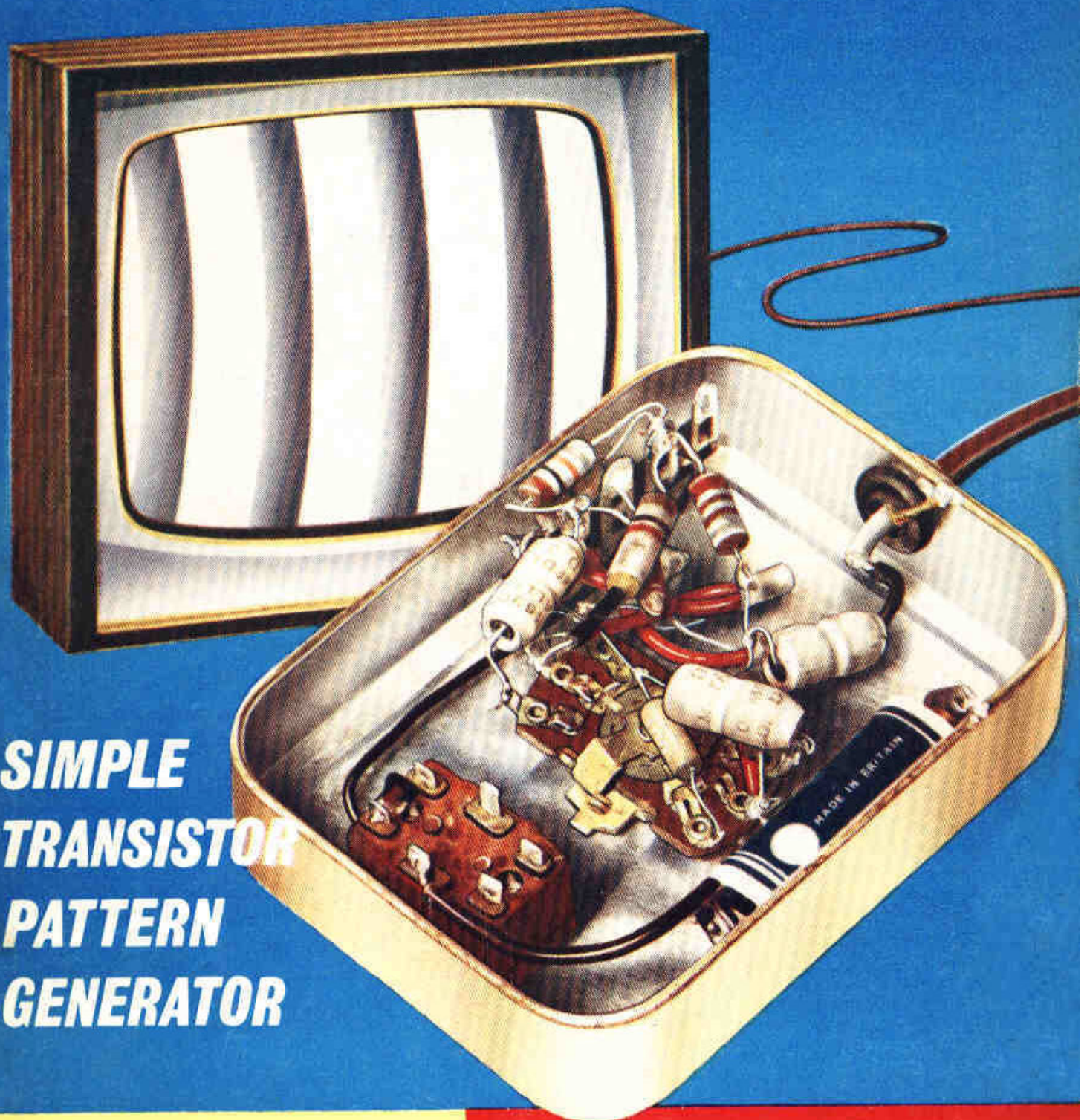


Practical

JANUARY 1963 2/-

TELEVISION



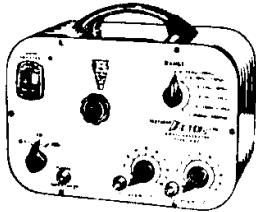
**SIMPLE
TRANSISTOR
PATTERN
GENERATOR**

**Frame Timebase
Troubles**

**Servicing Television
Receivers**

RADIO BARGAINS

SIGNAL GENERATOR



£75.0 or 30/- deposit and 6 monthly payments of 21/6. P. & P. 5/6 extra. Coverage 100 Kc/s. 100 Mc/s on fundamentals and 100 Mc/s to 200 Mc/s on harmonics. Metal case 10 x 6½ x 5½ in grey hammer finish. Incorporating three miniature valves and Metal Rectifier. A.C. Mains 200/250. Internal modulation of 400 c.p.s. to a depth of 30%; modulated or unmodulated R.F. output continuously variable. 800 millivolts, O.W. and mod. switch

variable. A.F. output. Incorporating magic-eye as output indicator. Accuracy plus or minus 2%.

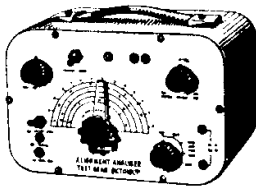
OSCILLOSCOPE FOR D.C. and A.C. APPLICATIONS
A high gain, extremely stable differential Y-amplifier (30 mV/C.M.). Provide ample sensitivity with A.C. or D.C. inputs. Especially suitable for measurements of transistor operating conditions where maintenance of D.C. level is of paramount importance. Push-pull X amplifier; Fly-back suppression; Internal Time-base Scan Waveform available for external use; pulse output available for checking TV line O/P Transformers, etc. Provision for external-I/P and C.R.T. Brightness Modulation. A.C. mains 200/250v. £18.18.0. P. & P. 3/- or £4.13.0 deposit, plus P. & P. 3/- and 12 monthly payments of 26/6. Full 12 Months' Guarantee including Valves and Tube.



ALIGNMENT ANALYSER

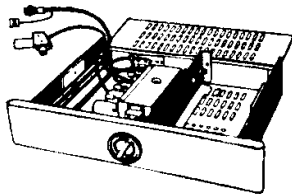
TYPE MCR2

A.C. mains 200/250 v. Provides: "Wobulator" (Swept Frequency) Operation, for FM/TV alignment linear frequency sweep up to 12 Mc/s. From 400 kc/s -80 Mc/s. Capacitance Measurement. Two ranges provided. 0-60pF and 0-12pF. Special Facility enables true resonant frequency of any tuned oct. I.F. transformer, etc., to be rapidly determined. Cash price £6.19.6. plus 5/6 P. & P. H.P. terms 25/- deposit, plus 5/6 P. & P. and six monthly payments of 21/6.



CHANNEL TUNER

Will tune to all Band I and Band III stations. BRAND NEW by famous manufacturer. Complete with P.C.C. 84 and P.C.F. 80 valves (in series). I.F. 16-19 or 33-38. Also can be modified as an aerial converter (instructions supplied). Complete with knobs. 32/6 plus 4/6 P. & P.



HEATER TRANSFORMER

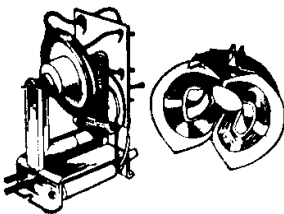
To suit the above, 200-250 v., 4/-, plus 2/- P. & P.

LINE E.H.T. TRANSFORMERS

With built-in line and width control, 14kv. Scan coil, 90in. deflection on ferrite yokes. Frame O.P. transformer pl. 18 kv smoothing condenser. Can be used for 14in., 17in. or 21in. tubes. Complete with circuit diagram.

29/6 Plus 4/6 P. & P.

Focus Magnet suitable for the above (state tube). 10/- plus 3/- P. & P.

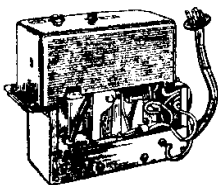


CHANNEL TUNER

I.F. 16-19 Mc/s continuously tunable from 174-216 Mc/s. Valves required, PCF 80 and PCC 84 (in series). Covers B.B.C. and I.T.A. ranges, also Police, Fire and Taxis, etc.

Brand new by famous manufacturer

10/- Plus 3/- P. & P.



RADIO & T.V. COMPONENTS (Acton) LTD.

21c HIGH STREET, ACTON, LONDON, W.3

All enquiries S.A.E. Goods Not Despatched Outside U.K.



SPEAKERS 7/9 EACH

6in. 8in. 7in. x 4in. Money back guaranteed. Enquire for other sizes. Ex. mfd. salvage. P.P. 2/3.

ILFord 6001/3

DUKE & CO (LONDON) Ltd
621/3 ROMFORD RD.
MANOR PARK E12
10 mins. from Liverpool St.

VALVES 9d. Each

Thousands of ex-service stock, and ex-government. All good. MOST TYPES AVAILABLE. Post 3d. FREE LIST.

REGUNNED TUBES

21 in. 99/6 17 in. 90/-
15, 14, 12 in. 70/-

Guaranteed 1 year. Ins. & Carr. 12/6

Add 10/- refundable on receipt of your OLD tube. 110° Tubes in Stock.

35/- 36/24, 14KP4, 14I. 5/-carr. Ex Rental stock

TV Aerials: 25/-. Indoor combined. Complete with 12ft.co-ax.and plug.P.P.2/6.

TV Aerials: 35/6. Loft combined. Single dipole BBC. with 3 element I.T.A. Swivel bracket for Universal fixing. P. & P. 3/6.

Co-ax Cable: 6d. per yd.

Co-ax Plugs: 1/3 new.

SEND FOR LIST

COMPLETE TELEVISIONS

14 INCH

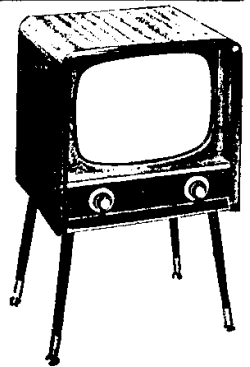
£7.10.0

17 INCH

£11.10.0

- ★ 12 months free replacement on Tubes, Valves, Components.
- ★ Ex Rental and repossessed televisions.
- ★ All channels available.
- ★ Demonstrations daily.
- ★ Legs—39/6 per set.
- ★ Part exchange allowance on Radios, TV's, etc.

Personal collection advised, or Insured Carr., 14in., 20/-; 17in., 30/-.



E.M.S. TELEVISION TUBES

PROVED with Δ reliability:-

PACK A GREATER PUNCH THAN EVER
TRY ONE NOW AND SEE THE DIFFERENCE!

18 month guarantee with all our tubes

SIZE	PRICE	COST TO YOU WITH ALLOWANCE ON RECEIPT OF OLD TUBE
12in.	£4. 7.6	£3.17.6
14in.	£4.15.0	£4. 5.0
15, 16, 17in.	£5.15.0	£4.15.0

Carriage and Insurance 10/6 extra on all tubes

★ BUY FROM ACTUAL MANUFACTURERS WHO KNOW HOW TO REBUILD A TUBE

MARSHALL'S for TELEVISION LTD.

131 St. Ann's Road, Tottenham, London, N.15
STAMFORD HILL 3267 & 5555

The decision is YOURS. To be a success in your chosen career; to qualify for the highest paid job . . . to control a profitable business of your own. ICS home-study courses put your plans on a practical basis; teach you theory and practice; give you the knowledge and experience to take you, at your own pace, to the top.

Choose the *RIGHT* course:

RADIO & TELEVISION ENGINEERING
INDUSTRIAL TELEVISION

RADIO & TELEVISION SERVICING
RADIO SERVICE AND SALES

VHF/FM ENGINEERING : ELECTRONIC
COMPUTERS & PROGRAMMING

ICS provides thorough coaching
for professional examinations:

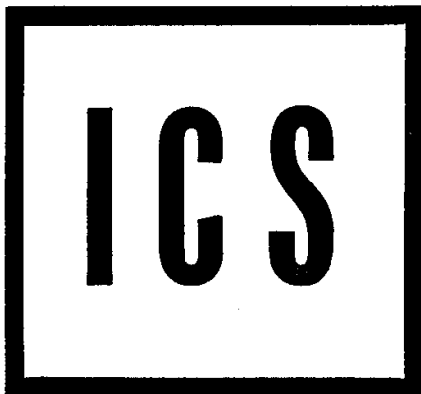
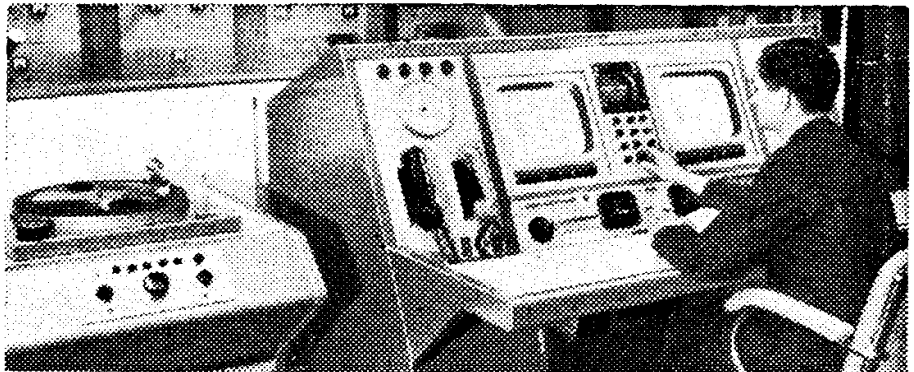
Brit. I.R.E., City and Guilds Tele-
communication Technicians, C. & G.
Radio & TV Servicing (R.T.E.B.);
C. & G. Radio Amateurs.

LEARN AS YOU BUILD

Practical Radio Courses

Gain a sound knowledge of Radio as you build **YOUR OWN** 4- and 5-valve superhet radio receiver, Signal Generator and High-quality Multitester. At the end of the course you have three pieces of permanent and practical equipment and a fund of personal knowledge and skill. ICS Practical Radio courses open a new world to the keen Radio amateur.

Technical Training in Radio, Television and Electronics Engineering with



THERE ARE ICS COURSES TO MEET YOUR NEEDS AT EVERY STAGE OF YOUR CAREER. FILL IN AND POST THIS COUPON TODAY.

You will receive the FREE 60-page ICS Prospectus listing examinations and ICS technical courses in radio, television and electronics PLUS details of over 150 specialised subjects.

Other ICS courses include:
MECHANICAL, MOTOR
FIRE, ELECTRICAL &
CHEMICAL ENGINEERING.
FARMING, GARDENING.
ARCHITECTURE &
WOODWORKING,
SELLING & MANAGEMENT.
ART. PHOTOGRAPHY,
etc., etc.

**PLEASE STATE ON COUPON
SUBJECT YOU ARE
INTERESTED IN . . .**

INTERNATIONAL CORRESPONDENCE SCHOOLS
(DEPT. 165), INTERTEXT HOUSE, PARKGATE RD., LONDON, S.W.11

PLEASE SEND FREE BOOK ON.....

NAME

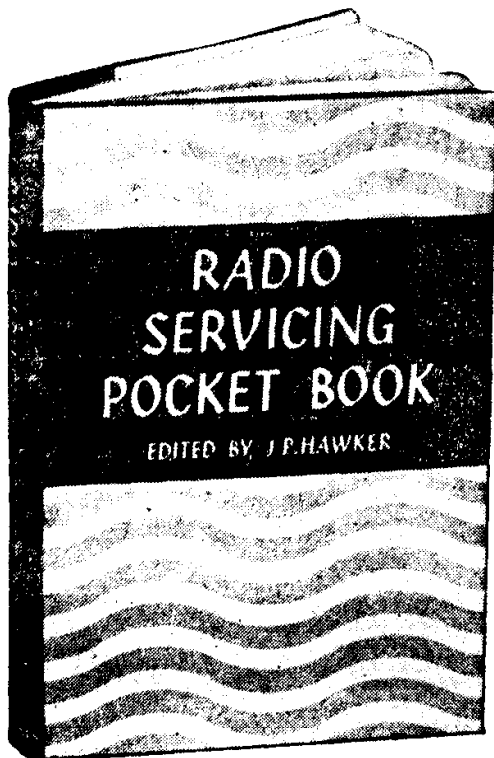
ADDRESS

.....

OCCUPATION..... AGE.....

1.63

**Two invaluable data volumes for servicemen,
engineers and the serious enthusiast . . .**



New, revised 2nd edition

RADIO SERVICING POCKET BOOK

edited by J. P. Hawker

The fully-revised second edition of this popular pocket manual and data book contains much new information. Of particular interest will be the practical guidance on the servicing of transistor receivers and the repair of printed wiring panels.

It provides the essential information and data needed in the day-to-day work of servicing the whole range of modern A.M. and V.H.F./F.M., valve and transistor radios. Experienced engineers, trainees and newcomers to servicing work will all find that this book shows an understanding of their real needs, and will repay its cost time and time again.

CONTENTS

Modern A.M. Valve Receivers . Principles and Practice of F.M. Receivers . Transistor Receivers . Car Radio Receivers . Mono and Stereo Record Reproduction . Workshop Organisation and Practice . Servicing Equipment . Fault-Finding and Replacements Receiver Alignment . Receiving Aerials and Earths . Electrical Interference . Useful Formulae . Colour Codes . Broadcasting Stations . Valve and Transistor Data Battery Equivalents.

**198 pages of facts, many line drawings and
circuit diagrams 12s 6d (13s 6d by post)**

**Now in its third revised and enlarged
edition . . . planned for on-the-spot use**

TELEVISION ENGINEERS' POCKET BOOK

edited by J. P. Hawker

Much new information has been added to the enlarged and fully revised third edition of this pocket manual and data book, specially designed to meet the every-day practical needs of all concerned with the repair and maintenance of modern television receivers.

Apart from essential reference data on cathode-ray tubes, valves, television stations and transmission standards, there are extensive sections on the basic circuits used in receivers, on fault finding—including a new trouble tracing chart—and on the alignment of Band I/III receivers. There is guidance on the conversion of Band I sets and a comprehensive list of receiver intermediate frequencies. Colour and transistorised receivers are described.

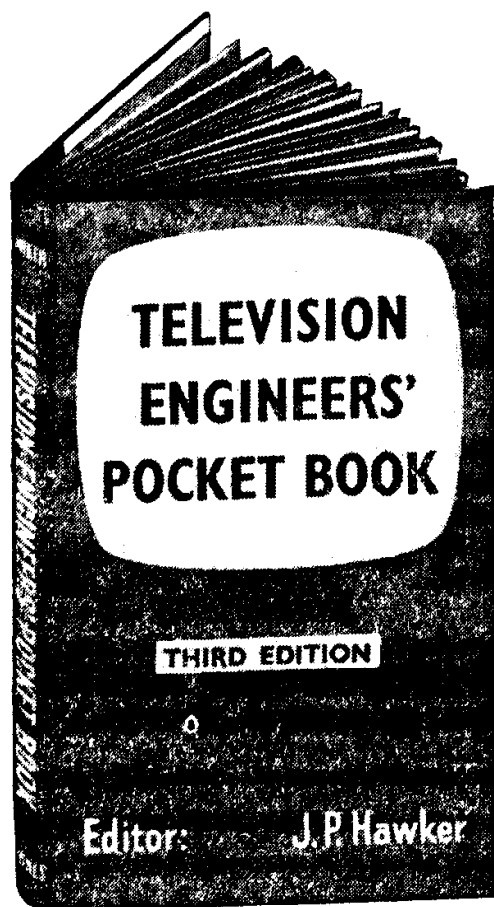
There are also special sections on servicing equipment, dealing with printed-circuit models and projection receivers, aerials and interference problems.

Both the experienced engineer and the newcomer to service work will find this handy book invaluable for on-the-spot repairs as well as a most useful addition to his workshop library.

**258 pages. Over 200 illustrations
12s 6d (13s 6d by post)**

FROM ALL BOOKSELLERS

...or, in case of difficulty, at post prices from
GEORGE NEWNES LTD., Tower House, Southampton
Street, London, W.C.2.



Only 12s. 6d. each

NEWNES

Practical Television

AND TELEVISION TIMES

VOL. 13, No. 148, JANUARY, 1963

Editorial and Advertisement
Offices:

PRACTICAL TELEVISION

George Newnes Ltd., Tower House
Southampton Street, W.C.2.

© George Newnes Ltd., 1963

Phone: Temple Bar 4363.

Telegrams: Newnes, Rand, London.

Registered at the G.P.O. for trans-
mission by Canadian Magazine Post

SUBSCRIPTION RATES

including post for one year

Inland - - - - £1.8.0 per annum
Abroad - - - - £1.6.6 per annum
Canada - - - - £1.5.0 per annum

Contents

	Page
Editorial	147
Telenews	148
Problems of 625-line Conversion	150
Servicing Data and Modifica- tions	153
Buying Second-hand Sets ...	156
The Principles and Practice of Television	159
Frame Timebase Troubles ...	162
A Simple Transistor Pattern Generator	168
The ABC of TV Circuits ...	170
Servicing TV Receivers... ..	173
Letters to the Editor	176
For Your Bookshelf	177
Underneath the Dipole... ..	179
Trade News	183
Your Problems Solved	184

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

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

Copyright in all drawings, photographs and articles published in "Practical Television" is specifically reserved throughout the countries signatory to the Berne Convention and the U.S.A. Reproductions or imitations of any of these are therefore expressly forbidden.

Prospects

THE New Year ahead of us heralds the promise of new and exciting prospects on the television scene. The Director of BBC Television, Mr. Kenneth Adam, recently stated that the Corporation hopes to start its second channel on 625-lines early in 1964, and that the BBC considers that some element of colour must be introduced at the earliest possible opportunity.

We were encouraged to hear that BBC-2 is not to be regarded simply as an extension of BBC-1. Mr. Adam spoke of alternatives to sport in the afternoon and light entertainment in the evenings. If this type of thinking can be translated into actuality then we should at last have a *real* alternative programme and not merely a choice between two similar types of programme.

Colour programmes will always be very expensive and it is likely that there will never be more than an hour or two of colour programmes per day. Colour will only be used for special highlighted programmes best suited to such treatment.

The real fly in the ointment is likely to be the cost of colour receivers—although a prominent member of the industry has forecast that in three years time sets may be available at just over £200. This would come down with demand, of course, and rental facilities will bring colour within the reach of many households, perhaps most.

All this, however, is still tantalisingly in the future. But in the meantime, new 625-line u.h.f. tests have been started from Crystal Palace on channel 44 (655.25 Mc/s vision, 661.25 Mc/s sound) both in monochrome and colour (NTSC now, SECAM later) daily Mondays to Fridays. Early in 1963, simultaneous transmissions will be made on channel 34.

All this hustle behind the scenes, and the imminence of the new 625-line u.h.f. programme in 1964, makes it all the more difficult to understand why the organisers have cancelled the 1964 Radio Show. It seems a major blunder to throw away a golden opportunity to display the new sets at a time when the public's interest will be at a peak.

That this viewpoint is shared by the industry is borne out by the plans being made by some of the larger companies to mount their own private exhibitions during the traditional Showtime period.

Seasonal Greetings

to all our readers

from the Editor and Staff of
Practical Television

Our next issue dated February, will be published on January 22nd.

Telenews

Television Receiving Licences

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

Region	Total
London	2,029,203
Home Counties	1,719,198
Midland	1,802,420
North Eastern	1,931,223
North Western	1,605,050
South Western	1,050,612
Wales and Border Counties	730,288
Total England and Wales	10,867,999
Scotland	1,108,247
N. Ireland	190,932
Grand Total	12,167,178

Another Aerial at Moray Firth

MANY more residents in the Moray Firth area of Scotland will be able to receive stronger television signals when extensions are completed at the British Broadcasting Corporation's television station at Rosemarkie. An additional aerial will double the size of the existing aerial array. A contract for the supply and installation of the new aerial array has been placed with EMI Electronics Ltd.

Signals being radiated in this area are Band I BBC TV programmes. Reception will be greatly improved by the new aerial, particularly for people living in outlying areas.

The additional aerial, which is being built to BBC specifications, will be erected in sections and fully tested at EMI's Hayes factory, before it is delivered to its site in Rosemarkie where it will come into use during the autumn of 1963.

Closed Circuit TV for Security

CLOSED circuit television is being used more and more in industry and business and one of

the latest applications is to add security to the headquarters of Messrs. Securicor Ltd. Persons approaching the building can be seen over a Beulah closed circuit TV installation before the door is opened.

For such purposes Beulah have recently brought out two special monitors, one with a 14in. screen and one with an 8in. screen. These may be used with nearly any type of closed circuit TV systems in use.

New Swindon Station

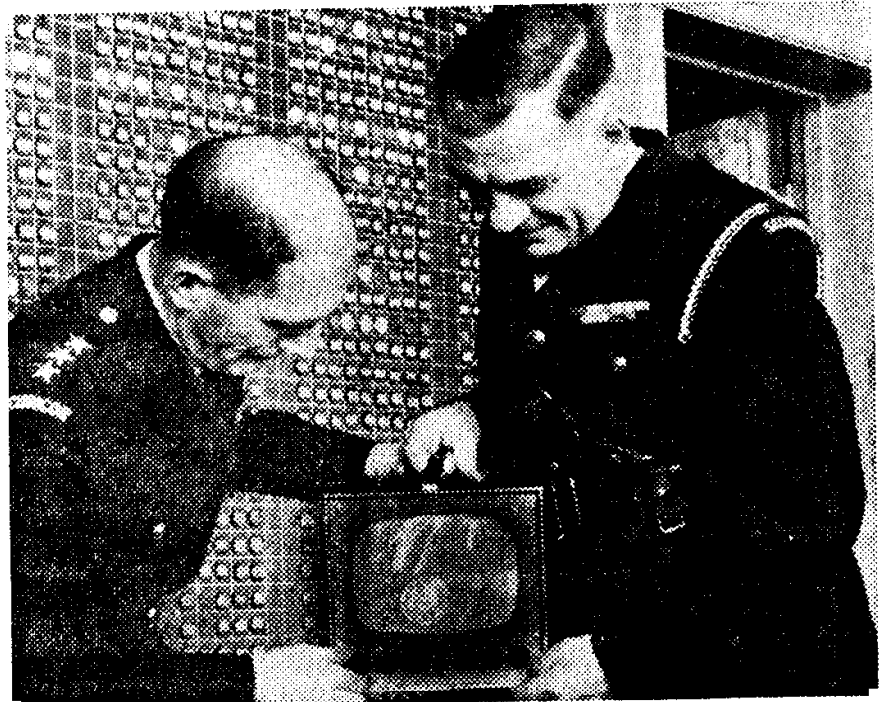
THE new television station at Swindon, Wiltshire, was bought into service on 5th November. This new BBC transmitter operates on channel 3 (vision 56.75Mc/s, sound 53.25Mc/s) using horizontal polarisation, which means that

receiving aerials must be horizontal. As it must share this channel with several existing BBC stations, the service area is restricted in order to avoid causing interference in other areas. The new station provides improved reception for a considerable number of viewers in and around the town of Swindon.

