture of a f/1·4 cine lens and good room illumination of around 5ft candles at home. Two or three 150W lighting bulbs of ordinary type (not short-life photographic lamps) in good reflectors will then definitely provide sufficient artificial illumination.

Choice of Focal Length of Lens

The above discussion has fixed the power of the ideally required lens to get optimum brightness ranges; we must now determine the optimum focal length to get a correct general angle of view and perspective.

The general rules are here applied, as always for considerations of this kind, by considering the diagonal of the image (diagonal of scanned frame of the vidicon target in present case). The focal length of the "normal" lens for general purpose use must be roughly equal to this frame diagonal. The impression created by the final reproduced image is then that of "normal vision". If the focal length used is n times shorter than the frame diagonal, we obtain a wide angle or panoramic impression from the reproduced images, and "n" is then called the panoramic factor of the system. If the focal length used is n times larger than the frame diagonal, we get a close-up or telephoto effect, where n is called the telephoto-factor, or often simply the magnification factor.

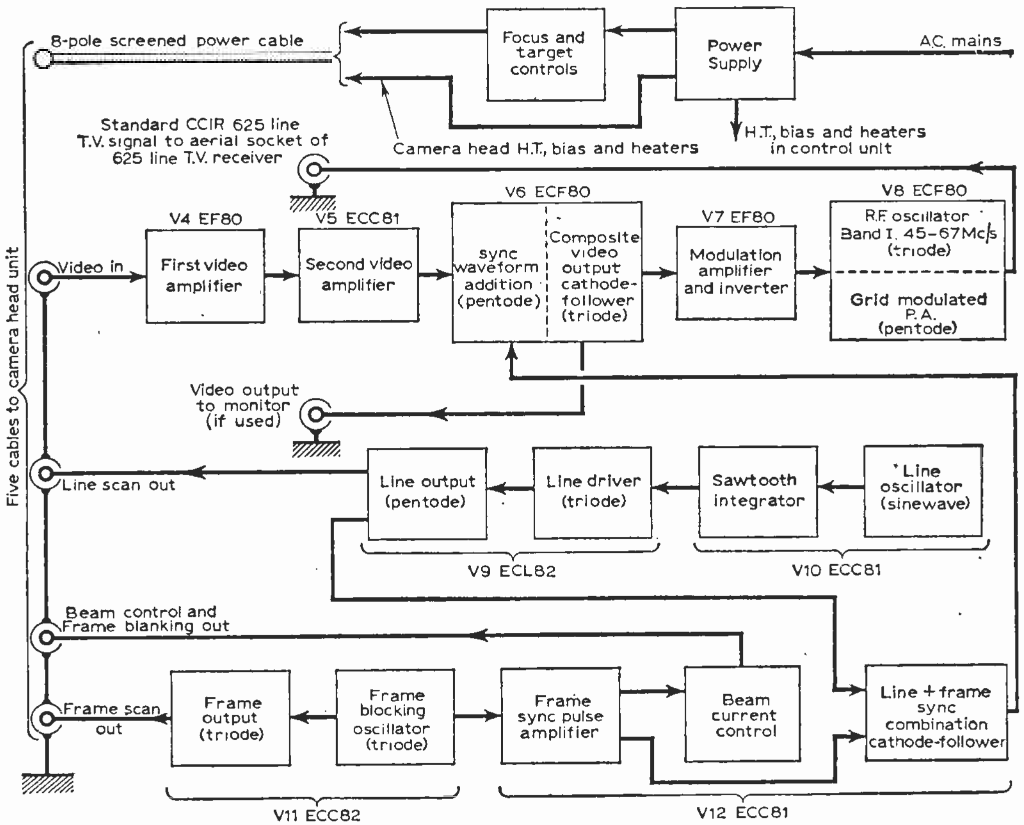


Fig. 3—Basic arrangement of CCTV Control Unit giving 625-line output on CCIR standard, for direct feed to aerial socket of domestic TV receiver. The final article of this series will give full constructional details, including information for obtaining 405-line BBC standard operation if desired.

It is of advantage, when intending to operate with a single general-purpose lens, to choose one giving a very mild telephoto effect with n=about 1·5. Such an arrangement is known as a "portrait lens" in photographic circles, and is here valuable, as mild close-ups will be frequent in most televised scenes and the true normal lens could be a bit weak in this respect. The frame diagonal scanned on the vidicon is 16mm, so that the focal length of the general purpose lens should be about 25mm.

This has now fixed the specification of the optimum lens as 1:1·4/f=25mm, smallest stop f/22. The normal lens of a 16mm cine-camera matches these requirements and can be obtained from any good photographic stockist. The author uses the Schneider Cine-Xenon RX originally intended for the Bolex 16mm amateur cine-camera.

This discussion given in detail will enable the reader to decide for himself whether or not other lens he may be offered on the surplus market or may already possess will be usable, and under what limitations. It should be pointed out that lens from the more common 8mm amateur cine-camera are less suitable, as they are not corrected for quite the full image frame size employed by the vidicon. However, they may be used, and bring the advantage that, on account of their shorter focal lengths, they allow panoramic wide-angle effects.

To obtain even quite powerful telephoto effects, the normal set of lens used by the 35mm snapshot photographer can be used. These have focal lengths of 35, 50 and 135mm in general (corresponding to wide-angle, normal and telephoto lenses respectively for 35mm work). With the 135mm lens, a telephoto factor of about 8·5 is already obtained with the vidicon tube, so that a head-and-shoulder television portrait of a person is then obtained at about 6yd range. However, the limiting factor here is the extremely high price of these lens if large maximum apertures are desired. Thus a 35mm film telephoto lens of 135mm focal length already costs up to 30 guineas for a power of f/4, which will certainly need a good spotlight for indoor work with the vidicon on CCTV, but is still more than ample for general outdoor work.

Those readers out to get the best, and where additional expenses are less important, should also remember that special lens are available for vidicon tubes having special optical correction giving an optical distortion of images of compensating character to slight electron-optical image-distortion in the vidicon, so that net cancellation of faults results. The manufacturers of the tube can give further details here.

