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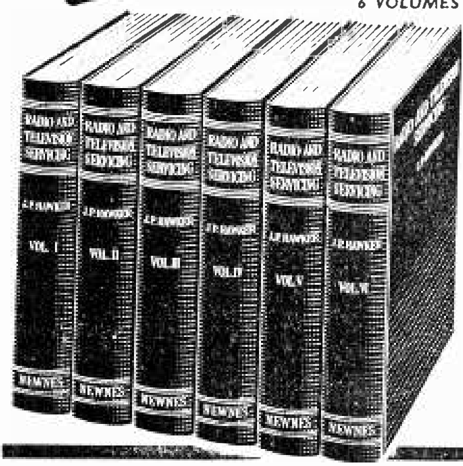

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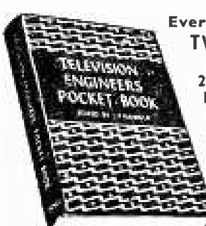

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Practical Television

AND TELEVISION TIMES

VOL. 13, No. 145, OCTOBER, 1962

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Contents

The Radio Show

WE were very gratified by the number of readers who visited the PRACTICAL TELEVISION stand at this year's show, and we were kept busy answering the many queries they brought with them.

Colour and 625-line television were, of course, inevitably major attractions this year, and we feel that this show will be remembered as the one that followed the publication of the report of the Pilkington Committee, for the television manufacturers at the show made it clear that their sets were already designed to meet the requirements of UHF transmissions.

As many of the readers who visited our stand have already heard, we have in hand several articles dealing with both the theoretical and practical aspects of UHF television, and these will appear in PRACTICAL TELEVISION in the near future. We will also keep our readers informed of new developments in this field, as such information reaches us.

Although colour and 625-line television probably managed to steal the show, we noticed that the G.P.O.'s exhibit always attracted a large crowd and a long queue seemed to be a permanent fixture outside its entrance. These visitors were no doubt waiting to see the communications satellite—like Telstar—which was featured on this stand.

DATA CHART

The Data Chart given away with this issue, is primarily for use in connection with the first of a new series of articles, beginning this month, called the Principles and Practice of Television.

In this new series the whole system of television broadcasting in this country will be explained so that the reader may more easily visualize the import of the imminent changes that are to be made to the system. So that the series will be all-embracing and complete within itself, and also as a means of bringing the newcomer to television into the picture, the basic principles of the television system are dealt with briefly in this first article.

However, the Data Chart will not automatically become of no further use immediately the series has finished, as the information it contains will be found of lasting interest and necessity by the amateur television enthusiast.

P.W. BLUEPRINTS

The latest series of *Practical Wireless* blueprints, which began in the October issue, is being continued in the November issue with two more P.W. designs, a pre-amplifier and a VHF tuner. Both these units have been designed for use separately or to form part of the hi-fi system, the first part of which was given on one side of the October blueprint, and was called the Strand Amplifier. These three units, and a loudspeaker enclosure which will be featured on one side of the December blueprint, will make up the complete system.

Our next issue dated November, will be published on October 19th.

Telenews

Television Receiving Licences

THE following statement shows the approximate number of Television Receiving Licences in force at the end of July, 1962, in respect of television receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland.

Region	*Total*
London	2,014,197
Home Counties	1,701,594
Midland	1,785,241
North Eastern	1,912,583
North Western	1,585,061
South Western	1,035,913
Wales and Border Counties	722,848
Total England and Wales	10,757,437
Scotland	1,096,207
Northern Ireland	185,999
Grand Total	12,039,643

TV Aids Prehistoric Shaft Excavations

CLOSED circuit television is being employed to save time and improve all-round control during archaeological excavations at the prehistoric Wilsford Shaft, near Stonehenge.

Excavations have already reached a depth of almost 100ft. in this shaft, which is quite unlike any other discovered in this country. It is 6ft. in diameter, vertical and extremely well engineered.

A closed-circuit TV camera situated at the bottom of the shaft and a television receiver in a hut at ground level—both supplied by EMI Electronics Ltd.—enable visual contact to be maintained at all times between the one or two operators who can work in the limited area at the base of the shaft and the remainder of the team above ground.

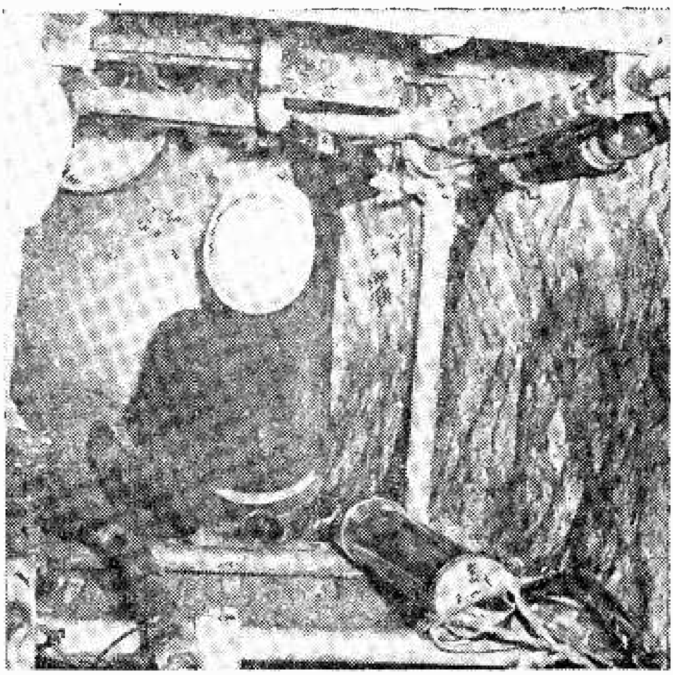
Use of this equipment saves communication time—the round trip to the bottom of the shaft and back takes 15 minutes—and enables the supervisor to make limited decisions, based on immediate appreciation of the difficulties of any new situation, without descending the shaft. It is also possible to take immediate photographs from the TV receiver screen of any finds which are in inaccessible positions and cannot therefore be quickly removed.

Middle Bronze Age urns and a shale ring discovered during the excavations suggest a possible date for the shaft of around 1500 B.C. Marks on the walls suggest that they were dug with antler picks and bronze axes, which were the tools widely used at that time.

New Television Station for Northern Ireland

THE BBC has placed a contract with J. J. Scallon & Sons Ltd. for the construction of the building for the new television and VHF sound transmitting station which is to be built on Brougher Mountain, nine miles north-east of Enniskillen.

This new station, which it is expected will be completed about the middle of next year, is one of several the BBC is building to extend and improve the coverage of its television and VHF sound services. It will serve some



At the archaeological excavations in progress at the pre-historic Wilsford Shaft, near Stonehenge, closed circuit television is being used to save time and improve all-round control conditions.

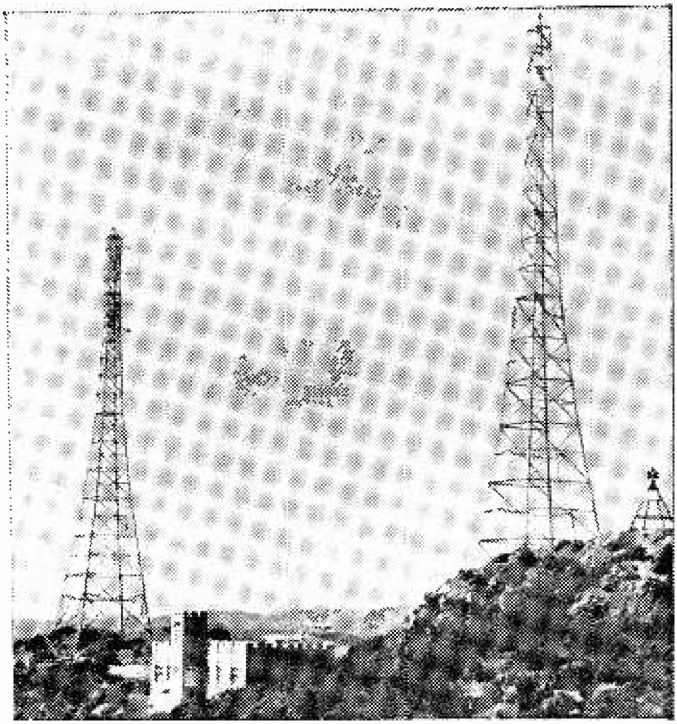
48,000 additional people and provide improved reception for a further 40,000 people living in Co. Fermanagh and the south-western part of Co. Tyrone.

Television Comes to the Channel Islands

SMALLEST television station in the British Isles—at St. Helier, Jersey—went on the air on Saturday, September 1st. It is expected that programmes immediately reach 28,000 of the 34,000 homes in the six main islands. There will also be 2,000 television receivers in hotels for the use of the many visitors to the islands.

Channel Television, contractor for the new station, placed the major contract for the principal items of studio equipment with EMI Electronics Ltd. These comprised two studio vidicon cameras, vision and sound mixing equipment, two telecine machines and the master control room system.

In view of the small size of the station many items of equipment have been designed for operation by a minimum staff. For example, joystick control of the camera channels enables them to be operated from the master control room instead of from the studio control room.



This illustration shows the Wellington television and sound broadcasting station of the New Zealand Broadcasting Service, which is already making active preparations for the visit of H.M. the Queen next year.

New Zealand Prepares for Queen's Visit

IN preparation for the Queen's visit next February the New Zealand Broadcasting Service has placed an order with Marconi's for the supply of another television outside broadcast vehicle.

Speed is the keynote in this instance, for the O.B. Unit has to be in New Zealand in time to cover the visit of H.M. the Queen in February next year.

The vehicle, which is for use at the Wellington television station, is to be supplied with three television for a fourth.

Films at the Radio Show

"STORY of a Network", the ITA's new documentary film, was released at the Radio Show, Earls Court. The film takes the building of the authority's new transmitting station and mast in the Prescelly Mountains in Pembrokeshire as an example and tells the story of the growth of Independent Television as a national service in eight years.

The cinema especially built for the show formed part of an extensive Authority exhibit. This also included a large animated relief map showing the extent of the coverage of Independent Television in the United Kingdom. A recorded commentary described the growth of Independent Television from its beginnings in 1955 to the present day.

"The New Journalism", produced by ITN, was a second film shown in the cinema.

Exhibitions in Australia and Malaya

DURING the latter part of August the latest television and other electronic equipment from EMI were shown to large crowds at exhibitions in Australia and Malaya.

Highlight of EMI (Australia) Ltd.'s stand at the Australia and New Zealand Association for the Advancement of Science Exhibition in Sydney, Australia, was EMI's new Type 8 closed-circuit television camera.

Colour television and educational television was demonstrated by EMI at the Radio and Television Exposition in Kuala Lumpur, Malaya, also held at the end of August.

New Scottish Television Stations

THE Scottish firm of Duncan Logan (Builders) Ltd. has been awarded the contract for the construction of the buildings for the BBC's new television and VHF sound relay stations at Fort William, Kinlochleven and Oban and the television relay station at Ballachulish. The aerial towers are being erected by the J. L. Eve Construction Co. Ltd.

Work on these stations is now in progress. The station at Fort William will be completed first and it is hoped that it will be ready for service at the end of this year. The remaining stations will be completed during 1963.

These new stations will extend the BBC's television and VHF sound service to some 16,000 people in the Western Highlands.

The PRINCIPLES and PRACTICE of TELEVISION

By G. J. King

REFER TO THE FREE DATA CHART, GIVEN AWAY WITH THIS ISSUE, WHEN READING THIS ARTICLE

IN this new series of articles the whole system of television broadcasting—as it is at present and how it will be in the future—will be reviewed and discussed in some detail.

Requirements

In any television broadcasting system there exists two distinct sections. Firstly there is the section which deals with the vision proper and, secondly, the section that is concerned with the sound accompaniment of the vision. Thus a television transmitter as a whole is made up of a sound transmitter and a vision transmitter, while a television receiver is made up of a sound receiver and a vision receiver.

In both cases one can operate without the other, but since there are various factors common to both sound and vision one section of the composite equipment often performs dual functions. Typical in this respect is the television aerial itself. When television was fairly new beginners often thought that the "H" type dipole aerial was so arranged that one of the vertical elements responded to the sound signal and the other to the vision signal.

This, of course, is not true as most of our readers will know, since only one of the vertical elements forms the aerial proper. This is called the "dipole" because it is in two half sections with the coaxial "downlead" to the set connected at the centre (see Data Chart). The other vertical element of the "H" type aerial is called a "parasitic element" because it is not connected electrically to the dipole but operates by reinforcing the signal at the dipole.

This gives the aerial "directivity"—that is, causing it to respond more in one particular direction than in the others. This means that the aerial can be "beamed" towards the required station and the pick-up of interfering signals coming in at the rear or sides is consequently reduced.

Further signal reinforcement and directivity are given, within limits, by extra parasitic elements in front of the dipole. these are called "directors," while the element behind the dipole is called the "reflector". Maximum pick-up of signal occurs on a line facing the directors and the overall response of an aerial is revealed by its "polar diagram" as shown in Fig. 1.

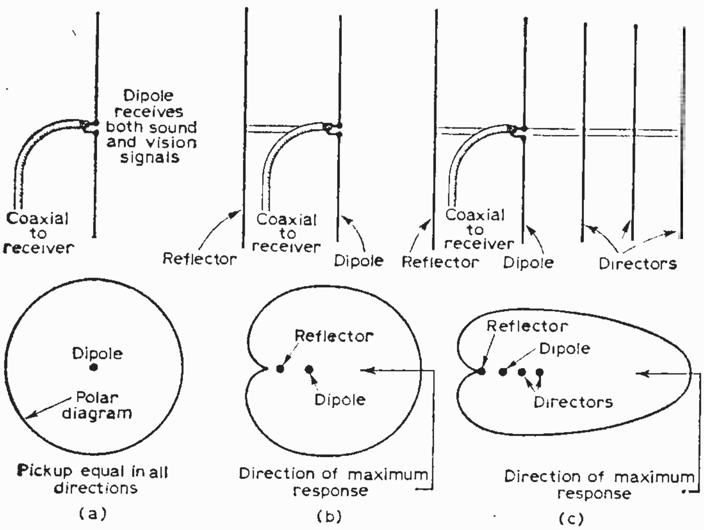


Fig. 1 (a)—Simple dipole aerial and its associated polar diagram. This kind of aerial has equal signal pick-up properties in all directions and, in common with all other types, responds as a whole to both the sound and vision signals. (b) The addition of a reflector behind the dipole alters the polar diagram of (a) and increases the forward gain at the expense of the gain at the sides and rear. (c) Even greater forward gain and directivity are given by the addition of directors in front of the dipole. A reflector is slightly longer than the dipole while the directors are slightly shorter. The length of the dipole itself is governed by the channel frequency.

Polarisation

At this stage it should be understood that while some television signals are "vertically polarised" others are "horizontally polarised". Vertically polarised signals require the receiving aerials to be mounted vertically, as with the vertical "H" type just considered. Horizontal polarisation, on the other hand, requires the receiving aerials to be mounted horizontally—that is, with an "H" type, for example, laying flat.

Most primary stations radiate vertically polarised signals, while secondary stations, which share the channels of the primary ones, use horizontal polarisation. The main reason behind this is to reduce as far as possible "co-channel" interference. This is where one station causes interference on another station sharing its channel number. Normally, stations sharing the same channel are spaced as far as possible away from each other, and under normal reception conditions cause little mutual interference, especially due to the extra discrimination given by the polarisation.

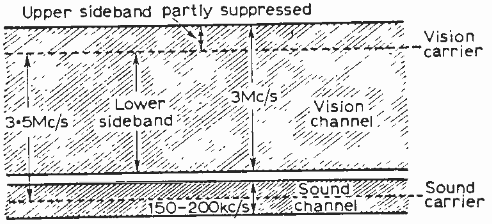
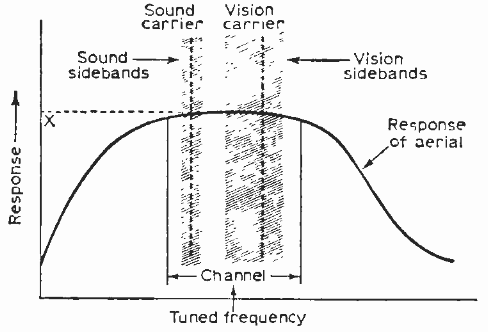


Fig. 2 (above)—Diagrammatical representation of a single sideband 405-line television channel.

Fig. 3 (below)—The response of a television aerial embraces the sound and vision signals equally.