TV at Manchester Airport

OFFICIALLY opened recently, was the new 2½ million pound air terminal building at Manchester Airport. By means of closed-circuit television passengers using this airport will be able to see as well as hear up-to-the-minute flight arrival and departure information.

Sixteen 27in. television receivers, placed at vantage points



Two Securicor officers adjusting a Beulah transistorised monitor in use at their headquarters.

throughout the building, are connected to a Flight Information desk designed and manufactured by Pye Telecommunications Limited.

There are four television cameras in the control console. Two cameras are used for arrival and departure information. A further camera is used to fill in quiet times with advertisements and the fourth is focused on the announcer when she gives information over the public address system.

E.B.U. Sound Sub-group Committee

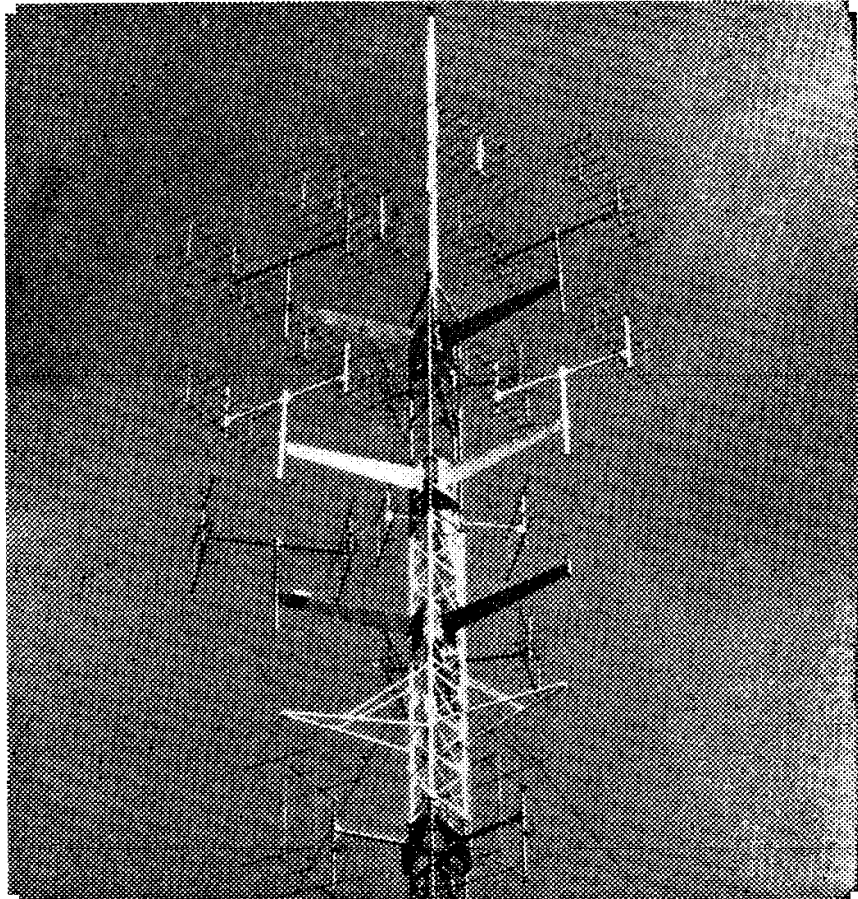
RECENTLY ATV were hosts to the European Broadcasting Union sound sub-group, their meetings being held at ATV House. This international group has members drawn from many European countries, including Italy, Germany, France, Austria, Holland, Belgium and the United Kingdom, and is under the Chairmanship of Mr. L. F. Mathews, of ATV. The terms of reference of this group include the study of all aspects of the sound transmissions of television services in the European Broadcasting Union, and also the sound only services.

The London meeting just held was of great importance, due to the number of far reaching matters requiring solutions, and concentrated study with little break, was required for the work to be concluded satisfactorily, and with a large measure of agreement.

Opera House Microwave Link

ONE of the most expensive television musical programmes ever presented by Associated Television Ltd. — "A Golden Hour", starring Maria Callas and several other international artistes — was transmitted live by microwave link from the Royal Opera House, Covent Garden, on 4th November.

The microwave link, manufactured by EMI Electronics Ltd. was installed on the Opera House roof. Television signals were beamed by the link across the rooftops of London to Highgate where EMI microwave link receiving equipment is permanently installed on a very tall block of flats. From there the signals were piped along a land line to the ATV switching centre



The aerials of this receiving station in Belgium were supplied by J-Beam Aerials Limited.

at Foley Street in the West End of London. The pictures were then relayed to transmitters throughout the country.

TV Aerials for Belgium

ALL the aerials used in the TV and f.m. relay receiving station at Liege, Belgium, were supplied by J-Beam Aerials Ltd., a British firm.

The tower at the receiving station is 150ft high. Twin aerials are supported by horizontal arms 9ft long, bolted to the side of the tower's shaft. A total of nine Band III twin double eight slot aerials, three Band II double four slot and two assemblies of four Band IV double eight slot aerials are used.

BBC 625-line Television Field Trials on U.H.F.

ON 3rd September, 1962, the BBC began a new series of television field trials in the u.h.f. bands on 625-line standards from a transmitter at the Crystal Palace site in London. For some time

the test transmissions, which are on channel 44, consisted of plain carrier, special test signals and test cards, but on Monday, 5th November, the full schedule of test transmissions forecast in previous announcements was introduced.

They take place daily from Mondays to Fridays inclusive between 10 a.m. and 1 p.m.; 2 p.m. and 5 p.m.; and 8 p.m. and 9.30 p.m.

The daytime transmissions include identification captions, test cards and still pictures both in monochrome and in colour. In the evening, both black and white and colour firms are transmitted.

The colour transmissions use the N.T.S.C. system, modified for 625-line television standards.

Early in 1963 simultaneous transmissions will be made on channel 34.

It should be noted that channels 34 and 44 are being used for experimental purposes only; they are not the channels that will be used for future 625-line services in the London area.

How will the new channels line up
 Can I convert my existing receiver
 How about the 405-line-only sets
 What kind of new set should I buy
 How do the dual standard sets work



PROBLEMS OF 625-LINE CONVERSION

by

GORDON J. KING

AMONG other things we can now be certain that the proposed third and fourth television programmes will be via the medium of u.h.f. on 625 lines and that the remaining two programmes, making a total of six channels, will also operate on similar standards. We can also be certain that the existing v.h.f. transmissions on 405 lines will continue for at least the useful life of a new 405-line receiver. This means, of course, that existing single-standard receivers will not suddenly be rendered obsolete.

These are but two of the recommendations made by the Pilkington Committee and which have since been accepted by the Government in a White Paper. It now remains for Parliament to sanction the implementation of this new mode of television broadcasting and this is expected to happen at the start of the winter Session of Parliament.

There are various political issues also involved which do not interest us here, but it has been promised by the Postmaster-General that these will not hold up the final authorisation on standards. Thus we are all set for a new era in television broadcasting.

Channel Line-up

The pattern is for an eventual six channels in all, operating both in the v.h.f. and u.h.f. bands and all on 625 lines. The first two new channels will be given over to the BBC and the ITA, the former to operate first and the latter when certain political factors have been settled. Thus at some point in the future we shall have four channels operating—the existing two of the BBC and ITA at v.h.f. on 405 lines, plus two more at u.h.f. on 625 lines. There is, however, the possibility that the two new channels will at first duplicate the programmes of the existing 405-line v.h.f. stations either in part or whole. Nevertheless, the new stations will put out from time to time compatible colour signals.

The new transmissions will start in the London area and the first transmissions are expected to take place either towards the end of this year, on an experimental basis, or at the beginning of next year, leading up to a permanent service. The new transmission will then spread across the country as speedily as possible in sections, thus building up to what we can call “phase one” of the new development.

During the development of phase one shadow v.h.f. stations on 625 lines will be constructed. These will not be put into service until some pre-

determined time in the future and on that day the old 405-line transmissions will cease, but by then all the existing 405-line receivers will be past their useful life and viewers will be in possession either of a dual-standard receiver or of a 625-line-only model (the latter have yet to be put on the market).

At that time the shadow 625-line v.h.f. stations will be put into operation and this we can call “phase two” of the development. At this stage, then, we shall have four channels all on 625 lines—two at v.h.f. and two at u.h.f.

There is room still for two more 625-line channels and these will be developed as “phase three” of the exercise, probably carrying colour signals. It should be understood, though, that colour will happen before that time, as has already been intimated, but it will be some years before a colour set is a domestic proposition. They may start off at about £700 or £800 within the next few months and the main demand will be by programme companies, technical institutions, advertising agencies and the like. As the demand increases, however, the price will fall and as a domestic set they will probably range between £150 and £250, depending upon style, screen size, sensitivity and so on.

Conversion

Shall I be able to convert my existing set? This question is one that cannot at present be answered with a ready “yes” or “no”. A considerable amount of development work has gone into the new dual-standard receivers, which are designed either for the immediate switching to one standard or the other or for later conversion to dual-standard operation.

These receivers are, of course, specifically designed for conversion and there should be no undue problems here apart from the connecting of a u.h.f. tuner and, in the “convertible” models, the fitting of the extra sub-sections to alter the operating standards and to facilitate the standards switching. Viewers in possession of such receivers may be able to obtain through their dealers kits of parts and instructions for undertaking the installation of the u.h.f. tuner or the complete dual-standard conversion.

In some cases, however, it may be the policy of the manufacturer to issue such kits only to dealers,

meaning that the dealer may not be in a position, or even prepared, to supply the experimenter with the necessary parts and instructions.

Each type and make of receiver will have its own method of conversion and, possibly, u.h.f. tuner, so there will be no "standard" kit of parts available for this work. It will be recalled that a very similar state of affairs existed when Band III started. The various manufacturers designed their own front ends and tuners and, although the design might have been based on a "standard" tuner, various alterations were made to enable it to suit the particular type of set.

The standard change, however, goes much deeper than Band III conversion, for there are really two distinct operations. One is to convert the set for switchable v.h.f.-u.h.f. operation and the other is to alter several circuits within the sound and video stages and the timebase so that the set proper will respond to signals having the CCIR characteristics.

Although the first is comparable to Band III conversion it will necessarily be somewhat more complex owing to the far higher frequencies involved, but it is a job that could be done by the average experimenter. The second is highly likely to result in complications. Most of our readers who are conversant with television circuits and construction could undoubtedly follow the manufacturers' instructions on fitting the various sub-assemblies so as to make a "convertible" set switchable over the two standards but, as intimated, the biggest problem may be in acquiring the necessary parts.

405-line Sets

Here the field is wide open and from time to time in these pages will be detailed methods of dual-standard conversion and, indeed, ideas for converting an existing 405-line receiver to 625 lines at u.h.f.

If the first two new channels simply duplicate the programmes of the existing 405-line stations then many readers with a "second" or experimental receiver may just want to try their hands at converting or rebuilding this for operation of 625 lines only. This will enable them to acquire very useful information on the various factors of the CCIR transmissions at very little cost.

This type of alteration would undoubtedly be far less complicated than endeavouring to make an ordinary 405-line set switchable over the two standards. Even if different programmes are initially transmitted on the new standards there still may be a good case for converting the second set to 625 lines. The existing "domestic" set could then still be used on the ordinary 405-line signals and the converted set on the new programmes. In that way one could very quickly assess the desirability of the extra number of lines and discover the idiosyncrasies of u.h.f. propagation as compared with v.h.f.

New Receivers

When the new transmissions start there will be many who will not wish to experiment with their existing sets but who will wish to purchase an entirely new model, and it should be remembered that many viewers have refrained from purchasing a new model pending the outcome of the Pilkington Committee report, so there is likely to be quite a demand for the new models.

The question will then be "What kind of set should I purchase?" By that time all new sets will be of the dual-standard variety, ready rigged with all the new circuitry and u.h.f. tuner in addition to a v.h.f. tuner. Choice of set will then be much as it is today or, at least, as it was yesterday. Most models will be engineered for the maximum possible useable gain, since the service area of the u.h.f. stations will be approximately one-third of comparable v.h.f. stations.

There will thus exist many fringe areas to start with, so the new sets must be designed to obtain as much signal as possible in these areas and also in the small pockets of low-signal field which are bound to exist in proximity to heavily-built-up areas and in areas which are screened by hills. By far the biggest factor in the new models will be the noise figure of the tuner, for upon this will depend just how little signal the set will operate on whilst giving a "snow-free" picture. The lower the noise figure the better will be the set's performance in poor signal areas.

Many of the new models, especially those designed specifically for fringe areas, will have flywheel line sync circuits, which is a desirability with the CCIR system, where negative vision modulation is employed.

If the new channels are to carry entirely different programmes from those on the partnered 405-line service then there will definitely be a great incentive for viewers to abandon their old sets and invest in a new dual-standard model, for these would then give a further choice of programmes coupled with the extra number of lines. If the programmes are to be duplicated to start with, however, the chief incentive for purchase will simply be the novelty of the extra number of lines on the u.h.f. channels. But, of course, these sets will always be ready for the new programmes when they start, and it seems that once development gets under way

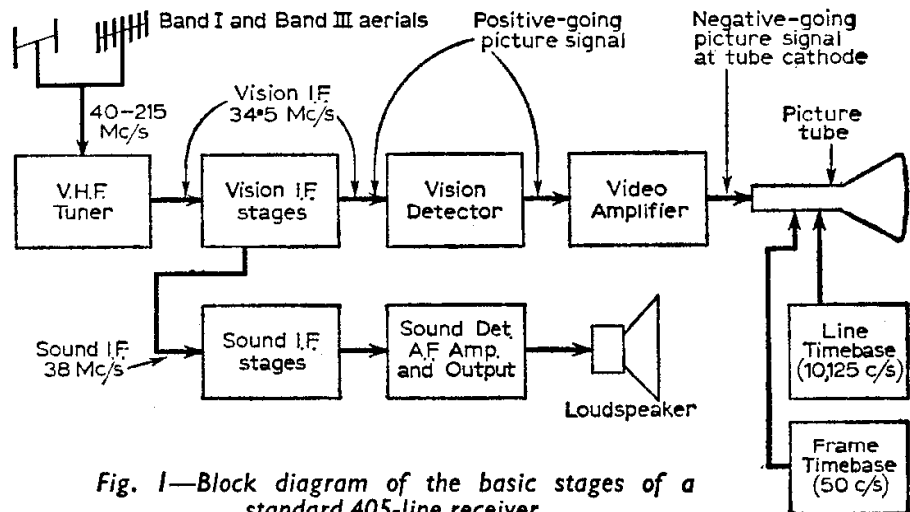


Fig. 1—Block diagram of the basic stages of a standard 405-line receiver.

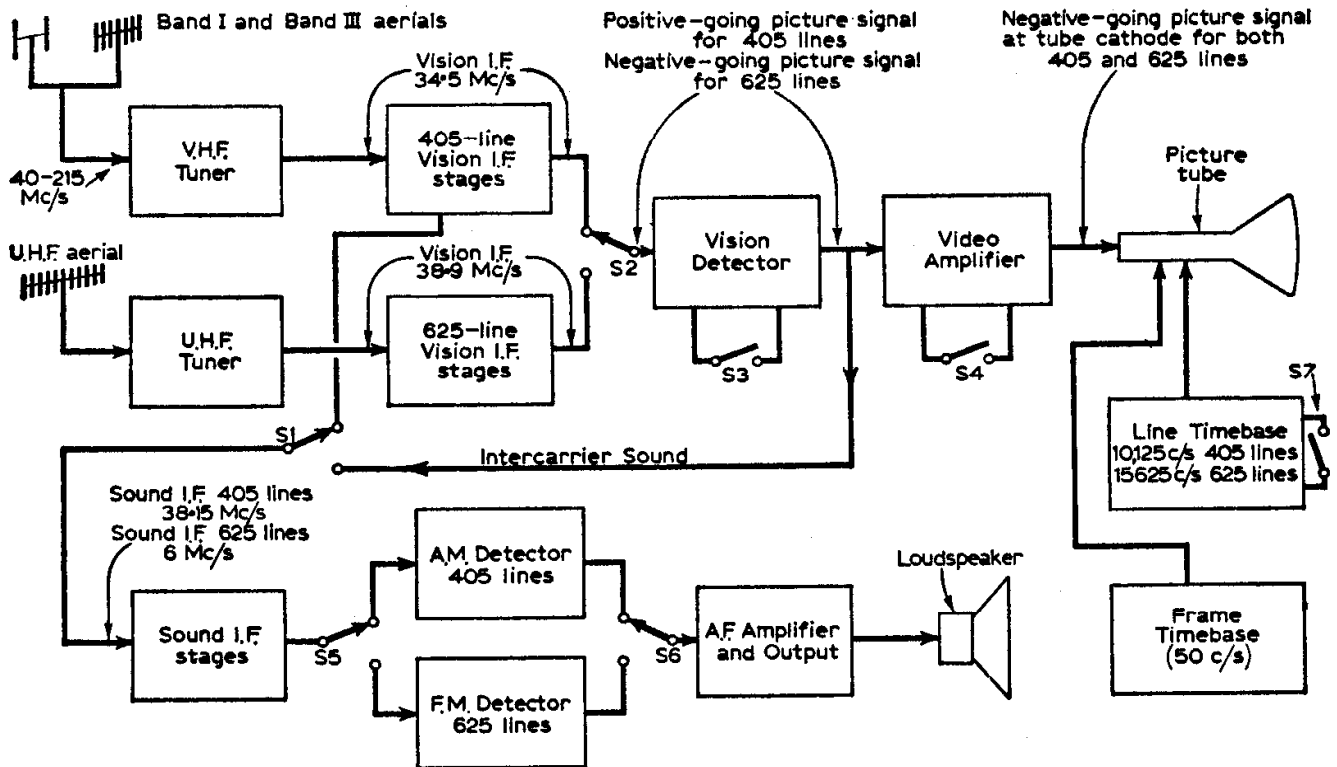


Fig. 2—The greater complexity of a dual-standard set is seen by comparing this block diagram with that in Fig. 1

it is quickly going to spread in both terms of area of coverage and programmes.

Basic Features

In Fig. 1 is given a block diagram of the existing type of 405-line sets and in Fig. 2 a similar diagram of a dual-standard receiver. That in Fig. 1 is well known by most of our readers where the incoming signals are converted to the "standard i.f." by the tuner and then amplified separately as sound and vision so that they feed the speaker and picture tube in the usual way.

Fig. 2 shows how the receiver is made that much more complicated by the dual-standard facilities. On 405 lines the receiver operates in the same way as shown in Fig. 1, but when the "standard-change" switches, S1 to S7, are changed over the following basic operations take place.

The v.h.f. tuner and 405-line vision i.f. section are disconnected and the vision detector is fed instead by the u.h.f. tuner and the associated 625-line vision i.f. section, this being handled by S2 on the diagram. Switch S3 changes over the polarity of the vision detector so that it is able to cater for the negative-going vision signal of the 625-line signals. Switch S4 alters the biasing of the video amplifier, bearing in mind that the picture tube cathode must still receive a negative-going signal on 625 lines, the same as it does on 405 lines.

It will also be seen that the vision i.f. on 625 lines changes to approximately 38.9Mc/s (from the 405-line i.f. of approximately 34.5Mc/s). The sound i.f. also changes from approximately 38.15Mc/s (405 lines) to 6Mc/s (625 lines). Actually this frequency is what is called the "inter-carrier i.f.", it being the difference between the

sound and vision carriers of the real signal. This, then, means that the real 625-line sound carrier is 32.9Mc/s.

The 6Mc/s inter-carrier sound signal is picked up either from the output of the vision detector or the video amplifier and is then fed, via switching, to the sound channel which is now responsive to 6Mc/s. The sound channel change-over is accomplished by switch S1. Switch S5 selects the appropriate detector and, as the sound is frequency-modulated on 625 lines, there is a change from an ordinary a.m. diode detector (405 lines) to a ratio detector, like that used in an ordinary f.m. receiver. Finally, switch S6 switches the output of the detector in use to the a.f. amplifier and sound output stages.

In the timebase circuits the frame frequency remains the same for both systems but the line frequency is changed (S7) from 10,125c/s (405 lines) to 15,625c/s (625 lines). In most sets there are two line hold controls, one for 405 lines and the other for 625 lines.

These, then, are the basic functions which must change on an existing receiver, but in addition the 625-line vision channel must be wider than the 405-line counterpart to accommodate the greater range of video frequencies that the higher definition pictures demand. On the face of it, therefore, it would seem that the constructor would be far able to produce a total change-over of standards than a set which would work adequately on both systems. In future articles we shall describe methods of changing the various stages of 405-line receivers so that the set as a whole will operate on 625 lines.

For those readers interested in examining the new dual-standard receivers in detail we would refer them to the two articles on the subject which appeared in the May and June, 1962, issues of PRACTICAL TELEVISION. □

SERVICING DATA AND MODIFICATIONS

By D. Elliot

(Continued from page 126 of the December issue)

THE experimenter invariably comes up against the problems associated with the use of a fairly recent tube in a not-so-modern chassis. Certain old-type tubes are becoming increasingly more difficult to acquire, thereby often demanding the employment of a tube which differs somewhat in characteristics from the original to keep the set in service.

There is another angle on this, and that is certain recent tubes are somewhat less expensive than the very old ones, especially on the surplus market. Thus when the time comes for tube replacement many an enthusiast is encouraged to experiment with a larger tube than that originally fitted to the set.

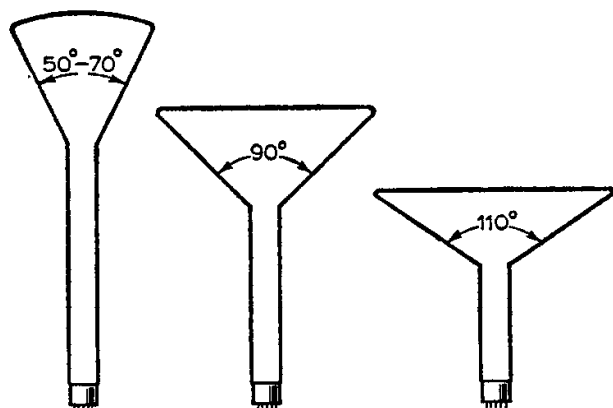


Fig. 44—The increase in scanning angle permits the design of tubes with larger screens and shorter necks, as this diagram shows. It is not easily possible to replace a narrow-angle tube with one of great scanning angle without also replacing the scanning coils and re-designing the timebase circuits.

At the outset it must be made perfectly clear that some of the early sets are just not capable of producing a *satisfactory* picture on a tube any larger than the original. This is not to say that a picture would not resolve on a larger tube, as pretty well any chassis can be adapted to give some sort of picture on a tube of almost any size.

There is very little satisfaction, however, in fitting, say, a 17in. tube into a 12in. chassis only to find that the picture cannot be made to fill the screen, that it is badly out of focus and that it has to be viewed in semi-darkness.

Four Factors

There are four main factors which should be examined carefully before a decision is made to try a tube which differs in type and/or size from the original. The most obvious is the mechanical one.

For example, can the chassis and cabinet be adapted reasonably easily to take the proposed tube?

The three remaining factors are electrical, and the most important is probably the scanning angle. Early tubes have a relatively narrow scanning angle compared with their modern counterparts. Generally speaking, the wider the scanning angle, the greater the scanning *power* required to deflect the electron beam across the screen (see Fig. 44). The very latest, short-neck tubes have a scanning angle of 110deg., compared with the earlier 90deg. and the very first 50-70deg.

Scanning power is delivered by the line and frame timebase amplifiers, and on many early models these stages are working pretty well flat out to deflect the beam over a relatively narrow scanning angle. Thus, it is not always easily possible to make a modification which will produce the extra power required. Such attempts often result in extremely bad linearity and early failure of the timebase valves and transformers.

After the scanning angle comes the final anode requirement. If the proposed tube requires, say, 16kV of e.h.t., then one cannot expect too much in the way of brightness if the chassis produces only 9kV. But, perhaps, it may be possible to step-up the e.h.t. voltage. Remember, though, that when this is done the electron beam becomes "stiffer" and calls for even more scanning power to deflect it fully across the screen.

Gun Assembly

The third major electrical factor is the gun assembly proper. In the early days most tubes were either triodes or pentodes using magnetic focusing. Today, however, there are many pentodes and multi-electrode tubes, some of which are designed for electrostatic focusing.

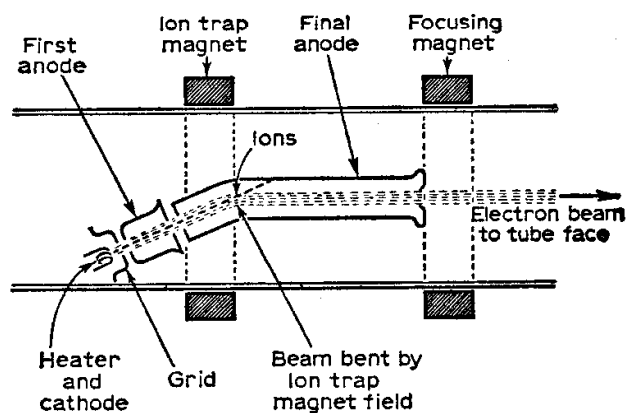


Fig. 45—An ion trap assembly similar to that shown requires the use of an ion trap magnet to bend the electron beam round the final anode. If a magnet is not used the beam will never reach the screen but will impinge upon the side of the final anode along with the ions.

A triode tube requires a greater magnetic focusing field for optimum performance than does a tetrode or pentode. This means that when changing from one to the other the focusing unit also has to be modified or replaced. It is impossible to increase the focusing field, but it is possible to reduce it by the use of magnetic shunts (see later).

When it is proposed to employ a tetrode or pentode to replace a triode tube, a relatively high first anode potential (400-500V) has to be obtained from the chassis. If the set features a booster diode this potential can be obtained from that circuit without too much trouble, but otherwise some other source has to be produced.

The heater is not so bad, for almost all tubes (apart from the very early ones) have 0.3A heaters for including in a heater chain of the same current. The heater voltage is then unimportant as any slight difference in voltage will be balanced throughout the chain. If the current differs from the chain current, a separate heater transformer is necessary solely for the tube heater (a.c. mains only).

Final Points

The remaining factors are probably not so important as the foregoing, and include such things as ion trap assembly and external conductive coating. While the original tube may not have an ion trap assembly, there is a strong possibility that the proposed replacement may have.

It is important, therefore, to find this out before spending a lot of time wondering why a raster cannot be obtained. An ion trap magnet is, of course, required to be accurately adjusted on the neck of a tube incorporating an ion trap assembly, for without such a magnet the beam will never reach the screen (see Fig. 45).