It is important to protect the vidicon from accidental "looks" through the lens direct at the sun, as this can cause *immediate* burn-out of the target even at the smallest lens-stops and even when no electrical supplies are connected.

The lens should thus be covered up during transport, and appropriate care exercised when aiming the camera during outdoor use. Under certain circumstances even reflected images of the sun in water or glass windows can damage the vidicon target.

New vidicon tubes may show "fatigue", i.e. temporary reduced sensitivity to low illumination scenes after operation at high intensity. This effect should vanish after the initial 20 operating hours of a new tube.

Definition of Vidicon TV-signals

The spot focus in the EMI 10667 vidicon tube is such that the scanning beam is about two lines in diameter at 405 lines. The achievable vertical *and horizontal* definitions are therefore about equal to a 405-line broadcast signal on a receiver with poor interlace. However, this can still give surprisingly good appearance. There is no need to care for excessively great bandwidth in the video amplifier, even when operating at 625 lines, due to these reasons; but the normal response familiar in 405-line receiver techniques should be maintained, to avoid further net reduction of definition.

Some improvements are possible, and officially recommended by the makers for special applications, by operating the tube at maximum voltages of 500 instead of the normal 300V, and suitably increasing the focus-field. However, these measures are not adopted here.

The Circuitry

Fig. 1 shows the basic circuit-plan of the EMI camera unit. Here the vidicon and i.f. amplifier are in the camera head, the rest in the control unit, giving a video output from the camera unit and not a modulated r.f. output as in the design here to be published. Otherwise, the design here follows the EMI design in many principles.

Fig. 2 shows the camera head unit, constructional details of which will be published in next month's article in this series. It is seen that it contains the absolute minimum of items, to reduce both size and weight. Use of a good conventional photographer's tripod is thus made possible, although a proper unit with profile legs and panorama head (pan/tilt) is still greatly preferable to a simple pocket tripod for a snapshot camera. Indeed, the use of the latter is inadvisable, as it gives poor stability, and if the camera unit falls over and receives a sharp knock, the vidicon tube and precision lens can receive irreparable damage.

The unit should not be transported with the vidicon target pointing downwards, as loose pieces of glass could then fall onto and scratch the photoconductive layer on the target.

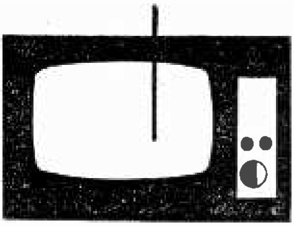
Fig. 3 shows the circuit plan of the complete control unit, full constructional details of which will be given in the third article of this series.

Detailed description of the circuitry involved will be left to the constructional articles.

TO BE CONTINUED

A MONTHLY COMMENTARY

Underneath the Dipole



BY ICONOS

EVERY couple of years, we hear requests from Members of Parliament that proceedings in the House of Commons should be broadcast or televised. I haven't heard that many requests have come from the public, but there is no doubt that the occasional Parliamentary bulletins by television reporters have been appreciated by many viewers. The automatic do-it-yourself studio of the BBC close-by at St. Stephens is a big asset, and the Independent Television News H.Q. in Kingsway is not far away. Encouraged by the general interest in these broadcasts, there is once again a move for proceedings of the House of Commons to be televised, this time in edited form. This poses a number of practical and political problems. A permanent installation of several television cameras, a control room, a video tape recorder and the facilities to edit the tape, is an elaborate expensive undertaking, requiring a large and skilled engineering and administrative staff to carry out the work speedily and with complete impartiality. The cameras would have to be carefully sited in the House, and remotely controlled to pick-up immediately any speakers in any part of the chamber. Lighting and acoustic problems would be far from simple.

However, once the politicians get their teeth into an idea, they rarely let it go, and a solution will have to be found sooner or later.

Editing the Speeches

It would seem to me that this is a clear case where film should be harnessed to television techniques. By the Electronic-Cam system with 16mm film cameras fitted with TV vidicons, a negative film is shot as required, with sound recorded on a magnetic stripe on the edge of the film. Monitors in a control room reproduce the pictures shot on the film cameras which are started and stopped instantly by vision mixing in the television style. The resultant film would be developed in a high-speed processing machine and edited in negative form. Within a few minutes, it can be put on a telecine machine and, by phase-reversal, broadcast as a positive. If extra positive prints are required for export, these can be made within a few minutes—and re-edited, if necessary. It is fortunate that the Central Office of Information already possesses quite a lot of equipment for doing this kind of job, including a very fine telecine equipment. It would be much more appropriate for a responsible Government department to carry out this delicate operation, rather than for it to be handed over to the BBC or to a commercial organisation like ITV.

The House of Lords

Many people think of the House of Lords as an anachronism—a relic of the days of Gilbert and Sillivan, with wigs by Clarkson and costume by Morris Angel. The final stages of the Television Bill did indeed produce both comedy and drama, but the debate was excellent, and witty exchanges were occasionally well up to the standards of the immortal W. S. Gilbert.

The interesting part of the Lords debate on the Television Bill was the uneasiness felt in various parts of the House on present policy trends in the BBC.

The Wrong Target

Putting on my "crossbencher" set, I will now comment on this fascinating debate. Firstly, it was unfortunate that Lord Morrison attacked the appointment of Lord Hill when it is obvious that the metaphorical brick should have been thrown at the Director General of the BBC, who alone must accept responsibility for the deplorable decline in BBC standards of decency and integrity, so clearly observed by the peers of all parties. Earlier in the year, Lord Morrison had complained of the unfortunate consequencies of the lifting of the ban on "Lady Chatterley", which has hamstrung police action, and has indirectly led to a general downward drift in standards of paperback literature, newspapers, broadcasting and television. It is a Gilbertian circumstance that one of the principal witnesses favouring of the lifting of this ban was also one of the principal architects of the Pilkington Report. It is also a deplorable fact that the BBC have tacitly allowed employees to attack publicly, in an offensive manner, persons who were their previous employers. Lord Francis Williams' description of TW3 as being fizzy lemonade laced with vinegar fell short of the mark; arsenic and old lace would have been a more accurate description. As for Lord Hill, he is well able to take care of himself, and present indications are that he is going to make a big success of his great responsibility as Chairman of the ITA.