Bands and Channels

The sound and vision parts of a television programme are carried from the transmitter to the receiver by signals in the very-high-frequency (VHF) bands. There are currently two such bands in use for television—Band I, which extends from about 41 to 68Mc/s, and Band III, which extends from about 174 to 216Mc/s. Each band is divided into *channels*, of which there are five in Band I and eight in Band III (see Data Chart). All five channels are used in Band I but only seven of the eight in Band III, Channel 6 not yet being clear for television.

Now each channel is sufficiently wide to accommodate the sound *and* vision carrier signals and also the extra space demanded by the sound and, particularly, the vision intelligence. The "carrier signals" themselves require very little spectrum room, but it is when these are "modulated" by the actual sound and vision signals, as originated by the microphone and the television camera, that considerable expansion occurs, thus calling for quite a lot of "elbow" room.

On all channels the vision carrier is 3·5Mc/s *above* the sound carrier and, with one exception, the vision carrier is 1·5Mc/s removed from the sound carrier of the *adjacent* higher channel. The exception is between Channels 1 and 2, where the spacing is 3·25Mc/s, which was necessary in the early days of television when Channel 1 carried a "double sideband" vision signal.

Single Sideband

In those days the vision carrier was allowed to spread out in both directions as the result of the modulation. It thus went about 2·7Mc/s above the vision carrier and 2·7Mc/s below the carrier for a picture of the greatest detail. Today, however, all stations use "single sideband" transmitters. This indicates that the whole of one sideband of the vision signal is transmitted, while a part of the other one is suppressed. As it is the lower sideband which is transmitted the system is sometimes called "lower sideband system", but since a "vestige" of modulation always remains in the upper sideband (it being impossible to eliminate all of the sideband) the term "vestigal sideband" may also be used.

A single sideband system shows a saving in spectrum space, of course, for although the carrier spreads out to around 2·7Mc/s below the carrier frequency on a picture of maximum detail it only expands to about 0·5Mc/s above the carrier frequency. With double sideband it would be impossible to accommodate five channels in Band I and eight in Band III because the carrier spreads out to 2·7Mc/s above and below.

Each channel is thus completely self-contained in terms of both sound and vision and is wide enough to handle the highest modulation frequency without adjacent channels breaking into each other. The sound modulation also causes the sound carrier effectively to "spread out" either side and on sound double sideband operation is adopted. This is because the bandwidth involved is so small —compared with vision—that single sideband operation would just not be worth the bother as there would be virtually no gain in spectrum space.

It should be made clear that the modulation in both cases is in terms of "amplitude" and *not* frequency. For those "conversant with the arts" it will be known that the modulation signal in relation to the carrier produces sidebands. Thus, if the carrier is on, say, 60Mc/s and the vision modulation frequency is, say, 2Mc/s, then an upper sideband of 62Mc/s and a lower sideband of 58Mc/s are created. But so far as vision is concerned we have already seen that most of the upper sideband is suppressed. What all this means is that the vision signals must have a channel of about 3Mc/s wide to work in, while the sound signals must have a channel of about 20kc/s wide. The diagram in Fig. 2 shows the make-up of a 405-line television channel.

Television is put into the VHF bands, for the higher is the frequency of the bands the greater the number of channels that can be accommodated. VHF also means that the one aerial can be made responsive over both the sound and vision carrier frequencies of a television channel. If this were not possible then two aerials per TV channel would be required—one for sound and one for vision!

Tuned Circuits

A television aerial is a tuned circuit. And like a more conventional circuit of that kind the dipole possesses distributed inductance and capacitance of values depending upon its length. Thus, its tuned frequency can be changed simply by altering its length. It is not a very sharply tuned circuit, which means that it will respond not only to signals falling at the exact frequency to which it is tuned but also to signals falling either side of the "nominal" frequency.

This, of course, is a good thing since it allows the one aerial to pick up both the sound and vision signals on a specific channel. Moreover, it ensures that even the highest sideband of the vision signal is catered for without attenuation. The idea is shown in Fig. 3. Here it will be seen that the top of the aerial response curve is fairly flat over the entire frequency of the particular channel for which the aerial is designed. Thus, the response "X", as indicated, is reasonably consistent over the whole channel width.

It will be seen that the response of television aerials does not just drop to zero either side of the channel but gradually falls with frequency off tune. This means then that an aerial designed, say, for Channel 4 would also work to some degree on Channels 3 and 5. Why this is so is shown in Fig. 4. The response to the adjacent channels falls on the sloping sides of the response curve and for that reason the sound signal on the upper adjacent channel will have a greater response than the vision signal, while the vision signal on the lower adjacent channel will have a greater response than the sound signal. Thus, by the use of an incorrect aerial not only will the overall response be less than it need be but the sound and vision signals will be considerably out of balance.

Most Band I aerials are designed for only one channel, but some Band III aerials are suitable for two or three channels. This is because at Band III frequencies the aerial tuning is even less sharp than it is on Band I. Thus. the response curve has a flatter top over a wider range of frequencies as shown in Fig. 5.

VHF Tuner

So far then we have seen that the aerial produces sound and vision signals and that, generally, a separate aerial is required for each channel; further that the aerial must be orientated to suit the polarisation of the signal. It is, of course, practice to receive two stations, one under the control of the BBC and the other under the control of the ITA.

To avoid two coaxial downleads the two aerials are usually combined either "electronically" (e.g., as in a combined Band I/Band III aerial) or by means of a filter, sometimes called a "diplexer". Whichever method is used two vision signals and two sound signals are fed to the tuner in the receiver through a common downlead as shown in Fig. 5. It is, therefore, the job of the tuner to select the channel which is required.

Indeed the tuner handles the signals in terms of complete channels (e.g., sound plus vision) rather than in separate sound and vision signals. This, then, is something else which is common to both the sound and vision of the system generally.

As shown in Fig. 5 the tuner is made up of three distinct sections, the VHF amplifier, mixer and local oscillator. It is the job of the VHF amplifier to lift the very weak aerial signals to a level which is suitable to operate the mixer, and this it does while producing the smallest possible amount of "noise" with either a single or double-triode valve.

Frequency Changer

The mixer and local oscillator sections together form the "frequency changer" and a single valve is usually employed for this operation.

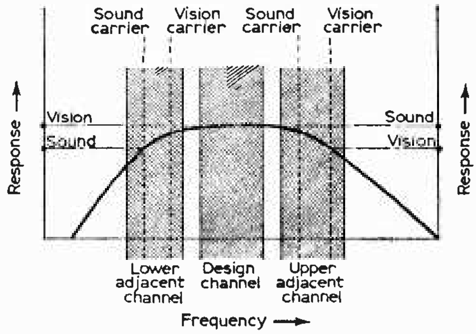


Fig. 4—If an aerial tuned to one channel is used on an adjacent channel, the response to the sound and vision signals will be uneven and the vision sidebands will be distorted.

It is the job of the frequency changer to alter the incoming VHF signals, irrespective of their frequency, to a consistent "intermediate-frequency" (I.F.). Thus, whatever channel is tuned in, the frequency of the signals at the output of the tuner will always be the same.

What happens is that the local oscillator itself produces a signal which is removed by a fixed amount from the frequencies of the sound and vision signals of any channel. The mixer then receives three signals, the sound and vision signals of the selected channel plus the oscillator signal. Now when three signals are fed to a mixer stage a selection of signals at differing frequencies occur at the output.

Let us take the case of the signals on one particular channel, say, Channel 4. Here the sound is at 58·25Mc/s and the vision at 61·75Mc/s. If we set the local oscillator at, say, 95·75Mc/s we get, at the output of the mixer, three primary sound signals: (i) at the actual frequency (58·25Mc/s), (ii) at the oscillator frequency *plus* the actual frequency (145Mc/s) and (iii) at the oscillator frequency *minus* the actual frequency (37·5Mc/s). We also get three primary vision signals: (i) the actual frequency (61·75Mc/s), (ii) the oscillator signal *plus* the actual frequency (157·5Mc/s) and (iii) the oscillator signal *minus* the actual frequency (34Mc/s). The signals which are selected by the mixer output tuned circuit are (iii) in each case. This then is the I.F., which is sound 37·5Mc/s and vision 34Mc/s. This is known as the "standard I.F." since it is the combination which has been found to give the least interference troubles and is used—with very small differences—in almost all recent models.

There are two important things to remember. One is that the local oscillator signal is *above* the frequency of the incoming signals, and the other, which is a function of the first, is that the sound I.F. is *above* the vision I.F. even though the sound signal is *below* the vision signal at the input of the tuner. This reversal effect is caused because the local oscillator is higher than the signal frequencies. It should also be observed that even at I.F. there exists the 3·5Mc/s spacing between the sound and vision carriers.

The tuner also contains switchable coil sections. There are usually three such sections for each channel which, in the case of turret tuners, are carried on two coil "biscuits". The "aerial" biscuit carries the inductance for the input of the R.F. amplifier along with the coupling winding for the aerial, while the mixer/oscillator biscuit carries the winding for the anode circuit of the R.F. (e.g., VHF) amplifier, the winding for the input of the mixer (coupled to the first in a bandpass arrangement) and the winding for the local oscillator. The VHF coils for the R.F. amplifier and mixer stages are damped with resistors so that the overall

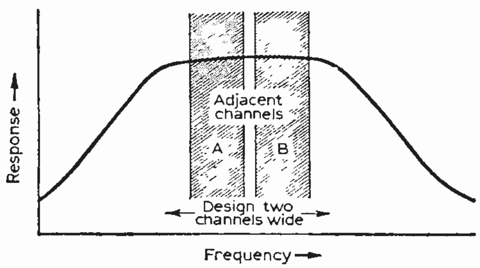


Fig. 5—Some Band III aerials are capable of responding fully to more than one channel, as this diagram shows.

response curve per channel is rather like that of the aerial, where both the sound and vision signals (and their sidebands) are fully embraced. These coils are tuned by their self-capacitance and sometimes by small fixed capacitors and trimmers. The former of each coil section carries a small brass core which can be adjusted to put the "nominal" tuned frequency at the centre of the particular channel.

The oscillator coil is tuned in a like manner, but across it there is also connected the "fine tuning control". This enables the operator to adjust the local oscillator to the exact frequency required to give the correct I.F.s in relation to the subsequent I.F. amplifiers and vision I.F. passband characteristics.

On turret tuners sets of coils are clipped on a revolving turret, the turret being mechanically coupled to the channel selector knob. Thus each channel has its own set of coils with the oscillator always being adjusted to give the required I.F. output.

Still another type is the "incremental tuner". Here small, self-supporting coils sections are carried on the contacts of rotary switch wafers and the switch selects the coils in small "increments" of frequency corresponding to the various channels in the two bands.

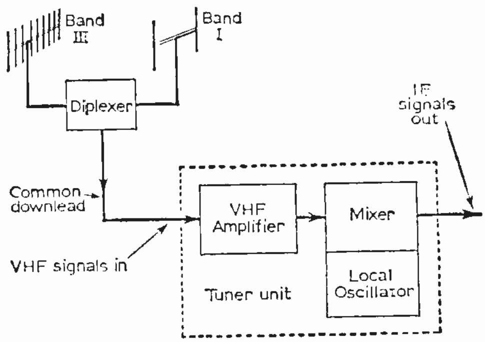


Fig. 6—The tuner changes the sound and vision aerial signals to lower frequencies, called intermediate frequencies. These are consistent, irrespective of the channel in use.

UHF Channels

The Pilkington Report and the subsequent White Paper on the future of broadcasting issued by the Government have made it clear that all new programmes of the future will operate in the UHF bands. There are two bands in this range, called Bands IV and V. Band IV extends from about 470 to 585Mc/s, while Band V extends from about 610 to 960Mc/s.

Thus, in addition to having facilities for 625-line operation all new receivers include either a UHF tuner (in addition to the VHF tuner) or facilities for fitting such a tuner when required. This type of tuner differs substantially from those used at VHF and some now available consist of an "earthed grid" R.F. amplifier followed by a self-oscillating mixer. At UHF the mechanical stability of a tuner unit is of prime importance.

The correct input impedance for the aerial is secured by the use of a wideband, π-filter input, and on some models there are alternative inputs for balanced or unbalanced downleads (e.g., twin feeder or coaxial), but at this time it would seem that coaxial will be standardised on UHF as it is on VHF.

As with VHF tuners, this type of UHF tuner gives an output at either the "standard" I.F. or at the CCIR standard, the latter being 33·4/38·9Mc/s. There are several ways of coupling a UHF tuner to a VHF receiver and these will be discussed in a subsequent article.

(To be continued)

Don't miss the second article in the series "Principles and Practice of Television", which will appear in the next issue of "*Practical Television*" and which will deal with UHF propagation and line standards.

SERVICING TELEVISION RECEIVERS

No. 82—ALBA T394 and T484

By L. Lawry-Johns

A LARGE number of these receivers are still in use and we regularly receive requests from readers asking us to identify this model and similar ones in the Alba range of the 1953 period. Most of them by now have been fitted with tuner units of the Cyldon P16H or Brayhead 16s type for dual band reception and where this has been done, V1 is replaced by the tuner R.F. plug and V2 by the Mixer plug or adaptor, thereby rendering T1, L1 and L2 coils inoperative. We present in this article, however, the original layout and circuit where T1 is the aerial coil, L1 the R.F. coil and L2 the oscillator coil—all tunable over the five BBC (channels 1-5) frequencies on Band I.

Associated Models

The models T301, T304, T494 and T504 are

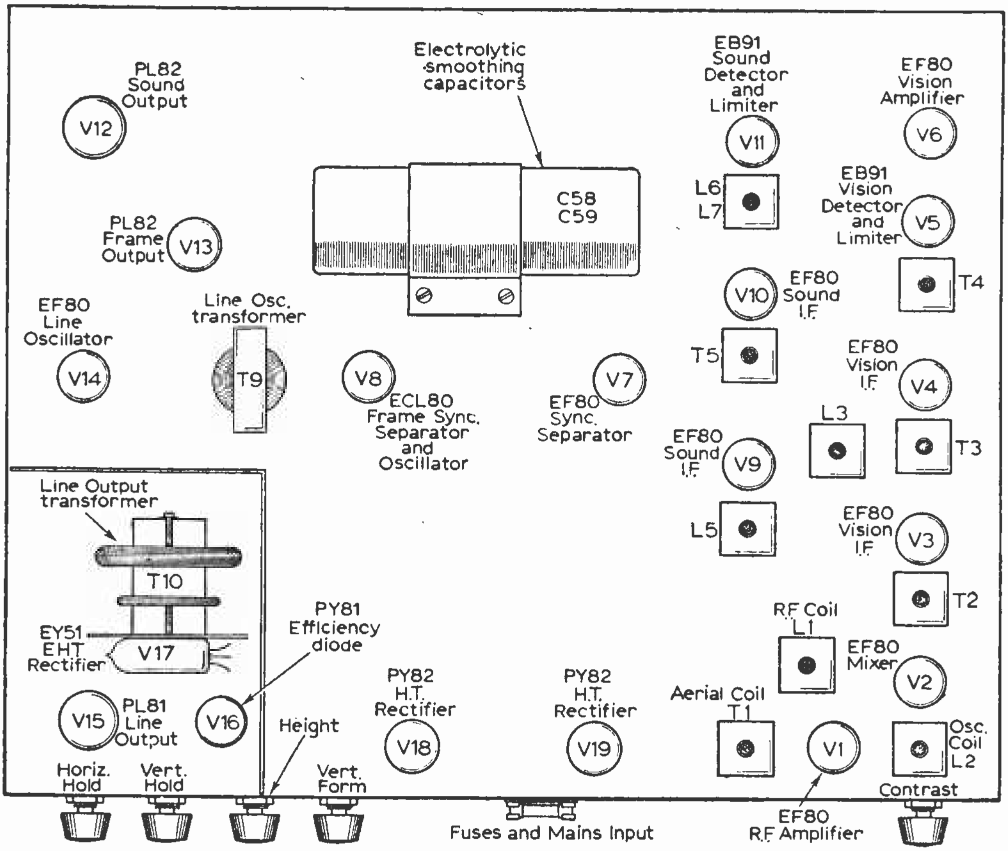


Fig. 1—The top chassis view showing the layout of the valves and coils.