Most modern tubes feature an external conductive coating on the flare. A similar coating is present inside the tube, and the two coatings form the plates of a capacitor, with the glass acting as

the dielectric. The inner coating is bonded to the final anode connector and the external coating must be bonded in several places to chassis, so that the so-formed capacitance will serve as the e.h.t. reservoir capacitor.

In receivers not employing this type of tube a separate e.h.t. capacitor is used, and there may also be an additional smoothing capacitor with a high-pulse type resistor connected between the two (Fig. 46). Thus, when a coated tube is used here the e.h.t. smoothing system can be abandoned. Conversely, an e.h.t. smoothing system must be fitted when a coated tube is replaced by a clear one.

Tube Replacement

With all these things in mind, the experimenter should, at least, be able to decide whether or not a proposed replacement is a feasible proposition. A number of manufacturers use a common chassis in both 14in. and 17in. models. In many cases this means that a 17in. tube can be used to replace the original 14in. without any difficult electrical modifications.

In other cases, there may be a slight modification to the line timebase circuits to produce a greater e.h.t. voltage for the 17in. or 21in. models, and this modification may include a line output transformer with slightly different characteristics from that used in the chassis with the smaller tube.

The characteristics of a picture tube are affected by the value of voltage used on the first and final anodes, but with other things being equal a 14in. tube can be replaced with a 17in. provided the electrode assembly and scanning angle of the proposed replacement are the same as that of the original.

With such tubes, as for instance the Mullard MW36-44 (14in.) and the MW43-69 (17in.), the bases are usually the same, as also are the heaters. In the majority of cases, the larger tube can simply be connected direct to the circuit and it will work.

To obtain the same value of light emission per given area of screen, however, the larger tube usually requires a slightly greater e.h.t. voltage than the smaller one. With the tubes mentioned above, for example, the 14in. runs at 12kV and the 17in. at 14kV. A 21in. tube, with the same scanning angle (70deg.), such as the MW53-20, requires some 16kV for optimum illumination. With all the tubes mentioned above, however, the first anode voltage is the same: 300V.

The negative grid voltage required for beam cut-off may vary, but it is not very difficult to pad for this in the receiver circuits. The bias present at the tube grid is relative to cathode, and as the cathode is already positive with respect to chassis (being connected to the anode of the video amplifier valve) it follows that the grid has either to be at chassis potential or some lesser positive potential than the cathode to be biased negatively.

In Fig. 47 is shown the basic elements of the brightness control circuit. Now, when the brightness control slider is at the chassis end of the element the grid is biased to its maximum value negatively (depending upon the actual positive potential at its cathode). As the slider is turned towards the R1 side of the element the voltage rises positively on the grid relative to chassis.

This means that the grid becomes progressively less negative with respect to cathode. For the best

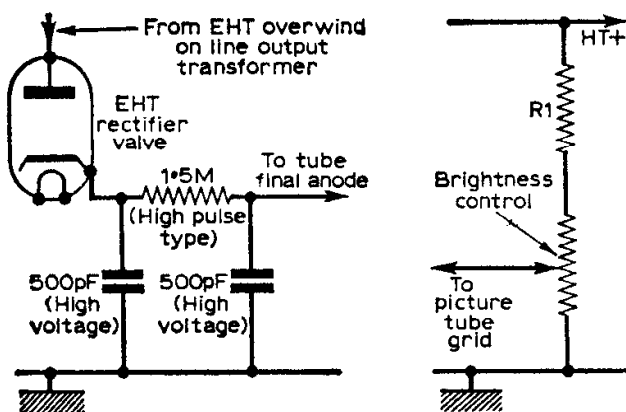


Fig. 46 (above, left)—When a coated tube is used to replace a clear tube, the e.h.t. smoothing circuits as shown here can be abandoned. However, when a clear tube is used to replace a coated one, such a circuit must be fitted.

Fig. 47 (above, right)—The correct tube bias can be achieved by adjusting the value of R1 for maximum brightness with the brightness control tuned fully clockwise.

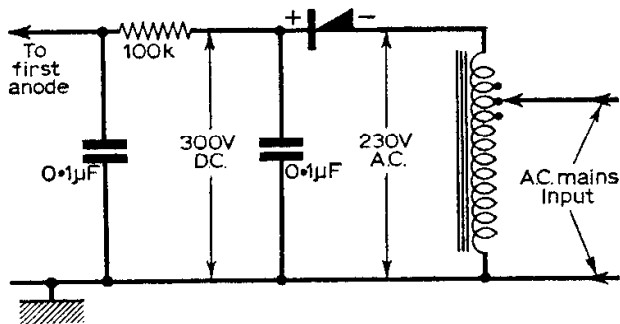


Fig. 48—A simple method for obtaining a first anode potential.

results, the raster should appear almost at full brightness (under no signal conditions) with the control turned fully clockwise (e.g., with the slider at R1 end of the element).

If the raster is far too bright, then R1 should be increased in value, and reduced in value if insufficiently bright. In that way the circuit can be adjusted to suit the cut-off characteristics of the replacement picture tube.

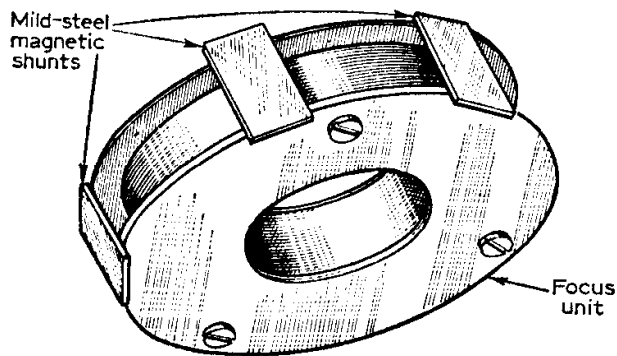


Fig. 49—The focusing field can be reduced when changing from a triode to a tetrode or pentode tube by mild-steel magnetic shunts as this diagram shows.

An interesting dodge to secure improved contrast ratio with a tube whose grid base fails to match the circuit exactly is to connect a 1.5MΩ resistor between the first anode (in the case of a tetrode or pentode) and cathode. It is surprising what a difference that this simple addition can make

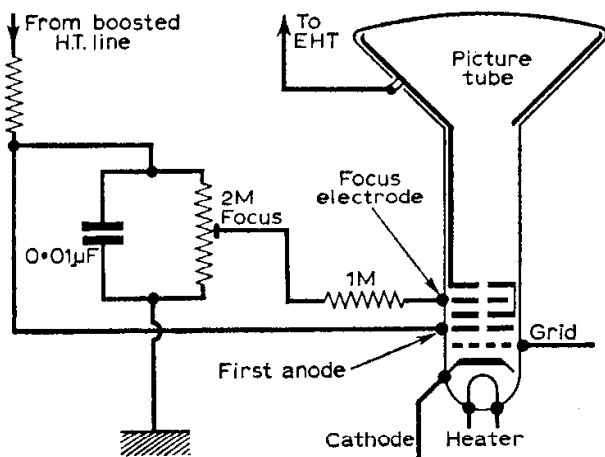


Fig. 50—Showing how the focus control is connected to the latest type of electrostatically-focused tubes.

in certain circuits, especially in GEC models, using GEC tubes.

When a pentode is used to replace a tetrode, the second anode should be strapped to the cathode. On duodecal bases, the second anode is usually on pin 7, with the grid on pin 2, the first anode on pin 10 and the cathode on pin 11. The heater is then connected across pins 1 and 12.

First Anode Potential

Where it is required to replace a triode with a tetrode or pentode a source of first anode potential must be obtained from the chassis. In many receivers the boosted h.t. voltage in the line time-base will meet this requirement. In very early models, however, such a voltage will not be available, in which case a small silicon or similar rectifier can be used to rectify the a.c. mains input voltage (Fig. 48).

Whichever way the first anode potential is derived it should be fed to the electrode via a 100kΩ resistor, as shown in the diagram. A second capacitor should also be connected between the first anode and chassis, the first being that connected between the positive of the rectifier and chassis. Such a circuit will give just a little over 300V d.c. from the normal mains voltage.

The focus field will also need to be reduced when a tetrode or pentode is used to replace the original triode. This is not a very difficult problem to solve, as shown in Fig. 49. Two or three magnetic shunts are used to bridge the pole faces of the focus unit, depending upon how much it is required to reduce the field. These can be prepared from mild-steel strips about 3/8 in. wide by 1/8 in. thick and long enough to bridge the pole pieces. They will be held in position by the magnetism of the unit and require no other form of securing.

Electrostatic Focusing

Some experimenters may wish to try one of the very latest electrostatically-focused tubes in place of a magnetically-focused original. The success of such a venture depends very much on the capabilities of the chassis, on the design of the scanning coils and the versatility of the enthusiast.

But for those who are prepared to have a go, the circuit in Fig. 50 may prove of assistance. This shows the feed from the boosted h.t. line to the first anode, and the connection of the focus preset from the first anode to chassis, with the slider going to the focusing electrode via a 1MΩ resistor.

To avoid confusion, the remaining electrodes on the tube have also been identified, but it should be noted that this kind of tube requires a picture centring unit on the neck and, of course, the original focusing unit must be removed. Small beam-correcting magnets may also be required to iron-out raster distortion which can sometimes prove rather a problem on 110deg. tubes.

Finally, remember that it is not easily possible to employ a 90deg. tube in a 70deg. (or less) chassis or a 110deg. tube in a 90deg. (or less) chassis. Large deflection angles call for specially shaped and designed scanning coils, which have to be driven from timebases which are far more efficient than those featured in some of the early receivers.

(To be continued)

SOME HINTS ON

BUYING SECOND-HAND SETS

BY H. PETERS

WHAT is the difference between a motorist and a viewer? Quite a lot of us are both, and cannot for the life of us see what is the point of the question, that is until we come to purchasing a second-hand car or a second-hand television receiver.

It is then that the difference is immediately apparent. A motorist can obtain books which will provide him with an inside look at the car, give him a rough idea of the current market price, and enable him to maintain it once he has bought it. He can also take it for a trial run, crawl about all over and under it, or get the A.A. or R.A.C. to "vet" it for him. A log book gives him the details of all the previous owners and the date when the car first took to the road.

No equivalent of this extensive examination is presented to the prospective purchaser of a TV. The purpose of this article is to begin to remedy this shortcoming. Like a car you can pick up a second-hand TV privately by personal recommendation, by answering advertisements, or by calling in at a local dealer. Advertisements will lead you either to a private house or a dealer, and so really there are only two cases to consider.

The Private Sale

This can be the most rewarding if you are lucky. Its advantages are that you will probably be allowed to inspect the "works" more freely, check on the date of purchase and subsequent repairs, and you should be able to haggle about the price. There are snags of course. There will be absolutely no guarantee possible, and the receiver may be one that a local dealer has already refused to make an allowance on. Try to find out the reason for sale, and also check that the receiver is not a rented one or still the subject of a hire purchase agreement. Some of the best bargains are to be found where the owner has been on a five year maintenance scheme which is just terminating, as the set should have been reasonably well looked after. A private owner is usually more keen for a quick sale than a dealer.

Shop Purchase

Here the vendor will have ensured that the set presents its best possible face to the prospective customer. It will have passed through the service department, and if considered worthwhile a good overhaul, including a replacement tube, may have been lavished upon it. In this case the dealer will be able to offer you the 12 months guarantee on the tube, and sometimes a three month guarantee on the rest of the set as well. Reputable dealers who stand by second-hand sets in this way will, in their own interest, weed out the ones which are likely to

be troublesome as they pass through, as two service calls to a second-hand receiver will absorb any profit it may have produced. A dealer obtains his supply of sets from part exchange deals, where the re-sale price will approximate the trade-in value plus the cost of any repairs needed as in the following example:

1955 17in. 13 channel set, working but very poor. Traded in at.....	£5	0.	0.
Materials used in repair (tube, r.f. amplifier, frame output valve).....	£12	0.	0.
Labour in repairing, re-aligning, and cleaning	£3	0.	0.
Service during first three months.....	£2	0.	0.
	<hr/>		
	£22	0.	0.

Such a set could be offered for re-sale at between £22 and £25 with a guarantee on the tube and free service for three months. Other sources of sets are terminated rentals and re-possession. Here the receiver is probably in good working order and the selling price will be arrived at by subtracting the amount recovered so far (less service) from the original rental price of the set thus:

Original selling price 69 gns.	£72	9.	0.
Less two years' rent @ 10s. per week.	£52	0.	0.
	<hr/>		
	£20	9.	0.
Plus two years' servicing costs including initial installation, say	£9	11.	0.
	<hr/>		
	£30	0.	0.

which makes the selling price around £30-£35, for a set just over two years old in working order without guarantee.

Other receivers would be broken up or sold at their scrap value, or trade-in value, and this accounts for the lack of good "in-between" sets around the £10 mark.

One point to remember is that a dealer will be in a position to offer to erect an aerial for you, which a private vendor will not.

Four Ages of TV

In dealing with receivers which are not new, a word about the history of the television set may be helpful, if only to discriminate the antique from the senile. At the end of the war Alexandra Palace re-opened to restore viewing in the London area, and most of the receivers manufactured were straight (t.r.f.) and used double sideband alignment. When television spread to the Midlands just before Christmas 1949 this type of receiver continued to be produced, suitably modified to channel 4. There were, of course, superhets but they were made

without a view to conversion to other channels at a later date. Screen sizes were mainly 9 and 12in., with the odd 10in. model.

The second age began in 1950 when the BBC continued to push its network upwards from Sutton Coldfield towards the North. Manufacturers realised that their sets would need to be tunable to any one of the five channels in Band I, but this was considered an engineer's job, and so the channel selectors were usually situated at the back. The 9in. and 10in. tubes vanished, and the 15in. tube took pride of place.

Stability of design was almost reached, when in 1955 the ITA began testing. This brought the channel selector to a knob on the front of the set, and at the same time heralded the introduction of the 17in. screen, which was to have an undisputed six years reign. Round and rectangular 14in. tubes took the place of the 12in. and 15in. while the big screen size was 21in. The chassis was laid along the base of the set below the tube, and access to almost everything was possible by laying the cabinet on one side and removing the false back and bottom. This was the Golden Age of Television.

The fourth age began in 1960 with the short neck 110° tube. To create the slimline look, the chassis became upright and was pressed close against the tube. The initial urge to get a quart into a pint pot produced some very compact receivers including a few in cardboard or plastic cases with a handle on top. This alone entitled them to the label "portable". Despite the compact design the heat dissipation was the same as on earlier models, and the fire brigades had some interesting calls.

1962 sees the beginning of the fifth age, with the 405/625 set. Two varieties are being produced; the convertibles which need an extra i.f. strip and tuner for the v.h.f. band; and the dual standard receiver complete with switchable i.f. stages. Both varieties give rise to some untidy chassis work, and a huge 405/625 switch running the whole length of the set—a switch that will in all probability be used only once.

Good Old Sets

There follows a list of models which, from the author's experience seldom get broken up, and which have given good service throughout their life. It is emphasised that there is a black sheep in every family, and that you may know of a really "dud" one of these models, or a really excellent set which is not mentioned.

BUSH	TV22, TV24.
EKCO	T161, T164. Also T221/231, T283*/284* Series. (If l.o.t. is in good order.)
MURPHY	V178, V240*/250*.
PYE	FV1.
R.G.D.	"Deep 17"*
SOBELL	TS17*.

* These models have plenty of room on the chassis and in the cabinet for experimentation to try converting to 625-line operation. They also have 38Mc/s i.f.'s which is an advantage.

Table 1—Some representative models generally worth while repairing.

It must be emphasised that much depends on the actual physical condition of the set. One which has rough usage and many repairs should be avoided, regardless of its "breeding".

State of the Tube

Despite the first-class "Lumenar" and "Extra Life" ranges that the two leading makers are now producing the tube still remains the most expensive item to replace. Fortunately its picture tells its own case history, and an experienced viewer can spot an old tube immediately. The commonest fault is low emission, which takes the form of a dull insipid picture which resists attempts to brighten. Glistening whites and a readiness to turn negative are apparent, the raster lines usually remain sharply focused, but with a hazy halo. Astigmatism (the focusing of upright and horizontal lines at different settings of the focus control) gets worse, and the picture is usually only visible in a darkened room. Similar effects can be due to a loose ion trap magnet, but in this case the picture will usually expand vertically and shrink in width as the brightness control is advanced. Do not confuse this, however, with a faulty e.h.t. rectifier. Here the advancing of the brightness control will stretch the picture at all sides, causing it to "blow up".

Other tube symptoms are: heater-cathode leak producing streaky pictures in early sets, and a hum bar or uncontrollable brightness in later ones; and grid emission, which will superimpose on the picture an unmodulated raster displaced by an inch or two.

Look round the back of the set to see if the tube has been boosted. This can be done by means of a small transformer, or a 10W resistor depending on the circuit, and the effect of boosting is to restore some of the brilliance to a tube which has become low in emission. Such boosting is never really permanent, but may give a tube between three months and a year of extra useful life.

The Cabinet

As a general rule the state of the cabinet is a good guide to the state of the "works" inside. There are exceptions of course, especially where the top of the cabinet has lifted due to the direct sunlight, or the glass feet of a vase of flowers have dug their way through the wood. Minor scratches are bound to occur, even in the best regulated households, but most of these will disappear with the application of a scratch removing fluid followed by a good wax polish.

The majority of cabinet finishes are cellulose sprayed. French polishing will only be on the very early high grade receivers. Since 1958 an increasing number of manufacturers have been using polyester finishes, and in the present advanced state of techniques it is very difficult to distinguish one from the other. In general the polyester finish is thicker than cellulose, and not as brittle. It resists scratches more readily, but if it is marked the scratches are more difficult to eradicate. Early polyester finishes had a faint haze about them and a characteristic pungent smell reminiscent of the wartime tear gas. Retouching on cellulose should be carried out with cellulose wood lacquers suitably tinted to match the tone of the cabinet, but french polish should be used on polyester, sparingly and carefully applied.

A badly neglected cabinet will often revive its lustre if all the grease and wax polish is removed first by soapy water (which works wonders on flower droppings) and then by an application of one of the abrasive car polishes or even metal polish. Finish off with wax furniture polish and elbow grease. If in doubt about the treatment of any cabinet try a small square in an inconspicuous corner first of all.

Overheating the Receiver

Service engineers are abruptly divided into two camps when the word "overhaul" is mentioned. Some say "If it's working at all leave it severely alone, isn't there enough trouble in the world?" whilst others claim that almost every television set can benefit from a new r.f. amplifier, h.t. rectifier, frame output valve, with a general clean-up, and will hotly deny that the disturbance produces more faults than it clears.

Let us assume that you have decided that the receiver is to have an overhaul, how do you set about it? First of all "in-test" the set, noting its performance and defects. Your in-test notes might read as follows:

"Noisy volume control. Picture lacks width $\frac{1}{2}$ in. each side and is compressed at the bottom. ITA is weak and channel selection switch is noisy on both channels. Aerial plug loose in socket. Dirty V-shaped mark at top of screen inside safety glass. Tube looks reasonably good".

Next remove the back and bottom from the cabinet, or unbox the set if it will come out in one piece, and blow out all the dust with a vacuum cleaner, loosening stubborn patches with a $\frac{1}{2}$ in. paintbrush. Do this in the open air and do not forget the inside of the cabinet and the loudspeaker grille.

Then test the set again, and if you have produced any faults by disturbance, put them right before proceeding.

H.T. Rectifier

At this stage check the h.t. rectifier and main smoothing. There should be a higher d.c. output from the rectifier than the a.c. input. Representative figures are 210V d.c. out for 195V a.c. in, and after smoothing this should give an h.t. line of about 180V. Check that the set is on the correct mains tapping as spectacular performance for a short while can be produced by setting the mains tapping to 200V and plugging in to 240V. The set is never quite the same again! Most metal rectifiers age over a period of years, the types giving the least trouble being those painted olive green. The PY32 valve is widely used, and this appears in three different shapes. The earliest had two separate anodes and a bulged envelope, the intermediate ones had a straight glass envelope with a single anode high inside the glass, whilst the latest ones have a straight glass envelope with the single anode set low with a gap at the top of the envelope.

All are interchangeable, and the new PY33 can be fitted instead. This valve has an improved cathode and a reduced anode-cathode spacing which gives an increased current rating and, when plugged into the PY32 holder, about 10V more h.t.

Silicon Diodes

What about fitting one of these new silicon diodes? you may ask. At first sight these pea-sized objects seem totally incapable of living up to their specifications, but provided they are fitted correctly, they give improved h.t. and long life. Earlier disadvantages of silicon rectifiers have now been overcome and the later varieties, such as the BY100, have a rating of 500mA and a peak inverse voltage working of 800V. Use transistor techniques when wiring up, holding the wires in a heat shunt and fitting the diode in a cool part of the set. A 25 Ω 5W surge limiter must be provided to reduce the switching-on surge if one is not already included in the circuit.

The Tuner

If the h.t. is satisfactory the tuner can be cleaned. Be careful about using some of the harsher switch cleaning fluids. A simple cleanser can be made by dissolving about 1oz of petroleum jelly (MS4 grease is better if you can get it) in a pint of white spirits—turps substitute. This quantity lasts a workshop three months so the average user will not need anything like that amount. The solvent can be brushed across the contacts with a toothbrush, and the tuner allowed to dry out before re-using. The volume control can be treated at the same time if noisy, and if the contacts of your particular tuner are not readily accessible, the fluid can be squirted in with an eye dropper. Be careful not to damage the contacts or disturb the layout. With the Cyldon type of tuner care must be taken not to bend the stationary contacts too far forward or else they may be folded upwards when the channel selector is moved anti-clockwise. Wear and tear on the tuner can be saved in some cases by fitting the BBC and ITA coils next to each other. This is not always possible, as some receivers have separate sensitivity controls for each group of channels, and in other models the ITA coils will not oscillate next to a BBC channel.

Check the PCC84 or 30L1 r.f. amplifier, and if it is low and you live in a fringe area you can try fitting a 30L15 which has the same base and will give more gain. The r.f. and aerial circuits will, however, need retuning, and this is often accomplished by unscrewing the screw type variable capacitors on the tuner chassis top. The 30L15, incidentally, is not a frame grid valve, but has a higher slope than the 30L1, and consequently higher gain. The PCC89, which is a frame grid valve, is capable of even greater gain than the 30L15, but only in circuits especially designed for it. It will not replace the PCC84 or 30L1, or even the 30L15, and give the same performance, even though it has the same base connections.

Line Output Stage

Not much can be accomplished in the way of overhauling this stage except to check the screen grid feed resistor of the line output valve. This is usually a 2-2k Ω to 4-7k Ω 2W carbon resistor, which in the course of time overheats and changes value, dropping quite often to as low as 500 Ω . When this

(Continued on page 183)

The PRINCIPLES and PRACTICE of TELEVISION

By G. J. King

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

(Continued from page 117 of the December issue)

LAST month it was revealed that to secure additional horizontal definition of a television picture to balance the improved vertical definition given by 625 lines, the vision or video channel bandwidth must be widened to accommodate without attenuation a greater range of video sidebands. Having in mind that television sets of the immediate future must cater for both 405- and 625-line transmissions, one may well be curious as to how the channel-widening process is achieved in practice.

Types of Receiver

Prior to delving into the electronics of standard switching, let us first get perfectly clear in our minds the various types of receiver which are—and will be—available.

Firstly, we have the existing 405-line models. These operate exclusively at v.h.f. on Bands I and III (some have facilities for the reception of the v.h.f.-f.m. sound signals on Band II) and are fixed in the line timebase for a frequency of 10,125c/s and are not designed to be changed.

Secondly, there are the new “switchable” receivers which, without further ado, are suitable for both 405- and 625-line transmissions. These models may or may not carry a u.h.f. tuner. But if a u.h.f. tuner is not at present fitted, there will be no trouble to install one when required, for the various switched circuits in the line timebase, vision, sound and detector channels are already set up and have been checked. This is the true dual standard receiver.

Thirdly, there are the so-called “convertible to switchable” models. Although some of these carry a “405/625” changeover switch they must not be confused with the true dual standard switchable models. To make such sets into dual standard versions, a reasonable amount of internal refitment is demanded, depending upon how the model is engineered for conversion, and there are several ideas in this respect.

Fourthly, although not yet available in this country, there are the 625-line-only models. These will come into being in Great Britain some time in

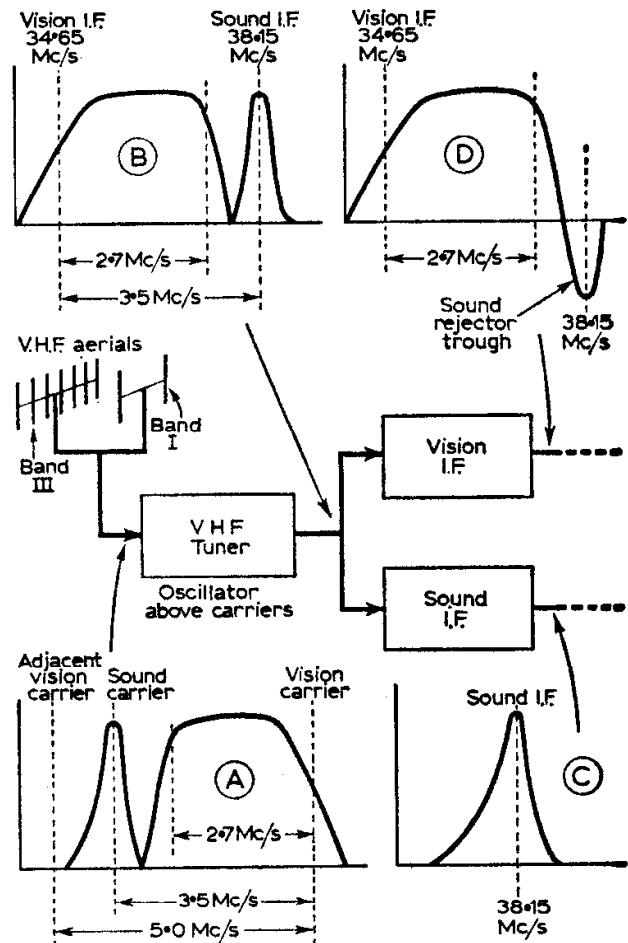


Fig. 18—The signal frequency-characteristics and responses of the 405-line television system.

the future when all of the channels—v.h.f. and u.h.f.—carry 625-line transmissions and, of course, they are already in use in certain parts of Europe.

The Pilkington Report and the Government's White Paper reply made it perfectly clear that 625-line transmissions would not supersede the 405-line transmissions for many years to come. The two standards will work side-by-side for, at least, ten years, with the 405-line signals employing the v.h.f. channels and the 625-line signals employing the u.h.f. channels.