Plotless Plots

Who is to blame for the television plays which seem to have no beginning, little or no plot, and almost always no ending? Is it the television script writers, the scenario editors of the BBC and ITV organisations, the producers or the public? For it is the public which is supposed to get the kind of entertainment it wants, whether it is the cinema, books, "steam" radio, television or the live stage. Apart from London, there isn't very much live theatre in Britain as compared with twenty or so years ago, and London's huge population is large enough to support both the "popular" and the "unpopular" theatre—the latter being mainly small club-type places which cater for specialised and restricted audiences. These little theatres do well enough in their way, but their appeal is strictly limited. The plotless plays, unsavoury subject, objectionable themes and squalid settings (when there are settings) would get "the bird" at any provincial theatre. They are not all objectionable, however—and one of these, *"The Sponge Room"*, adapted for the Royal Court Theatre play, was on BBC television on a recent Sunday night. Trivial, plotless and slightly unpleasant, it would seem to me to be most unsuitable for peak-time viewing on a Sunday night.

Passing the Buck

The television script writers blame the scenario editors of the BBC and the programme companies for the present trends. One of them recently publicly stated that the submission of a television play with a real plot merely invited rejection. Careful constructional and development of a story is, at the moment, regarded with suspicion by the staff personnel who have the job of reading, vetting and selecting scripts. So what is a poor script writer to do? For a start, through his Union, the Screen Writers Guild, he is asking for more money. The sum of £200 or so, he says, is about the figure paid to many writers for work spread over many weeks. £500 should be the minimum, they say.

£3 6s. 8d. per Minute

The script writer's point of view is understandable, but the timing of the request for an increased minimum is unfortunate. Never, in the history of British television, have so many plays been televised which were (from the viewer's point of view) not worth £50 — never mind £500. This phenomenon may not be altogether the fault of the writers—it may be due to the peculiar satiated tastes of the television script readers, patrons of the egg-head little theatres in London's West End.

WHAT IS WRONG WITH THE BBC ?

An open letter to H.M. Postmaster General Rt. Hon. R. Bevins, P.C., M.P.

Sir,

That the BBC deeply resent any infringement of their privileges if anybody criticises them, is a point that was emphasised recently in the House of Lords, when the Television Bill was debated. Lord Swinton said "There is some control through public opinion, but I am not sure that the BBC are as amenable as some other institutions to criticism from public opinion. I hope that the Postmaster General will be able to exercise some control."

Similar sentiments were expressed by other noble lords on both sides of the House. The fact is, there is general dissatisfaction with the general tone of many BBC programmes, satirical and otherwise. The encouragement of cynicism, the mockery of religion, the acceptance of low moral standards are against the interests of the nation.

If you accept the valuable suggestions made in the House of Lords, it may be necessary to ascertain the origins of the scurrilous attacks upon institutions and individuals. Are they planned in Broadcasting House itself, or, as rumoured, over brandies in the clubs of Greek Street, Frith Street or King Street, Covent Garden. Who make the bullets, and whose finger is on the trigger?

Yours etc.,

ICONOS

Plotless television scripts are not confined to kitchen sink dramas. They are seen in comedies, too, and it was unfortunate that Bud Flanagan, the veteran comic from the Crazy Gang, should be handicapped by poor material in the series "*Bud*". Here was a grand comedian who is at his best in rip-roaring burlesque, tied down to feeble material which did not give him or his fellow fugitives from the Crazy Gang a chance to exploit their own special goon type of humour. Burlesque sketches are not too difficult to evolve. The formula was found for the Morecambe and Wise Show, in which their well-matured double-act has been given a new twist with Roy Castle as an extra "straight man". Plenty of laughs here, with Morecambe and Wise in top form, with Roy Castle adding to the fun as well as to his reputation as a first-class light entertainer.

Hornblower

After a diet of egg-head plays, it was a relief to sit back and watch the BBC's "*Hornblower*", which was a film adapted specially for television from C. S. Forester's best-seller book. An exciting plot, spectacular scenes and first-class scripting and direction resulted in the most exciting gripping fifty-minutes for many weeks on TV. Beautifully photographed by Harry Waxman, B.S.C., and with quite lavish settings, the production must have cost a great deal of money. The performance of David Buck as Captain Hornblower was memorable, his interpretation of the character had the same qualities as Rex Harrison as Caesar in the film "Cleopatra" he was cool, meditative, wise and strong. This is a type of person unknown to the angry boys of Sloane Square. How the spectacular sea battle scenes were obtained within the budget of a television film is quite beyond me. particularly as it was shot in colour with an eye on the U.S.A. colour television market. Sound was superb, editing was smooth and effective, and the whole production must have had viewers seated on the very edge of their armchairs. Comment must be made, too, on the excellent telecine transmission which was made from BBC studios, Lime Grove, on the original 12-year-old Rank Cintel flying-spot equipment, commonly referred to as the "battleship". This showing I saw was a "repeat"—but it could well be repeated again when the British colour television services get going.

THE HENLOW wide-band OSCILLOSCOPE

A high quality instrument specially developed for television application

designed and described by

D. R. BOWMAN

Part Five

CONTINUED FROM PAGE 561 OF THE SEPTEMBER ISSUE

DIMENSIONAL details of the upper chassis are included in the component layout diagram, Fig. 19.

Since both the timebase circuits and the amplifier carry r.f. currents at high frequency, it is important to prevent cross-coupling. To this end the top chassis, which carries both sets of circuits, is divided down the middle by an aluminium screen some 2½in. in height and extending from end to end of the chassis, as nearly as may be.

It may be necessary to cut away small portions of this screen, so that when mounted in position it does not foul the high voltage capacitors which smooth the e.h.t., or other components on the lower deck.