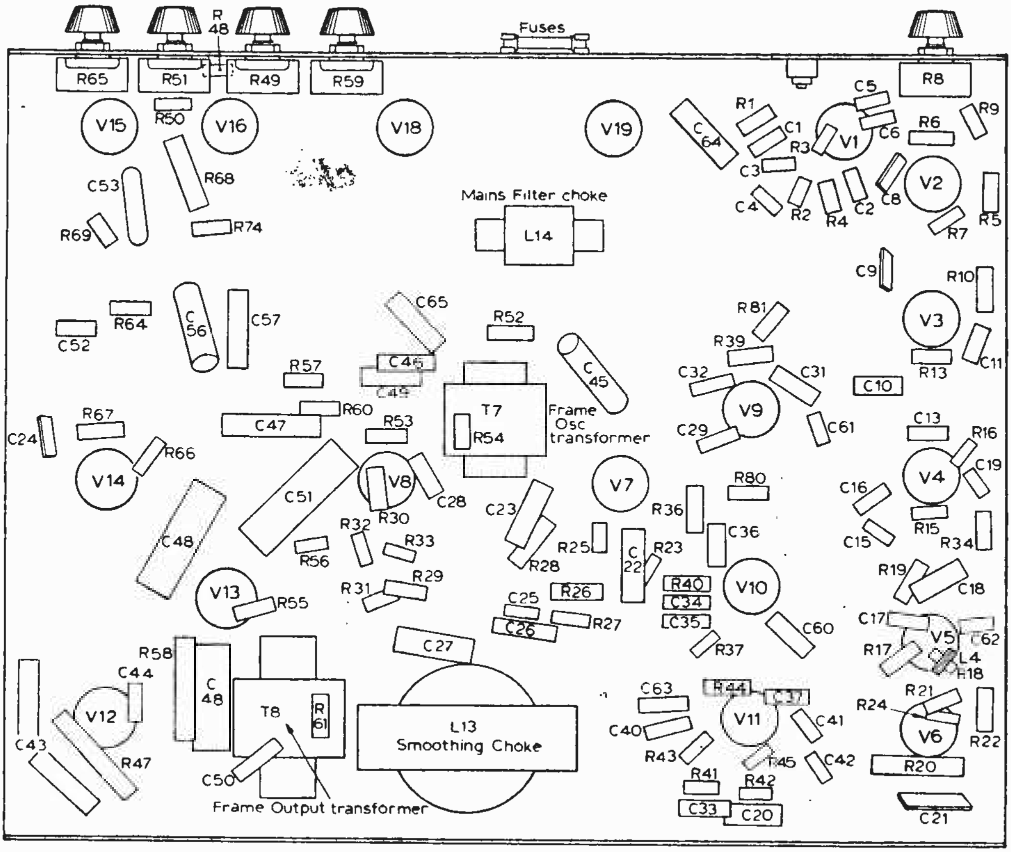


Fig. 2—The underchassis view.

very similar and differ only in small details. For practical purposes the circuit and layout is the same. The circuit is quite simple and straightforward and the sound and vision stages rarely give trouble.

Trouble Spot

When things do go wrong, it is usually the line output stage which is at fault. Such symptoms as: distinct rulings down the left side of the screen, one side compressed, the PY81 or the PL81 valve red hot, usually point to a faulty component in the line output stage most often under the scanning coils.

Resistors R70, R71, R72 and R73 should always be checked when the symptoms of striations (vertical rulings down the left side) or uneven expansion or compression are evident. Shorted components in this section can also cause complete line timebase breakdown and the PL81 valve to appear red hot. This latter condition will also be obtained if there is a fault in the line oscillator circuit or if there is a short inside V15 itself. To put this more clearly, if V15 is running red hot, first ensure the oscillator is working. A faint whistle should be heard and a negative voltage should be obtained at pin 2 of 14V (EF80). If the stage is not oscillating check the H.T. voltage (195V) at pins 8 and 9. If there is no reading check the continuity of the T9 windings. If the voltage is present, check V14 and the grid circuit components. If there are oscillations but no drive to the PL81 control grid check R67 (820k) which can "go high," and C68 for leakage. If the drive is present and the PL81 is not defective, the line output components should be checked.

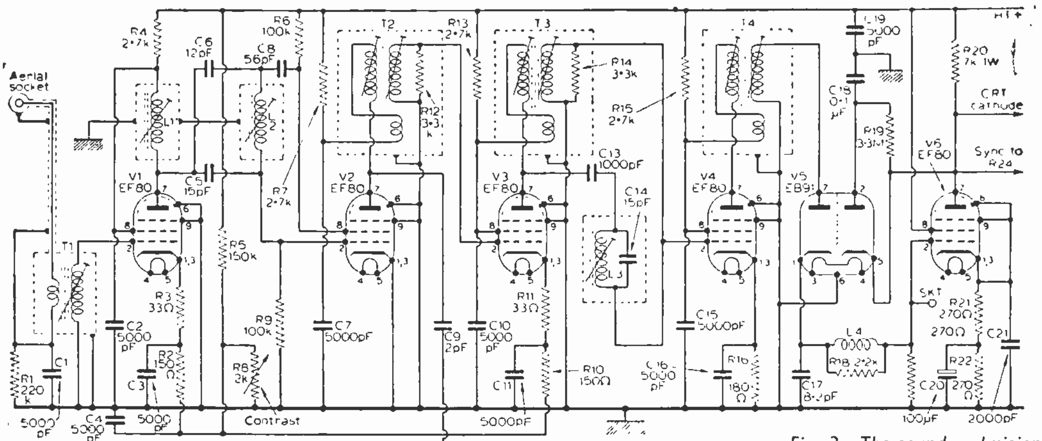
If C54 (100pF) becomes shorted, R71 and R72 will rapidly overheat, probably change value and cause first one side of the picture to become compressed and then cause complete collapse of the line output stage.

Lack of Width

Lack of width is normally due to a low emission PL81 valve, but the 820k (R67) anode resistor of the oscillator V14 should also be checked and the H.T. voltage which should be 195V as shown on the circuit diagram.

No EHT

If there is no raster displayed when the brilliance is advanced and tests show that the EHT is absent, note whether the EY51 (V17) is lighting up and whether the line timebase whistle is audible



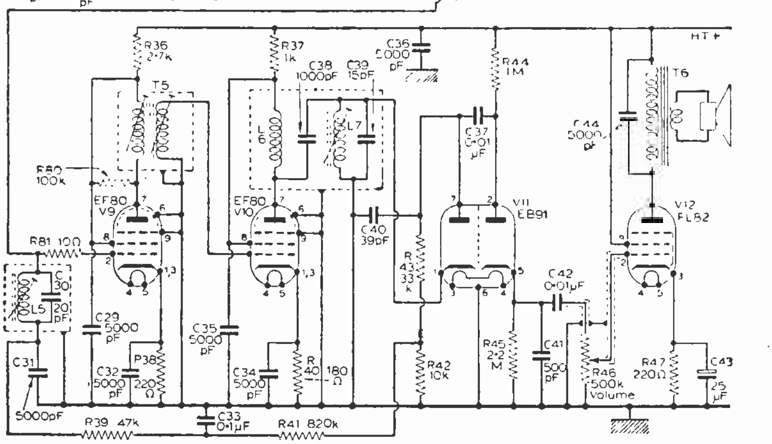


Fig. 3—The sound and vision strips.

400V as specified. If the voltage at pin 10 is correct check the pin 2 voltage which should vary from nil at minimum to about 130V at maximum. If the voltage remains low at maximum, check R34 (22k) and the brilliance control itself (50k). The pin 11 voltage should be 100V. If much higher than this check V6 (EF80), R20, R21, R22, etc.

Excessive Brilliance

When the pin 11 (cathode) voltage of the tube base is very low and R20 is overheating disconnect the lead to pin 11 and if this restores normal video anode voltage the tube is at fault with a heater-cathode short. If the tube is to be retained the heater must be supplied from a 6·3V heater isolating (low loss) transformer. Check V5 or disconnect the video anode lead from it, if the tube is not at fault. Also check C21 and C20 if the voltage is present but fairly low. If the pin 11 voltage is correct check pin 2 which if high may denote a faulty brilliance control, open circuit at the chassis end.

Frame Troubles

A horizontal white line across the centre of the screen will denote a failure in the frame timebase. Check V13 (PL82) and V8 (ECL80). If in order ensure that H.T. is reaching pin 7 of the PL82. If H.T. is absent check T8 winding for continuity. If the PL82 is properly supplied check the ECL80 base voltages particularly at pin 1; if absent check through to the height control. When the voltage is present at the junction of R52-C45 and T7 but absent at pin 1, T7 is at fault. When the voltage is absent at the junction of R52-C45 but present at R52—height control—check C45 for shorts. If voltage is only present at one tag of the height control R49, the control is open circuit.

(To be continued)

or not. If not, check the PL81 and note whether it is overheated as described above. If it is not overheated and the boost line voltage is low (it should be over 400V) check the C56 0·1μF boost capacitor and the line output components as previously described. If the line whistle is quite clear check the anode end of the EY51 which should provide a healthy spark to any offered metal object. If all is well up to this point the EY51 itself is most likely to be at fault. Complications occur when the EY51 is internally shorted as this has the effect of overloading the line output stage but this can be checked by removing the EHT lead from the tube when the circuit will come to life and the spark from the free end of the EHT lead will have a flame-like quality as opposed to the normal thinner blue D.C. spark. If the spark is normal and the EY51 is in order check the tube itself for inter-electrode shorts.

Dark Picture

If the brilliance control has to be fully advanced, check the tube base voltages as the capacitor C57 (0·02μF) often becomes shorted thus dropping the first anode (pin 10) voltage down to that of the H.T. line, i.e. 195V instead of over

A GENERAL PURPOSE Q-METER

By D. R. Bowman

(Continued from page 579 of the September issue)

THE colour coding of the leads from the thermocouple used in the Q-meter must be noted carefully. The green coded leads are for R.F., while the red and black leads are for the meter movement. The heater resistance is 10Ω, the couple resistance 2Ω, the couple output 15mV open-circuited, while the maximum current is 50mA. With thermocouples, the overload capacity is very limited—here only 50%. Fuses cannot be used to protect them, and therefore very great care has to be exercised. The measured capacitance between the heater and the thermocouple is only 0·4pF, and hence in the low impedance circuit used with it, leakage of R.F. into the meter movement is not a problem.

The above discussions will have indicated that in this instrument the constructor will have not only a Q-meter but also an accurate valve voltmeter, a test oscillator, a resonance indicator, a means of measuring the inductance of coils, a calibrated variable capacitor and incidentally a meter for measuring low R.F. currents. This seems good enough value for the small cost of building it!

Notes on Construction

The layout of the various circuits comprising the Q-meter is by no means critical, providing a few reasonable precautions are taken. The valve voltmeter, being purely "D.C.", can be put anywhere so long as it is arranged that its input terminal is close to the capacitor which resonates the coil under test. The oscillator must be very well shielded, and in the prototype occupies a totally enclosed box at one end of the chassis. Very good decoupling is also needed to prevent R.F. from leaking into the remainder of the circuit, whence it can be radiated or fed inductively into the coil under test. There is not quite the same need for perfect shielding that is encountered in a signal generator, so it is here quite allowable for metallic control spindles to emerge from the oscillator compartment, and double screening is not needed.

Printed circuit construction has been used in the prototype, and a suitable circuit template is shown in Fig. 6. Those who do not wish to use this type of construction will however find that a metal chassis serves quite well instead.

If printed circuit construction is employed, it will be found necessary to mount the valves on the same side of the board as the main components if the use of very long spindles is to be avoided and the depth of the instrument retained within reasonable limits. To accomplish this economically, ordinary valveholders were stripped of the metal surround, and the socket tags were soldered direct on to the connections on the circuit board. This involves remembering, when wiring up, that the order of the valve pins is apparently mirror-imaged. Inspection of the template given in Fig. 6 will show what is meant.

The oscillator valve has to supply a maximum of about one hundred milliwatts of R.F. power to the thermocouple. If used in a conventional grid-current oscillator, a small R.F. pentode of the EF80 class would do well, but here the oscillator has to work as a class A amplifier—which is much less efficient. Consequently a small output pentode is used—an EL91, which is obtainable cheaply from many advertisers in this journal. This worked well within its rating, strapped as a triode, and so overheating is minimised and with it the frequency stability is improved.

The operation of the amplitude limiting arrangement is as follows. Referring to Fig. 3 (page 578 of the September issue), the normal bias due to VR1 is 4V which biases the valve as a Class A amplifier. The slider of VR1 is set at about 2V. As oscillations build up, nothing happens until the oscillation amplitude exceeds 2V, when the diode begins to conduct. The current through the diode passes also through the resistor R1 and develops a negative voltage across it which is added to the bias. This moves the working point of the valve towards a region of lower mutual conductance, and the amplitude of oscillations therefore begins to decrease. A steady state is eventually reached and, if the slider of VR1 has been properly adjusted, the valve acts as a Class A amplifier, working without grid current. In fact this does not quite hold good, because diode current flows instead which clips the peaks of the grid waveform. Some harmonic content of the anode waveform is therefore found, and indeed more than might be expected because the "triode" characteristic curves are not quite straight lines in any case. However, the resulting anode current is of sufficiently

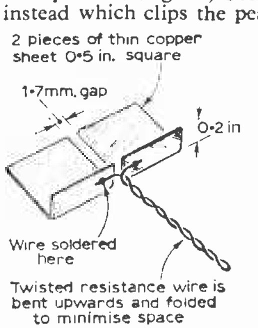


Fig. 5—The construction of the standard resistor.

pure "sine-wave" form for reasonable accuracy. Harmonics can certainly be found, but they are only small and may need a quite sensitive receiver to locate.

The utmost care is needed in constructing the R.F. current measuring section, and especially in making the standard resistor and its mount. The lead between the vacuum thermocouple and the standard resistor should be short—not more than about half an inch, for preference; this is not to avoid capacitive effects, which can be neglected in this part of the instrument, but to avoid the lead's being an appreciable fraction of a wavelength. If it were, the current through the resistor would be different from that recorded by the thermocouple meter. The standard resistor is constructed as follows. Two pieces of thin sheet copper or brass each 0·5in. square are cut and placed side by side on a flat surface. The distance between them is adjusted to be 61·7mm as exactly as possible, and they are then pinned in position. A piece of 36s.w.g. Eureka wire is now cut to a length of about three inches, carefully straightened with the fingers, and laid across the copper lugs squarely and about 0·1in. below the top end of each sheet of copper. The resistance wire is then soldered to the copper, taking great care that the solder does not run on to the wire between the copper sheets (Fig. 5). If carefully constructed this standard resistor should be accurate to better than 2%. The wire is now coated thinly with shellac varnish or polystyrene cement and allowed to dry well. When quite dry but not brittle, the wire is folded exactly in half, and twisted gently but firmly so that an even and closely wound pair is formed. The loop at the end can then be closed up carefully with pliers. The idea is to ensure that the twisted wires enclose no area. The twisted wire is now gently bent back and forth upon itself to minimise the space occupied.

TABLE I

Values of R3 to R6

Range	Resistor
30Mc/s-50Mc/s	zero
9Mc/s-14Mc/s	33Ω
5Mc/s-7Mc/s	68Ω
800Mc/s-1,100kc/s	100Ω
450Mc/s-550kc/s	150Ω

Each copper lug can now be bent at right angles so that the part to which the resistance wire is soldered is 0·2in. high at most. If one of these lugs is soldered to the printed circuit board "earth surface" and the other—soldered to an isolated area of the laminate—is used as the R.F. connection to the thermocouple and the lead to the coil under test, the inductance of the mount can be exceedingly small. The lugs should be so placed as to be parallel and edge to edge, with not more than a millimeter between their edges. If a metal chassis is used, one lug can be attached to the surface by three or four small screws—one is by no means enough—and the other fixed to the chassis by a sufficient layer of contact adhesive or by sticking it to a small paxolin square bolted to the chassis. The lead to the coil under test and that to the thermocouple should be attached to the same point and as near to the point of attachment of the resistance wire as possible. Fig. 7 shows what is required. When in position the thermocouple may be calibrated, using D.C. and a D.C. milliammeter. The greatest care must be exercised to avoid overloading the thermocouple.

It should be noted that Eureka resistance wire is as easy to solder as copper. Manganin and any of the nickel-chromium alloys should be avoided as these are hard to solder and need special treatment.