All this adds up to the fact that existing 405-line-only models will be allowed to continue in service for, at least, the full life of the set. Indeed, it may even pay viewers in certain parts of the country to invest in a new 405-line-only model, even at this

time, for it is likely to be some years before the u.h.f. 625-line service extends fully across the country — starting from the London area and probably to be followed by u.h.f. transmitters in the Midlands and North.

It would seem that 405-line models may be substantially reduced in price, so those viewers whose existing set is in need of replacement, and who are living in areas where it is likely to be some time before the u.h.f. service reaches them may do well by purchasing a 405-line-only model.

Many viewers, on the other hand, may be keen to obtain a new dual standard model. Here, then, will be posed the question — what shall I buy, a true dual channel switchable model or a convertible to switchable model?

Viewers in the London area and certain areas in the Midlands and in the North—where u.h.f. is already projected—would not do wrong by investing in a true dual standard model which requires only a u.h.f. aerial and—probably—a u.h.f. tuner to get it working on both standards. Such a set, however, may not represent equally as good a buy to viewers in areas where it may be some years before the u.h.f. service is available to them.

Here, a convertible to switchable model or even a 405-line-only model may suffice. Remember that true dual standard models have various switched circuits, and if these remain quiescent for several years the switch contacts and associated components could deteriorate. This applies also to a u.h.f. tuner, which will have to be paid for and probably not used for some time.

These, then, are the basic points which should be investigated and discussed by those contemplating the purchase of one of the new models.

Signal Characteristics

We have seen, therefore, that the existing 405-line transmissions will continue to be carried by channels in Bands I and III, and that the new 625-line transmissions will use entirely new channels in Bands IV and V—the u.h.f. bands.

We have also seen that a dual standard receiver requires to be switched not only in the line time-base but also in the i.f. channels to do justice to the higher definition 625-line signals. Moreover, of course, a u.h.f. tuner—as distinct from a v.h.f. tuner—will be needed to pick up and select the 625-line channels.

Before we can go much farther, we shall have to learn how the 625-line signals differ from the 405-line signals. The essential differences are revealed in Table 1, and the main points to observe at this time are the *channel width* (e.g., the spacing between adjacent vision carriers), the *video bandwidth* and the *frequency relationship* between the sound and vision carriers.

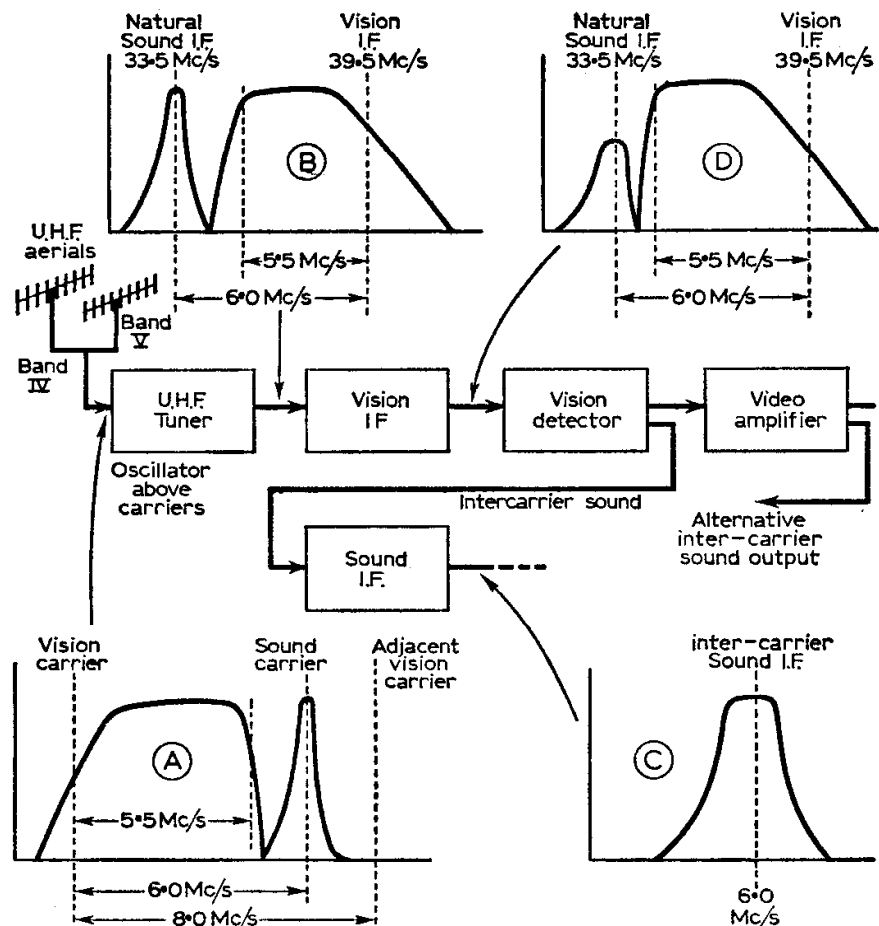


Fig. 19—The signal frequency-characteristics and responses of the 625-line television system. Note the method of extracting the inter-carrier sound i.f., this being the 6Mc/s difference between the natural sound i.f. and the vision i.f.

The best way of getting to grips with the two types of signal are to look at them separately as they come from the aeriels and enter and pass through the various stages. Fig. 18 shows the 405-line situation. Here we have the v.h.f. aeriels on Bands I and III feeding signals to the v.h.f. tuner. The responses at A show how the signals line up at the input to the tuner and at the output of the r.f. amplifier stage contained therein.

	405-line	625-line
Spacing between adjacent vision carriers	5.0Mc/s	8.0Mc/s
Video bandwidth	3.0Mc/s approx.	5.5Mc/s approx.
Sound carrier	3.5Mc/s below vision	6.0Mc/s above vision
Vision carrier	3.5Mc/s above sound	6.0Mc/s below sound
Vision modulation	A.M. positive-going	A.M. negative-going
Sound modulation	A.M.	F.M.

Table 1: Revealing the essential differences between 405-line and 625-line signals.

Signals of this nature are applied to the tuner mixer stage, and because the local oscillator signal also produced in the tuner has a frequency at the i.f. *above* the corresponding incoming carrier, the responses as shown at B are produced at the output of the tuner.

The carriers have now been changed to i.f. values, but note that the sound i.f. is *above* the vision i.f., which is the opposite of the carrier situation, where the sound carrier is *below* the vision carrier. This happens simply because the local oscillator signal is above the incoming frequencies.

The original relationship would remain if the local oscillator were below the carrier frequencies, but then channel changing would be difficult and various interference problems would result—hence the reason why the sound and vision i.f.'s as shown at B were chosen.

The vision at 34.65Mc/s and the sound at 38.15Mc/s are known as the "standard" i.f.'s for the 405-line system, and almost all recent models use this combination, or values very close to those given above.

From the v.h.f. tuner, the i.f. signals pass into sound and vision i.f. stages, sometimes via a common i.f. stage which handles both sound and vision signals together. The sound i.f. stages are so designed that they pass only the sound signal, resulting in a response such as that shown at C.

The vision i.f. stages, on the other hand, retain the full 2.7Mc/s video bandwidth, while rejector circuits tuned to the sound i.f. totally suppress the sound signal and prevent it from getting into the vision detector, where its presence would cause sound-on-vision interference.

Response D reveals the vision i.f. channel set-up.

The responses of Fig. 19 show how the conditions differ for the 625-line system. Here the composite sound and vision signals are applied to the u.h.f. tuner from the Bands IV and V aeri-als. The responses at A occur at the input to the tuner and at the output of the r.f. amplifier, from which will be seen that the sound carrier is 6Mc/s above the vision carrier.

The local oscillator in the u.h.f. tuner also works above the carrier frequencies, so, again, the sound and vision relationship is reversed at i.f. The responses at B show the sound and vision i.f. signals at the output of the tuner, and the local oscillator frequency is displaced from the carrier frequencies to produce a natural sound i.f. of 33.5Mc/s and a vision i.f. of 39.5Mc/s.

These represent the "standard" i.f.'s for the 625-line system. If B in Fig. 19 is compared with B in Fig. 18, the differences at i.f. will be readily appreciated. We shall see later that these specific differences enable a common i.f. channel to be employed in the vision channel of dual standard receivers, with switching simply to tailor the response to suit the particular signal.

Intercarrier Sound

A rather unconventional situation occurs so far as the sound signal is concerned, for as can be seen in Fig. 19 both the sound and vision i.f. signals are applied to the vision i.f. amplifier stage. The sound

is not extracted as it is in the 405-line system, but is allowed to pass through the vision i.f. strip along with the vision signal, so that at the output of the vision strip we get both the vision signal and a partially suppressed sound signal (responses D).

This means that there are no normal sound rejectors as we have known them in the past in the vision i.f. channel. On the face of it, this may lead one to believe that bad sound-on-vision interference would occur. But this is not so because the sound signal on the 625-line system is frequency-modulated, and since there is no variation in its *amplitude*, sound-on-vision interference is naturally avoided.

However, the two carriers—sound and vision—which are spaced by 6Mc/s beat together at the vision detector (e.g., one tends to modulate the other owing to the non-linearity of a detector circuit) and there is produced a third signal equal to the difference in frequency of the two carriers.

This 6Mc/s signal is known as the "intercarrier i.f." and its frequency changes in accordance with the sound modulation in exactly the same way as the real or natural sound i.f. The signal is extracted either directly after the vision detector, or is allowed to pass through the video amplifier to give it extra lift. From the selected take-off point it is fed to the sound i.f. stage, which itself is responsive to 6Mc/s over a sufficiently wide pass-band to cater for the extended sidebands of the f.m., as shown by response C.

The signal is then applied either to a limiter or some form of f.m. detector, which responds only to frequency-modulation and not to amplitude-modulation, and this is a good thing because there is present a certain amount of amplitude modulated picture signal and sync pulses, which would produce bad sound buzz if the sound detector were responsive to amplitude-modulation.

The intercarrier sound set-up, therefore, is geared to the fact that f.m. is used for sound. Such an arrangement could never be employed on the 405-line system.

Next month we shall see how the two systems are integrated into a dual standard receiver.

(To be continued)

A REFRESHER COURSE IN MATHEMATICS

By F. J. Cunn

5th Edition 8s. 6d. by post 10s.

Geo. Newnes Ltd., Tower House,
Southampton Street, London, W.C.2

CAUSES AND CURES
OF TYPICAL FAULTS
IN THIS SECTION OF
A RECEIVER

FRAME TIMEBASE TROUBLES

By
K. Royal

THE frame timebase of a television receiver is a section all on its own and about the only things that it has in common with the rest of the receiver are the l.t. and h.t. power supplies. It is the job of the frame timebase to cause the scanning spot on the screen of the picture tube to move from the top to the bottom and then swiftly back to the top again to repeat the process 50 times each second.

This it does by supplying a current waveform of the nature of a sawtooth (Fig. 1) to the frame scanning coils on the tube neck. The current in the coils produces a magnetic field which deflects the electron beam downwards during the scanning stroke and deflects it upwards at very high speed during the retrace.

The shape of the scanning part of the waveform is related in such a way to the circuit elements so that the electron beam—and hence the scanning spot—is deflected at a constant speed in the downward direction. This is essential to avoid vertical cramping of the picture.

It will be understood, of course, that the frame timebase works in relationship to the line timebase. And since the latter is deflecting the spot horizontally at 10,125 times each second a raster of 405 lines is produced. There are 50 frame scans each second but, as these are interlaced, there are 25 complete pictures each second.

On the 625-line system the frame timebase still works at 50c/s (since this is the power supply frequency in Great Britain), but the line timebase is speeded up to 15,625c/s.

SYNCHRONISING

In the tube of the television camera there is also an electron beam and this must be deflected in absolute sympathy with the beam in the receiving picture tube. Synchronism of the beam in the receiving picture tube with that in the camera tube is achieved by synchronising pulses sent out by the transmitter along with the picture signal.

From the frame timebase aspect, a series of frame synchronising pulses is transmitted at the end of

the frame scanning period and this triggers the frame timebase for the next scan. The line timebase is triggered in a like manner by a line sync pulse at the end of the line scanning period.

BASIC FAULTS

A very common fault in the frame timebase is the inability of the circuit to produce sufficient scanning current in the frame coils to give a full downward deflection of the scanning spot. This causes the bottom of the picture to cramp to a degree depending upon the shortcoming (Fig. 2).

Fig. 3 gives a circuit of a frame timebase which is currently featured in the majority of models with several differences in detail. The triode-pentode valve V16 is wired as a cathode-coupled multivibrator. It will be seen that the pentode section is wired as a triode, the valve thus acting as a double triode.

This produces a voltage waveform as shown at A for application to the control grid of the frame amplifier valve V17. The voltage waveform at the anode of the amplifier (waveform B) is modified in terms of current in the frame scanning coils to that shown at C, which resembles very closely the waveform in Fig. 1.

CRAMPING AT BOTTOM

Let us now investigate the fault shown in Fig. 2 in greater detail. The fact that cramping occurs at the bottom of the picture means that the finish of the scanning stroke is suppressed and curved instead of being straight. This is caused mainly by low emission of the frame amplifier valve, this reaching a condition of saturation prior to delivering its full output.

The best test here is to try a replacement valve known to be in good order. The next best thing is to have the valve checked for emission by a dealer possessing a good valve tester. If the valve

NOW
YOU can MASTER ELECTRONICS!

BRITAIN'S MOST COMPREHENSIVE PRACTICAL COURSE IN RADIO • ELECTRONICS TELEVISION!

THESE SPECIAL TRAINING KITS — YOURS TO KEEP

Multi-Range TEST METER

CATHODE RAY OSCILLOSCOPE

AM and VHF/FM LUXURY RECEIVER

SIGNAL GENERATOR

Complete set of Picture Way books and Experimental Manuals

LEARN BY BUILDING NOW for your CAREER • HOBBY OWN BUSINESS

YOU RECEIVE

- Complete kits of equipment as illustrated.
- Complete set of experimental manuals.
- Complete set of "picture-way" theory books.
- Modern test-yourself examination sheets.
- Study programme.
- Unlimited consultation with Tutors.

FREE BROCHURE

POST NOW

RADIOSTRUCTOR

TO RADIOSTRUCTOR (DEPT. M102)
 READING, BERKS.

NameBLOCK

AddressCAPS

.....PLEASE

(We do not employ representatives) 1/63

BENTLEY ACOUSTIC CORPORATION LTD.

THE VALVE SPECIALISTS

38 CHALCOT RD., LONDON, N.W.1

FOR ONLY 6d. EXTRA PER ORDER WE WILL INSURE YOUR GOODS AGAINST DAMAGE IN TRANSIT. ALL UNSHIPPED PARCELS AT CUSTOMERS' RISK.

EXPRESS SERVICE!!
C.O.D. ORDERS RECEIVED BY 3.30 P.M. EITHER BY LETTER, PHONE, OR WIRE, DESPATCHED SAME AFTERNOON

Nearest tube Chalk Farm

PRImrose 9090

0A2 17/6	6AG7 7/8	6K25 19/5	12AT7* 5/-	90C1 18/-	EABC80 9/-	EF36 4/-	EM81 9/6	PCC88 18/-	U12/14 8/6	UCH61* 9/6	OA79 3/-
0B2 17/6	6AK5 3/-	6L1* 22/8	12AU7* 5/-	90CG 37/6	EAF42* 9/-	EF37A 4/6	EM84 10/6	PCC89* 8/6	U16 10/-	UCL82 9/6	OA81 3/-
0Z4 5/-	6AL5 4/6	6L1G* 7/6	12AX7* 7/-	90CV 37/6	EB34 2/6	EF39 4/6	EM85 16/10	PCF80* 7/6	U19 45/8	UCL83* 18/9	OA86 4/-
1A5 6/-	6AM6 3/6	6L7GT 7/6	12BA6* 5/-	150B2 18/-	EB41 9/6	EF40 15/-	EN31 55/-	PCF82 10/6	U22 8/-	UF41* 9/-	OA91 3/-
1A7GT 12/-	6AQ5 7/6	6L18* 13/-	12BE6* 9/-	807 6/-	EB91 4/-	EF41* 8/-	EY51* 8/6	PCF84 16/2	U24 29/1	UF42 12/6	OA95 3/6
1C5 12/6	6AT6 6/-	6LD20* 16/7	12K5 17/6	5763 7/6	EBC3 23/10	EF42 10/-	EY83 16/2	PCF86* 9/6	U25* 17/6	UF80* 10/6	OA210 9/6
1D6 10/6	6AU8 10/-	6P28* 25/11	19AQ5 10/6	7475 5/-	EBC33 5/-	EF50(A) 7/-	EY84 14/-	PCL82* 9/-	U26* 9/-	UF85* 9/-	OA211 13/6
1G6 17/6	6BA6 6/-	6Q7G 8/-	19H1 10/-	AZ31 10/-	EBC41* 8/-	EF50(E) 5/-	EY86* 7/6	PCL83* 9/6	U31* 11/6	UF86* 13/6	OC16W 35/-
1B5GT 10/6	6BE6 6/-	6Q7GT 11/-	20D1* 14/11	AZ41* 13/7	EBC81* 8/-	EF54 5/-	EZ40* 6/6	PCL84* 7/6	U33* 29/1	UF89* 8/-	OC19 25/-
1L4 3/-	6BH6* 8/-	6R7G 10/-	20F2* 25/11	B36 9/-	EBF80 8/-	EF73 10/6	EZ41* 7/-	PCL85* 10/-	U35* 29/1	UL41* 10/6	OC22 23/-
1L5 5/-	6B16* 6/-	6U5G 7/6	20L1* 25/11	BY100 8/-	EBF83 13/7	EF80* 5/-	EZ80* 6/-	PCL86 16/2	U37* 32/4	UL44 25/11	OC26 25/-
1LN5 5/-	6BQ7A 15/-	6V6G 4/6	20P1* 25/11	CL33 18/9	EBF89 9/6	EF85* 6/-	EZ81* 6/-	PEN46 4/6	U45 13/6	UL46 14/6	OC28 24/6
1N5GT 10/6	6BR7* 9/-	6V6GTG 8/6	20P3* 22/8	CY31 11/-	EC52 5/6	EF86* 9/-	GZ30 9/-	PL33 18/9	U50 5/6	UL84* 8/6	OC29 27/6
1R5 6/-	6BR8* 18/2	6X4 4/6	20P5* 25/11	DAC32 10/6	EC54 6/6	EF89* 9/-	GZ32 10/-	PL36* 15/-	U52 4/6	UM4 17/9	OC35 18/-
1R4 9/-	6BW6* 10/6	6X5GT 5/-	20P5* 22/8	DAF91 5/6	EC70 12/6	EF91 3/6	GZ34 14/-	PL38 25/11	U54 19/5	UM34 16/10	OC36 21/6
1R5 5/-	6BW7* 5/-	6Y30L2* 10/6	25Z4G* 11/6	DAF96 7/6	EC81 27/6	EF92 4/6	HN309 29/1	PL81* 10/6	U76 6/-	UM80 14/11	OC41 9/6
1T4 3/-	6C4 5/-	7B7 8/6	27R0 25/11	DD41 13/7	EC92 13/-	EF97* 13/-	HVR2 10/-	PL82 7/6	U191* 16/2	UY1N 18/2	OC44 9/3
1U5 5/6	6C5 6/6	7C5 8/-	28D7 7/-	DF33 10/6	ECC34 23/11	EF98* 13/-	KT38C 8/-	PL83 9/-	U201 16/2	UY21 18/2	OC45 9/3
3A4 6/-	6C6 6/6	7C6 8/-	30C1* 7/6	DF66 15/-	ECC35 8/6	EF183* 18/2	KT36 32/4	PL84* 12/4	U251* 14/-	UY41 6/6	OC65 25/6
3A5 10/6	6C9* 13/6	7H7 8/-	30F5* 6/-	DF91 3/-	ECC40 17/6	EF184* 9/6	KT41 29/1	PM84 16/10	U281* 19/5	UY85 6/-	OC66 22/6
3R7 12/6	6CH6 7/6	7H7 8/6	30FL* 9/6	DF96 7/6	ECC81* 5/-	EK32 8/6	KT44 12/6	PX4 10/6	U282* 22/-	VR13C 7/-	OC70 6/6
3D6 5/-	6CW4 24/-	7V7 8/6	30L1* 7/6	DF97 9/-	ECC82* 5/-	EL32 5/-	KT61 12/6	PY32 13/6	U301* 22/8	VR105 7/-	OC71 6/6
3Q4 7/6	6F1* 25/11	7Y4 7/6	30L15* 9/-	DH63 6/-	ECC83* 7/-	EL33 12/6	KT63 7/-	PY33* 13/6	U309* 14/-	VR150 7/-	OC72 9/-
3Q5GT 9/6	6FG4 7/-	9BW6 14/11	30P4* 15/-	DK32 12/-	ECC84* 9/-	EL34* 15/-	KT68 15/-	PY80 7/6	U424 5/6	W107* 22/8	OC73 16/-
3R4 6/-	6F13 10/-	10C1* 12/6	30P12 7/6	DK91 6/-	ECC85 7/6	EL38 25/11	KT88 43/6	PY81 7/6	U801* 29/1	W729 19/5	OC74 8/-
3V4 7/6	6F23* 9/6	10C2* 25/11	30PL1 9/6	DK92 10/6	ECC88 16/6	EL41* 9/-	KTW61 6/6	PY82 7/-	UABC80 9/-	X65 12/6	OC75 8/-
5R4GY 17/6	6F24* 8/6	10F1* 25/11	30PL13 10/6	DK96 8/6	ECC80* 10/6	EL42* 10/-	KTW62 7/6	PY83 7/6	UAF42 9/6	X78* 29/1	OC76 7/-
5U4G 4/6	6F33 7/6	10LD11 15/7	35L6GT 9/6	DL33 9/6	ECC82 10/6	EL81 16/2	KTW63 6/6	PY88 13/-	UB41 12/-	X79* 45/3	OC77 12/-
5V4G 10/6	6J5 5/-	10P13* 16/-	35W4 7/6	DL66 17/6	ECC86 19/5	EL83 19/5	KTZ63 7/6	PZ30 19/5	UBC41* 8/6	X109 29/1	OC78 8/6
5Y3 5/6	6J6 4/6	10P14* 18/9	35Z4GT 8/-	DL68 15/-	ECH21 22/8	EL84* 7/-	L63 0/-	R18 14/-	UBC81* 11/-	Y63 7/6	OC81 8/-
5Z3 19/5	6J7G 3/8	12AC6 14/11	35Z5GT 9/-	DL72 15/-	ECH35 6/6	EL85 13/7	MHLD612/6	R19 19/5	UBF80* 9/-	Z66 9/6	OC82 10/6
5Z4G 9/-	6J7GT 10/6	12AD6 16/10	50C5 10/-	DL92 6/-	ECH42 9/6	EL86 16/10	MU12/14 8/-	SP41 3/6	UBF89* 9/6		OC83 6/-
6A7 10/6	6K7G 2/8	12AE6 13/7	50L6GT 10/-	DL94 7/6	ECH81 7/6	EL91 5/-	N37* 25/11	SP61 3/6	UCC84* 14/3	Transistors and diodes	OC84 8/6
6A8 9/-	6K7GT 2/8	12AH7 3/-	5A2 16/-	DL96 7/6	ECH83 13/7	EL95* 10/6	N78* 29/1	SU25 27/2	UCC85 7/6		OC170 9/6
6AC7 4/-	6K8GT 10/6	12AH8* 12/6	90AG 67/6	DM70 7/6	ECH84 16/2	EL820 18/2	N108* 29/1	T41 9/-	UCF80* 16/2	OA70 3/-	OC171 10/6
6AG5 5/6	6K8G 5/-	12AT6* 7/6	90AV 67/6	E80F* 30/-	ECL80* 9/-	EL821 25/11	N308* 20/1	TY86F 13/-	UCH42 9/6	OA73 3/-	OCPT1 17/6
				E83F* 30/-	ECL82* 9/6	EL822 19/6	N339* 15/-				
				E180F 34/6	ECL83 18/9	EM34 9/6	P61 3/6				
				EA50 2/-	ECL86 16/2	EM71 23/10	PCC84* 7/6				
				EA76 9/6	EF9 22/8	EM80 9/-	PCC85 9/6				

Terms of business:—Cash with order or C.O.D. only. Orders value £3 or more sent post/packing free. Orders below £3 please add 6d. per valve. C.O.D. orders:—Minimum fee, including post and packing, 3/-. We are open for personal shoppers. Mon.-Fri. 8.30-5.30. Sat. 8.30-1 p.m.

* Indicates valves with new type chemical cathode for extra life and reliability.

All goods new, boxed, and subject to makers' full guarantee. We handle first grade goods only, and do not sell seconds, rejects, nor items stripped from new or used equipment. All orders despatched same day. Complete catalogue of modern and obsolete valves and components with terms of business 6d.

Better, Brighter Picture Tubes

BRAND NEW THROUGHOUT
extending glass

12in. ...	... £4.10.0	14in. ...	... £5. 5.0
15-17in. ...	... £5.15.0	21in. ...	... £7.15.0

New Silver Screen and Aluminiuming. All makes Mullard, Mazda, Emiscope, Cossor, Brimar, Emitron, etc.

REBUILT MULLARD AND MAZDA TUBES

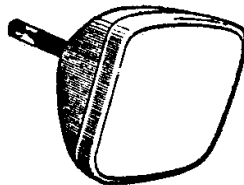
12in. ...	... £3. 0.0	14in. ...	... £4. 0.0
15-17in. ...	... £4.10.0	21in. ...	... £6.10.0

All Tubes Fully GUARANTEED 12 MONTHS. Dispatch same day. Cash with Order. Carriage and Insurance 10/-.

S.T.S. Ltd.

35 POUND STREET, CARSHALTON, SURREY

Telephone: WALLINGTON 9665



"SABRINA" STILL WELL IN FRONT

Bring your TV set up 100% again by fitting our:

COMPLETELY REBUILT C.R. TUBES ALL TYPES (including electrostatics)

12" now £5. 0.0	} For Single Tubes
14" to 17" now ...	... £5.10.0
21" now ...	... £8. 0.0

ALL C.W.O.—TRADE SUPPLIED

Special Bonus Scheme for Service Engineers—Reducing to:

12"—87/6; 14"/17"—97/6; 21"—147/6
FREE Pass. transit & Ins. anywhere in British Isles or N. Ireland (12 months' guarantee).

SABRINA C.R. TUBE CO.

Electron Works, North Bar

BANBURY, OXON

Telephone 2390

is definitely proved to be in good order the reduction in power output could be caused by defective biasing or poor cathode decoupling of the amplifier.

The cathode bypass capacitor C75 is a suspect of the first order and, as this is normally of a very high value (100 to 1,000 μ F), a reduction in its value or complete open circuit would subject the stage to excessive current feedback. This would impair the sensitivity to a large extent and thus demand an advanced setting on the height control to provide full frame scan.