Wiring-up Details

After assembling the upper and lower chassis in position it will be necessary to make some further connections to the cathode ray tube socket; the focus, brilliance and astigmatism controls will already have been connected up, see Figs. 16 and 18 in last month's article.

The leads still to be soldered are those to the X and Y plates, and the connections to the network D2, R57, R58 and C47. The coaxial cable to the master oscillator will be readily enough recognised, but the remainder should be identified by tags in some way, or perhaps coded with coloured sleeving.

The settling of the controls on the front panel may be a tricky job, but if reasonable leads have been left where the d.c. controls are concerned the main attention may be given to those carrying r.f. where short leads are essential. For testing purposes these will all have been attached before assembly, and all that remains is to tuck the d.c. leads away neatly inside the space between the chassis, and to shorten the "hot" leads as far as necessary *in situ*.

The lead connecting C35 to S3 cannot be very short, but it should be spaced as clear as possible from any other wires or components to minimise circuit capacitance and to prevent unwanted feedback. In no circumstances should this lead be enclosed in an earthed braid.

Good connecting wire for high voltage components is ordinary p.v.c. covered flex. For additional safety, the soldered points of these components may well be covered with contact adhesive.

Screening Cans and Ventilation

Valve screening cans are needed only for the valves V8 and V9. The remaining valves are either internally screened or non-critical in this respect, and need good ventilation to dissipate the heat produced.

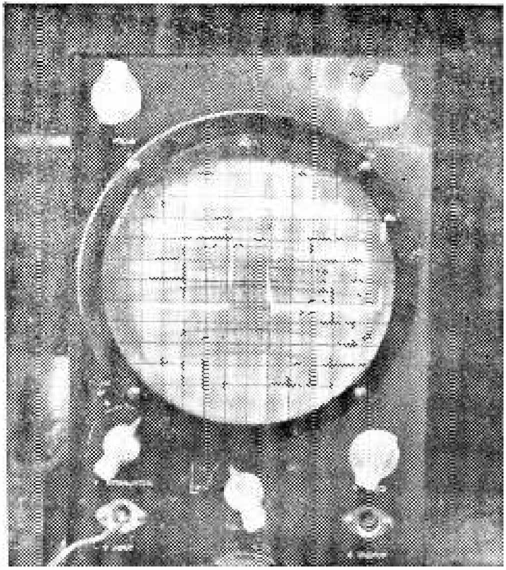
It has been found that with the instrument case lacquered in black crackle enamel no ventilation louvres are needed, as the temperature rise is relatively small. If desired, a couple of slots each side, top and bottom, will provide all the air circulation needed.

Alternative Valve Types

It is fair to state what alternative valves may be found suitable if the constructor wants to make the most use of his spares box. The time-base generator V3 may be a SP61, V4 may be any good triode, while V5a and V5b may be SP61's connected as triodes, in which case R14 and R15 should be changed to 27kΩ each. V1 and V6 should not be replaced by alternatives, nor should the valves in the Y-amplifier. ECC81 is by far the best valve for V7, but other double triodes such as 6SN7 may be found suitable.

Switching On

On switching on the instrument, the "H.T." position of the switch should not be selected until



The face of the finished instrument, displaying a trace.

the valves have warmed up; this is readily indicated by the appearance of a green spot in the cathode ray tube screen, if the brightness is advanced suitably. Since only 1300V e.h.t. is now supplied, the spot is defocused and there is little risk of " burning " the screen.

Allow a few further seconds and select " H.T." when a trace will be displayed. Naturally some five minutes extra should be allowed for " warming up " before any measurements are taken. On switching off the neon light on the panel will take a few seconds to go out as the smoothing capacitors discharge. This neon is not used to show whether the instrument is switched on, but to indicate the presence of the h.t. supply.

2 The Timebase Generator Output Amplifier

(a) Select a medium operating frequency between 5 and 10 kc/s; operate shift controls until trace is seen and is central, adjusting brightness as necessary. Focus as accurately as possible, adjusting astigmatism control as needed (this control has a fairly critical setting, but do not worry too much about this at present).

(b) Operate expansion control to obtain a trace about 2in. long; no Y input.

(c) Operating VR4 with one hand and VR5 with the other adjust until the maximum length of trace is obtained.

(d) Adjust trace length to about 5in. and

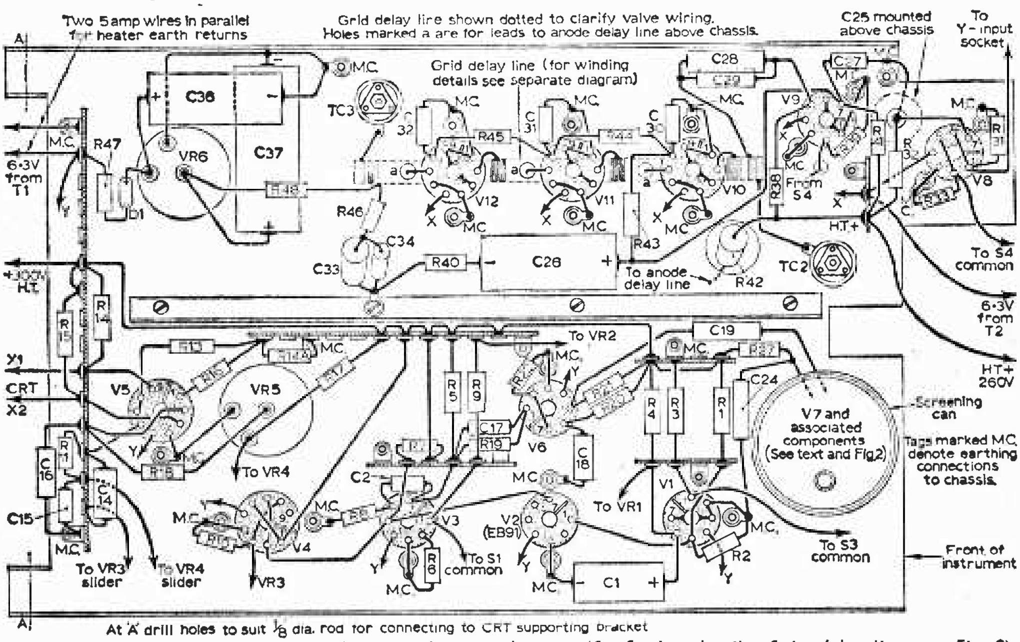


Fig. 19—The top chassis component layout and wiring diagram (for further details of the delay lines see Fig. 9) with overall dimensions also provided.