The capacitor connecting the coil under test and

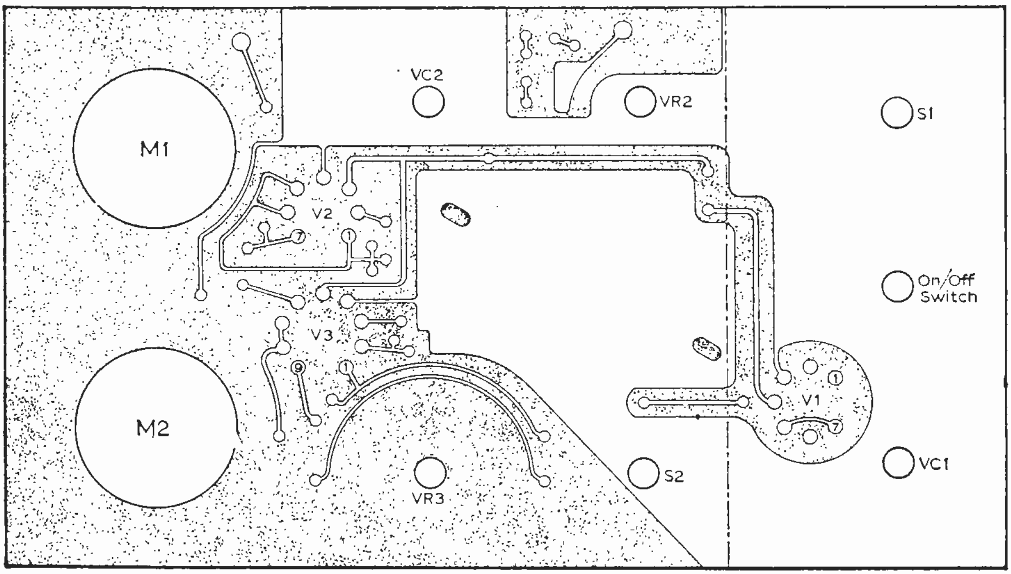


Fig. 6—The printed circuit.

VC2 to the valve voltmeter should be absolutely above reproach. If it leaks the slightest amount, a large voltage may be applied to the grid of one of the triodes in the valve voltmeter and this will prevent any reasonable operation of the meter. A mica or polystyrene film capacitor must be used in this position, as even good paper tubular capacitors show slight sporadic leakage which causes the needle of the voltmeter to waver about instead of remaining in a steady position. Two $0{\cdot}01\mu F$ mica capacitors in parallel will do well in this position.

The heater choke isolating the oscillator from the other valves has to carry a fair current, so may be constructed from 22s.w.g. enamelled wire. Sixty turns in two pies, each of 30 turns, gives good results. The capacitor C2 is placed just inside the oscillator compartment and the choke just outside.

The values of R16/R20 will depend on the resistance of the meter and its sensitivity. The calculation is simple, and is carried out as follows.

The total resistance in the meter movement circuit is

$$\frac{2}{gm} + Rm + R\ ext.$$

where gm is the working mutual conductance of the triodes, Rm the resistance of the meter and R ext the external resistance in series with the meter. Since, in this instrument, only half the voltage developed at the diode is applied to the grid of the amplifying triode—by means of the potential divider R8/R11—the current through the meter I is given by

$$I = \frac{0{\cdot}5V\ in.}{2/gm + Rm + R\ ext}$$

TABLE II

Windings of the Inductors

Range (Mc/s)	Primary (anode)	Secondary (grid)	Tertiary (R.F. feed)	Wire
30-50	5 interleaved with	4	2*	22s.w.g.
9-14	20	8	3*	28s.w.g.
5- 7	45	18	6*	28s.w.g.
800-1,100 kc/s	180	60	10†	36s.w.g.
§450-550 kc/s	450	150	25†	40s.w.g.

* Tertiary is thin connecting wire in plastic sleeving.

† Tertiary is No. 28s.w.g.

§ Windings are placed, random wound, between cheeks on the former ½in. apart.

All wires enamelled copper.

All inductors are wound on 0·3in. Aladdin formers with dust core.

Windings are placed one on top of the other in the order Primary (anode), Secondary (grid), Tertiary (R.F. feed).

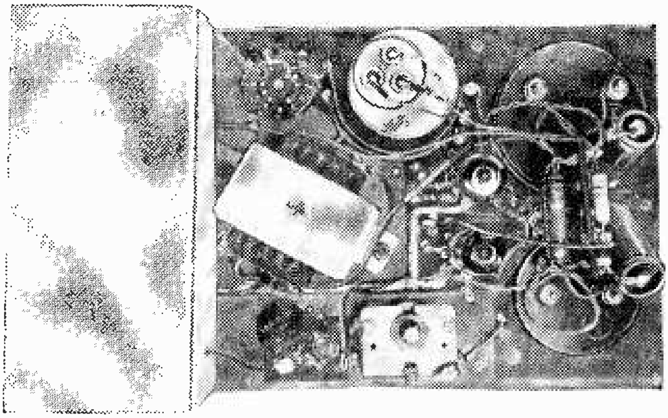
Windings are separated by one layer of Sellotape.

Figures in the above table are complete turns of wire.

where V in. is the voltage input via C8. This, on rearrangement, gives the formula

$$R\ ext = \frac{0{\cdot}5V\ in.}{I} - \frac{2}{gm} - Rm$$

If I is the full scale deflection of the meter, and V in. is the maximum reading for the range in question, these can be put into the equation and so the required resistance computed. A value is selected from stock which is within 1%, and the calibration can then be checked using 50c/s supply;



This view shows the wiring of the instrument with the oscillator screen in position.

the potential divider used for this purpose should have a low resistance—say 10,000Ω. Suitable ranges are 250V, 100V, 10V, 1V or 2V, and if the meter has high enough sensitivity a range for 0·1V or 0·25V as well. The normal use of the instrument as a Q-meter will involve only ranges 0-10V and 0-1V; the other ranges are provided to allow the valve voltmeter, used separately, to have ranges suitable for other measurements. When measuring R.F. in such circumstances, CG should always be set at its lowest capacitance.

The measured input resistance of the meter is 3M, and this puts negligible damping on any practical coil in the ranges of frequency used. Frequencies lower than 300kc/s, with coils of $1500\mu H$ or more, represent a special problem.

The last feature to be described is the means of measuring Q on the highest range of frequency. In this range, the reactance of the mounting and of the standard resistor and of its mounting is too high, and spuriously large values of Q will be obtained by using the equations given on page 18. The capacitor VC2 has to be calibrated in any case if it is intended to apply the correction formula to measured values of Q on the lower frequency ranges. This is accomplished by ensuring that VC2 is of the "straight line capacitance" law, when placing the order for it, and then it can be assumed that if calibration checks are made at 10pF intervals and the law is found to be obeyed approximately, subdivisions of the 10pF intervals on the scale—made by trial and error using a pair of dividers—are as accurate as the 10pF capacitor used for establishing the check points. It is possible to obtain close tolerance capacitors reasonably cheaply, and if two or three of these are used as a check on each other, quite high accuracy is obtainable. The method of calibrating the capacitor VC2 is the obvious "substitution" method; a resonance indicator is available in the valve voltmeter section of the instrument, and the inductor used as part of the tuned circuit should be such as to tune to 465kc/s approximately. At this order of frequency, the inductance of the leads to the coil is so small as to be negligible. It is important also to obtain the residual capacitance of VC2 when set to its minimum position. This can be done in the same way. The scale for the capacitor should be marked in values of total capacitance.

chassis. This cuts out of circuit the standard resistor R7 and the coil Q is thus read direct without having to make a correction for the added resistance. The calculation above, which can usually be done mentally, assumes that the total capacitance in the circuit is that read from the calibrated capacitor. This is not strictly true, since all coils have some self capacitance amounting to a few pF. This may be guessed near enough from the dimensions of the coil and added to the total capacitance in the circuit, unless the latter is very small or the coil is of unusual construction. A small solenoid coil will have a self capacitance of

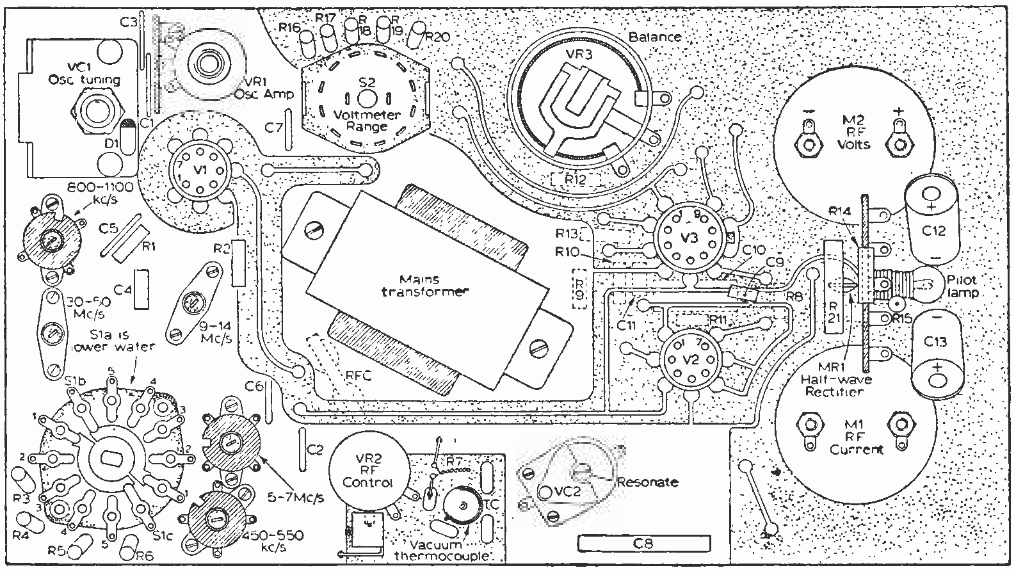


Fig. 7—The complete wiring diagram.

The best results are obtained with VC2 of low maximum value; about 30pF is suitable, and then the 1pF points on the scale are about 6° apart. This enables estimates to be made with fair accuracy to 0·1pF. A suitable capacitor for this position in the circuit is Jackson Bros. Air Tune C804 capacitor which is supplied in various capacitances including 30pF.

To measure Q, resonance is obtained at about half-setting (Cx) of VC2. The R.F. control is advanced until the needle of the voltmeter gives a reading of a convenient amount, say 100. Then, the capacitance in the circuit is increased until the meter reads 0·71 of its maximum, and the capacitance (CY) read. The value of VC2 is next decreased until the meter reading, having passed through the peak again, has again dropped to 0·71 of the maximum reading. The reading of VC2 (Cz) is again noted. Q is calculated from the formula

$$Q = \frac{2C_X}{C_Y - C_Z}$$

When obtaining Q in this way it is best to use lead B with a separate earth lead connected to the

about 1 to 3pF, while a wave-wound coil of higher inductance will usually have a self-capacitance of 3 to 5pF; it may be larger if the coil is wide and shallow. Normally, it is not necessary to make this correction.

It might be thought that when measuring Q at the highest frequencies without the use of lead A there would be no coupling between the oscillator and the coil under test. If the oscillator were perfectly screened there would still be a quantity of energy transferred since the thermocouple and its leads are necessarily in fairly close proximity to the resonating capacitor VC2. This is enough in the prototype, but if a chassis is used, it may be necessary to ensure that sufficient coupling exists by connecting leads A and B together and using the combined lead with the separate earth lead as the connections to the coil under test. A and B should be connected by means of a capacitor of about 1pF, external to the instrument.

Measurements on the other ranges carried out by the two methods show close agreement. On the

(Continued on page 35)

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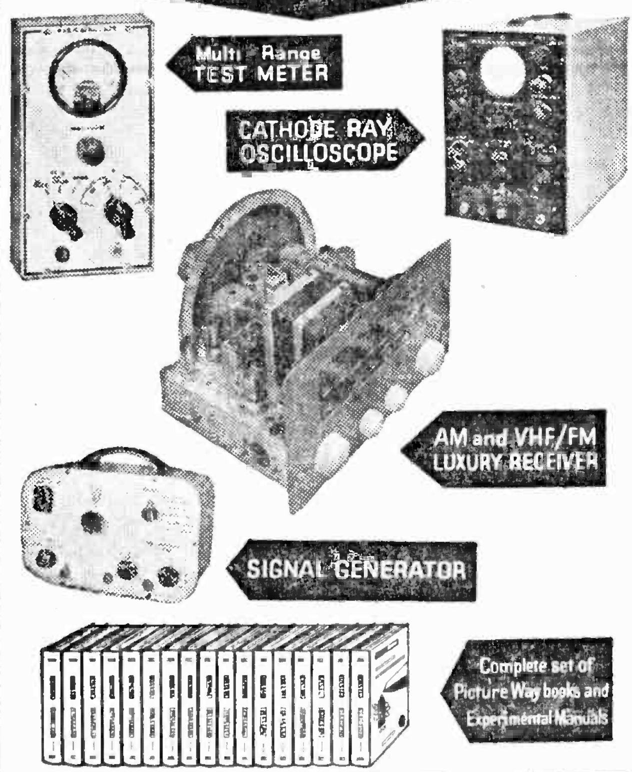

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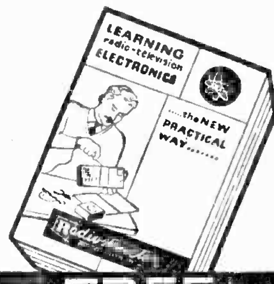

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UNDERNEATH THE DIPOLE

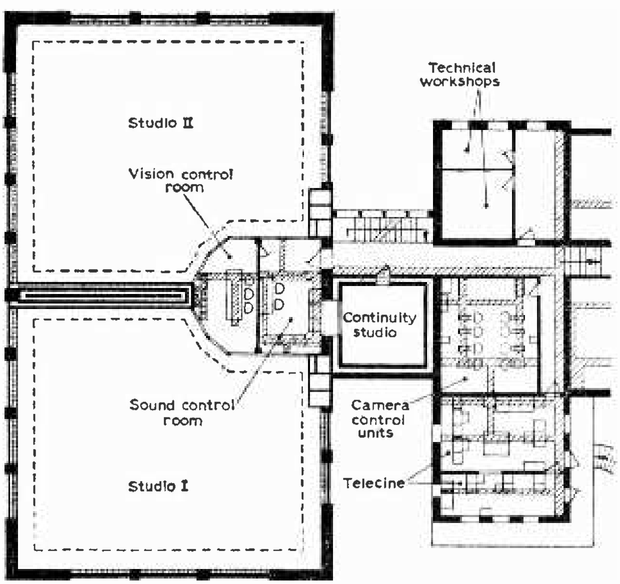
A MONTHLY COMMENTARY

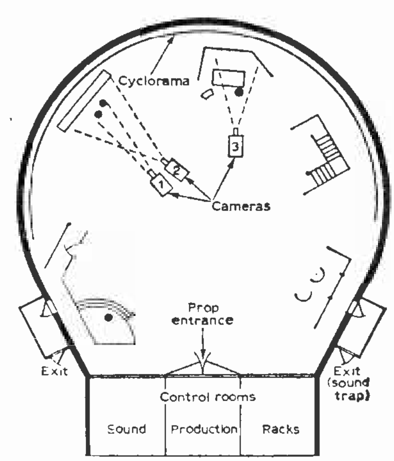
BY ICONOS

WALES is certainly in the limelight, television-wise. The start of the Wales (West and North) Ltd. ITV programmes this September from the ITA's transmitter at Prescelly, Pembrokeshire, brings commercial television to a further 700,000 or so people. This transmitter has two satellites, one at Llyn, not far from Anglesey and one at Moel-y-parc, serving Flintshire and Denbigh. These bring the total population within the Wales (West and North) area to about a million persons. In addition to its own Welsh speaking programmes, the W-W-N will be transmitting the T.W.W. programmes that are in the Welsh language. Most confusing—these initials, aren't they? The original name of this new ITV contractor was Wales Television Association — W.T.A. — which was much easier to say and write. The programmes will penetrate into the heart of Wales, into towns which to me have unpronounceable names with bilingual inhabitants. I would have thought that this excellent new coverage was a pretty complete answer to the confused thinking on the matter of Welsh television by the Pilkington Committee. Why waste a further frequency on a local language programme which will be necessarily restricted in its scope?.

The Shape of Studios to Come

Television studios are tending to become more and more square. In fact, some people think that a hexagon shape, or even a circular studio, will come along in due course. Gone are the traditional rectangular and narrow studios of the silent film days of which there was at least one in London which had dimensions of 25ft x 100ft! The method of shooting a number of settings with television cameras is to locate the cameras in the centre of the stage and to track or "panoram" them so that the lens is looking at a particular set at a particular time. The control rooms need not necessarily overlook the studio, but it is an advantage for them so to do. In Germany, one control room for vision and sound overlooks two studios, one on the right and one on the left. Building can therefore proceed in one studio while the other is in use. British TV studios claim that building and striking sets is now done so quickly that a control room is necessary for every studio stage. I suppose that a horseshoe-shaped studio would be the ideal, with the control room in the horseshoe opening, and the sets sited around the curve, on the wall of which a cyclorama backing is suspended. This is, in fact, the reverse of the plan of





The shape of studios to come: (left) a plan of part of a German studio arrangement, where one control room overlooks two studios, and (right) the ideal studio with five settings arranged around a central camera area.

the Chichester-Theatre-in-the-Round. Cameras would be placed where the actors are in this theatre, and the settings where the seats are. It is now generally considered that dimensions for regional TV studios should be not less than 2,500sq ft and for TV network studios 5,000sq ft. If the cyclorama backings are well sited, so that they can be against the walls instead of allowing for access to exits behind them, then much useful working space can be saved.