However, the valve is likely to overload badly with the greater drive and cause cramping and distortion of the kind under discussion. A quick and definite test is to bridge the suspect with a capacitor of fairly large value and note the effect on the picture. If the scan is restored then a correct replacement should be fitted.

Remember, though, that the capacitor could be short-circuit or leaky. This would reduce the bias on the output valve and badly disturb its operating conditions. The best check for a short would be to measure the voltage between the cathode (positive) and chassis. If there is zero voltage or very low voltage (compared with that given on the circuit or in the service sheet) the capacitor is almost certainly defunct, assuming that the valve and h.t. feed components are in order.

The bias can also be upset by a leak in the coupling capacitor C71. This would reflect a positive voltage on to the control grid of V17 and thus tend to neutralise its normal negative bias.

FRAME LINEARITY CIRCUIT

To ensure that the scanning stroke current in the frame coils occurs linearly the voltage waveform from the frame oscillator as applied to the control

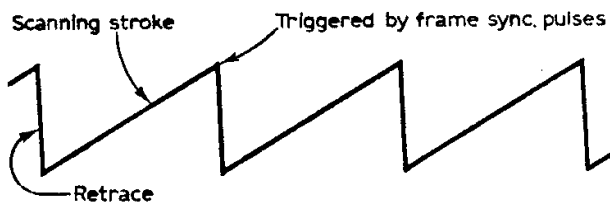


Fig. 1—The scanning and retrace current waveforms which are required in the frame scanning coils to deflect the scanning spot downwards linearly and upwards very swiftly at 50 times each second.

grid of the amplifier valve can be altered slightly in form by the application of selective feedback introduced via the vertical linearity control (vertical form) circuits.

The circuit under consideration features two linearity controls. R85 is the normal control which is accessible from the rear of the receiver, while R74 affects mainly the top of the picture and this control is situated inside the cabinet on the chassis.

The latter preset should require adjustment only after the replacement of a valve or component in the frame circuits, while the other control should be adjusted in conjunction with the height control on Test Card C to secure the best possible overall linearity. If this control is badly out of adjustment the symptom of Fig. 2 may well result, so it is as well to ensure that the control is correctly set before delving too deeply into the rest of the circuit.

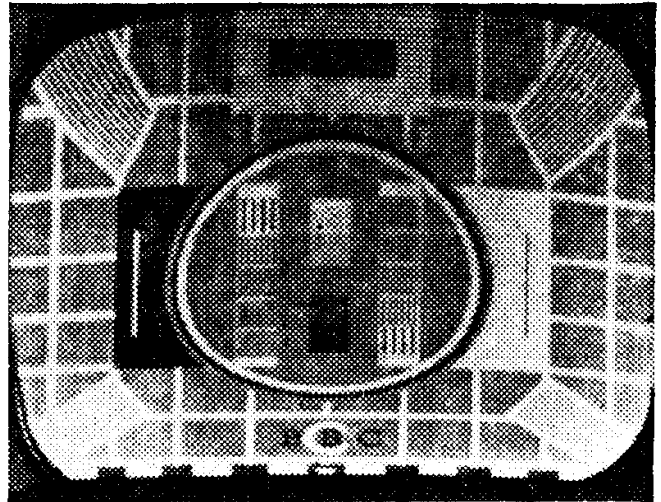


Fig. 2—Cramping at the bottom of the picture is a common symptom of the frame timebase and can be caused by several factors as described in the text.

Normally, if a component associated with the linearity control goes completely open-circuit, the bottom of the picture is greatly stretched and the top of the picture cramped (Fig. 4). However, alteration in value of an associated component could modify the condition and even give the symptom of Fig. 2.

INSUFFICIENT HEIGHT

If the overall linearity is reasonable but the frame scan fails to fill the screen even at maximum setting of the height control the drive from the oscillator to the amplifier is probably low. In receivers where the frame oscillator is powered h.t.-wise from the boosted h.t. line circuit via the height control (as in Fig. 3), the first thing to check is the fixed resistor connected in series with the height control (R66) for increase in value.

The emission of the oscillator valve should next be checked and if both of these things are in order the trouble could lie in the boosted h.t. circuits. This would probably also result in low width and light vertical lines (or just one line) towards the left-hand side of the picture. The e.h.t. voltage would also be low and the picture as a whole may be out of focus to some extent.

Another cause of the symptom is increase in value of the anode load resistor of the first multi-vibrator triode R61. The top of the picture is mainly affected in this case and a series of short, horizontal lines may develop at the top (Fig. 5).

COMPLETE FAILURE

Complete failure of the frame timebase causes collapse of the frame scan, the symptoms being a very bright horizontal line across the centre of the screen. The first move in this instance should be to determine whether the fault lies in the frame oscillator or amplifier.

The oscillator can be checked in several ways, one being by listening for the frame signal in a pair of headphones. These should be connected to the control grid of the frame amplifier valve and

chassis and in the interest of safety an $0.005\mu\text{F}$ capacitor should be connected in each lead. Failure to observe this precaution could result in a very serious electric shock to the wearer of the headphones, especially from an a.c.-d.c. type receiver.

The frame signal will be heard as a loud buzz which can be altered in pitch by adjusting the frame hold control. If such a signal is present at the control grid of the frame amplifier then the trouble lies in the amplifier stage itself.

Firstly, the amplifier valve should be checked for emission and, if normal, voltage checks should be made at the anode, screen and cathode electrodes of the valve and compared with those given in the service sheet. Simple tests of this nature would almost certainly reveal the faulty part. For instance, lack of anode voltage would probably mean that the primary winding of the frame output transformer TR4 is open-circuit (check by measur-

either a break in the wiring from the secondary of the frame output transformer to the frame coils or an open-circuit in the coils themselves.

Resistors R80 and R81 across the frame coils prevent the coils from oscillating at or near the line frequency. Oscillation here, due to open-circuit of one of these resistors, would cause slight waviness at the left of the picture.

If the oscillator is proved to be faulty (no frame signal in headphones) the emission of the oscillator valve should first be checked and, if normal, followed by voltage tests at the electrodes. Remember that an oscillator stage which is not oscillating will have anode voltages somewhat different from those given in the service sheet, since these were taken under normal conditions.

Nevertheless the voltage as measured—or lack of it—should give some idea of the whereabouts of the trouble. In some cases it is necessary to check the anode resistors and feedback capacitors (C64) by substitution.

Another way of checking for frame signal is to couple the control grid of the frame amplifier valve via an $0.1\mu\text{F}$ capacitor to the centre tag on the volume control (sound section). The a.f. stages in the set will then greatly amplify the frame signal, which will be heard in the loudspeaker as a very loud buzz.

WRONG FRAME SPEED

The repetition frequency of the waveform produced by the frame oscillator is determined by a time-constant produced by C64, R68 and R69 and the repetition frequency or speed can be varied by adjusting the element R69 which is labelled "vertical hold".

The correct frequency (50c/s) should occur when R69 is set to the centre of its range or thereabouts. If the frequency differs from 50c/s the picture will "roll" upwards or downwards, depending upon whether the timebase is fast or slow, at a rate governed by the difference in frequency. This effect should normally occur as a control is adjusted either side of its correct "locking point".

However, it sometimes happens that one or more of the time-constant elements alters in value and upsets the balance of the frame hold control (vertical hold). A small alteration in value does not matter much because there is sufficient scope on the control to correct it.

A substantial alteration in value though may put the correct locking point either right at the end of the control or completely outside its range. When this happens the control has to be rotated hard against one of its stops to secure frame lock and even then the oscillator may only be on the fringe of its correct speed. This causes the picture to

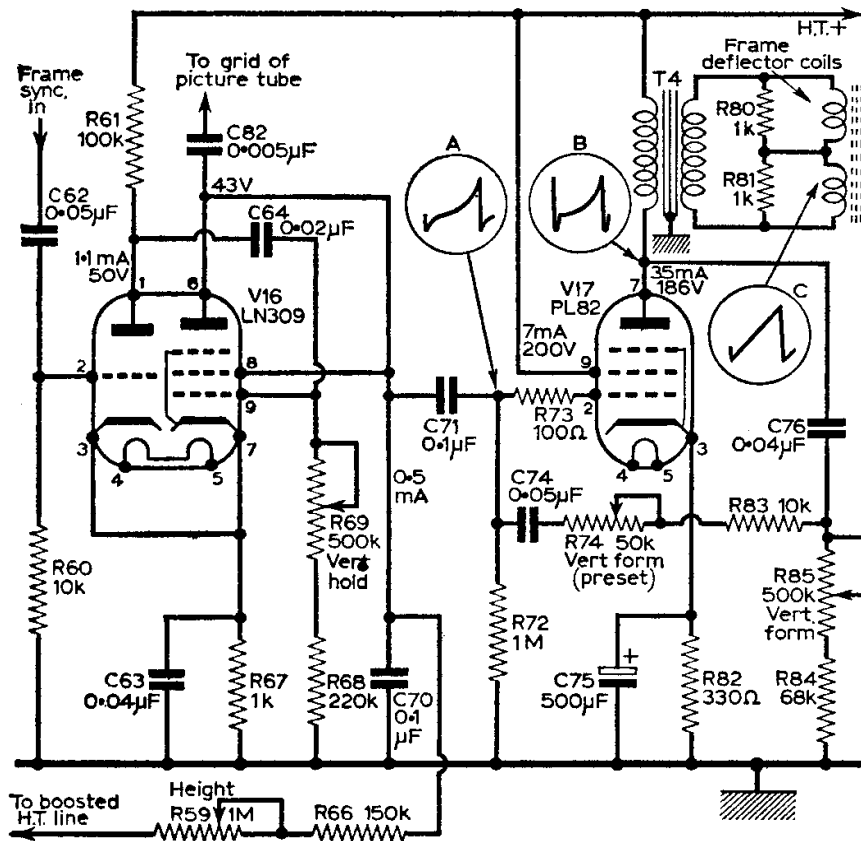


Fig. 3—The frame timebase circuit of the G.E.C. BT5246 series receivers.

ing the voltage at the h.t. side of the winding).

A very high voltage at the cathode would be caused by the cathode resistor R82 being open-circuit. The high voltage would probably cause the bypass electrolytic C75 to fail as well. The voltage at the screen should be checked in a like manner, for although the circuit in Fig. 3 shows the screen connected direct to the h.t. line some sets use a screen feed resistor and bypass capacitor.

If all seems well in the amplifier circuit and the frame signal can be heard loud and clear at the anode of the valve the cause of the fault could be

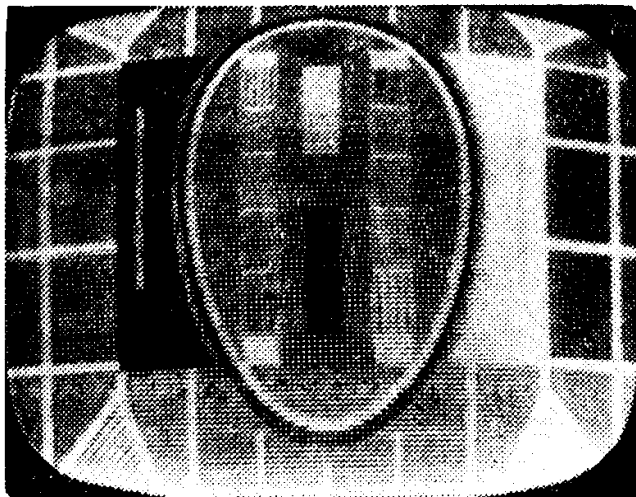
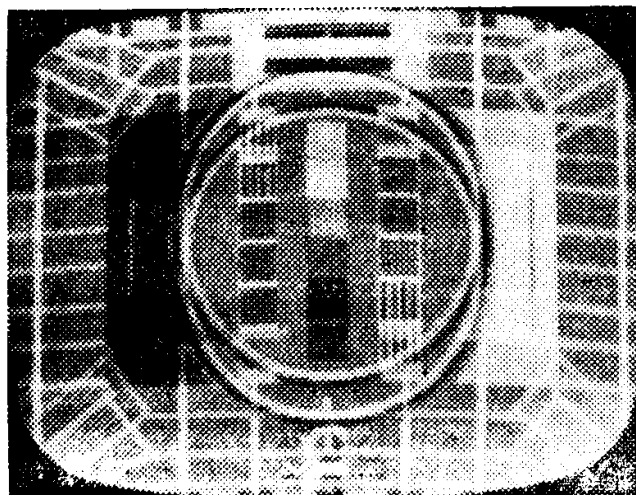


Fig. 4 (above)—This effect can be caused by open-circuit of a component in the frame linearity negative feedback section.

Fig. 5 (right)—Slight cramping at the top of the picture accompanied by a series of short, horizontal white lines, as shown, should lead to a check of the anode resistor of the first multivibrator triode.

Fig. 6 (below)—The symptom of frame judder, or frame bounce as it is sometimes called.

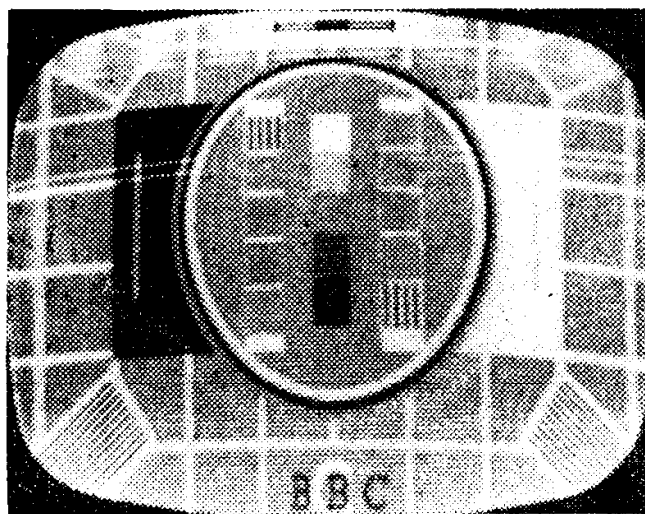


roll intermittently, particularly during bursts of impulsive interference or on changes of picture content. If the alteration in value is great then it will be impossible to lock the picture even with the control fully retarded or advanced.

A change in characteristics of the oscillator valve can cause the trouble and it pays, if possible, to check the valve by substitution before delving too deeply into the circuit. If the fault cannot be corrected in that way the time-constant components should be checked for value and replaced if necessary. The resistor in series with the hold control (e.g., R68) often increases in value and causes the trouble.

There is a distinct difference between the fault described above and that which results in a poor frame lock. In the former case the trouble results from an incorrect time-constant and in the latter case from weak or distorted frame sync pulses. Here the correct frame speed would be within the range of the hold control, but it would be difficult to keep the picture in lock.

Under normal conditions it should be possible to retain lock over a reasonable rotation of the hold control (within the so-called "locking range"), but if the frame sync pulses are to blame the lock would be extremely critical and there would be virtually no locking range.



This symptom should lead to a check of the components feeding the frame sync pulses from the sync separator valve and interlace filter diodes to the frame oscillator such as C62. With circuits using a frame blocking oscillator instead of a multivibrator, poor insulation in the windings of the blocking oscillator transformer distort or weaken the frame sync pulses sometimes without affecting the oscillator action.

FRAME JUDDER

This symptom also arises from a frame timebase fault (Fig. 6). A chief offender is the oscillator valve itself, but value increase in one of the anode resistors of the multivibrator can also cause the effect. In Fig. 3 the multivibrator really acts as an electronic switch to discharge C70, this action producing waveform A.

Thus the time-constant formed by C70 and R66 can have a bearing on the operation of the stage. A low-value capacitor or increase in value of the resistor sometimes aggravates frame judder while also reducing the frame amplitude. Similar trouble can also result from alteration in value of C63 or R67 in the cathode circuit of the oscillator valve. In frame blocking oscillator circuits a faulty blocking oscillator transformer is another possibility. □

A SIMPLE TRANSIS

PATTER

THE AUTHOR DESCRIBES THE
USEFUL PIECE OF EQUIPMEN

The reason for this approach is that it simplifies the circuitry of the apparatus, the r.f. oscillator and modulator being the most difficult part of a conventional pattern generator to build, and it avoids any chance of annoying neighbours with stray r.f. signals.

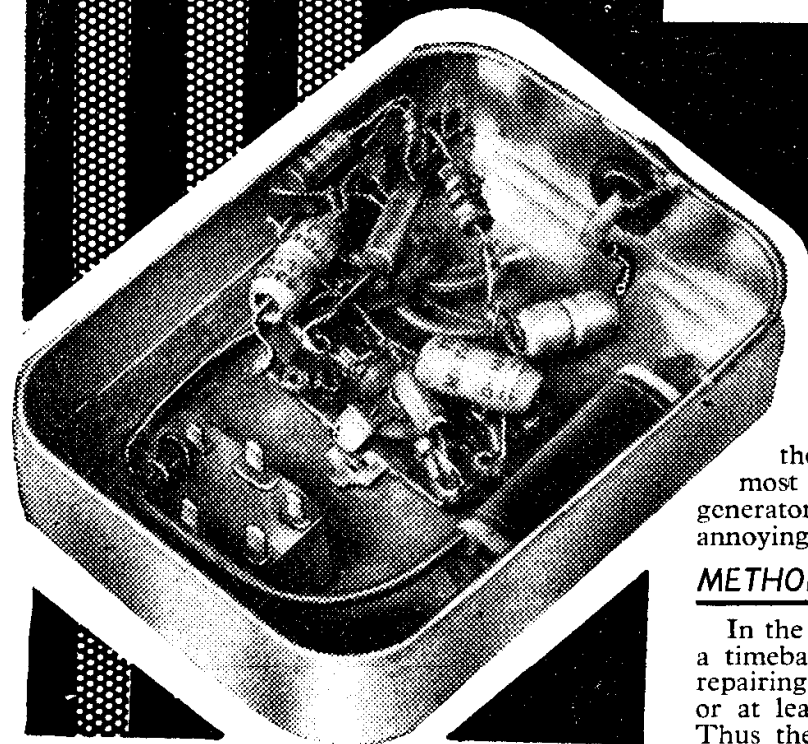
METHOD OF USE

In the normal run of events, whilst trying to cure a timebase linearity fault on a TV set the person repairing it will have the chassis out of the cabinet, or at least have the under-chassis cover removed. Thus there is no difficulty in getting at the video amplifier wiring. Fig. 2 shows how the output crocodile clips are joined on to the circuit of a conventional type of video amplifier.

Most video amplifier stages of TV sets are of this form, but all types of video output circuit will handle the pattern generator waveform. The only precaution required when using the generator is to disconnect the aerial and put the TV set gain control down to minimum in order to avoid confusion from BBC or ITA signals.

CONSTRUCTION

When the original pattern generator was built an empty tobacco tin was used to house the wiring. Construction is simple, only one tag-strip being used to mount the components used.



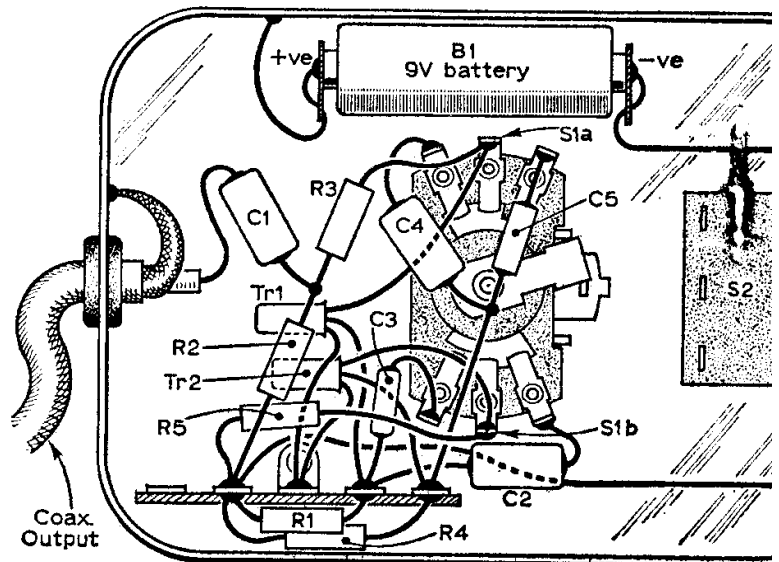
IN the last few years it has become increasingly difficult for the TV amateur and service engineer to be able to receive Test Card "C" in order to adjust his television receiver accurately. This is because a large percentage of the hours during which this test card used to be transmitted are now being used for Educational and Women's programmes.

The need for a pattern generator to check frame and line timebase linearity has thus become much greater and the following apparatus was conceived by the author as being the simplest possible. Nevertheless, although simple, very good results are obtained from it.

CIRCUIT DESCRIPTION

The circuit is essentially a multivibrator using r.f. transistors of the "White Spot" variety, these being readily obtainable from retailers advertising in this magazine. As can be seen from Fig. 1, two frequencies are obtainable by means of a double-throw switch, these frequencies of square wave giving eight bars either horizontally or vertically upon the TV picture.

In the normal pattern generator the square wave generated to produce bars or cross-hatch patterns is used to modulate an r.f. signal in order to produce a signal for application to the aerial socket of a television receiver. This has been avoided in the circuit described and instead the output of the generator is crocodile clipped directly on to the grid of the video amplifier.



PATTERN GENERATOR

THE CONSTRUCTION AND APPLICATION OF A VERY SIMPLE YET EFFECTIVE MEANS FOR PRODUCING TEST PATTERNS ON TELEVISION RECEIVERS

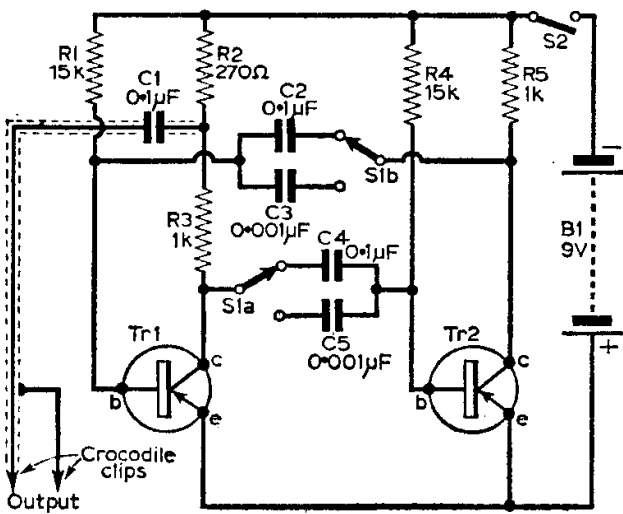


Fig. 1—Circuit diagram of the transistor pattern generator. The two switches S1a and S1b are ganged. When the switch is in the clockwise position horizontal bars are selected; in the anticlockwise position, vertical bars.

The length of the crocodile-clip lead was made approximately 6in. long, this being a length long enough for the convenient use of the apparatus, but not long enough to cause instability in the video amplifier.

COMPONENTS LIST

Resistors (all 10% ½W):
 R1 15kΩ R4 15kΩ
 R2 270Ω R5 1kΩ
 R3 1kΩ

Capacitors:
 C1 0.1μF paper
 C2 0.1μF paper
 C3 1,000pF mica or ceramic
 C4 0.1μF paper
 C5 1,000pF mica or ceramic

Switches:
 S1 2-pole, 2-way S2 1-pole, 1-way

Transistors:
 Tr1, 2 OC44 or OC45

Battery:
 B1 9V Ever Ready PP5

Miscellaneous:
 Four-way tag strip. Metal box. Two crocodile clips. Length of screened cable.

Details of the component layout and general construction are given in Fig. 3 and in the photograph. A pilot light may be added if required but it will take more current than the actual pattern generator. □

Fig. 2—Showing how the pattern generator is connected to the circuit of a conventional type of video amplifier.

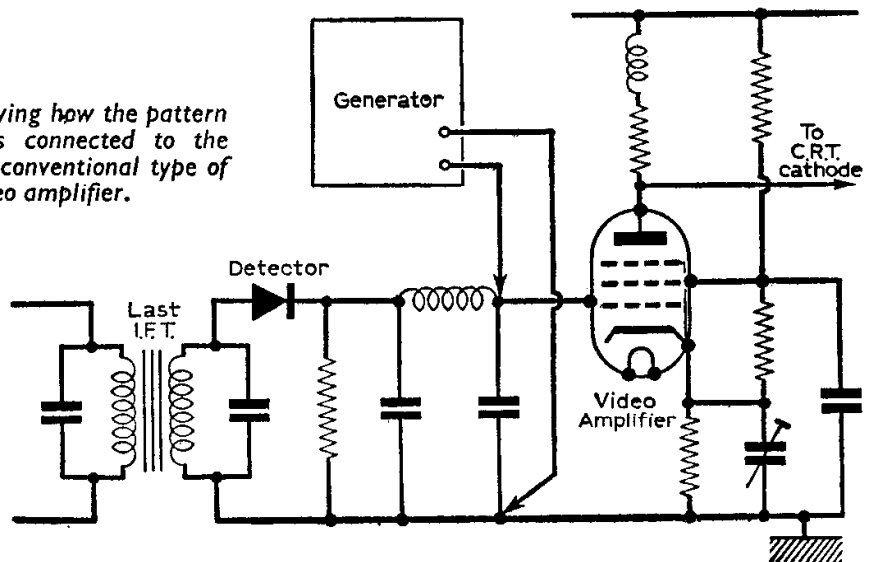
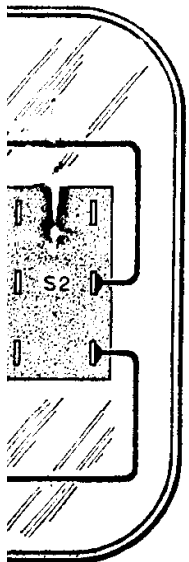


Fig. 3—Details of the component layout and wiring as seen with the lid of the box removed.



The ABC of TV Circuits

AN ANALYSIS OF THE DEVELOPMENT OF TELEVISION CIRCUITS

By T. L. May

(Continued from page 140 of the December issue)

HERE have been several attempts in the past to fill in the gaps between the lines of a television picture to reduce lininess. Probably the most well known in this respect is the "line diffuser" or "spot wobbler" introduced by E. K. Cole and others.

The circuit of this system is given in Fig. 25, from which will be seen that a triode valve is connected in a modified Colpitts oscillator circuit. The oscillator coils are, in fact, the spot-wobble coils and are placed at right-angles to the line scanning coils on the neck of the picture tube.

The inductance of the spot-wobble coils in conjunction with the parallel-connected capacitances fix the frequency of oscillation, which ranges from about 11.5Mc/s to 12.5Mc/s. The actual value is set according to the channels used for zero beat interference by the 50pF trimmer capacitor.

The oscillator current in the coils causes rapid vertical deflection of the spot and as this traverses a line scan the line is wobbled in the form of a sine-wave as shown in Fig. 26. As this is happening so quickly the actual sine waves are invisible unless greatly magnified and the net effect is that the black gaps between the lines are filled with diffused illumination.