Setting Up the Oscilloscope

The following procedure is recommended for the final adjustment of all circuits before the cover is put in place.

1 The distributed amplifier

(a) Disconnect the h.t. lead to R41 and insert a milliammeter on 0—100 mA range.
(b) Adjust VR6 until h.t. current is 40 mA.
(c) Reconnect R41 to h.t. (temporary joint).
(d) Break h.t. lead to whole amplifier. Check that total current is between 62 and 65 mA.
(e) Reconnect h.t. lead (temporary joint).
(f) Check voltages as follows:
 (i) h.t. supply 255 to 263V.
 (ii) Any EF184 anode pin 185 to 190V.
 (iii) Any EF184 screen pin 175 to 182V.
(g) Allow half-hour warming-up period: readjust VR6 if necessary and check all through as above.
(h) Allow further half-hour warming-up period and readjust as above.

repeat adjustment of VR4 and VR5 until maximum trace length is obtained. Both halves of V5 are now working on the linear part of their characteristic curves, and the trace should be linear with time. Check by applying a sinusoidal voltage to Y amplifier so as to display about 10 to 20 waves; note that sine-waves are equally spaced. If not quite linear, effect further slight adjustments of VR4 and VR5 for best results. Note that sync will cause a little non-linearity at the very beginning of the trace unless the barest lock is achieved.

(e) If possible check that the adjustment holds on all time base speed ranges; no further adjustments should be needed, and if any are so needed suspect a leaking capacitor in the timebase generator or in couplings.

3 Adjusting the Distributed Amplifier

The trimming capacitors TC1, TC2 and TC3 may be put in their minimum capacitance position

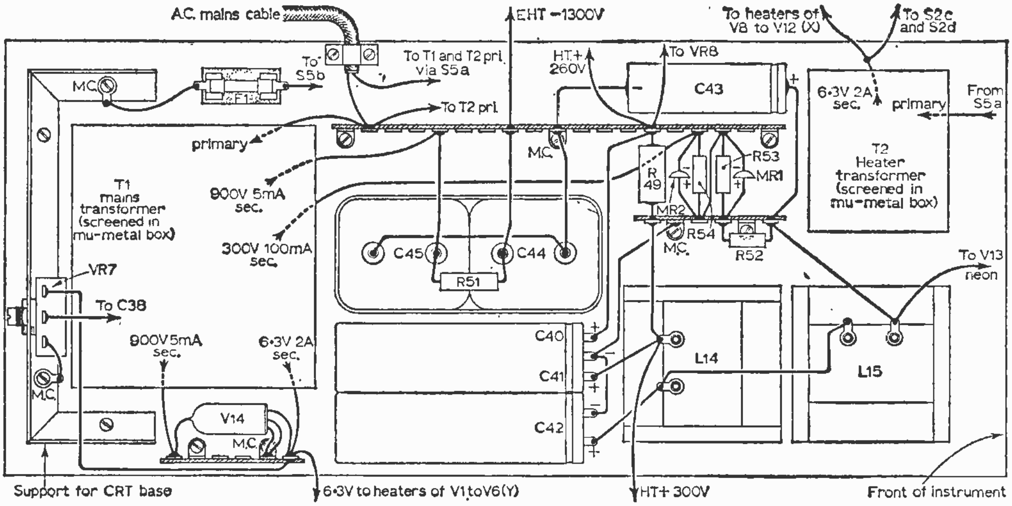


Fig. 20—The wiring of the power deck (see Fig. 13 for the dimensions).

for good results, since the required capacitance is about 3 pF.

For the best possible results a pulse generator is needed, and it should generate pulses of rise time less than 40μs. If such is available, apply the pulse to the Y-amplifier, the pre-pulse sync to the sync terminal and select external sync. Adjust sync control to obtain a steady trace.

Adjust the trimmer capacitors in turn until the cleanest possible leading edge and trailing edge are obtained on the pulse. Serious maladjustment will cause loss of steepness on the rising and falling parts of the pulse, and apparent "ringing" on the pulse front, or brightening of the trace at odd spots on the leading or trailing edges. It will not necessarily be possible to remove all of these spots completely unless the pulse generator is guaranteed not to degrade the wavefronts at all, and it is of course vital to ensure that the pulse generator output is properly matched to its cable and that the cable is properly terminated at the Y-amplifier input. The best adjustment will be easy to find, and if it is found that more than about 5pF is needed something is wrong somewhere.

If a pulse generator is not available a substitute good enough for this adjustment can be arranged with a thyratron; a suggested circuit shown in Fig. 21.

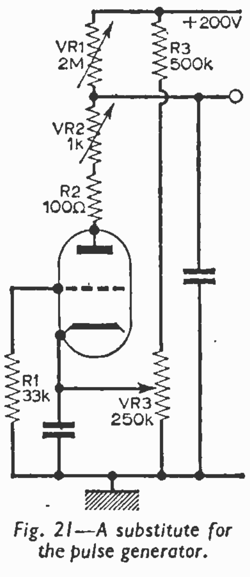


Fig. 21—A substitute for the pulse generator.

VR1 controls the frequency chiefly, and VR3 the amplitude, while VR2 varies the rise time of the fly-back, which is the interesting part of the waveform. R2 should not be reduced below 100Ω because even small capacitors give rise to huge currents through the thyratron when flyback occurs and this current needs to be limited to give reasonable valve life. All connections should be kept *very short* to minimise inductive effects, as the frequency spectrum generated on flyback extends well beyond 1,000 Mc/s.