Sir Robert Fraser

Having heard one of the members of the Pilkington Committee speak at a private meeting of the Society of Film and Television Arts, I am beginning to see the fire behind the smoke of its report. There is no recognition in the report of the really fine job Sir Robert Fraser has carried out in the building up of this new concept of television, a job commenced under adverse conditions and which at one time seemed to be certain to fail. Now, the main criticism seems to be of its success. The ITA have achieved more programme and engineering progress in six years than the BBC did in the previous twenty, a fact which seems to have escaped the notice of the "Pilks."

Stage Shows

The Black and White Minstrel Show is now achieving popularity in the live theatre. But the live theatre shows, in which the audience participation plays an important part, continues to maintain their popularity on the home screen. Bernard Delfont's Sunday show and the Morecambe and Wise show continue the presentation in the Palladium manner. There is nothing very original about this type of entertainment, but if the comedy gags are really good and well-timed, the laughter of the real audience is infectious and a good time is had by all. There are other types of programme which would benefit with the presence of a live audience. Controversial programmes of the "forum" type are much better when stimulated by the reactions of an audience. But I think the participants should be on a real stage, with the audience in the stalls and circle. Putting a few rows of seats in a studio just isn't good enough.

Satellites

The opening of the two Welsh ITA satellite transmitters draws attention to their absence elsewhere, as compared with the BBC, who have no less than twenty-three satellites planned now, with a lot more to come. The ITA have three or four planned, to take care of bad spots in Bedfordshire, Peterborough and on the north east coast, but not much more. In the meantime, the BBC satellite masts rise in dozens, and not only strengthen the local signal but cause interference with perfectly good ITA transmissions. This interference arises mainly from reflections caused by the BBC mast on the ITA signal. It is high time that the ITA hastened their thinking on the desirability of these booster stations; the BBC are beating them to it!

Women Announcers

Do women make good announcers? I think that it depends upon the types of programme they announce. Not often appearing in the peak viewing hours of ITV, they are more often seen, thoroughly at home, announcing regional programme items or local news. The BBC have increased the use of women announcers but do not seem to have been so successful, either in their choice of person or in their allocations to particular programmes. Mostly, they seem ill-at-ease and lacking the poise of the blonde or the brunette girl announcers, Jasmine Bligh and Sylvia Peters, who started it all at the Alexandra Palace. Sometimes they fail in their diction, making the common mistake of dropping end syllables or consonants. On the other hand, diction in plays and general features is of a higher standard in BBC programmes than on ITV. There may be exceptions, but the BBC appear to be more aware of the importance of an "international" accent, which softens down local accents and dialect so that it can be understood, not only all over this country, but in Canada, Australia, U.S.A. or any English speaking country. The BBC are very commercially minded — a fact which has escaped the notice of the Pilkington Committee. As a result, film prints of most of their comedy and dramatic plays and series are sold to TV stations all over the world. The ITV programme companies, on the other hand, have tended to be slightly more documentary in their approach to the subject of accents, and some Cockney items are unacceptable abroad or even to the northern counties. Film producers have experimented with untrained highly accented voices and, as a result, the cinemagoers have stayed away in their thousands, excepting in those parts where the dialect is the local one.

SOUND-ON-VISION and VISION-ON-SOUND

By J. Longrise

(Continued from page 575 of the September issue)

To effect the cure for the sound fault described at the end of last month's article, the oscillator core on the particular channel selected must be adjusted. A long, thin insulated trimming tool is required to reach the core, but a fine-grade plastic knitting needle, filed at one end to form a screwdriver blade, is ideal for such adjustments.

When it has been established beyond doubt that the tuner oscillator is correctly adjusted in relation to the fine tuning control, attention should be directed to the vision I.F. channel. In Fig. 5 is shown the response curve for the vision I.F. channel, it being seen that the response is very low at the sound frequency. This sort of negative response is given by the sound rejectors in the vision I.F. channel and, provided they are in correct adjustment, then the response at the sound frequency is negligible (it being some 100 times down from the vision response).

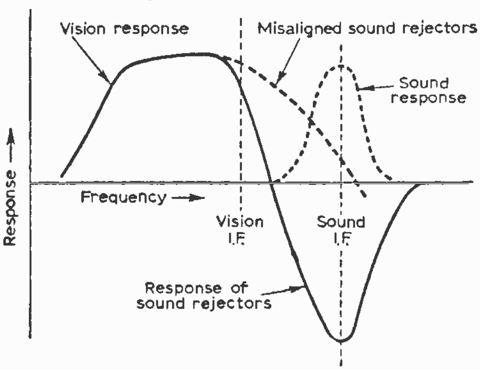


Fig. 5—When the sound rejectors are all tuned to the sound I.F., a dip occurs in the overall vision response at the sound frequency. As this response is some 100 times down on the vision response, it is impossible for sound signals to enter the vision channel. However, if the rejectors are mistuned, as shown by the broken-line extension of the vision response curve, there will be insufficient rejection at the sound frequency and the symptoms of sound-on-vision will almost certainly be present.

However, if the rejectors are out of adjustment, the vision response could extend into the sound I.F. response, as shown by the broken-line extension of the vision response curve in Fig. 5. Similarly, it will be understood (also from the foregoing—which is important) that maladjustment of the fine tuner could cause the sound and vision carriers to be shifted along the response curves, so that the sound I.F. signal may enter the vision response region, even though the vision response curve is of the correct shape and characteristics as moulded by the vision I.F. transformers and rejectors.

If it seems that the sound-on-vision is caused by sound rejector trouble, it is best to undertake complete realignment of the vision and sound I.F. stages, as guided by the service sheet or manual. In some cases, though, provided the picture definition is well up to standard, the sound rejectors can be adjusted reasonably accurately without a lot of instruments. The fine tuner should first be adjusted very carefully to give maximum sound consistent with optimum definition of picture, as appraised on Test Card C.

The line hold control should then be adjusted to give conditions of "false line lock"; that is, with the picture divided by a wide vertical bar. Under this condition the picture is most sensitive to sound break-through, and the sound modulation can easily be seen as ripples at the edges of the Test Card.

It is best to wait for test-tone modulation from one of the stations, for then sound break-through gives a consistent ripple at the picture edges. Set up in that way, it is a fairly simple matter to adjust the various sound rejectors to eliminate the sound-on-picture. A very slight turn of the appropriate cores is all that is usually required, and care must be taken to avoid setting the rejectors too far from the correct frequency, as then the picture definition would also suffer. Hence the desirability of using Test Card C for this adjustment.

The sound rejectors are usually marked on the circuit or in the service sheet or manual. In the circuit in Fig. 3, the rejectors are the tuned circuit of L13, adjustable by T1 and L17.

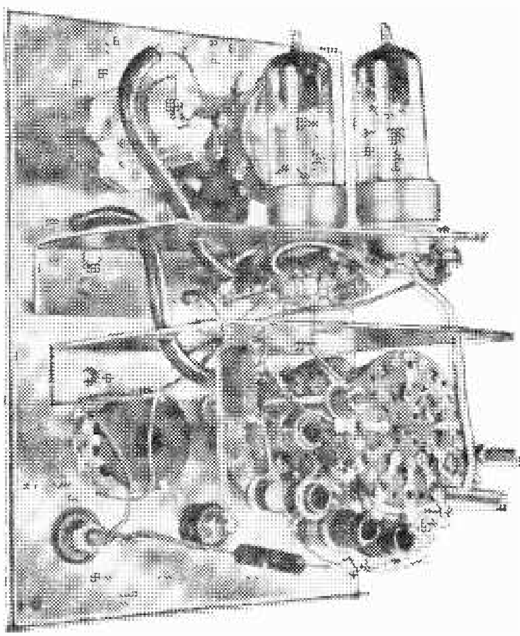
Intermodulation

In certain cases and on certain receivers, sound-on-vision and vision-on-sound, occurring simultaneously, may be caused by overloading in those stages common to both sound and vision. For instance, in the R.F. amplifier, mixer and/or common I.F. amplifier. Here, the cure lies in reducing the aerial signal or in the replacement of a low emission common valve.

Modern sets, however, rarely exhibit such troubles, unless the aerial signal is extremely large, for the AGC system cater for large signals without unduly affecting the intermodulation performance. The best way of reducing the aerial signal is by the use of through-type coaxial attenuators, as marketed by Belling and Lee Limited and others. These are available in a wide range of values and can be selected to give the best results in any particular area.

An IMPEDANCE BRIDGE

THE circuit designer who is interested in high frequencies has had for some time now the choice of vacuum tubes or transistors as his active elements. For certain applications the vacuum device is by far the more convenient of the two, but in receivers the present tendency is to make more and more use of the solid-state device for reasons which hardly need mentioning. With valves a very extensive body of experience exists together with a well worked-over collection of circuit theory. Most of this has been extremely useful to the transistor circuit engineer, but there are differences in emphasis as well as differences in application with which he has to be familiar.



A view of the interior of the instrument.

One of the problems which now has to be faced every day is one which hardly bothered anybody who used vacuum tubes. The vacuum tube at moderately high frequencies imposes little loading on a tuned circuit connected between grid and cathode, and even at Band III frequencies the effect is relatively easily taken into account in the few circuits in a receiver which operate at signal frequency. In an I.F. amplifier the effect cannot be completely neglected, but normally causes few headaches since the input resistance of a valve is usually so much greater than that required in the circuit anyway to obtain the bandwidth required. The use of pentodes, with their extremely high anode impedance, results in negligible resistance in parallel with the anode tuned circuit, and so the H.F. pentode is a device offering few if any snags to the designer. The virtual absence of coupling between grid and anode is also a property which simplifies calculations.

With the transistor the effects which could be neglected formerly, now take on the highest significance. Where a grid input resistance of many thousands of ohms was usual, now a base input resistance measurable in tens of ohms is found, often associated with a capacitance of anything up to 100pF in parallel. Output resistances of kilohms instead of megohms are common, and feedback capacitances of several pF instead of values a hundredth as large Circuit design therefore has to regard as of overriding importance such quantities as with valves may be minor difficulties.

The author has, in the past, satisfactorily solved circuit problems for transistorised equipment which has been described in this journal and PRACTICAL WIRELESS. The current problem is the design of a transistor television receiver, and to date some progress has been made in various portions of the receiver. One especially severe difficulty has been the obtaining of the correct bandwidth in the vision I.F. amplifier, and this because the transistors selected for use have to be employed well away from the frequencies for which published data are available. Thus it has been necessary to obtain by measurement figures for input admittance, output impedance, feedback and transfer admittance and the corresponding phase angles, before a rational approach to stage design could be attempted. To effect some of these measurements a suitable instrument was made up, and this is now described in the belief that other amateurs may find it useful in their own work.

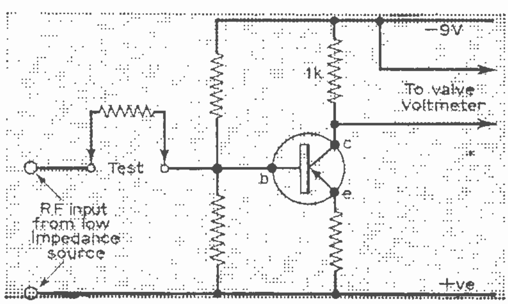
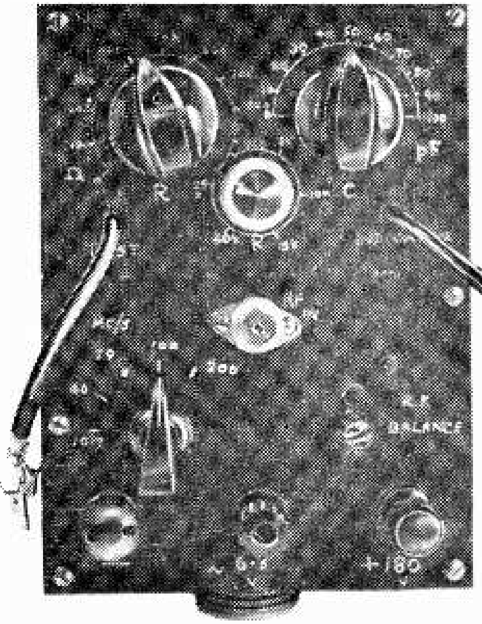


Fig. 1—One method of measuring the input impedance of transistors.

for Transistor Measurements

By N. Mears



The front panel of the bridge.

Originally it was considered that a simple measuring device, such as is illustrated in Fig. 1, might prove sufficient to measure input and output impedances. The considerations were as follows—a signal from a low-impedance source (a constant voltage generator) is fed into the base of a transistor arranged with its proper D.C. bias. The amplified signal is measured with a valve voltmeter, and the reading noted. Then series resistance is added to the input until the reading of the valve voltmeter is just halved. In this case half the voltage is dropped across the series resistor and half in the transistor, and thus the added series resistance is equal to the input resistance of the transistor. Poor results were obtained with this arrangement, for the obvious reason that the input capacitance of the transistor causes a phase change which is not paralleled externally. However, at low frequencies consistency of results was observed, and at audio frequencies the method is simple and direct.

Fig. 2 gives the complete circuit diagram of the instrument as finally made up. Fig. 3 is a simplified version of the circuit which reveals the principle of operation more clearly. Referring to Fig. 3 therefore, it will be seen that in essentials it comprises a bridge. R.F. current from an external source is needed, and this will normally be a well-shielded signal generator with an output of low impedance—usually about 80Ω. When R.F. is fed to the input terminals it traverses the arms of the bridge R2—R1C1 and R3—RiCi. R2 and R3 are equal, and so when the impedance R1C1 is exactly equal to RiCi the potentials at A and B are equal in magnitude and phase. RiCi is the unknown quantity, and thus if R1 and C1 are known as well as the equality of R2 and R3 the problem is solved. It remains to note only that the equality of the potentials at A and B is ascertained by feeding these potentials to the grids of two amplifying pentodes, whose anodes supply two separate tuned circuits. To both these tuned circuits is coupled a single R.F. pick-up coil, and the presence of R.F. voltage in the pick-up coil is shown by any suitable indicator. When both pentodes are handling equal signals the fields of the anode coils cancel out and no R.F. is induced in the pick-up coil; when the signals at the two grids are not equal the anode currents differ in phase or magnitude, or both, and a voltage appears in the pick-up coil. Thus by using a reasonably sensitive indicator the precise null point can be reached when R1 and C1 are properly adjusted.

Design Considerations

The basic bridge circuit is of course so well known as to merit little comment. The actual values of components used however may need some explanation. It has to be remembered that the instrument was intended for work with transistors whose input and output resistances are much smaller than those associated with vacuum tubes. A bridge tends to be most accurate when the four arms are nearly equal, and consequently R1, R2 and R3 are rather small. It is for this reason that the R.F. input should preferably be from a low impedance source. On the other hand, the input and output impedances of transistors are so different in size that some compromise is essential if both are to be measured by the same instrument. Thus R2 and R3 are specified as 1·2k, and the balancing resistor R1 is split into two, one of 25k and one of 1,000Ω. It is of course necessary to ensure that the 25k potentiometer has a true zero, and a means of ensuring this will be described.

Where a bridge is to be used at high frequencies it is obviously most necessary to remove as much stray inductance and capacitance as possible. If it cannot be removed it has to be balanced out or, if this should fail, allowed for. While in the instrument described every precaution must be taken to minimise such "strays", certain compensatory devices are used which will be described.