The oscillator can be switched on and off by S1 and the amplitude of the "wobble" can be adjusted by the variable 10kΩ resistor in the h.t. supply circuit. The idea is first to adjust the focus of the picture with the spot-wobble off, then switch it on and adjust the amplitude control for maximum diffusion effect. In this way the vertical and horizontal definition remains unchanged in spite of the line effect disappearing. This would not be the case, of course, by endeavouring to eliminate the lines by simple defocusing.

Elongated Spot

For optimum horizontal definition of a television picture the scanning spot has to be as small as

possible so as to define rapid changes in the brightness of horizontal picture elements. The bandwidth of the whole of the video channel also governs the horizontal definition, for it is this which determines the speed at which the scanning spot can change in brightness. On modern tubes the scanning spot is usually much smaller than it need be for 3Mc/s resolution or, indeed, for the 5Mc/s resolution of a 625-line picture. Thus the definition limit is not related to the dimensions of the spot, as it used to be on the very early tubes, but on the bandwidth of the video system.

This results in the line structure of a correctly focused television picture being extremely prominent, even though the interlace performance is beyond reproach. There is no point in making the scanning spot larger in diameter, even though this can easily be done by modifying the first anode potential, as this would eventually tend to destroy the horizontal definition and the limit would no longer be in the bandwidth of the system.

However, there is a great case for elongating the scanning spot in the vertical direction as shown in Fig. 27, provided the horizontal dimension is not increased. This technique maintains the best possible horizontal definition while filling in the gaps between the lines.

With this in mind units for clamping on the neck

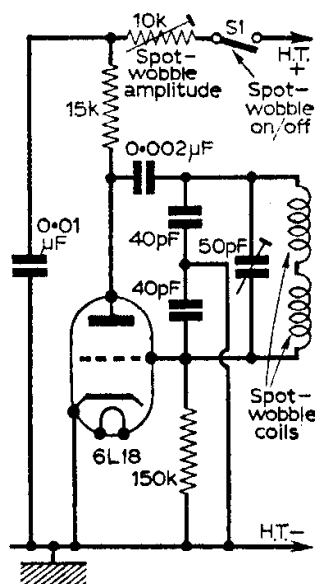


Fig. 25—A typical spot-wobble circuit as used in some commercial receivers.

of the picture tube which create an eccentric magnetic field have been produced on the Continent for line elimination. The field is produced either by a permanent magnet system or an electromagnet and the eccentricity simply stretches the scanning spot in the vertical direction without affecting its width. It is interesting to note that such units are in use on the 625-line standard in Germany and a survey undertaken some two years ago revealed that the line structure was then the main performance factor requiring improvement—on 625 lines!

Optical Method

Another interesting idea evolved a couple of years ago by a German manufacturer is depicted in Fig. 28. This is an optical method for eliminating

the scanning lines without impairing the horizontal definition. A specially corrugated, transparent plastic viewing screen is placed a little in front of the picture tube screen and could replace the old-style implosion guard.

The parabolic corrugations have the effect of dispersing the light from the activated lines vertically as the left-hand magnified section of the diagram shows. Because the viewing screen is flat in the horizontal direction there is zero light dispersion in this sense and the horizontal definition thus remains virtually unchanged.

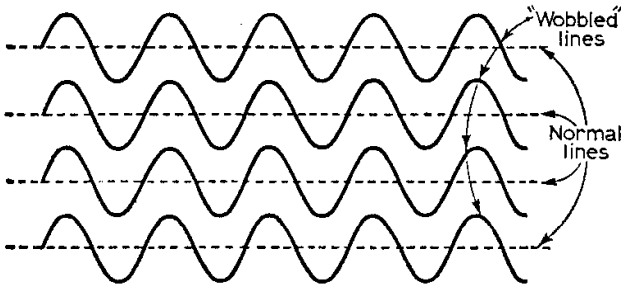


Fig. 26—An amplified view of four lines of spot-wobble. The oscillator current in the coils causes rapid vertical deflection of the spot as it traverses a line scan, and the overall effect is that the black gaps between the lines are filled with diffused illumination.

However, to the viewer the lines completely disappear. Another way of looking at this is to consider that the screen elongates the spot vertically, thereby creating more or less the same effect as the eccentric magnetic field described earlier.

To the writer's knowledge such a screen has not yet been introduced into Great Britain, but there would appear to be quite a call for it, particularly if the design is such that there is negligible loss of through light. There seems to be no reason why it could not be polarised to improve the contrast ratio in high levels of ambient light or even be incorporated in the picture tube itself.

New Idea by Kolster-Brandes

Even in this 625-line age efforts are being made still to overcome lininess and a recent K-B innovation is worthy of note. It is well known that recent receivers employ picture tubes with electrostatic focusing—the focusing being accomplished by the application of a positive voltage to the focus electrode. A preset control is usually available to allow the focus to be optimised (Fig. 29).

The K-B idea is to rectify the pulses in the line output stage to produce a negative voltage, which is then applied to the focus electrode. This tends to defocus the scanning spot sufficiently during line scans to fill in the gaps between the lines.

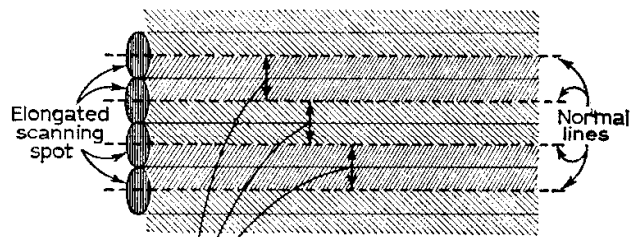
There is little doubt that larger screen sizes, improved picture tubes and circuits all tend to emphasise the line structure and, even though we are now changing to 625 lines, the lininess of a large-screen picture is still as bad—if not worse—than that of the early 9in. and 12in. tubes. Thus there is still a strong case for line eliminators of some form or other.

Standby by Mullard

Contrary to expectations the life of valves and picture tubes is somewhat shortened by the constant current surges in the heaters each time the equipment is switched on. This is less troublesome now that current limiting devices are employed in series connected heater chains, but tubes and valves would not perish quicker if their heaters were left running—and there is every reason to believe that their life would be extended.

Moreover, the warm-up period of valve equipment is sometimes disadvantageous and is emphasised by the immediate operation of transistor equipment. With these factors in mind Mullard Ltd. has suggested a circuit (Fig. 30) whereby the heaters are approximately half-powered even when the set is switched off. Thus, since they are warm, only a little time is required for them to reach full emission when the set is properly switched on.

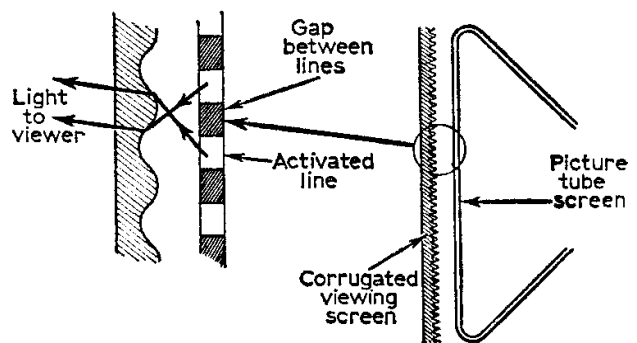
The switch has three positions—"on", "off" and "standby"—and there are four ganged sections. In the "off" position the mains supply is removed on both poles as is existing practice by sections S1A and S1B. In the "on" position the mains is applied to the series connected heater



Gaps between lines are filled

Fig. 27 (above)—By making the scanning spot elliptical without increasing its horizontal dimension, the line structure can be eliminated without detracting from the horizontal definition of a picture.

Fig. 28 (below)—This diagram shows how a viewing screen can be used to eliminate the line structure by optical means. The screen is made of transparent plastic, on one side of which are formed parabolic corrugations. The corrugations have the effect of dispersing the light from the activated lines vertically, without affecting the horizontal definition.



chain via the mains dropper and the input to the h.t. rectifier via the surge limiting resistor in the usual manner. In the "standby" position, however, the heater chain is transferred from the mains

supply to the output of the h.t. rectifier by switches S1C and S1D, the latter also removing the h.t. line from the output of the rectifier.

This results in the heaters being partially energised by the direct current in the silicon rectifier and associated surge limiting resistor and, since the h.t. line is disconnected, the set is quiescent and yet immediately available for normal operation by switching from "standby" to "on".

Frame Pulse Suppression

It is not widely known that quite a large voltage pulse occurs across the primary of the frame output transformer during the frame flyback. The actual amplitude of the pulses depends upon the design of the output stage. The pulses arise from the speedy change of current in the inductive elements of the circuit, but since the rate of change of the current

such useful work and their presence is rather an embarrassment, for the extra high insulation requirement of the frame output transformer and frame amplifier valve is dictated essentially by them.

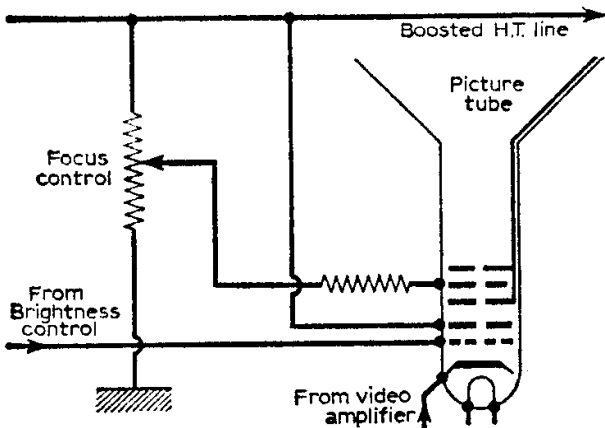


Fig. 29—The focus circuit associated with an electrostatically-focused picture tube. Line elimination on the new K.-B. models is achieved by rectifying the pulses at the line output stage and applying the resulting negative voltage to the focusing electrode.

is smaller in the frame than in the line circuits the pulses at the anode of the frame amplifier valve are smaller than those at the anode of the line amplifier valve. The latter pulses, of course, are

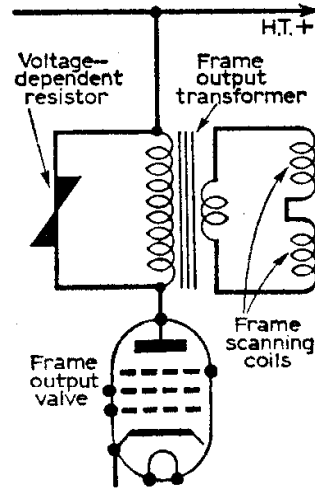


Fig. 31—The use of a voltage-dependent resistor to suppress the high amplitude pulses during the frame flyback.

With the advent of larger screen, wider scanning-angle picture tubes, the problem has been aggravated by the call for greater scanning power and something has had to be done to avoid the frame output transformer and valve from becoming too large and costly.

One way by which the problem is solved is shown in Fig. 31. Here one of the recently developed voltage-dependent resistors is connected across the primary winding of the frame output transformer. Such resistors have the property of decreasing in resistance when the voltage across them is increased. Thus, on the normal frame scan, when the induced voltage is relatively small, the resistance value is very high and does not shunt the transformer by any appreciable amount.

On the flyback, however, when the peak voltage is high the resistance value decreases, shunts the transformer and thereby effectively suppresses the pulses. This arrangement also helps to rid the

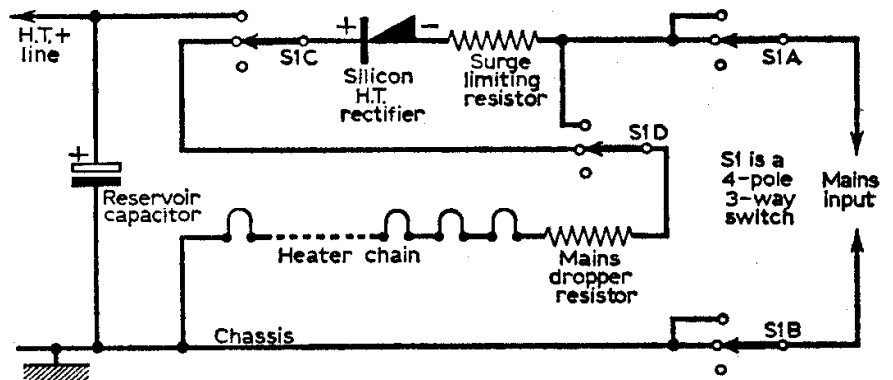


Fig. 30—The "standby" circuit suggested by Mullard Limited to avoid the delay when switching on a receiver from cold.

produced by the line flyback and are stepped up by the e.h.t. overwind on the line output transformer, rectified by the e.h.t. rectifier and then used as the e.h.t. voltage for the picture tube.

The frame pulses unfortunately cannot be put to

frame amplifier of undesirable oscillations (ringing) which may otherwise cause bad distortion of the frame scan.

(To be continued)

SERVICING TELEVISION RECEIVERS

By L. Lawry-Johns

No. 85: ULTRA VI7-70 Series

(Continued from page 117 of the December issue)

Picture Shift

The shift adjustment on 17in. models consists of a clamp immediately behind the deflection coils holding a round magnetic element which may be rotated to move the picture according to the position of the clamp. On 21in. models two shift plates are provided instead of the clamp and the picture is shifted by the rotation of these plates with respect to one another.

Line Linearity

A closed loop or shorted turn sleeve is located on the tube neck and its movement in or out of the scanning coils provides control of line linearity and to an extent width. The sleeve cannot be adjusted until the deflector coil clamp is slackened.

The sleeve must not be pushed too far into the deflection coils as not only will the width of the picture be affected but overheating may occur. The sleeve has a locating key or slot which must be to the side of the tube neck, never to the top or bottom. It should be on the right-hand side viewed from the rear.

Chassis Removal

Remove the two wood screws at the bottom of the cabinet back and raise the back cover to disengage it from the top hinges. The side knobs are secured by spindle screws accessible from inside the cabinet. The channel selector grub screws are revealed by rotating the fine tuner knob. The volume control knob is secured by a screw which passes through a collar.

There are two screws under the cabinet and two smaller screws securing the cabinet top to the chassis extension panel. Remove these and slide out the chassis. Ensure that the loudspeaker is pushed clear of the cabinet when replacing chassis.

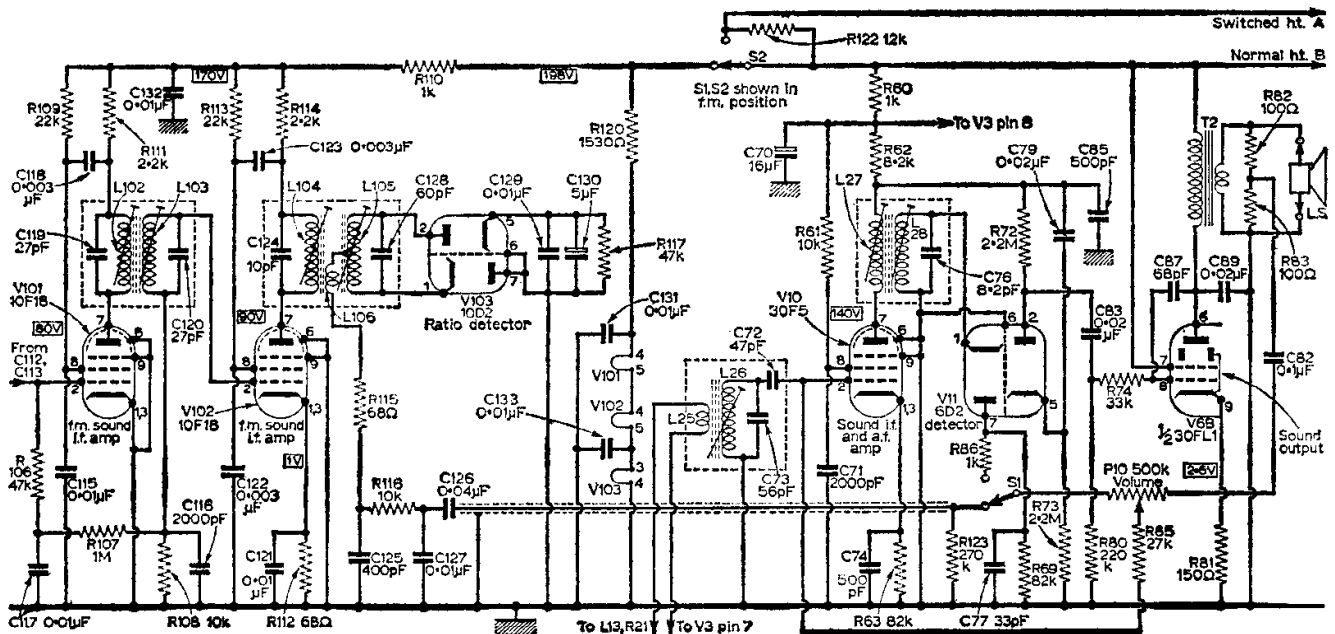


Fig. 4—The sound stages showing f.m. circuit and heater supply and normal sound circuit.

Sound Stages

So far the sound stages have not been mentioned apart from the references to the f.m. unit and its power supplies. It will be realised that the f.m. unit plays no part at all in the amplification of the TV sound signals.

The TV sound signals are common with the vision signals up to the anode circuit of V3 and therefore loss of sound signals indicates a fault in the circuit after V3 i.e. confined to V10, V11 or V6 stages if of course the vision signal is normal.

Loss of vision and sound signals leaving a raster on the screen and f.m. normal is unusual but points to a fault in the V3 stage and a check on this valve and voltage supplies should reveal the cause. If no signals are present at all but a raster is revealed when the brightness is turned up, the tuner unit should receive attention and both valves should be checked by substitution.

Distortion

When all sound signals are distorted, particularly when the volume is turned up, check R72 (2.2M Ω) the limiter resistor to pin 2 of the 6D2 (V11). If the distortion is more pronounced when the volume is turned low check C83 for leakage (0.02 μ F also to pin 2 of V11).

Distortion of f.m. signals is often due to an inefficient aerial and the effect of an efficient aerial should be tried before checking the f.m. unit. The valve base voltages normally to be expected are given in Fig. 7 and these should be taken before making any substitution checks. The writer has not experienced any trouble with this unit except for R120 becoming o/c thus putting out the unit

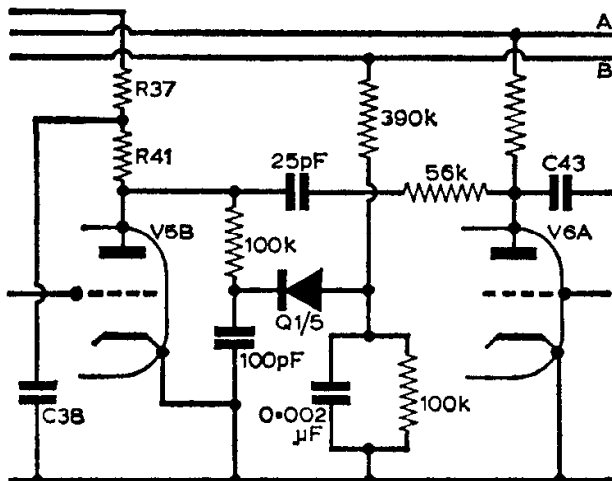


Fig. 5—Showing the circuit differences in the line timebase circuit of the 21in. versions.

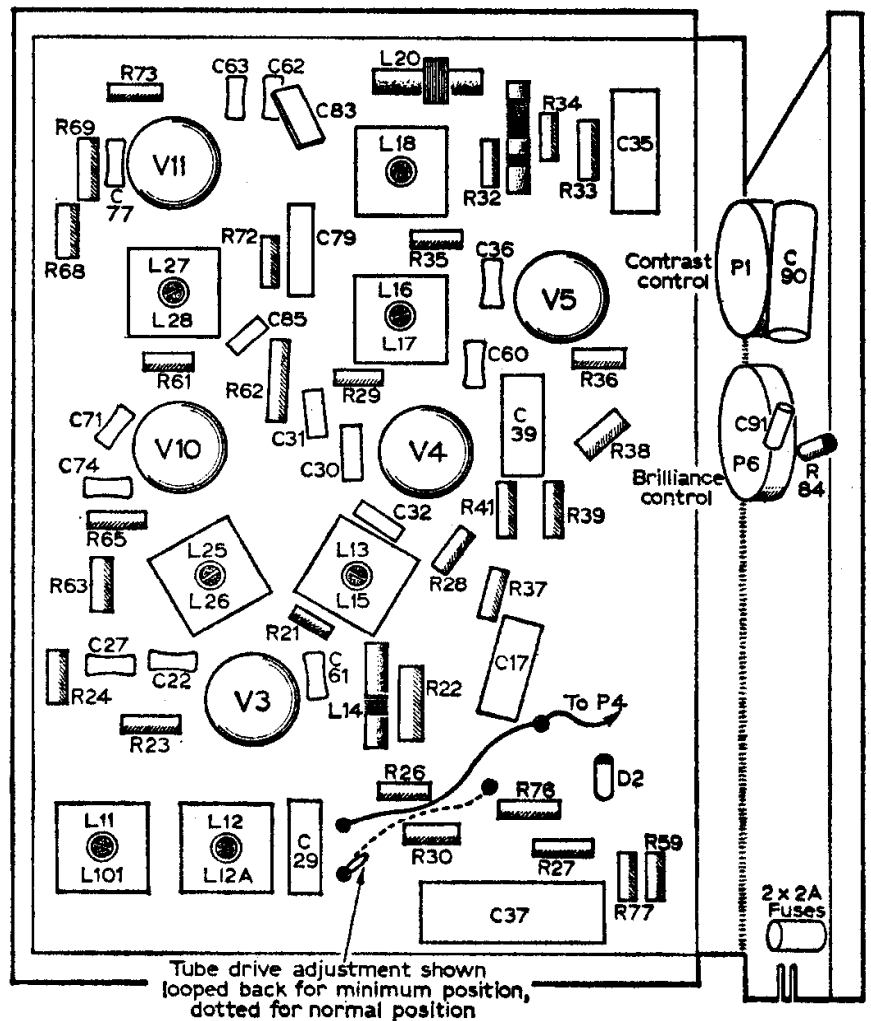


Fig. 6—Front view of the printed panel.

valve heaters and is therefore unable to point to any weak links.

As a matter of interest it is pointed out that V10 not only functions as a TV sound i.f. amplifier but also as a reflex a.f. amplifier where the audio (demodulated or detected) signals from the f.m. unit and the TV sound detector (V11A) are passed to the volume control thence to the control grid of V10.

The audio signals across R62 are passed via C79 (0.2 μ F) to V11B pin 5 which is the limiter, signals appearing at pin 2 being conducted via C83 to the output stage.

No Sound

In the event of sound failure which is not due to a faulty valve check C79. A s/c here biases back the diode V11B causing complete absence of signals or alternatively very low and distorted signals. A quick check is to short pins 2 and 5 of V11. If this restores volume check C79 and R72.

Frame Timebase

Rapid bouncing or jitter in a vertical direction is occasionally experienced and quite often replacement of V13 is all that is required.

There are times when valve replacement will not

help and C102, C100 and C95 should be substituted. One can be at fault although it may test perfectly on a bridge. Also check C93 although this is usually at fault on the score of bottom compression.

Where the frame scan is severely affected showing symptoms of jitter, loss of hold, lack of height, etc., and the usual causes have been explored, C38 (0.1μF) should be checked.

Picture Rolling

Vertical hold at the end of its travel; check R88 (180kΩ) and the hold control itself, which can decrease in value.

Line Hold

Similar troubles can affect the line timebase and loss of line hold may well indicate a faulty hold control P2 (200kΩ) or series resistor R49 (220kΩ) if V6 is not at fault.

Severe Shading on One Side of Screen

When the left-hand side is much darker than the right-hand side check C48 (0.04μF). This can only be experienced when P3 is in the circuit. When P3 is in the minimum position C48 is at chassis potential in any case and there is no feedback to the video amplifier.

Points of Interest

Note that the gun or control grid of the tube pin 2 is directly tied to chassis. This electrode does not connect to the brilliance control as is usually to be found. It is the cathode (pin 7) which not only receives the modulating signal via C90 but also carries the standing bias from the brilliance.

Flyback suppression is applied to the first anode (pin 3) via C92, the potential being a little lower than usual at about 260V. The focus electrode is brought out to pin 4.

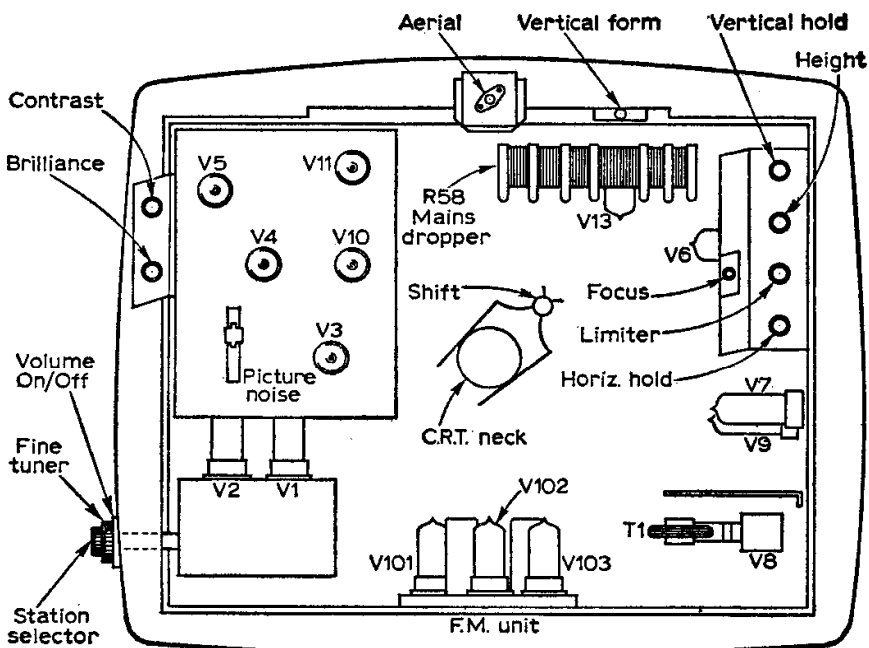


Fig. 8—Rear view of the receiver with the back removed.