4 Setting up the Marker Oscillator

The chassis and the screening can will have been drilled for access to the cores of L1 and L2, which are mounted on the same former as mentioned previously.

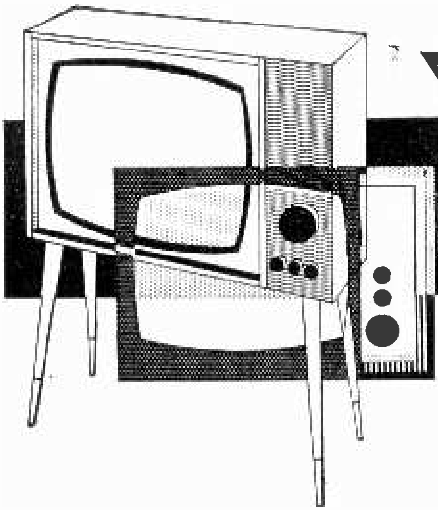
The switch S2 should be set to the 1μs range and ten minutes allowed for warming-up.

Select one of the three highest time-base speed ranges by means of S1, and adjust the brightness control so that a row of markers appears on the tube face. Use focus and astigmatism controls as necessary. Apply the output of a signal generator, set to 1 Mc/s precisely, to the Y input, and adjust sync and attenuator controls, and time-base speed control, to obtain a steady trace, with three or more sine-waves displayed. Adjust the core of L1 until a marker dot appears at the same point on each wave. If about 20 waves are displayed it can readily be seen whether the line of marker dots is parallel with the base line of the display.

The same process is repeated, using a lower time-base speed, for display of the 10μs markers. The signal generator input should be at 1100kc/s. If the signal generator does not go as low as this, set to 200kc/s and see that a marker dot appears on alternate sine waves.

If no signal generator is available, stray radiation can be picked up on a domestic receiver tuned to 1 Mc/s or the long-wave Light Pro-

—continued on page 45



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

R.G.D. DEEP 17C

Quite suddenly the whole set went dead; no sound, vision or timebase whistle.

I have since restored the sound by replacement of the EB91 detector and limiter valve. The timebase whistle is also present once more but the screen remains blank apart from a white line across the centre of the screen, about $\frac{1}{4}$in. in width.

I have changed the PY81, the PL81 and the PCF80 line oscillator but have not corrected the fault. The height control has no effect on the white line.—J. Obress (Ipswich, Suffolk).

The trouble lies in the frame timebase. You should check the PCL82 in the centre of the chassis under the tube, its associated components, and voltages to pins 6, 7 and 1, etc.

PETO SCOTT 1719T

Previous to the complete loss of picture on this set, the frame hold control had to be turned fully clockwise to keep the picture relatively free from rolling. Also the linearity control had to be fully advanced and a dark $1\frac{1}{2}$in. wide strip which had appeared at the bottom of the screen, was not affected by adjustment of R52.

A faint " click " was all that preceded the complete disappearance of the picture. The line whistle and e.h.t. are both still present. Increasing the brilliance only produces a faint blur on the screen.

I have substituted V6 with V10 and V17 with V19, but without success. I have also checked all components associated with these valves but all were in order.—N. Colville (London, S.E.24).

You do not say whether or not the EY86 lights normally. If it does, the e.h.t. and line timebase can be cleared of suspicion, the attention then being directed to the tube base voltage, setting of the ion trap magnet etc. If however, the EY86 is not glowing properly, check the boost line 0·25μF capacitor, width components, etc.

The original frame timebase trouble was presumably caused by V10 and (or in addition) R47, but C48 and R57 should also be checked.

ALBA T866

The fault occurs on sound only and takes the form of a buzz or hum superimposed on the sound, with accompanying distortion. The fault is intermittent and is not affected by alteration of the volume control except that at low volume setting it worsens. The fault appears on both Bands and can sometimes be cured temporarily by changing the Band selector switch. However, alteration of of the preset channel tuning controls has no effect. Another temporary cure is to turn the volume control quickly to its maximum and then back to normal.

The first attempt at a permanent cure was the replacement of the sound detector valve, but this had no more effect than the replacement of the PCL82 sound output valve which was next tried. I obtained from the manufacturers a plug-in exchange amplifier panel which I inserted in the set with the original valves. Again, however, no better results were obtained and the final attempt of changing the PCF86 tuner valve also drew a blank.—W. A. Toner (Belfast, 6).

We notice that your letter makes no mention of the EF80 sound i.f. amplifier (try interchanging this valve—V3—with V6, the vision i.f. valve).

If this makes no difference, concentrate on the sound circuit components which are not on the panel. This includes the volume control (check goodness of chassis or earthing connections), output transformer and C56 (50μF) which could well be at fault. Check the connections and earthing of these components.

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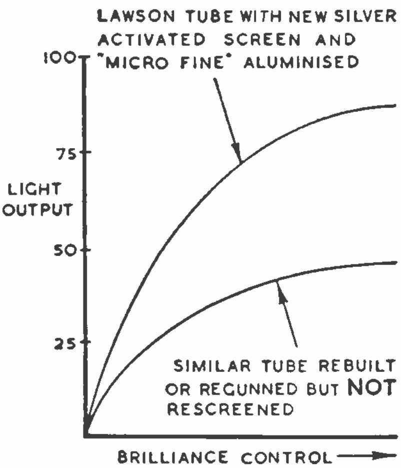

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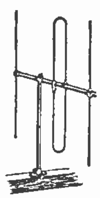

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NEWNES

BUSH TV 53

The fault in this set lies with the e.h.t. Whenever the set is switched on, the screen remains blank and the sound is "warbled". I can restore correct e.h.t. by disconnecting the line deflector coils. With the deflector coils in circuit, I can draw only a very small spark from the final anode lead.

I replaced the EY51 and a PCC82 which was found to be faulty. All other valves checked o.k. —Herbert Graham (Belfast, 13).