In the first place, leads carrying the measuring current have to be as short as possible. This is not of such import in the anode circuits, but here the danger of stray field affecting the grid circuits

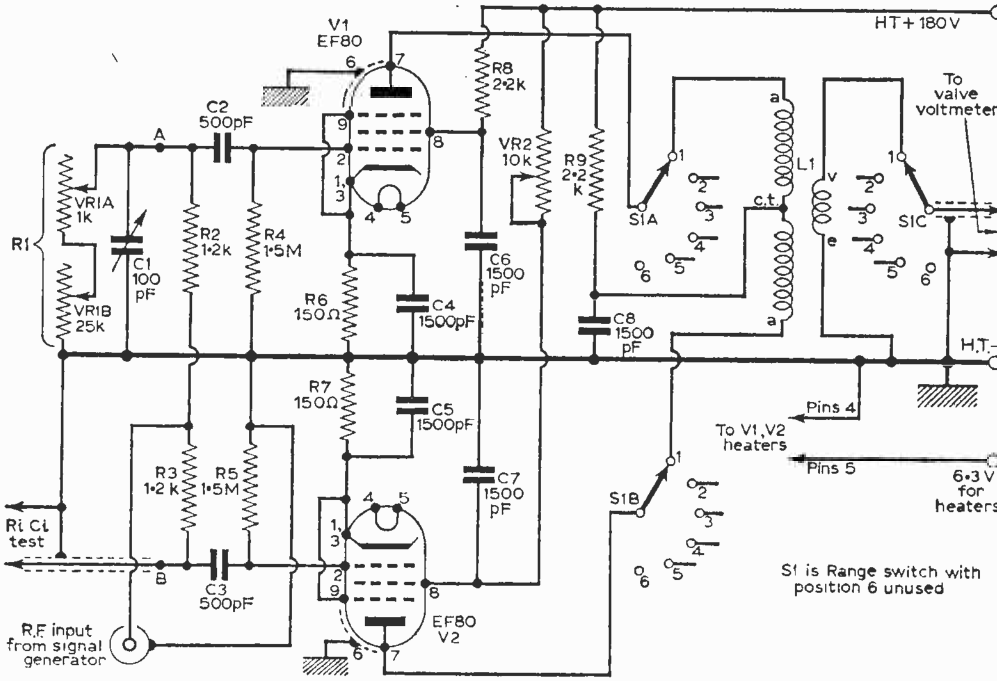


Fig. 2—The complete circuit.

exists. Consequently, adequate screening must be provided. Secondly, it is obviously necessary to bring leads outside the instrument to make contact with the transistor or other device under test. Because of this, the leads to R1 and C1 have themselves not negligible inductance and capacitance. If the balancing circuit elements R1 and C1 are within the case of the instrument their leads are likely to have very different values of inductance and capacitance. Thus, when balance is achieved, although resistance will be right, capacitance as measured will show quite considerable errors. To compensate for this difficulty the balancing elements are not connected to the case of the instrument direct but by way of a piece of coaxial cable exactly equal in length to the external lead; the lengths must be correct to 0·1in., including the length of crocodile clips if used.

Besides taking normal precautions such as either matching R2 and R3 exactly, from stock, or using 1% tolerance components, care has to be taken to ensure exactly the same amplification by each pentode. Variable-mu frame grid valves might be used with an adjustable resistor in one cathode lead. Here however the readily obtainable EF80 is used, and matching of the valves is done by varying the screen voltage of one by a few volts one way or the other. If no precise match can be found it is only necessary to change the valves over and try again; they will seldom be so far from specification that this trick will fail.

Winding the Coils

The tuned circuits in the anodes are very critical, and the most precise symmetry must be achieved in winding the coils. This is not difficult, but requires care and a little skill; it is most pressing

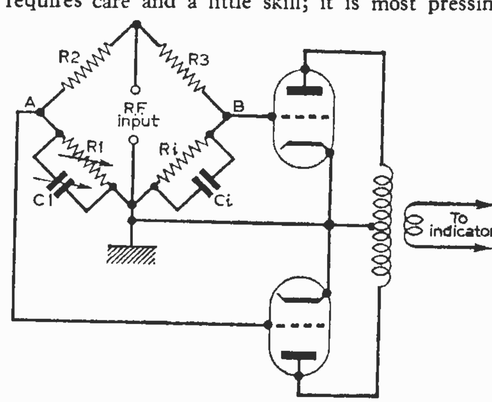


Fig. 3—The principle of the instrument.

where the smallest coils are concerned, for a little inaccuracy in placing one turn cannot usually be corrected in a subsequent turn of wire. It may be found necessary to discard one coil and try again from scratch. The lower frequency coils are very much easier to wind accurately.

Symmetry is further assisted by the actual wiring of the coils into place, and this matter will be discussed later.

Spot Frequencies

Five spot frequencies were decided upon as being all that would be needed for most work. It might have been thought better to tune each of several ranges so as to obtain full coverage of all the interesting bands. However, this would have introduced much complexity—and probably inaccuracy—into the instrument and it was decided against. The actual frequencies used may be decided by the constructor, but it is thought that

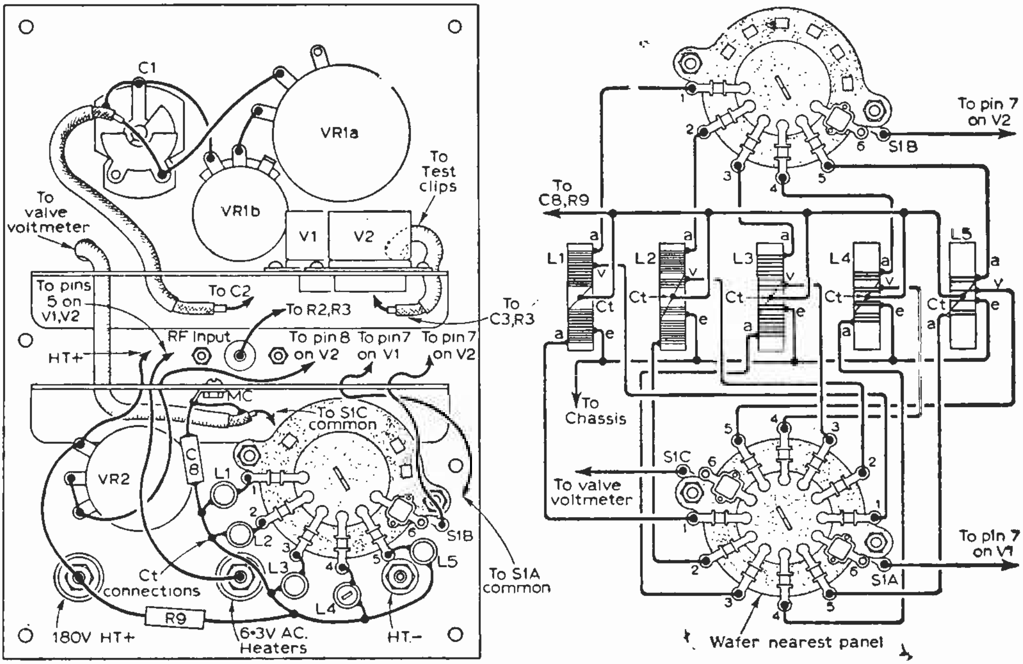


Fig. 4—The main wiring diagram showing the arrangement of anode and take-off coils.

COIL WINDING DATA

All coils wound on 0·3in. diameter formers with dust cores or brass slugs as needed. The formers should be about 1·25in. long. All primaries centre tapped, H.T. to c.t. windings all in same direction.

10·7Mc/s—Being 45+45 turns 40s.w.g. enamel, spaced 0·3in. between ends. Secondary 5+5 turns thin P.V.C. wire close-wound between primary windings. The secondary may have to overlap the inner ends of the primary.

40Mc/s—Primary, $9\frac{1}{2}+9\frac{1}{2}$ turns 32s.w.g. enamel close-wound, spacing about $\frac{1}{2}$in. between ends. Secondary, 2+2 turns same wire close-wound adjacent to halves of primary at inner side.

70Mc/s—Primary, 7+7 turns, secondary $1\frac{1}{2}+1\frac{1}{2}$ turns, as above.

100Mc/s—Primary, 3+3 turns 18s.w.g. close-wound. Secondary, $1\frac{1}{2}+1\frac{1}{2}$ turns over-wound at c.t. thin P.V.C. covered connecting wire.

200Mc/s—$1\frac{1}{4}+1\frac{1}{4}$ turns 18s.w.g. spaced by wire diameter. Secondary, 1 turn as above at c.t., interwound with primary.

the following will cover most requirements.

Switch position	
1	10·7Mc/s.
2	40Mc/s.
3	70Mc/s.
4	100Mc/s.
5	200Mc/s.

The sixth switch position can be used for an additional frequency or used merely to join the anodes of the EF80's together and to H.T.+ for testing purposes.

Construction

As the circuitry is simple and relatively few components are needed the instrument can be fitted into quite a small box. The chassis was therefore arranged to fit into a small metal container 7in. by 5in. and 4in. deep. The size will of course be determined by the tin box available, but a large container is unnecessary. The lid was discarded in favour of a panel of aluminium, to which the chassis and screening could be attached, so that the whole circuit could be removed at will. To avoid the chance of stray radiation or induction field penetrating the box, the panel was secured by means of several self-tapping screws.

(To be continued)

SERVICING DATA AND MODIFICATIONS

By D. Elliot

DEALING WITH THE CORONA EFFECT AND BARRETTER TROUBLE

(Continued from page 587 of the September issue)

ON certain early model receivers a small magnet may be found clamped on the neck of the picture tube, even though the tube does not feature an ion trap assembly. Such tubes usually have aluminised screens as a precaution against ion burns, and the magnet sometimes causes confusion in the mind of the experimenter and home repairer as its adjustment does not appear to affect the brightness of the picture.

Neck Shadowing

Tubes of this kind are the GEC 16in. 6901A and the 14in. 7201A, used in GEC models of the BT5147 and BT5246 series. The magnet assembly is similar to an ion-trap adjusting magnet but is fitted to the neck of the tube to remove "neck shadowing" which may otherwise cause a loss of picture in the corners of the screen. The magnet is normally correctly positioned at the factory and should not require subsequent adjustment unless the picture tube is replaced.

However, when adjustment is necessary the magnet should be positioned on the neck close to the tube cap with the arrow pointing to the screen. The picture should then be centred normally with the picture centring controls and the height and width presets. At that stage the magnet should be rotated to the optimum position to eliminate any neck shadowing that may be present, moving the magnet forward on to the glass neck only should greater correction be required. After that adjustment the picture should again be re-centred.

It is rather important to keep the magnet as close as possible to the base of the tube, consistent with adequate correction, for if the magnet is pushed too far along the neck there may be too great a sideways bias applied to the picture, thereby making it impossible to centre the picture by the centring controls. On no account must the magnet be positioned so that the picture brightness is affected.

G.E.C. Models BT5147, BT4544 and BT5543

On early models as above the U25 EHT rectifier was subject to premature failure due to excessive tube beam current. This usually happened as the result of slight misplacement of the ion-trap magnet, so that no apparent increase in screen brightness occurred when the brightness control was turned towards maximum. Beam current, nevertheless, will rise under this condition in the usual manner.

As a protective measure the 10k resistor (R50 in Fig. 33) in series with the brightness control was increased to 33k in later production models, and it is recommended that this change is made on any existing receivers still in use. The resistor increase makes it impossible to run into excessive beam currents, even at maximum setting of the brightness control, and does not affect the useful range of the brightness control.

Corona Effect

A break-up of the picture with the symptoms of corona in the line output transformer is sometimes caused by failure of the 50pF capacitor in the line

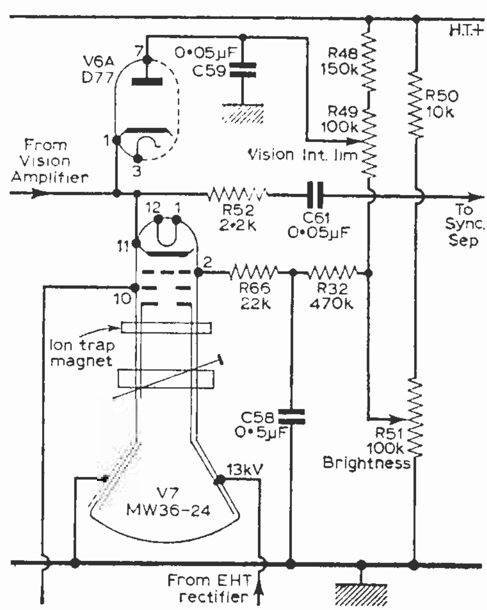


Fig. 33—To avoid excessive tube beam current from damaging the EHT rectifier valve at maximum setting of the brightness control, resistor R50 should be increased from 10k to 33k.

timebase. This component is shown in Fig. 34 and is designated C51.

Intermittent line scan or a reduction in picture width should lead to a check of the 1·8k resistor (R39, Fig. 34) connected in the screen grid circuit of the KT36 line output valve. In some cases the capacitor develops a leak (C50, Fig. 34) which causes overheating of the resistor mentioned.

Failure of Both Sound and Vision

With this symptom the raster is normal and can be controlled by the brightness control. The

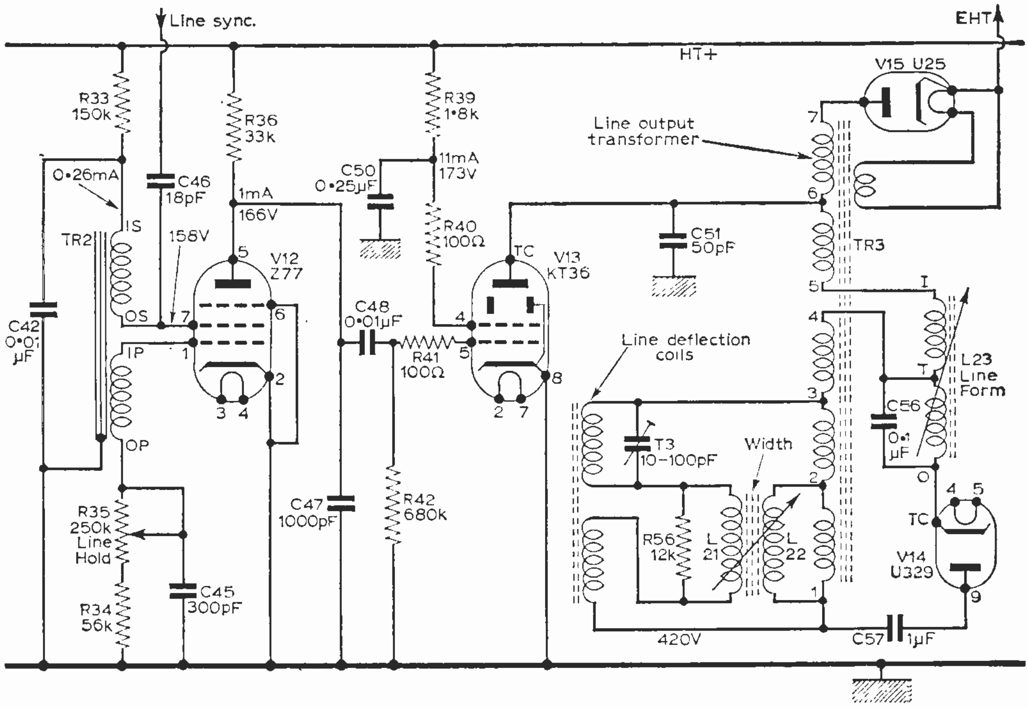


Fig. 34—If violent "snow storm" occurs on the screen of a GEC BT5147 series, accompanied by a rushing noise on sound, the 50pF capacitor C51 should be suspected for insulation breakdown. This capacitor is rated at 5kV. R39 in the screen grid circuit of V13 is often responsible for line collapse or a decrease in picture width.

trouble is, of course, in one of the common stages and is more often than not in the frequency changer stage. It sometimes happens that sound and vision can be restored either by touching the envelope of the Z77 frequency changer valve or by touching almost any part of the oscillator circuit with a test probe.

When this is the case attention should be directed to the two 8·2pF capacitors in the local oscillator tuned circuit (Fig. 35), for it usually transpires that C19 across the oscillator coil is open-circuit.

Barretter Trouble

The range of GEC receivers under discussion features a barretter for heater-chain current control (Fig. 36). Sometimes this component becomes prone to frequent failure; and there is no apparent reason for this since its replacement restores normal operation.

However, it pays to examine the faulty barretter before undertaking a further replacement. The break in the resistive element can usually be seen with the naked eye, but a small magnifying glass can assist with the examination. If each side of the break is formed into a small blob of metal, then it can almost certainly be taken that a burst of excessive heater current caused the wire to fuse, while just an ordinary break would more likely be due to normal wear.

In the former case an intermittent short in the U329 booster diode V14 or the KT36 line output valve V13 (Fig. 34) should be suspected. Fig. 36 shows that these valves are connected next to the barretter in the heater circuit, which means that a heater-to-cathode short would put a very heavy current through the barretter.

One way of checking for this trouble is to remove the barretter and connect in its place a 15W 250V household lamp. When the set is first switched on the bulb will be almost full brilliance and will dim as the valves warm up. However, if the bulb remains bright or if it flashes brighter intermittently (try tapping the valves mentioned above) one of the valves is faulty. At this stage it is best to substitute each valve in turn before the replacement barretter is fitted.

Sound Channel Faults

The sound I.F. detector, noise limiter and A.F. stages are shown in Fig. 37. A high noise level on sound with crackling which takes

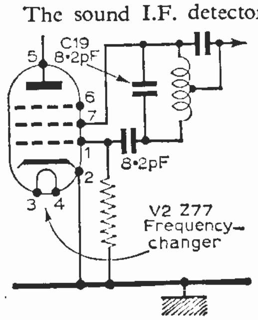


Fig. 35—This is the basic circuit of the frequency changer oscillator in the GEC BT5147 series, and oscillator failure, cutting out on both sound and vision, is sometimes caused by a fault in C19 (see text).

place only when the set is tuned to a sound carrier is often attributable to intermittency in the noise limiter crystal diode GR2, which is a GEC type GEX34. If the diode is tapped the symptom may or may not be aggravated. The best plan is to check by substitution. Another idea is to put a temporary short across the diode; this will greatly increase the normal impulsive interference, but if the original trouble is cleared the diode should be replaced.