Note that the contrast control has no effect on the a.g.c. voltage and it is therefore essential to pre-set the a.g.c. by means of the Tube Drive Adjustment and picture noise control to avoid overloading of the video stage resulting in chipping of whites and a negative picture in strong areas. □

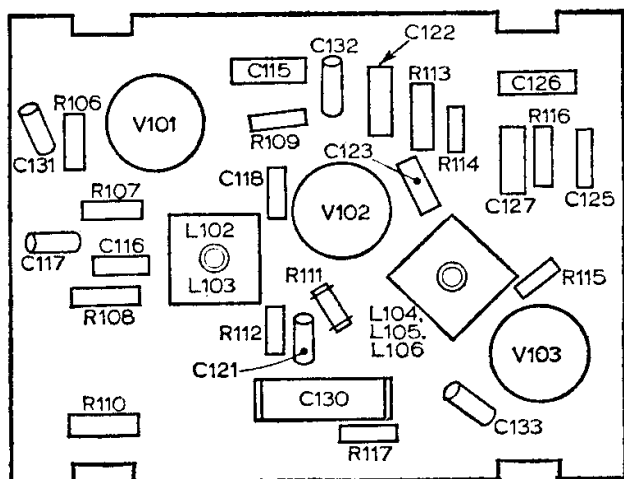


Fig. 7—Layout of the f.m. panel.

FRIDAY, FEBRUARY 1st, 1963

A FILM SHOW

(in collaboration with Mullard Ltd.)

CAXTON HALL, WESTMINSTER

at 7.30 p.m.

Send for your free tickets now marking your envelope "Caxton Hall" in the top left-hand corner and enclosing a stamped addressed envelope (at least 3½ in. x 6 in.) for the tickets.

The films to be shown will include "Fuel for the Future" and "The Electroneers", and as in previous years, the programme has been arranged to appeal to all who are interested in radio.

The demand for tickets will be great; order yours NOW.

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.

IRISH VIEW

SIR,—The following information may be of interest to some of your readers. Ireland's first Continental system (625-line) television transmitter began transmission on 1st November 1962. The vision frequency is 207.25Mc/s and the sound 213.25Mc/s. The picture modulation is negative-going, in accordance with the C.C.I.R. system, and frequency-modulated 6Mc/s intercarrier sound is used. The transmitter has an e.r.p. of 100kW. The aerial is omnidirectional and horizontal polarisation is used.

The programmes are produced at the studios at Montrose, a few miles outside Dublin city, and from there they are relayed by microwave link to the transmitters on Kippure Mountain, in Co. Wicklow.

As some television enthusiasts living on or near the Welsh coast have had good fringe area reception of the old 405-line Telefis Eireann transmissions, the 625-line transmissions should also reach them.

Various test cards are used by Telefis Eireann, including Test Card "C", and the words "Telefis Eireann" are always printed at the bottom.

For reception near the Welsh coast, a channel 11, 12, or 13, 8- or 11-element, aerial should be suitable.—MICHAEL HEALY (Co. Cork, Ireland).

[Our thanks to Mr. Healy for this useful information.—Ed.]

NO SCOPE FOR IMPROVEMENT

SIR,—You may be interested to learn that an oscilloscope I built from a circuit which appeared in the June 1961 issue of PTV, was exhibited on the R.S.G.B.'s stand at the Radio Communication Exhibition held during November.

The VCR138 c.r.t. was ex-government equipment purchased for 6s. and all the other components were taken from old radio sets, etc. The chassis was home-made and the case I also built myself.

I would add that I was 16 years old when the 'scope was completed, and it now operates most satisfactorily.—R. J. C. DAVEY (Boreham Wood, Hertfordshire).

MYSTERIOUS FAULT

SIR,—I would like to know if any of your readers can give an explanation for the following fault, which I have only twice come across in over ten

years of television servicing; once in a "Philco", and, more recently, in a "Decca DM3C".

On setting up the frame linearity on the BBC test card, perfect over-all linearity could be obtained. Then, on switching to the ITV channel, the linearity went completely haywire, being cramped at the bottom, and severely extended at the top. I found that by manipulating the linearity controls again, almost perfect linearity could be obtained, but then on switching back to the BBC, the picture was once again thoroughly upset. This time, however, it was extended at the bottom and cramped at the top!

Eventually the clue to the cause of the trouble came to light when it was discovered that the symptoms were completely reversed when the mains plug was turned round so that the chassis was "live".

It seemed logical that the trouble was caused by mains ripple appearing in the frame timebase somewhere, and this, in fact, was borne out when the fault disappeared after replacing the main 100+200 μ F smoothing capacitors (though no hum was apparent on either sound or picture). But why should the symptoms have been apparent on one channel only? It seems completely illogical to me.

In the case of the "Philco", the fault was completely cleared simply by replacement of the frame output valve, but the reason for this peculiar behaviour remains a mystery.—R. W. T. HORNE, GM3KJA (Jedburgh, Roxburghshire).

TV SOUND QUALITY

SIR,—I can't help agreeing with your correspondent D. B. Williams (November PTV) in his criticism of the transmitting authorities and the television receiver manufacturers for using transmitting and receiving techniques which result in poor quality sound reception for the viewer. But I would also like to see the viewing public take some of the blame for not raising enough protests about this deficiency in our television system before now. After all we have had 25 years of television in this country, in which to judge and pass judgement on the system, but little is ever said about the sound, which is, I consider, very poor.

However, I can't help feeling that nothing will alter until the powers that be decide that it is worth their while to change the system.

I have overcome the problem to a certain degree, by making some straight-forward alterations to the sound circuits of my receiver, and I now have fairly good reception. But for myself and any other enthusiasts who feel they need improved sound, I think the only answer can be the use of a separate audio amplifier feeding a larger loudspeaker.—S. F. G. SIMPSON (Birmingham).

(Continued on page 177)

For Your Bookshelf

REVIEWS OF RECENT PUBLICATIONS

TELEVISION RECEIVER SERVICING

By E. A. W. Spreadbury, M.Brit.I.R.E.; published by Iliffe Books Ltd.

Volume I: Timebase Circuits. 362 pages, 8½ x 5½ ins. Price 25s.

Volume II: Receiver and Power Supply Circuits. 475 pages, 8½ x 5½ ins. Price 35s.

THESE two volumes are the second edition of a comprehensive book written primarily for radio service engineers who wish to obtain a thorough knowledge of television servicing work. The books approach the subject by assuming that the reader has a basic knowledge of the principles of radio servicing techniques and tells him how to apply this knowledge to the servicing of television receivers.

In the first volume timebases and their associated circuits are covered. The second volume deals with all the other sections of the receiver, including the video stage, tuning circuits, the sound channel and power supplies. A large section is devoted to aerials, aerial installation and signal distribution systems.

Because of the many developments which have taken place since the publication of the first edition the present one has been completely revised. Additional chapters deal with TV/f.m. receivers, printed circuits and the effect on servicing work of the introduction of 625-line receivers.

These two volumes can be recommended to anyone dealing with the servicing of TV receivers. They contain a wealth of practical information which includes numerous "tips" on small points of technique leading to saving of valuable time and to improved workmanship. The books will also be found valuable by the amateur television experimenter, enabling him both to understand the

operation of receivers more easily and to give him an insight into modern servicing techniques.—R.S.

COMMUNAL AERIALS AND COAXIAL RELAY PRACTICE

By Gordon J. King, Assoc.Brit.I.R.E., Grad.T.P.A.;

published by Gordon J. King (Enterprises) Ltd.

71 pages, 43 illustrations. Price 8s. 6d.

ANYONE interested in the future of television must be well aware that the lonely rooftop multi-array aerial is becoming impracticable. Higher frequencies mean greater attenuation of signals, more noise reflections (ghosting), and fading. The only feasible answer is a well-sited aerial feeding a properly distributed system to a group or community of viewers.

Within this broad scheme there are various differences; low-frequency multi-channel, r.f. wide-band, Band I repeated, Band I split, a.g.c. controlled, etc.

Mr. King explains the variations and goes into the finer points of the coaxial relay system, in his characteristic style. In 13 close-packed chapters he deals with the history of relay, the various systems, siting and design of the aerial system, and goes on to describe a typical coaxial system. He surveys the controlling factors, a.g.c., equalisation, line powering and distribution. There are chapters on planning a network, signal levels, noise, aerial systems, and a final review of equipment.

This is an excellent handbook for the professional and amateur alike, concise, lucid and well-presented. It is based on a series of articles written for "Electrical and Radio Trading", and is entirely practical in approach.—H.W.H.

LETTERS TO THE EDITOR

(Continued from page 176)

SERVICING SCANDAL

SIR,—Although I would be the first to admit that TV repairmen have a very difficult job, a recent experience of television servicing has shown me that there is a lot to be desired in this field of electronics.

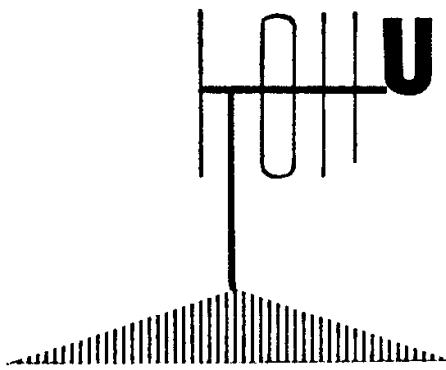
The set in question lost its sound. When it came back from the repair shop of a large and reputable firm, the sound was back all right, not only on the sound channel, but also on the vision. Sound-on-vision was so bad that the picture was completely broken up without the sound carrier being modulated when the set was tuned properly.

The set then made another journey to the repair shop. No improvement. Then another. Still no improvement.

I was therefore asked to see if I could do anything. Although I had not seen the inside of that

model before, it was easy to see how to remove the r.f. board, as it had not been screwed back properly by the shop. When I came to put it back later I discovered that the screws were of the wrong size. I gave the vision dust cores half a turn in each direction, finally leaving them as I found them, and in half a minute the core which was causing the trouble was found. Having set it to eliminate the fault, I put back the printed board and the back of the set. The whole thing took about five minutes.

This is not the only story I could tell, and I have come to the conclusion that the chief trouble is that some servicemen do not understand fully the working of the sets they are supposed to repair. This causes much unnecessary work. I am not suggesting that they should be expected to know the heavy mathematics of the television receiver, but a basic knowledge of the working of the set would seem to be essential. A little more education would save much time and many feet of cored solder.—R. H. ABBOTT (Oxford).



UNDERNEATH THE DIPOLE

A MONTHLY
COMMENTARY



BY ICONOS

IF I could commence my notes musically I would start this month with a chord in G. The reason is my first paragraph concerns title music and, therefore, this paragraph should be read at *ff* level or even *fff*! Ever since the lion first growled on the opening titles of an M.G.M. picture film title music has been notable for crashing chords, elaborate orchestrations and overloaded sound tracks. Occasionally this convention has been ignored, usually for some gimmick reason such as the plinking of a zither on "The Third Man" or the folksy tunes behind the main titles of the famous Ealing comedy series. Television play title music has tended to follow the Ealing pattern of fairly quiet music of a character which more appropriately leads into the opening scenes or even carries on over them.

In the Groove

Association of special tunes with comedies or comedy series is a wonderful way of getting the listeners into the right mood. One has heard laughter in cinemas when the famous Laurel and Hardy music started up, even before these great comedians made their entrance. Similarly, the *Steptoe* title music, by Ron Grainer, creates the right atmosphere for this excellent BBC series. What about other feature programme title music? Some is good and some is bad. *Candid Camera* has appropriately off-beat crazy title music which sets the stage and soon we'll be hearing this again. The TV newsreels haven't yet found music to equal the famous Movietone and Gaumont title music and we have almost forgotten the stirring opening music of British Paramount News. The BBC's news title music is good, far better than

that of Independent Television News. The latter is familiar enough but the quick fade-out of the music in the middle of a bar, now carried out by the ITN producers, is both untidy and unprofessional. If the same tune has to be retained (and I know that a lot of people like it) then at least it should be recorded to length with a clean and proper ending. Actually this is the only fault I find with this lively and enterprising newsreel and I hope that this paragraph catches the eye of Geoffrey Cox, its live-wire chief editor. He should authorise the making of a new disc and get his producers out of the groove.

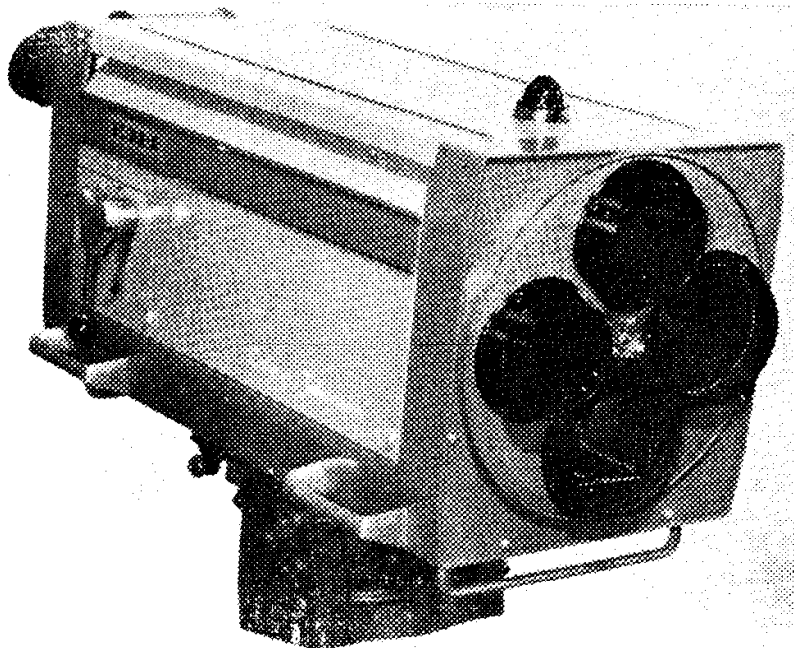
Pilkington Music

The Pilkington Report did not favour music behind newsreel items. I hope the BBC and ITN do not take this suggestion too seriously. The fact that most news items are shot with mute cameras means that commentaries

must be used throughout or complicated effects tracks added—that is, excepting when the news items are shot with a synchronised sound track. Much better to have some kind of background music to fill the gap. In any case, a continuous fusillade of overlaid words becomes rather monotonous. Provided the music does not intrude or become a counterpoint to political, international or very personal items it is harmless enough. I do agree that a musical background to a scene of a murderer being hustled off to prison would be as inappropriate as 'The Robbers' March from "Chu Chin Chow" on shots of a Boy Scouts' Jamboree.

On the Square

The BBC seem to have made a geometrical progression in their TV play titles. From circles they have turned to squares with *The Square Peg*, following the series



The new E.M.I. type 204 colour camera which can be used for broadcasting, telecine, industrial and medical applications.

It's a Square World. Michael Bentine strikes first-class zanie form in "It's a Square World", which is an inconsequential mixture of crazy-gang material with satirical sketches in the modern off-beat manner. True, some of the sketches are prolonged after their basic joke had been put over, a fatal error in the presentation of revue black-out sketches. Still, there are a lot of laughs in the show if this is the type of humour that appeals to you. "The Square Peg" was notable for reversing the trend for glorifying the irresponsibility of youth and the social significance of remaining unwashed. The young hero of this story, an artist, played by Christopher Guinee, gets mixed up with a beatnik circle of painters and sculptors, headed by his father, an artist. But he prefers the city, the financial newspapers and a bowler hat. How he made good both as a painter and as a business man made an agreeable if somewhat improbable story. Production values were first class, with good direction by Eric Taylor.

Monday's Newcomers

I don't know whether you ever look at commercial television on Mondays at 10.30 a.m. There is a special programme at that time which is quite an endurance trial in its way. It is a programme in which 60-second, 30-second and 15-second commercials are unveiled to the trade for the ITA, the television programme companies, the advertising agents and the advertisers to evaluate the newest commercials that are about to be circulated. The differences in sales talks and techniques are enlightening and frightening. Twenty minutes of this and you feel you are back in a cinema where you actually pay for about the same period of time devoted to advertising films, trailers and ice cream. Recently, however, *Monday's Newcomers* was prolonged by an excellently made film, produced by Independent Television News, which was in effect a dummy commercial about an imaginary travel agency.

The commercial was presented in three or four versions, each with different types of sound treatment. There were versions with overloaded sound, over-compressed sound, excessive sibilants and other distortions as well

as a version which was correctly recorded and printed. Curiously enough, every one of these distortions was present to some extent in most of the real commercials that had just been shown. It was obvious that some makers of commercials were overloading the sound track in order to achieve, as they thought, maximum impact with the viewers. What actually happened was that the level was reduced by the sound balancer at the ITV studios which transmitted the films to keep it within acceptable limits. Thus a **GARGANTUAN VOICE** became a very small and distorted voice. The sound which came over best by far was in the ITN's dummy commercial and the next best was the sound on some very funny cartoon advertisements. Female voices weren't very satisfactory and the speakers who made their appeals with staccato, whip-like commands to their captive audience sometimes failed even to convey the names of their products. Let this demonstration be a lesson to them! The ITN should now produce a film which illustrates with diagrams and sound tracks just how compression, echo, volume and bass cut should be handled for television. But it should be strictly in words of one syllable. My guess is that some of that *Monday's Newcomers* were transient guests who will be withdrawn and given new voices.

To Zoom or Not to Zoom

The introduction of zoom lenses with a 10-to-1 ratio—that is to say, a variable focal length from 35 to 350mm.—has caused quite a stir. Previously the ratio has been about 4 to 1. This

means that a change can be rapidly made from quite a wide angle to a very close shot, a valuable facility for a cameraman shooting sporting events, cricket and football. It can also be usefully applied to general TV studio productions as well as ordinary newsreel items. But it must be handled with care. The BBC televised a match between Wolves and Everton at which the camera operator was trigger happy on his zoom lens and camera movement. The picture was zoomed in and out with the zany irresponsibility of a trad jazz trombone and rocked and rolled with appropriate rhythms around the pitch. It was obvious that he was far more enthusiastic than any of the players on the field. The result was a very poor show, difficult to follow, and could not be compared with the dignified handling of similar events by the cameramen of ATV and Granada. The BBC handling of zoom lenses was better on the Horse of the Year Show. This was a splendid affair which was a regular evening date for a large number of viewers who like to watch the beautiful animals accomplish amazing feats under the equally inspired horsemanship of the world's best riders. Horse shows are a natural—for Technicolor and for television.

My guess, as a matter of fact, is that the first colour television reportage on a horse show will be via ultra-rapidly processed colour film and not by colour television cameras. The latter are likely to reveal bright green tail-coated equestrians mounted on blue horses at the merest touch of the wrong button! Cough and the picture goes all red; sneeze and it disappears in a cloud of smoke!

PRACTICAL WIRELESS

MAIN FEATURES OF THE JANUARY ISSUE

General Purpose Communications Receiver
Quality Switch-tuned Radiogram
Top Band 'Phone Transmitter
Transistor Audio Oscillator
TRF Transistor Portable
Advanced Geiger Head
Simple Filter Network
Mains Midget Portable

Radio & TV Engineers' Reference Book

FREE
 to every keen radio man
FOR A WEEK
 WITHOUT
 OBLIGATION
 TO BUY

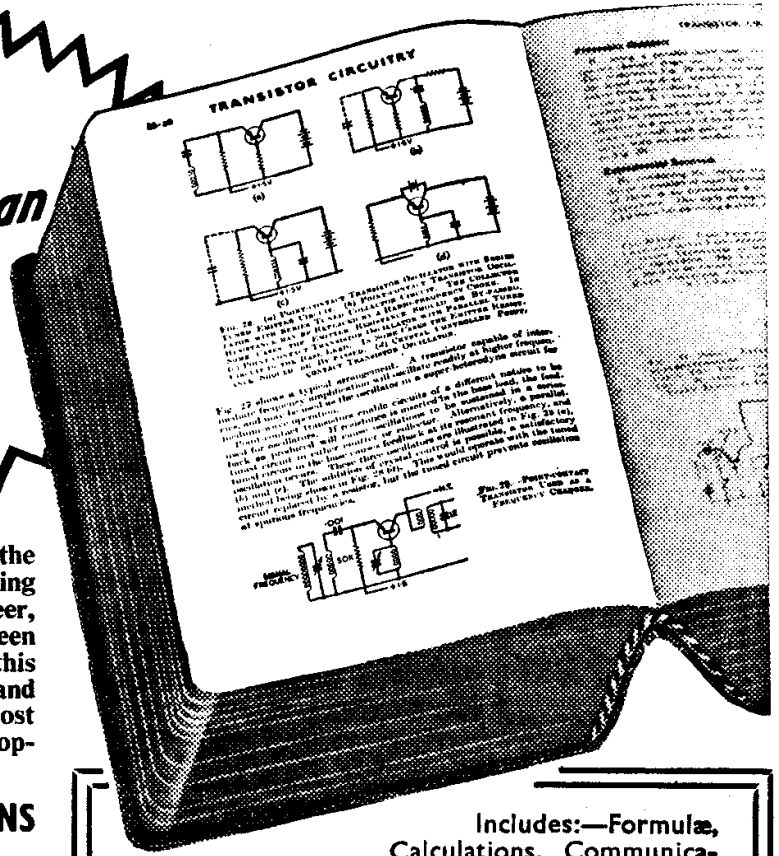
Now you can have for 7 days' free examination the revised 3rd Edition of this very practical engineering and servicing work. If you are a Radio Engineer, Technician, Mechanic, Instructor, Student, Keen Amateur, or engaged in the electronics field, this great wealth of data in all branches of radio and television will prove invaluable. It covers a most comprehensive range of subjects, new developments and techniques.

BROADCASTING • COMMUNICATIONS
SERVICING • NAVIGATION

1,800 PAGES, 47 SECTIONS
2,000 DIAGRAMS AND TABLES

Written for you by nearly 50 Specialists

Including L. S. Allard, B.Sc., A.INST.P. (G.E.C. Cathode-ray Tube Group); S. W. Amos, B.Sc.(HONS.), A.M.I.E.E. (B.B.C. Tech. Instructions Section); E. S. Bacon, M.Sc.(LOND.), A.R.I.C. (Chief Supervisor Elec. Labs. Ever Ready Co. (G.B.) Ltd.); W. T. Blackband, M.Sc., A.M.I.E.E. (Aerials Research, R.A.E., Farnborough); R. H. Burdick, A.G.C.I., A.M.I.E.E. (Marconi's); L. Driscoll, B.Sc., A.M.I.E.E., A.M.BRIT.I.R.E. (Murphy Radio); E. A. Fielding, B.Sc.TECH.(HONS.), A.M.C.T., M.I.E.E., A.I.R.E. (Salford Electrical Instruments Ltd.); D. H. Fisher, A.M.I.E.E. (Regentone); L. S. Foskett (E.M.I.); R. C. Glass, M.A., B.Sc., A.M.I.E.E. (Lecturer Applied Physics, Northampton Coll. Ad. Technology, London); F. J. Grimm, A.M.BRIT.I.R.E. (Pye); P. Jones (Aerialite Ltd.); J. M. Kirk, M.B.E., B.Sc.(HONS.), D.I.C., A.C.G.I., M.I.E.E. (Standard Telephones and Cables Ltd.); L. A. Moxon, B.Sc.(ENG.), A.M.I.E.E. (R.N. Scientific Service); D. F. Urquhart (Erie Resistor Ltd.); V. Valchera (Valradio Ltd.); A. H. B. Walker, B.Sc.(ENG.), D.I.C., A.C.G.I., M.I.E.E. (Westinghouse Research Lab.).



Includes:—Formulae, Calculations, Communication Theory, Electron Optics, Colour TV, Materials, Studio Equipment, Transmitter Power Plant, Broadcasting and Communication Transmitters, V.H.F. Equipment, Amateur Radio Equipment, TV Transmitters and Aerials, Radio-Frequency Transmission Lines, Waveguides, Broadcasting Receivers, TV Receiver Design, Commercial H.F. Radio Links, Broad-band Systems, Radio Navigation and Radar, Aero Radio and Radar, Radio Astronomy and Satellite Communication, Aerials, Valves, Tubes, A.C. Rectification and Ripple Filters, Transistors, Diodes, Resistors, Capacitors, Inductors, Transformers, Gramophone Pick-ups, Speakers, Interference, Recording, Batteries and Conversion Equipment, H.F. Reproduction, Measuring and Test Equipment, R/TV Installation and Servicing, Noise, Projection TV, Oscillators, Industrial TV, Units and Symbols, Progress & Developments, etc

POST NOW
7-DAY
FREE
TEST

GEORGE NEWNES LTD., 15-17 LONG ACRE, LONDON, W.C.2.

Please send me Newnes RADIO AND TELEVISION ENGINEERS' REFERENCE BOOK without obligation to purchase. I will either return the work within eight days or I will send the first payment of 5/- eight days after delivery, then ten monthly subscriptions of 10/- until the sum of £5 5s. has been paid. Cash price in eight days is £5. Free Examination offer not available in Eire. Coupon invalid if not signed and questions answered.

Name and Address in Block Letters please

Mr., Mrs., Miss _____

Address _____

Occupation _____

Signature _____ (Parent signs if you are under 21)

(RB)538/19

Tick ✓ where applicable
 The address on left is—

My Property	<input type="checkbox"/>
Rented unfurnished	<input type="checkbox"/>
Parents' Home	<input type="checkbox"/>
Furnished Accom.	<input type="checkbox"/>
Temporary Address	<input type="checkbox"/>

Please accept our sincere apologies. Since our first advertisement appeared, a disastrous fire destroyed the complete test section of our laboratories. As things slowly come back to normal we shall endeavour to keep up with the tremendous demand for our camera kits. Thank You!

BUILD YOUR OWN COMPLETELY TRANSISTORISED TELEVISION CAMERA!

KIT No. 1 consists of Price £12. 0. 0
Scan Coils. Focus Coils. Horizontal Inductor Coils. Vidicon "Top Hat" Screen. Target Connector. Circuit Diagrams. Layout Instructions. Instruction Manual.

KIT No. 2 consists of Price £14. 0. 0
Printed Circuit Panel. All Variable Resistors. All Hi-stability Resistors. All Capacitors and Electrolytics. Coil Former and Trimmer. Mains Transformer. Rectifiers. Nuts, Bolts, Screws, Clips. Solder and Hook-up Wire.

KIT No. 3 consists of Price £6. 8. 0
13 special first grade Mullard Transistors. 6 special first grade Mullard Diodes. 1 special Vidicon Base.

KIT No. 4 consists of Price £4.10. 0
Ready drilled and stove-enamelled heavy gauge steel case specially designed and produced for the Golden Rule Camera, complete with lens mounting ring.

OR COMPLETE KIT AS ABOVE Nos. 1, 2, 3 & 4 **£35. 0. 0**

**DEALER
INQUIRIES
INVITED**

The completed Camera can be seen working at
GOLDEN RULE ELECTRONICS LIMITED
ONE OF THE JAGGERS GROUP OF COMPANIES
SOUTH VIEW LABORATORIES, LITLINGTON
Nr. Royston, Herts. Phone: Steeple Morden 366 (3 lines)

ALL GRADES OF E.M.I. VIDICON TUBES IN STOCK FROM £8.00 UPWARDS

TUBES

Guaranteed 12 mths.—Carr. Free by Passgr. train COMPLETELY REBUILT & RESCREENED

14" - - - £5. 5. 0
15" - 17" - - £5.10. 0
21" - - - £8. 0. 0

BRAND NEW 12in MW31-74 £4.4.0

"CLARION" TRANSISTOR LINE OUTPUT TRANSFORMERS
BATTERY TAPE RECORDER
Capstan drive. Constant speed
3 1/2 i.p.s. Durable plastic case.
Complete with mike and tape.
Free illus. leaflet. List price 25 gns.
Our 15 GNS. Price Carr. 7/6
CONVERTERS—New. Less valves.
Mainly Ch. 1, 9, Cosmor 927.
Ekeco TU142, 169, 211, G.E.C.
BT1251, 4536, Philips 1446, 1746,
1747U, Ultra 815 series. All 35/-.
Cyclon 168, 10/6.
Post etc. on above, 3/6.