You should replace the 0.1μF boost line capacitor under the right side chassis. Trace the front end lead from the scan coils to it, where it joins with a 100kΩ resistor at one end and a 12Ω resistor at the other.

MASTERADIO T917

Could you please tell me if this set can be converted to receive ITV transmissions, and if so, which tuner must I obtain?—N. Innes (Dysart, Fife).

A tuner is not generally available for this model but one can be wired into the circuit. This will require a separate heater transformer for the tuner valves. The first 10F1 valve in the set should be removed and a 220Ω resistor (3W) connected in place of the heater across tags 1 and 8 on the holder.

The triode section of the 10C1 frequency changer should be disconnected and the pentode section should be used as a low-gain i.f. amplifier. The grid (pin 6) should be disconnected and a 100Ω resistor connected between it and chassis. The tuner signal i.f. should be applied to that grid (inner conductor of the tuner output cable) and chassis (outer conductor). The inner conductor should be connected in series with an 0·001μF capacitor.

The sound i.f. is 23·25Mc/s and the vision i.f. 19·75Mc/s, so a tuner capable of giving these i.f.s is essential.

SOBELL T171

I am unable to obtain a raster or any illumination on the screen of this receiver. I have recently changed the MW43-64 c.r.t. and the V8 (PL81), V9 (EY51) and V10 (PY81). As far as I can, I have checked that all valves are functioning as normal and that the e.h.t. transformer is in working order.

By removing the final anode connection of the c.r.t. and testing, satisfactorily, for a spark, I have assumed that e.h.t. is present.—H. Bray (Ascot, Berkshire).

Check the setting of the ion trap magnet on the tube neck. Adjust this for maximum screen illumination—with the brightness control advanced two-thirds of its travel—by moving the magnet up and down the tube neck while, at the same time, rotating it.

If illumination still cannot be obtained, suspect trouble in the tube biasing circuits. Check the brightness control and the video amplifier stage. Ensure that the tube grid can be reduced to about 5 to 10V negative with respect to cathode with the brightness control turned fully clockwise.

EKCO T164

I wish to replace the c.r.t. in this set and I wonder if you could let me know the correct procedure for the operation?—H. Bourne (London, N.E.10).

First unplug all connecting leads between the tube cradle and chassis. Then remove the chassis.

Turn the set upside down and release the tube cradle and take off the perspex mask and rubber dust seal. Unclamp the tube bowl, and withdraw the tube from the cradle, noting the position of the e.h.t. connector and the sense of the scan-coils.

Reassemble in the reverse order.

COSSOR 921

This set has developed a line timebase fault. The screen shows two pictures; one superimposed on the other.

Any adjustment to the line hold control causes the picture to break up, and the line linearity control has no effect whatsoever.

I have changed V7, V8 and V9 without curing the fault.—R. F. Tolley (Wildoen, Stourport-on-Severn, Worcestershire).

The symptoms denote a high line oscillator speed, and this is usually due to faulty line blocking oscillator transformer.

REGENTONE 173

Recently the picture brightness on this set decreased on both BBC and ITA and the contrast control had to be advanced to make the picture viewable. Now, however, the fault has worsened and the picture is hardly visible at all.

I have tested by substitution the PCF80, the EB91 and the EF80's, but the fault remains.—D. M. Flatters (Norbreck, Blackpool, Lancashire).

You should check that the ion trap magnet on the neck of the c.r.t. is set for maximum brightness of picture. This can be adjusted by rotating the magnet and moving it to and fro along the tube neck, while observing the screen with the brightness control two-thirds on. If this does not improve the brightness, yet the picture (as dim as it is) is in good focus, the tube may be low emission.

BAIRD C5621

The line hold control on this set will not keep the picture steady as at the slightest adjustment the screen becomes a mass of lines. Occasionally I can get a fair picture, but this does not last more than a few moments before the top of the picture shifts, followed by a complete break up once more.

I have replaced a number of suspect valves and checked the rest by substitution.—A. C. Street (London, S.E.14).

You should check the 300pF capacitor to pin 5 of the 20P4, the 68kΩ resistor from pin 2 of the 10C2 and the 100kΩ resistor to pin 5 of the same valve.

Check the 10kΩ hold control and series 680Ω resistor if necessary; also the 2μF electrolytic capacitor.

MURPHY V470

I have recently moved from Hampshire to my present address and I have bought a set of new coils to enable this set to receive BBC and ITA programmes which are on channels 1 and 9 in this area. Could you please supply the details for fitting the coils?—W. L. Crocker (Marlow, Buckinghamshire).

Disconnect the set from the mains and remove the small card panel on the back beside the aerial and the curved tuner cover inside.

Remove the present BBC and ITA coils and fit the new ones in their place. Replace the covers, connect the supply and aerial, and tune the coils from beneath the cabinet via the small hole and using a plastic trimming tool.

PYE 17T

I wish to replace the tube in this set and I would like to know if the MW43-80 can be substituted for the MW43-64 which is the set's original c.r.t?—H. Goodlad (Sheffield, Yorkshire).

We would inform you that the MW43-80 will not replace the MW43-69. The scanning angle is different and the neck much shorter.

FERGUSON 992T

Both picture and raster are absent on this set, and the sound, although present, is not as strong as normal. The contrast control affects the sound but the screen remains completely blank.—P. V. Groom (Bintree, Dereham, Norfolk).

You should suspect lack of e.h.t. voltage on the final anode of the tube. If the line whistle is weak and the PL81 gets very hot, suspect shorting turns in the line output transformer.

BUSH TV 86

I recently fitted a new LW15 rectifier to this set and I now find that the picture is somewhat extended at the top.

No adjustments to height, width and frame linearity controls affect the picture.—O. Greenwood (Skewen, Neath, Glamorgan).

There is a top linearity preset control on these receivers, but if alteration of this does not help matters, change the PCL82 (top right) frame output valve and its 360Ω cathode bias resistor and 100μF cathode electrolytic capacitor.

TEST CASE -11

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.