A high level of sound distortion, often with suppressed sound output, often points to open-circuit or value increase of the 10M resistor R11. This biases the diode for normal conduction but, if the resistor goes high, conduction is limited as also is the audio fed to the A.F. amplifier (e.g., the triode of V10). At the same time it is also desirable to check the 1M resistor R18 for value and replace if necessary.

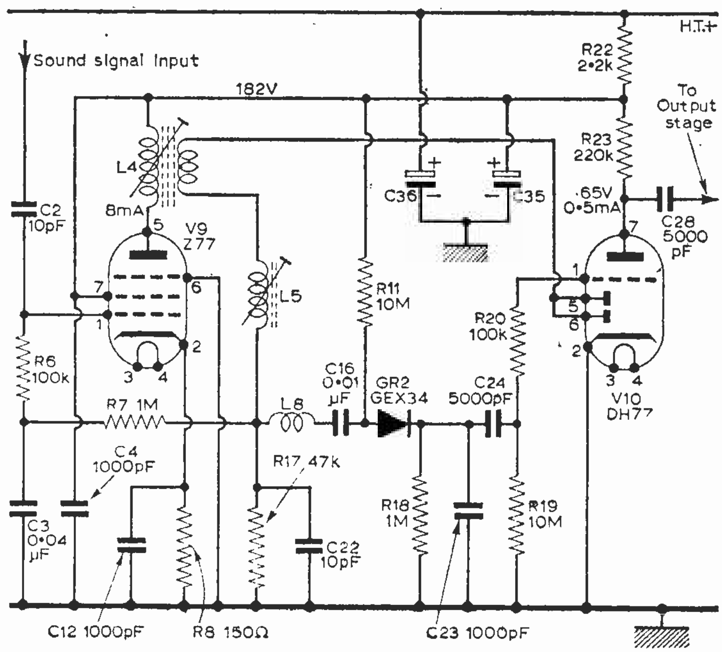


Fig. 37—The sound channel of the GEC BT5147 series, in which the noise-limiter diode, GEX34, can cause trouble.

G.E.C. BT3251—Line Hold Control Trouble

If the locking point for the line timebase occurs at the end of the range of the line hold control the trouble in this model may not be caused by a worn line oscillator valve or alteration in value of a time-constant resistor; misplacement of the grid lead running from pin 2 of the line oscillator valve V13 is another possibility which should first be checked.

The lead is coloured yellow and if when it is moved the line hold control is brought into correct balance it should be dressed well clear of the line output stage towards the centre and front of the chassis.

Corona Effects

On both the GEC BT3251 and the BT9343 a corona discharge may occur in proximity of the glass envelope of the EY86 E.H.T. rectifier valve. This can be observed as a violet glow round the valve when the inside of the set is viewed in a darkened room. It is due essentially to humidity and occurs mainly during the damp winter months.

The cure recommended by the manufacturers consists of slipping a short length of PVC tubing over the EY86 valve to extend into the shroud of the socket.

G.E.C. Models with Flywheel Sync

These are fringe models in the series BT1450, BT2449, BT5446, BT5545 and BT9343. One trouble is "poor line hold," which is attributable to incorrect adjustment of the discriminator transformer. There are two cores in the transformer, L44 at the tag end and L43 at the opposite end, and these should be carefully adjusted as described below.

(Continued on page 43)

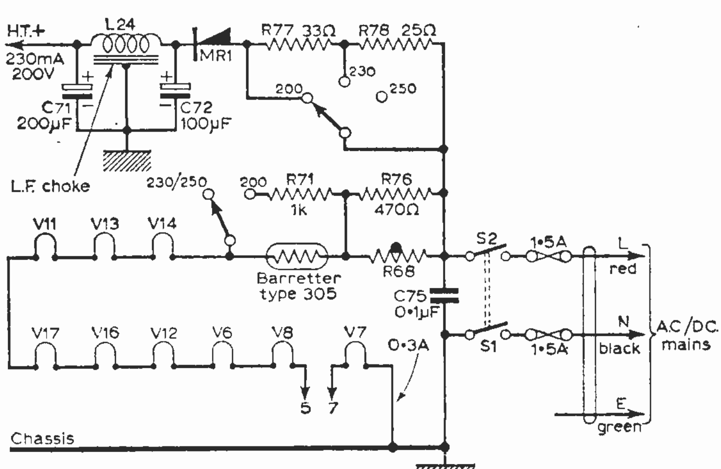


Fig. 36—Frequent failure of the barretter can be caused by a heater to cathode short in V13 or V14 (see also Fig. 34).

The ABC of TV Circuits

AN ANALYSIS OF THE DEVELOPMENT OF TELEVISION CIRCUITS

By T. L. May

(Continued from page 595 of the September issue)

WAYS of removing interference spots from a picture without detracting from picture quality have led to many ingenious circuits. There are three basic arrangements for this purpose. One is to set the operating conditions of the video amplifier valve in such a way that normal video output is obtained from the anode circuit, while interference pulses rising to levels in excess of peak white picture give little or no output.

The second arrangement is to use a diode circuit in the output of the video amplifier and set its operation so that it conducts only on pulses of interference. This leaves the picture almost unaffected, while by-passing the unwanted interference signals.

The third arrangement usually employs a triode valve as an interference pulse inverter. The idea being to feed to the tube grid, a replica of the interference pulse which is present at the cathode along with the signal. The phasing is so arranged that the interference pulse at the cathode is effectively cancelled by the pulse applied to the grid.

Video Valve Limiting

Video valve limiting is quite interesting, and will be considered first. Fig. 11 gives a circuit of a video amplifier which has been designed for this sort of limiting. It will be seen that the suppressor grid (grid 3) is connected to a potentiometer across which is a voltage from about 30V negative to a positive value as determined by the H.T. line voltage and the value of R1 and other resistive elements. In practice, the slider goes over a potential range from about 30V positive to 30V negative. Now, as the slider is connected to the suppressor grid through R2, the suppressor grid can be altered over the above range by adjustment to the limiter control (bearing in mind that there is no suppressor grid current).

With the limiter control in position "A", the video amplifier behaves in the normal manner, as shown by the diagram, Fig. 12(a). Here the video input signal is well within the limits of the valve, as also is the interference superimposed on the video. Thus, at the output occurs both video and interference.

However, as the limiter control is turned towards position "B", the maximum unsuppressed output from the amplifier is decreased, as shown in Fig. 12(b). Here the limiter control is adjusted fairly critically so that peak white picture signals give normal output; but since at that setting further output is unobtainable, the interference pulses are effectively clipped and do not appear at the output.

In practice, the limiter would hardly be set so critically, for if it were, any increase in video signal amplitude would cause clipping of picture whites as well as interference. The general set-up would be for clipping of interference pulse peaks. This would adequately reduce the disturbing nature of the interference spots on the screen without impairing the contrast ratio or quality of the picture.

This arrangement is sometimes called limiting by anode-current saturation. Under normal conditions, the output from a video amplifier increases substantially linearly with increase in drive signal up to the point when further increase of drive does not result in increased output. This point is the saturation limit of the valve. By increasing the negative potential on the suppressor grid the saturation point is made to occur at a lower level of input signal.

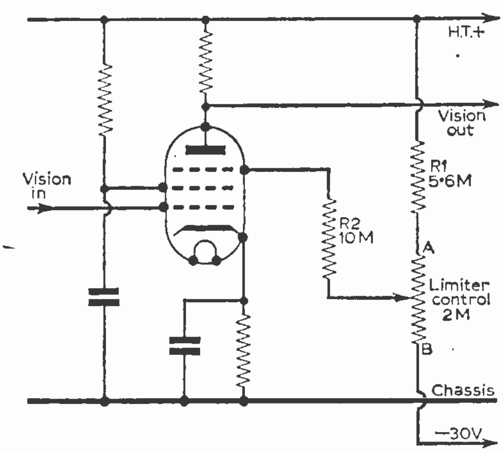


Fig. 11—The circuit diagram of a "saturation" type vision interference limiter.

Diode Limiting

Both semi-conductor and thermionic diodes are used in practice and may be connected either before or after the video amplifier. The basic circuit of a simple post-video limiter is given in Fig. 13. Under static conditions, C1, which is an electrolytic, charges through R1 and the limiter control from the H.T. line. The amount of charge in C1 depends on the setting of the limiter control, and for normal suppression the control is set so that the voltage at the diode anode is

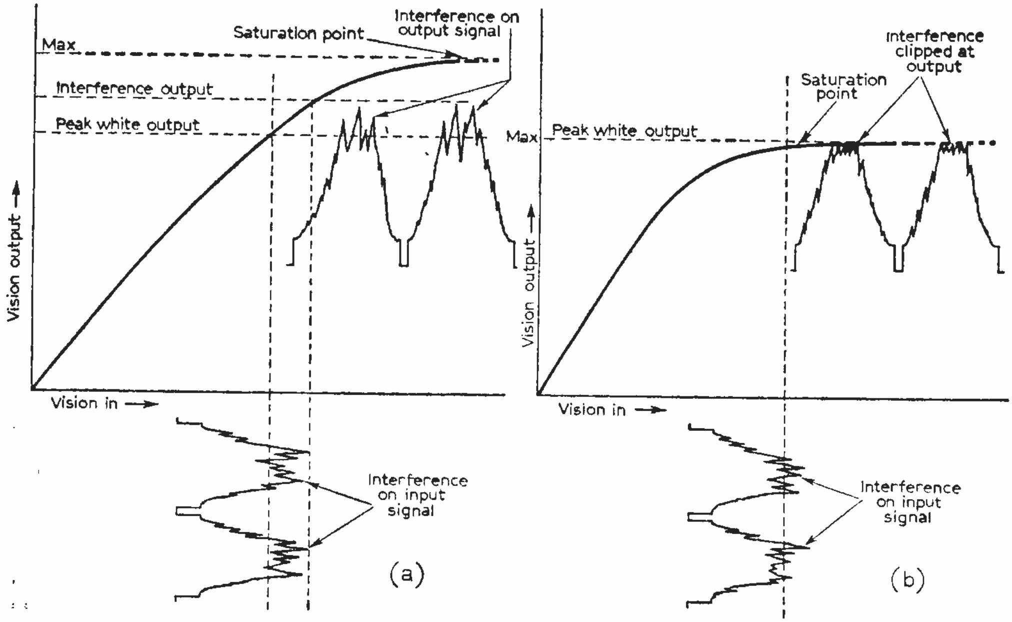


Fig. 12—The operation of the saturation limiter; (a) the saturation point well in advance of the interference pulses, which are thus passed through the valve to the tube, (b) the saturation point reduced and the interference pulses clipped.

just a little below the voltage at the cathode on peak white signals.

This means, then, that the video signal is conveyed from the video valve anode to the cathode of the picture tube without the limiter circuit influencing the operation in any way.

Now, at the occurrence of a burst of inpulsive interference, the video valve anode falls sharply negative, under which condition the diode anode is more positive than the cathode, since the voltage across C1 cannot follow such a rapid change. The diode thus conducts and most of the interference (and only a little of the picture signal) is by-passed away from the tube circuit through the diode and C1 to chassis. In this way the picture is cleared of most of the interference effect.

This circuit is rather neat in that it is somewhat self-compensating for changes in the actual video signal level. As the signal level at the video valve anode—and hence the voltage—changes, so does the charge across C1, and once the correct limiting position is established by the limiter control, the circuit tends to balance about that point for a wide range of signal levels.

Pre-Video Limiter

The basic circuit of a pre-video limiter is given
(Continued on page 35)

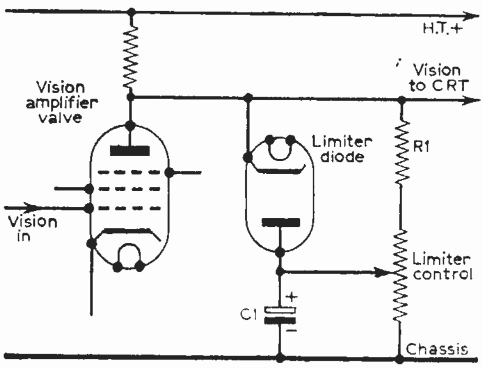


Fig. 13—The circuit of a simple diode limiter, which is self-compensating.

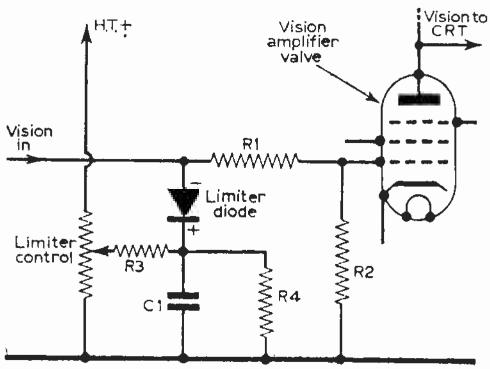


Fig. 14—In this circuit a semi-conductor diode is used prior to the video amplifier.

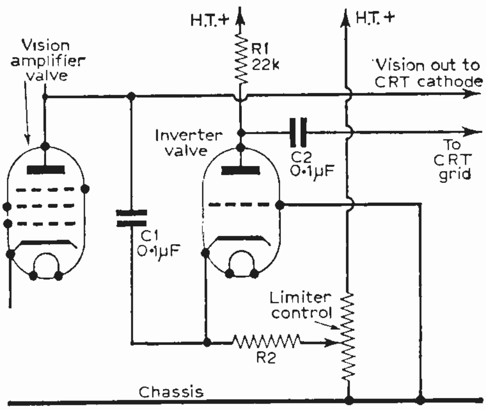


Fig. 15—A circuit diagram of a white spot inverter in which a triode valve plays the major part.

(Continued from page 32)

conduction by a positive potential picked up from the slider of the limiter control and applied to cathode (the positive terminal) of the diode through R3. The anode (or negative terminal) of the diode is " tied " to chassis (negative) via R1 and R2.

Now, a burst of impulsive interference causes a rapid peaky rise in voltage on the video-in line. This makes the anode of the diode go more positive than the cathode and promotes conduction, which occurs through the diode and R4. The interference signal is thus by-passed from the control grid circuit of the video amplifier valve through the diode and C1.

White Spot Inverter

Although not by any means new, quite a few recent receiver models feature a so-called white spot inverter circuit instead of the conventional diode limiter (Fig. 15).

With the connection between the anode of the video amplifier valve and C1 removed, interference would arrive at the tube cathode in the form of a steep negative-going pulse. This " looks " to the tube like a peak white picture element and it thus records it as such, producing the well-known interference spot.

The cathode of the tube going negative, is exactly the same as the grid going positive. This means that if a negative-going pulse of interference of exactly the same shape as the pulse at the cathode is applied to the grid, the tube in effect will " see " no pulse at all, and the interference will be neutralised. The white spot inverter works along these lines.

To the cathode of the inverter valve is applied a sample of the video signal, via C1. Since the grid of this valve is connected to chassis, the negative-going signal at the cathode is the same as the grid going positive with respect to cathode on the signal. A phase change occurs in the valve with respect to the signals at grid and anode, so across the anode load resistor R1 is developed a negative-going signal.

The signal here is coupled to the grid of the tube through C2, and the requirements considered above are achieved. The component values are chosen so that the inverter responds essentially to interference rather than video signal. Moreover, since the triode cathode is connected to a positive potential through R2 and the limiter control (which, again, is the same as the grid being made negative with respect to cathode) the valve only passes pulses which are strong enough to overcome the bias.

The valve conduction point can be adjusted by the limiter control in the same way as an ordinary diode limiter. As the interference is cancelled, black or grey spots appear on the picture instead of the probably more disconcerting peak white spots.

(To be continued)

A GENERAL PURPOSE Q-METER *(Continued from page 18)*

465kc/s range, the Q of a certain coil by current and voltage was found to be 75, while, by the capacitance variation method, the value was 76. On the medium wave range, another coil showed values of 88 and 89 respectively. Values on the other two ranges were 63 and 64 (at 5·5Mc/s) and 108 and 103 at 10·7Mc/s. It may therefore be taken that the potential accuracy of the instrument is of the order of a few %.

The Q of an aerial can be determined also with this instrument. Generally the actual measurement is less important than the bandwidth of the aerial, which can be derived from Q. Since Q for an aerial is usually very low, neither method described above is very satisfactory, and the following method —though apparently less accurate—may be found sufficient.