? *An experimenter was called in by a friend to clear a sound distortion fault, on a five year old set, which had been developing gradually for some time. The distortion was found to be present at all settings of the volume control while the picture was perfect in all ways.*

Having had quite a bit of experience on the servicing of broadcast receivers for this kind of trouble, the experimenter immediately suspected poor insulation in the a.f. coupling capacitor to the control grid of the sound output valve. This was proved to be in perfect condition. Subsequently both the valve itself and the grid bias were proved to be normal, and there was little doubt that the a.f. amplifier stage, being fed from the sound detector, was operating quite satisfactorily.

What was the most likely cause of this trouble, and what method could be adopted to prove the diagnosis?

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

SOLUTION TO TEST CASE 10

(Page 571 last month)

One of the biggest single troubles of disturbed interlace is the shattering surge of current which is induced into the frame oscillator circuits during the line flyback. On most modern sets, various artifices are employed to prevent the line pulses getting back into the generator, while adequate decoupling and the use of large value electrolytic capacitors avoids the h.t. voltage applied to the frame circuits, jumping too much when the line flyback occurs.

Nevertheless, a great amount of unwanted coupling between the line output stage and the frame oscillator or generator can take place if the screen or cage around the line output transformer and associated valves is insecurely clamped to the metal chassis after a servicing operation. Many cases of poor interlace are traced to this trouble.

Badly misplaced wires from the line output transformer to the various other parts of the circuit can also result in the symptom, particularly if leads carrying heavy line pulse current are routed around the frame oscillator circuits.

The experimenter who discovered that the interlace performance was bad after replacing the line output transformer should have given extra special attention to these points, particularly since the interlacing was very good before the repair.

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This coupon is available until OCTOBER 22nd, 1963, and must accompany all Queries sent in accordance with the notice on page 33.

PRACTICAL TELEVISION, OCTOBER, 1963

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The HENLOW OSCILLOSCOPE

—continued from page 37

gramme as necessary; in the latter case the second harmonic will be picked up. Set to zero beat with the Light Programme.

To adjust the marker oscillator on the third range, 100μs, a calibrated audio signal generator is ideally necessary. If this is not available the method given in the foregoing paragraphs cannot be applied and the procedure should be as follows:

Remove the can surrounding the marker oscillator assembly to secure access to the end of L3. Display about 30 or 40 waves at 100kc/s and check that every tenth wave is in the centre of the darkest part of the trace, increasing brightness if necessary to limit the dark areas caused by the marker dots; it should be possible to arrange this so that no more than three waves are blacked out. If necessary the tuning capacitance should be varied by substitution to obtain an accurate result. When this adjustment is completed the screening can should be replaced firmly. It may be soldered up if all is well, as it will need to be removed at most infrequent intervals.

Some constructors may feel that 1μs markers are too close together and would like to include a range of 100 or 200μs markers. The oscillator will work quite well with a tuning coil arranged to give oscillations at 5 or 10Mc/s at sufficient amplitude to modulate the cathode ray tube electron beam. The coil designed for 1Mc/s operation can, if the tuning capacitor is removed and the coil tuned only by strays, be adjusted to operate at 2Mc/s by rotation of the core.

It may be remarked that when the marker oscillator is in circuit the flyback trace is automatically blanked. While this has little effect on the lower speed ranges it has the advantage that flyback is not visible even at high brightness settings on the high speed time base ranges, and the flyback trace does not appear on photographic records at any time base speed.

The Voltage Calibrator

In order to relate the Y deflexion of the display to voltage input to the Y amplifier a simple calibrator is provided. This is not switched into the Y amplifier, as might be thought. The elegance of switching costs too much in input capacitance. Instead, a socket is provided on the front panel, to which either 1V peak to peak or 0·1V peak to peak can be switched at will. This may then be applied to the Y input socket through a short length of wire.

Referring to circuit diagram Fig. 2, it will be seen that a 6·3V r.m.s. supply is divided either by R28 or R30 or R29 and R30 depending upon the setting of switch S2d. 6·3V r.m.s. represents 19·8V peak to peak, and therefore R28 is 1,880Ω and R29 is 19,700Ω if R30 is 100Ω. These values should be selected from stock to 1%. The nearest preferred values are 1·8kΩ and 18kΩ.

Delay Lines

In the constructional details for the anode and grid delay lines (Part 3—August 1963) the diameter of the paxolin tube was not stated. This tube should have an outside diameter of ¼in. ■

OSCILLOSCOPE TIMEBASES

—continued from page 14

When trimming a circuit, after selecting the desired set for the Miller capacitors C to get the required range of speeds, the value of C1 wired to each switch position should be decreased until a brilliant spot at the right-hand end of the trace of the CRT is *just* no longer produced when the amplitude control in the grid circuit of the left-hand triode is turned to maximum timebase amplitude on the c.r.t. (lowest voltage on slider of potentiometer). C2 determines the flyback time and should be as small as possible for satisfactory operation. Its time-constant together with the suppressor-leak must, however, exceed the time-constant of the selected Miller capacitor C with the anode load Rx.

It may thus be necessary to use a third switch wafer to select appropriate values for C2, which will be in the region of a tenth as large as C and C1 or even less. If C2 is too large the circuit will rest unduly long after flyback before commencing another run; if C2 is too small flyback will be incomplete and the timebase will run at reduced maximum amplitude. The loss of useful output-amplitude due to the tap on the anode load of the Miller valve must be minimised by tapping C no further away from the anode than really necessary for stable multivibrator action. Experiment may show positions considerably closer to the anode than indicated in Fig. 13(b) to be quite usable.

Alternatively, the timebase output can be taken from the Miller anode instead of from the anode load tap. This gives greater sawtooth amplitude but also a correspondingly larger Miller step, which causes the spot on the c.r.t. to jerk forwards a large distance suddenly before commencing the uniform-speed trace. The ideal solution is to employ the arrangement virtually as shown in Fig. 13(b) and use subsequently one of the amplifiers described at the end of this article.

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