If a dipole is under test the coaxial lead attached to leads A and B should be terminated with an 80Ω resistor. This simulates the actual input of a receiver and also serves to short circuit any hum voltages which would seriously affect the working of the instrument. Advance the R.F. control until, with VC2 at its minimum setting, a resonance point can be found on rotating VC1, the tuning control of the oscillator. Set the valve voltmeter to an appropriate range (0 to 1V), and advance the R.F. control until a maximum reading of the valve voltmeter of 100 is shown, at resonance. Note the frequency reading. Swing VC1 each side of the resonance point until a voltage reading of 71 is obtained, and note each reading. Then the bandwidth of the aerial is the difference in the two side frequencies $f1$ and $f2$, while the Q of the aerial is the resonance frequency $f0$ divided by $f1$-$f2$. For a plain folded dipole without parasitic elements, the terminating resistors should be 300Ω, but a folded dipole with directors and reflector will need 80Ω, as with a plain dipole.

The power supplies for the instrument are modest, the requirement being for 250V at about 30mA and 6·3V at about 1A. The H.T. smoothing need not be very elaborate. In the prototype an instrument transformer with a 250V secondary was used, rectification being " half-wave " through a 1,000V p.i.v. semiconductor diode. Smoothing was accomplished with a reservoir capacitance of 16µF, a smoothing resistor of 3·3k and a smoothing capacitor of value 16µF. ■

Letters to the Editor

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

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

TV SOUND QUALITY

SIR,—It does seem strange to me that whereas an appreciation of good sound reproduction has been encouraged over recent years by the manufacturers of Hi-fi audio equipment, the TV set makers, on the other hand, appear to consider sound as just a minor adjunct to the "all important" picture. In cabinet design the acoustical requirements are the least considered and the smallest possible loudspeaker is grudgingly squeezed into the interior, often in the worst position for the viewer-listener.

I think all TV receivers should have "audio output" sockets to enable one to feed the undoubted high quality sound to an A.F. amplifier and loudspeaker system capable of doing it justice. —F. A. HARMSWORTH (Reading).

AERIAL DESIGN

SIR,—In view of the approaching introduction of UHF signals, and the resultant need for a new aerial, I agree that it is time some idea was worked upon to make the present aerial or aerials suitable for many frequencies. At present we have one BBC and one for ITV but surely it would be quite practicable to use one single aerial, either a dipole or some form of array, so chosen that it would not be cut to the correct length for a single station, but would be harmonically related to several. For instance, it could be full-wave at one frequency, and half-wave at another, and I am sure that the experts could work out something on these lines to save us having to put up more ironwork on our already overloaded chimney stacks.—P. SAVILE (Hornsey).

[The above is only one of many letters which have been received on aerial problems, and we are hoping to publish an article in a later issue dealing with these problems.—Ed.]

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. 43 must be attached to all Queries, and if a postal reply is required a stamped and addressed envelope must be enclosed.

MURPHY V210

There is no raster and on switching on, the H.T. across the smoothing capacitor is normal, but as the valves warm up, it drops to around 100V. Looking into the back of the set, the large transformer (top left) has a ¼W resistor wired across two of its tags and this gets very hot, so much so that the markings have been burned off, and I cannot read the value. I would be very grateful for any help you can give me.—C. Fawcett (Leeds).

The resistor which is overheating is the 33Ω anode stopper in the 20L1 frame multivibrator circuit. This indicates either a faulty 20L1 or the 100pF capacitor from one anode to the other grid becoming short circuit.

FERGUSON 992T

The picture suddenly collapsed to a narrow band about 1in. high across the screen. I have changed the ECL80 valves around, tested T3, which seems to be in order, and checked the voltages at V7, 12 and 13. These seem to be higher than the stated values.—D. Ralph (Yeovil, Somerset).

The trouble probably lies somewhere in the frame amplifier section. If the associated valve is definitely in order, suspect shorting turns in the primary of the frame output transformer. Also, if necessary, check the components associated with the frame amplifier valve and frame linearity control.

PHILIPS 1768U

Recently when the set was switched on, the picture failed to appear. The screen remained blank, with no raster and the brightness control had no effect. An initial check indicated that the the CRT and all valves were alight, but there was a slight hissing noise from the line transformer assembly can. I loosened the six retaining screws and raised the complete assembly about a ¼in. in order that V9 could be seen. When the set was switched on again, this valve lit momentarily after the usual warming up period, then went out and the hissing noise stopped. There does not appear to be any EHT voltage on the tube and the voltage on the first anode and focus electrode is in the region of 150V instead of the 480V quoted on the service sheet. The line output assembly is now quite quiet.—G. C. Gould (Swansea).

This is very much like insulation collapse in the line output transformer. A hissing noise is often produced when this happens and, of course, EHT and the booster circuits fail completely.

PYE VT7

The picture on this set now appears too large for the screen with a fold over at the bottom and in adjusting the line linearity control the length of objects on the screen become out of all proportion to the width. When I close the picture in with the width control to examine the scan I find that the left-hand side of the scan is perfectly straight and the right-hand side is rounded at the top and bottom corners. The EHT rectifier valve EY51, and the PL82 have been changed.—G. M. Chesney (N. Ireland).

We suggest you check the PL82 frame output valve and also the frame height and linearity control.

PHILCO A1962M

The trouble with this set appears to be in the sync separator circuit. The picture comes on with the line broken up, and the frame rolling very fast. After two or three adjustments to the line-hold, the line settles down to the proper frequency, but the frame-hold is far from steady, and the picture will not lock as it should do. All three symptoms appears on Band I and Band III and with the weaker signal, the frame hold will not lock at all. I have replaced C37 and C74, and C70 is all right on test. I have tried V14 by substitution, and have replaced V8 and V10, also MR1, but without any success.—J. Connor (Ireland).

Check V6 and V7 by substitution. If the trouble persists, check R31, C31, C33 and R36.

KB OV30

Would you kindly assist me to rectify a fault that has recently made itself evident in my television receiver. The fault is that the picture is mis-shapen in the upper half and to left-hand side, while there is some compression in the lower half. —W. Grieve (Edinburgh).

If the appropriate linearity controls fail to correct the trouble, the cause could be low H.T. voltage, especially if it has been necessary of late to advance the height control to fill the screen correctly. In this event, you should have the H.T rectifier checked and replace it if low.

RAYMOND F105

When this set has been on for about 45 minutes the line hold becomes very critical and sensitive. The flickering is accompanied by a highly pitched sound, though the TV sound itself is unaffected. It is also very difficult to eradicate the sound-on-vision. The tuner valves have recently been replaced.—S. E. Phillips (Llanelly, S. Wales).

When the high pitched sound occurs, check for signs of sparking inside the PL36 line output valve.

If there are no signs of sparking, change the ECC82 line oscillator to the left of the screened section, V17.

VIDOR CN4230

Could you please tell to what points of the chassis I connect the line scan coils of this receiver? I have a service sheet, but I cannot find the capacitor C81 to which I intended to connect one line scan lead. I have the set working by means of a flying lead to the boost diode top cap. —F. Aiken (Belfast).

It is only necessary to trace the top cap lead of the PY81 to the junction of C81 and terminal 3 on the line output transformer directly under the scanning coils. The same effect is obtained by connecting to the PY81 top cap.

PETO SCOTT 1720

With the width control (which is located on the EHT housing) at maximum the picture still leaves a 2½in. gap either side on the screen. I would be grateful for any information you could give me to rectify this fault.—L. Hunter (Cornwall).

You should check the H.T. voltage if possible and if this is low, check the PY32 H.T. rectifier. However since you do not mention any decrease in height we would suspect that the fault is in the line output stage. You should therefore check the PL81 and PY81 valves (in the screened section) also the 1·5k resistor to pin 8 of the PL81 valve base.

MURPHY V410

I should be grateful if you could help me to rectify the following fault that I am experiencing with the above set. The trouble is on ITV (channel 8) sound only, the BBC channel 4 being satisfactory. The effect is a gradual fading of volume from normal, when switched-on, to being barely audible with the volume control up to the maximum position and the contrast control adjusted until the picture is on the verge of going negative. Except for having to make the contrast control adjustment to increase the volume, the picture remains satisfactory on both channels. Some months ago the local dealer carried out a repair to the sound section, but on this occasion the trouble was a hum which was not apparent on switching-on, but gradually increased. On this occasion the fault affected both channels equally. —R. C. Lacey (Birmingham).

You should fit a new set of channel 8 coils to this receiver. These can be fitted without "unboxing" by using the hatch at the back of the set and tuning the local oscillator via the hole in the bottom of the cabinet.

FERGUSON 206T

The trouble is that the screen gradually gets darker after about thirty minutes of use, until there is almost no picture. Any advice you can give me would be appreciated.—J. Franks (London, S.E.18).

This could be caused by a faulty picture tube. A likely cause is a partial short across the series-connected heater. Suspect this if the heater brightness falls as the trouble occurs.

PHILIPS 1468U

On switching on this set a fair picture is received but this fades to a black screen within ten minutes. The PL81 and EY51 valves have been checked and found in order. If the aerial is disconnected the raster is as normal but it drifts, after some time has elapsed, to the left and down of screen.—R. Graham (New Romney).

If the EHT voltage does not fail when the fault occurs, suspect trouble either in the tube, the video amplifier or vision I.F. stages, assuming that the sound remains normal.

BANNER BT112

When the volume is turned down there is a loud squeal and the speech becomes distorted; turning the volume up cures this, but then the sound is deafening. Disconnecting the aerial will not stop this. I have replaced the volume control and had the sound output valve tested.—R. E. Allen (Seagrave, Leicester).

This is probably caused by instability in the A.F. channel, that is if the vision remains normal. In this event, check the decoupling and electrolytic capacitors associated with the A.F. valves.

PYE VT4

I can receive BBC channels 1 and 2, Ulster TV channel 9 very well, but I cannot get Telefis Eireann, channel 7, unless I screw up the horizontal hold. Then the picture received is very faint and ragged. The sound comes in reasonably well by adjustment of the fine tuner. I am using a Telefis Eireann, channel 7, six-element aerial. I should be most grateful if you would advise what I could do to improve the picture.—D. O'Sullivan (Co. Donegal).

From similar letters which we have received we would say that your troubles are shared by a number of readers. You could try fitting a 30L15 valve in place of the PCC84 in the tuner, or you could write to the makers quoting the serial number and ask if they have made a more sensitive tuner for your set (they have done so for some models). Try also adjusting the small trimming screws on the top of the tuner chassis.

EKCO T164

I would like to convert this set to receive channels 1, 7 and 9. I would therefore be very grateful if you could send me details of the components required and also if possible some instructions on the fitting of the same.—J. Mullan (Co. Down, N. Ireland).

One unit which is suitable to convert your receiver is the Cyldon U16H which plugs in to the valveholders at present occupied by 10F1 valves, V1 and V2. Full instructions are given with new kits of these units.

BUSH TUG26

While watching one evening, the picture just disappeared, the line whistle was there and could be varied with the hold control. The EY51 heater was out but when tested it was found to be in working order. The PL81, PY81, ECL80, EF80 (V3 and V4) were also checked in another set and proved good. When the fault developed the PL81 became red hot. The tube was suspected for a short and the final-anode cap was disconnected but

(Continued on page 43)

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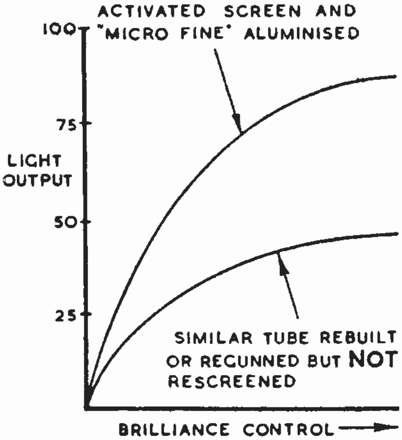

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(Continued from page 40)

the PL81 still glowed red hot. Then, the anode top cap of the PL81 was disconnected and the valve then cooled down. The same thing happened when the anode top cap of the PY81 was disconnected.

I have checked most of the resistors and capacitors.—R. S. Hale (Battersea).

The fact that the PL81 glows red hot probably denotes that there is insufficient drive from V4 reaching V5. Since the line whistle is present, T4 must be in order and V4 must be functioning. You have checked most components in the circuit and it all specified are definitely in order, only TC1 is left to check. Note the effect of disconnecting it.

REGENTONE 17T

The picture is perfect except for 1in. at top, where the horizontal lines are more pronounced. Also after viewing for half an hour, thick horizontal streaky lines start working down the picture until about 3in. of the screen is affected. After five seconds or so, the picture becomes clear again. This goes on every five minutes or so, until I adjust the line hold. This fault repeats itself and I'm continually adjusting the line hold.—J. McKay (Paisley).

The frame output valve V10 (ECL80) is cathode-biased by a 390Ω resistor and 500μF capacitor from pin 3 to chassis. Check V10 and these bias components particularly the 500μF capacitor. The replacement of V10 may also solve the line hold problem since the line oscillator is the triode section of V10. Check if necessary the 150k resistor (brown-green-yellow) wired to the hold control.

PHILIPS 1468U

The trouble is non-linearity—short legs, tall heads. This condition leaves a border of about a quarter of an inch at the bottom of the screen. —R. Taylor (Cinderford).

On the front right-hand side of the chassis are two ECL80 valves. Check both of these. If they are not at fault check the 250μF bias electrolytic capacitor connected to pin 3 of the right-hand valve and the 18,000pF to pin 9.

McMICHAEL TM417

When the brilliance is turned up, the picture enlarges and then disappears. With the raster on alone, and the brilliance half on, the raster is flashing bright and dark. The top half seems to be worse than the bottom. — M. T. Irving (Newbiggin-by-Sea).

Replace the EY51 EHT rectifier and reset the ion trap magnet for maximum brilliance.

FERGUSON 995T

The screen went blank and so I changed the EY51 and now I have vision again. However, the picture is egg-shaped, stretched at the top. I have changed V15 (EF80) with a tested valve, and tried adjustments but with no effect. The frame linearity and picture height controls at the back of the set are advanced fully clockwise. Also I tried reverting to BBC only.—G. Chase (Gosport).

Since the only faults you describe, picture egg-shaped and rolling, concern the frame timebase, there is little point in replacing V15 or reverting to BBC only. We advise you to check V20 and V19 (ECL80) and also C74, if necessary.

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PRACTICAL TELEVISION, OCTOBER, 1962.

Servicing Data and Modifications

(Continued from page 30)

First set the line hold control to the centre of its range and then short-circuit the line sync pulses to the discriminator. This is accomplished by shorting the wire-ended test point to chassis, it being located a little below and to the right of the transformer adjacent to the focusing assembly.

Next unscrew the core of L44 until is is flush with the end of the transformer and adjust the core of L43 until the picture is moving neither to the right nor to the left. It will not lock, of course, since the sync pulses are shorted, but by careful adjustment it will be possible to hold the picture fairly steady. There are two positions of the core where this effect will occur but the correct one is when the core is furthest out, nearest to the end of the transformer.

The short at the test point should now be removed, when the picture will lock, though it may be displaced to the right or left of the raster. This can be corrected by reducing the contrast and increasing the brightness until the blank raster at each side of the screen can be seen and then adjusting the core of L44 until there is about ⅛in. of blank raster down the right-hand side of the picture. In order to see the edge of the picture it may be necessary to dispace it by adjusting the picture centring control on the focus assembly.

With sets employing flywheel sync a random sideways movement of the picture is caused by phase changes in the transmitted sync pulses and this may at times happen normally from both the BBC and ITA stations. However, where the effect is very troublesome due to fading and aircraft reflections it may be reduced with slight impairment of the flywheel characteristics by short-circuiting the 470k resistor connected to pin 2 of the D77 discriminator diode V16. This valve is located directly to the right-hand side of the discriminator transformer and the resistor is located adjacent to the socket of the valve and is accessible if the chassis is slightly withdrawn from the cabinet.

(To be continued)

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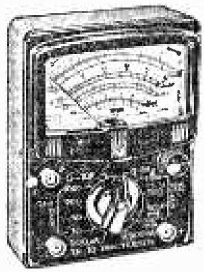

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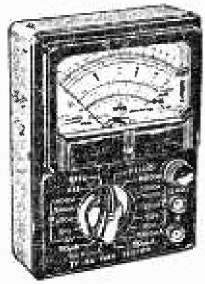

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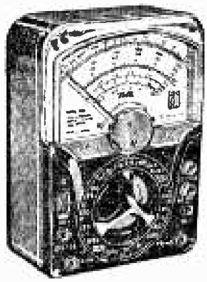

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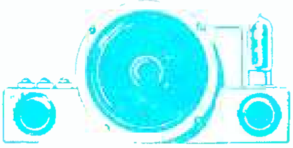

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