Bush, TV 11A, B; 12A, B	45/-
Cosmor, 930, 931, 933/4, 948	62/8
Ekeco, TS146; TS113-14; T161	47/8
T221, 231, TSC311, etc.	59/8
Ferguson, 841/2/3; 941-945	59/8
990-8T; 103-145, 203, etc.	60/8
Ferranti, 14T3, 4; 17K3, 17T3; 4	45/-
14T2, T1205, 1215, 1225, 1325	65/-
G.E.C.-H.M.V. mostly	55/- to 60/-
Murphy, V240/250, V270	94/-
Philips, 1114, 1115, 1437, 1446,	
1726, 1746, 1747	73/-
Pye, LV30, 16T, CS17, VT17	68/9
CTM4, V4, VT4, V7, VT7	55/-
Add post 3/6.	
Radar Kilovolt	£3.17.6

Tests actual EHT. P.P. 2/6.

WESTWAY RADIO

S.A.E. with enquiries please.
5 Westward Way, Preston Road, Harrow, Middx.
Tel: WOR 2663

4 watt AMPLIFIERS 3 VALVE AMPLIFIERS

Ex-relay units rebuilt into excellent amplifier with high gain preamp. stage, tone control, negative feedback, ready for immediate use, individually tested. Amazing volume and clarity, easily worth £5. Our price whilst stocks last. Carr. 45/- packing, etc., 7/6.

Kit of new parts, consisting chassis, mains and output transformers, valves (P61, 696G, 6X5G) and all components. With full instructions for making high gain amplifier with separate base and treble controls, negative feedback, etc. Truly unusual value at..... 29/-

4-Speed Record Players
Latest Turntable together with lightweight Staar Galaxy dual sapphire crystal turnover pick-up head. Amazing value £3.10.0 (pick-up only 19/-) Carr. 3/-.

B.B.C./I.T.A. TUNERS
Famous makes complete with PCF80, PCC84 valves, 38 M/c I.F. Fantastic value. 19/-

100 RESISTORS 6/6

100 CONDENSERS 10/-
Miniature Ceramic and Silver Mica Condensers 3 pF to 5,000 pF. LIST VALUE OVER £5.

TECHNICAL TRADING CO.

DEVONIAN COURT, PARK CRESCENT PLACE, BRIGHTON

REBUILT TV TUBES

Complete New Guns—12 months' Guarantee

12in.	£3.10.0
14in.	£3.15.0
15-17in.	£4.0.0
21in.	£5.10.0

Old Tube required in exchange. Electrostatic Types 5/- extra. Carriage & Insurance extra.

NU-GUN TELETUBES

3 THE MEWS

Duckett Road, Harringay, London, N.4
Telephone: MOUNTVIEW 2903
Also various Ex Rental TV Sets available.

T rade N ews

New Set-top Aerial

THE latest addition to Belling & Lee Ltd.'s range of set-top aerials is the "Sentinel".

The Sentinel has been designed for strong signal areas. The two elements are telescopic (extending to a maximum length of 23in.) and are also fully adjustable for inclination and direction.

The finish is in gold and beige and the price is 25s. The manufacturers of this new aerial are *Belling & Lee Ltd., Great Cambridge Road, Enfield, Middlesex.*

Channelised or Broad-band u.h.f. Arrays

AN "interim" u.h.f. aerial, UHF 201, may now be obtained as a "single channel" model (i.e., for channel 34 or channel 44) or as a broad-band model covering channels 34 to 44, from Antiference Ltd.

The list price of the aerials, which employ a 20-element array consisting of a six-element grid reflector, folded dipole and 13 directors, is 150s. for the array only and 180s. complete with a 3ft cranked arm and chimney lashing.

The makers of this aerial are *Antiference Ltd., Aylesbury, Buckinghamshire.*

Transistorised Sets

TWO portable television receivers—one model being transistorised—may soon be available on the British market. Although current production models are 525-line sets, the manufacturers—the Tokyo Shibaura Electric Co. Ltd., of Japan—propose bringing out 405- and 625-line sets for export.

The model 10-TH, which is completely transistorised except for the c.r.t. and its high voltage rectifier valve, contains 25 transistors and 12 diodes.

It weighs only 21lb and can be operated either on household power or from its own built-in 12V lead battery.

The set features immediate vision the instant the switch is turned on. This is made possible by two heaters in the picture tube, one of which turns off after three or four seconds.

The British agents for this company are *Hall Electric Ltd., Anglers Lane, London, N.W.5.*

BUYING SECOND-HAND SETS

(Continued from page 158)

happens the symptoms are lack of width, short life of the line output valve, and sometimes line oscillator drift.

Frame Output Stage

A common symptom on a set of any age is the inability to obtain sufficient height. This is usually due to a faulty frame output valve, but sometimes its replacement does not completely restore the height. If the picture is cramped at the bottom suspect the cathode bias decoupling capacitor, but if it is cramped at the top, a leaky grid coupling capacitor is more likely to be the trouble.

Receivers with V.H.F.

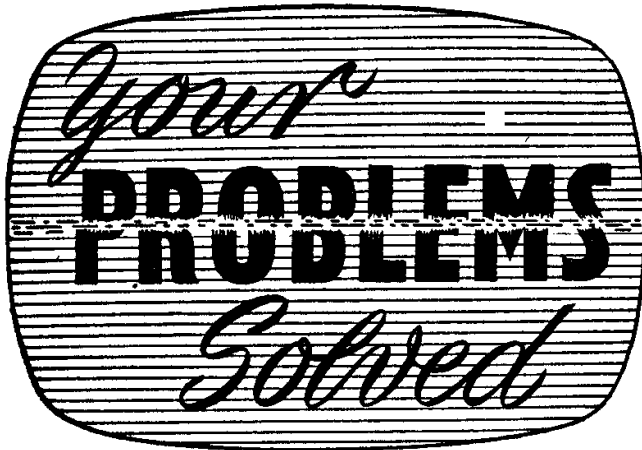
If a receiver is working satisfactorily on TV, but has a faulty v.h.f., the best advice is to ignore the v.h.f. section completely. The industry has never been happy about the inclusion of v.h.f. in the TV sound receiver, and up until 1959 the v.h.f. section was always something of a compromise. Since that time receivers have been fitted with either dual i.f. stages, or, in the case of manufacturers such as Ferguson, H.M.V., Ultra and Pye, a separate v.h.f. chassis altogether.

Summing Up

In conclusion it is emphasised that the advice given here is only general in its character. Regular readers can always take advantage of the "Queries" service for specific advice in connection with a particular set that they intend to purchase. It is not possible to give any help regarding service sheets, but these can be obtained from certain of our advertisers. A letter to the manufacturer concerned might be rewarding. Some (but not all) are extremely helpful. Also remember the golden rule when overhauling, namely to check the performance of the set after each separate stage of the repair, otherwise you will never know at what point you inserted an extra fault on the chassis. □

JOIN THE PRACTICAL GROUP

PRACTICAL WIRELESS	2/-
Every Month	
PRACTICAL MECHANICS & SCIENCE	2/-
Every Month	
PRACTICAL MOTORIST	1/9
Every Month	
PRACTICAL HOUSEHOLDER	1/3
Every Month	



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

ULTRA VT 9.17

A fault has recently developed on this set, and is, that altering the setting of the contrast control has no effect on the picture.—H. J. Withins (Dartford, Kent).

Contrast is usually rendered inoperative by a shorted capacitor in the a.g.c. line. Check C76, a $1\mu\text{F}$ capacitor. Also check the controlled valves V1 (PCC84), V3 (10F1), V18 (20D1) and V8 (20L1).

PILOT PT 450

As a result of the failure of the line output stage in this receiver recently, it was necessary to replace the line output valve. After having done this, however, there was an intermittent failure of the line scan, which was eventually traced to a faulty capacitor, C50.

I have found out that there may be some variation in the capacity of this component according to the model, but it is so badly discoloured that I cannot read its value. I believe the rating is 12kV, but I should appreciate your help in this matter.—N. Pitcher (Norwich, Norfolk).

C50 may be 140pF or 180pF according to the transformer or deflection coils used. The rating is 12kV.

K.B. LFT50

Can you please tell me the value of the component (I think it is a resistor) connected from pin 5 of the 6AM6 to the terminal block. The 6AM6 is situated on the right of the tube. This component has become so overheated that its markings are unrecognisable.—T. Froud (Pelton, Co. Durham).

The value of the video amplifier anode load resistor is $6.8\text{k}\Omega$, 1W.

PAM 750

The sound is perfect but the picture has faded to such a degree, that it can hardly be seen. If the brilliance is advanced the picture goes nega-

tive. I thought it was the EY86 and so I bought a new one and tried it without success. I also checked all the other valves except the PL82 but still found no improvement in picture quality.

The picture remains full size and steady, but on switching off, a bright horizontal line about 2 or 3in. long, appears on the centre of the screen, quickly disappearing to a white spot.

The voltages at the tube base appear rather low.—J. W. Robinson (Co. Durham).

From the results of the tests you have made, we would say that the c.r.t. is faulty and should be replaced.

PYE VT 17

The fault on this receiver is an apparent failure of the automatic gain control on the vision circuits. On peak whites, the white spot suppressor cuts in, resulting in greys or blacks although the suppressor potentiometer control is at zero.

Valves V6, V14, V15 and V16 are all new components.—G. Martyn (Sandy, Bedfordshire).

Check that the c.r.t. is not becoming low emission, as this fault generally appears on these receivers after the tube has some use. If you live in an area of low interference, you can disconnect the signal feed to V6B by removing the pin 7 connection and joining the pin to chassis or pin 8, whichever gives best results.

PHILIPS 2155U

The first fault which developed was a blank screen with the sound remaining all right. All the valves and c.r.t. heaters lit except the EY51, which on testing with a screwdriver, gave only a faint spark at its anode. I replaced this valve and also the PY81 but the fault persisted.

Some time after this fault first appeared, the lower section of one of the droppers overheated and the sound section went dead.—J. Rotchford (Liverpool).

Failure of the dropper was caused by overloading due to the PL81 passing excessive current as the result of a fault in the line timebase (e.g., that cutting off e.h.t. voltage and vision). The line timebase fault—if the line oscillator can be heard working—is probably caused by shorting turns in the line output transformer.

MURPHY V310

After it has been switched on for three or four minutes, it is impossible to lock the line hold. All the valves have been checked and found in order.—E. H. Jones (Benllech, Anglesey).

Check the 47pF capacitor and small rectifier connected to pin 5 of the 30P4. Note also that although the 30P4 may appear in order on a valve tester, a drift in characteristics during normal operation would cause the trouble described.

ULTRA V2170

The trouble with the picture of this set is multiple images, with the whites blurred above and to the left. Good focus is hard to achieve and the definition is very bad. Another strange fault is that on changing channels, the picture turns negative before righting itself.

Recently the 150pF, 12kV pulse capacitor shorted and was subsequently replaced with the
(Continued on page 187)

TELEVISION BOOKS ON FREE TRIAL! THEN ONLY 5/- PER WEEK FOR THOSE YOU KEEP!

No. 200. TELEVISION SERVICING COURSE.
Let this new course help you in TV servicing. A real bargain! Complete, only 32/6 full price for all lessons. You get lessons on picture faults, circuits, adjustments, short-cuts, alignment facts, trouble shooting, use of test equipment, picture analysis. SPECIAL only 32/6.

No. 39. RADIO AND ELECTRONICS COURSE.
If some of your basic theory of electronics is a little shaky then we recommend that you take this course. A good understanding of the fundamentals of electronics is essential for intelligent TV repair and this course will provide all the information you will need. Just imagine! You get 35 large, fact-packed lessons for little more than 1/- per lesson! The lessons are crystal clear, practical, easy to master and use. Early lessons make fundamentals clear even to the beginner, while other lessons will give you the practical "know-how" of an expert! The price! Only 36/-, plus postage. Graduates of No. 39 course can qualify for a certificate, details sent with each course ordered.

No. 1 COYNE'S ELEMENTARY PRACTICAL RADIO-TELEVISION SET consisting of three volumes. A reference set you will use for years to come. Has sturdy vinyl hard covers for long life. Written in an easy to follow manner, yet explaining everything completely. Teaches television and radio together, saving time. Each book available separately at 28/- each or 82.12.6 if you buy the set at one time. You could search all the bookstores in England but you won't find a better value than this! Pay only 5/- per week on this 1,038 page set without interest charges.

No. 8. PIN-POINT TV TROUBLES IN 10 MINUTES. Price 31/6. Without a doubt one of the most useful books ever published about television. Do you have a copy? If not you are really missing something. This is the only book of its kind ever published. It's not an ordinary text book. It's useful to both amateurs as well as experts! No matter how clever you are at fixing televisions, it would be impossible for any man to have all the knowledge stored in this book. Over 340 cross indexed pages; 50 time-saving check charts. It's your most useful on-the-job "tool." Quickly and easily pin-points the exact trouble in ANY television set! Also includes 290 diagrams and photos; explanations of circuits and designs. Over a quarter of all the readers of *Practical Television* own and use this book every day! Why not send for your trial copy today? Then if you decide to keep it, pay only 5/- per week until completed. This book must be able to earn you more than its cost within two weeks or your money will be refunded!

No. 29. TELEVISION SERVICING HANDBOOK by Gordon J. King. Here is a useful book by one of Britain's top technical writers. Tells you how to deduce from a given fault the most likely cause of the trouble, and how to do an effective repair. This book together with Pin-Point TV Troubles will give you real money making TV repair knowledge. You can have this book on free trial, time payment plan privilege for the regular bookshop price of 30/-.

**BIG BOOK CATALOGUE SENT FREE!
FREE TRIAL COUPON**

To Sim-Tech Book Co., Dept. P.T.V.27,
Gater's Mill, West End, Southampton, Hants.

Please send me the books number
() () () ()
for seven days' free trial. One at a time. If I am not satisfied with any book I may return it post paid without further obligation on my part. Otherwise I will pay cash or 5/- weekly after seven days until paid.
 Tick here if enclosing full price (we pay postage. Same 7-day money-back guarantee). Postage charges: Orders up to £3 allow 1/6. £3 or over allow 2/-. Overseas customers please send full amount.

Name

Address

NEW VALVES! Guaranteed Set Tested 24-HOUR SERVICE

1R5	7/-	DL92	5/11	PCL82	8/3
1R5	5/6	DL94	6/9	PCL83	10/-
1S6	4/6	DL96	6/9	PCL84	9/9
1T4	3/3	EB91	3/-	PENDD4020	
3S4	5/11	EBC41	7/6		17/8
3V4	6/9	EBF80	7/9	PL36	9/8
5U4G	4/6	EBL21	12/-	PL81	8/8
5Y3GT	5/3	ECC40	13/-	FL82	6/6
5Z4G	8/6	ECC81	4/6	FL83	6/6
6AM6	2/9	ECC82	4/6	FL84	8/-
6K7G	1/9	ECC83	6/3	PY31	8/6
6K8G	4/9	ECC84	7/6	PY32	11/-
6Q7G	5/6	ECC85	7/6	PY80	7/-
6V6G	4/-	ECP80	6/9	PY81	6/6
6X5GT	6/6	ECP82	8/3	PY82	6/-
12K7GT	4/3	ECH42	7/9	PY83	7/3
12K8GT	9/-	ECL80	6/9	U25	11/-
12Q7GT	7/6	EF40	11/-	U26	8/9
12SN7GT	4/8	EF41	7/6	UABC80	6/-
35L6GT	8/-	EF90	4/3	UAF42	8/-
35Z4GT	5/-	EF85	5/9	UBC41	7/-
AZ31	8/9	EF96	8/6	UBF80	8/-
CL33	9/6	EF99	6/9	UCC85	7/-
DAC32	8/9	EF91	2/9	UCH21	11/6
DAF91	4/6	EL41	9/-	UCH42	7/6
DAF96	6/9	EL84	6/3	UCH81	8/9
DF33	8/9	EY51	7/3	UCL82	9/3
DF91	3/3	EY86	6/9	UCL83	13/-
DF98	6/9	EZ40	6/-	UF41	6/9
DH77	8/-	EZ80	5/9	UF89	6/9
DK32	10/6	EZ81	6/-	UL41	8/-
DK91	5/6	MU14	5/6	UL84	6/6
DK92	6/9	PCC84	6/9	UY21	10/8
DK96	7/3	PCC89	9/-	UY41	5/8
DL33	7/6	PCF80	7/6	UY85	6/3
DL35	9/6	PCF82	7/6	Z77	2/9

Postage 6d. per valve extra. Any Parcel Insured Against Damage in Transit 6d. extra. Any C.O.D. Parcel 3/- extra. Office address, no callers.

GERALD BERNARD
(Note new address—formerly of Leeds)
83 OSBALDESTON ROAD,
STOKE NEWINGTON, LONDON, N.16

FIRST-CLASS RADIO AND T/V COURSES... GET A CERTIFICATE!

After brief, intensely interesting study—undertaken at home in your spare time—YOU can secure a recognised qualification or extend your knowledge of Radio and T.V. Let us show you how.

FREE GUIDE

The New Free Guide contains 120 pages of information of the greatest importance to both the amateur and the man employed in the radio industry. N.I.E. provides first rate postal courses for Radio Amateurs' Exam., R.T.E.B. Servicing Cert., C. & C. Telecoms., Grad. Brit. I.R.E. Guide also gives details of range of diploma courses in Radio/T.V. Servicing, Electronics and other branches of engineering, together with particulars of our remarkable Guarantee of

SUCCESS OR NO FEE

Write now for your copy of this invaluable publication. It may well prove to be the turning point in your career.

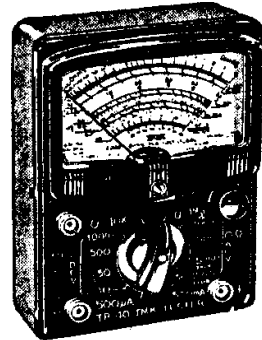
FOUNDED 1885—OVER
150,000 SUCCESSES

**NATIONAL INSTITUTE OF
ENGINEERING**
(Dept. 462), 148 HOLBORN
LONDON, E.C.1

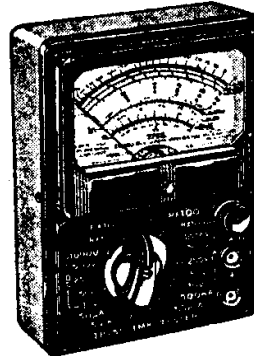
S. Africa: P.O. Box 8417, Jo'burg.
Australia: P.O. Box 4570, Melbourne.

T.M.K. TEST METERS

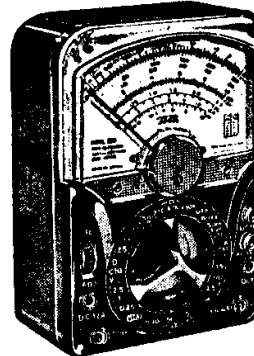
A fine selection of test meters to suit every constructor, A MUST for every T.V. Engineer and Serviceman



2,000 O.P.V. MODEL TP-10. Reads A.C. & D.C. Volts up to 1,000; D.C. Current to 500mA; Resistance to 1 Meg; Capacitance to 1mF; Decibels from -20 to +36; Output jack for Audio Measurements. Size 3 1/2 in. x 5 1/2 in. x 1 1/2 in. £3.19.6.



20,000 O.P.V. MODEL TP-5S. Reads voltage up to 1,000; D.C. at 20,000 ohms per volt and A.C. at 10,000 o.p.v.; D.C. Current to 500 mA; Resistance to 10 Megs.; Capacitance to 0.1uF; Decibels from -20 to +36. Size 3 1/2 in. x 5 1/2 in. x 1 1/2 in. £5.19.6.



30,000 O.P.V. MODEL 590. Volts to 1,000; D.C. at 30,000 O.P.V.; A.C. at 20,000; 12 Amps D.C. Current; 60 Megs Resistance; -20 to +56 Dbs; Internal buzzer short circuit warning. Size 3 1/2 in. x 6 1/2 in. x 2 1/2 in. £8.19.6.

All new stock with leads, prods and internal batteries. 6 months guarantee, backed by full service facilities. Further details sent on request.

SPECIAL OFFER AVO MODEL 7

Limited number of reconditioned AVO METERS MODEL 7. Complete with leads and internal batteries £11 each. P. & P. 5/-. Or with solid leather carrying case. £12. P. & P. 5/-.

**HARRIS ELECTRONICS
(LONDON) LTD.**
TEST METER DIVISION

138 Gray's Inn Road, London, W.C.1.
Phone Terminus 7937

"WAVE GUIDE AERIALS"

Manufacturers of TV Radio and Ham Transmitting Antennas wish to offer examples from their range of products. For the amateur Enthusiast and the Do-it-Yourself type.

A SUPER HIGH GAIN ARRAY FOR THOSE DIFFICULT RECEPTION SPOTS

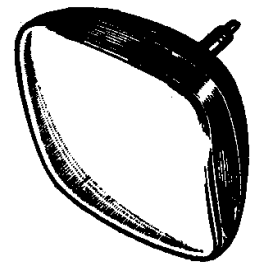
	£	s.	d.		£	s.	d.
3 Element BBC Folded Dipole, Channel 1, with a Double Five Channel 9 ITA, complete with all clamps	7	10	0	5 Element ITA Loft Aerial	1	6	0
or Double Eight Element ITA	8	10	0	8 Element ITA Aerial outdoor	2	9	4
Mast Equipment per your specification extra				Double 5 ITA Super Fringe outdoor Aerial	4	0	0
S/D5 Combined BBC, ITA Loft Aerial ...	1	10	0	Double 8 ITA Super Fringe outdoor Aerial	5	0	0
S/D 5 Combined BBC, ITA Outdoor Aerial, wall mounting, complete ...	2	13	6	32ft. Garden Masts, complete for erection, two sets guy pickets, etc., with fitting instructions	12	10	0
H & 7 combined BBC, ITA with chimney lashing equipment	4	13	0	Coax Cable semi low loss, 7d. per yard; super low loss 1/2d. per yard.			
BBC Loft Aerial			12	Cross over boxes for combining separate BBC and ITA Aerials 9/6d.			
V.H.F. Loft Aerial			11	Please send 6d. stamp for full list of aerials and accessories. Terms C.W.O. orders over £4 post and packing free.			
5 Element ITA Aerial for attaching to existing mast	1	10	0				

PLEASE STATE CHANNELS REQUIRED WHEN ORDERING

**WAVE GUIDE AERIALS
DICKER MILL, HERTFORD**

LAWSON

DIRECT REPLACEMENT TELEVISION TUBES



12 MONTHS' FULL REPLACEMENT
GUARANTEE

DESIGNED FOR PERFORMANCE

The modern Lawson television tubes are specially designed to give all types of television set very much improved performance. Their new silver activated screens are much brighter with better contrast, exclusive "microfine" controlled thickness aluminising gives 50% more light output (superb daylight viewing). New small anode aperture electron guns by Mullard, Mazda, G.E.C., Brimar, E.E., Cossor, etc., ensure needle sharp definition and focus, and silicon vacuum pumping plus depth formed cathodes give very long life. Each tube is 100% BRAND NEW (glass excepted), and Lawson are the only tubes guaranteed to be exact replacement for the original tube, ensuring complete accuracy and efficiency.

**FROM STOCKS OF OVER 5,000 TUBES OF 200
TYPES WE CAN SUPPLY THE EXACT TUBE
YOU REQUIRE BY RETURN.**

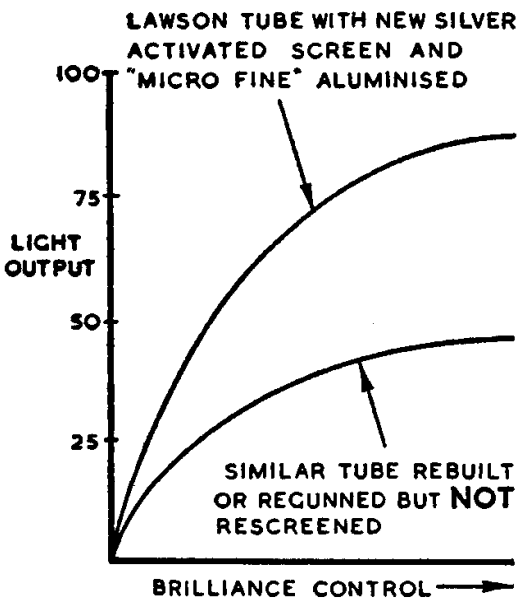
12"	—	£4. 10. 0
14"	—	£5. 5. 0
15 - 17"	—	£5. 15. 0
19", 21", 23", also available		

CARR. and INS. 7/6

C.O.D. or C.W.O.

10/-

Gladly refunded if you wish to return your old tube (excepting 12")



EXPRESS PASSENGER SERVICE—
Orders received by 3 p.m. are despatched same day.
Special direct services to Scotland and Ireland.

Full fitting instructions with every tube.

LAWSON TUBES LTD. Tel. 2100

2 PEACHFIELD CLOSE, MALVERN, WORCESTERSHIRE.

(Continued from page 184)

result that there is now a gap of about $\frac{1}{4}$ in. on either side of the screen. A reasonable picture can only be obtained with flyback lines present on the screen.—M. Grosvenor (Rugby, Warwickshire).

If the ghosting effects have not been troublesome before the trouble almost certainly lies in the vision i.f. stages. Misalignment or the vision amplifiers being on the verge of instability are the most likely causes. Check the vision i.f. valves and, if the alignment has not been disturbed, the small bypass capacitors connected to the screen and cathode of the valves concerned.

PHILIPS 1746U

Although this set is working quite well, I feel that the time has come to replace the tube. The tube in use at present is a MW 43/64. I would appreciate any information you could give me regarding this operation.—R. Jackson (Merioneth).

The tube is removed as follows: remove the chassis, c.r.t. base and ion trap magnet. Next slacken the clamp on the picture tube stem. Turn the cabinet on to its front and remove the two bolts which hold the die cast deflector unit frame to the support plate in the cabinet top. Remove the screw holding the earthing tag to the right-hand side of the focus unit back-plate. Slide off the focus magnet assembly. Slide off the deflecting coil rotation lever. Slacken the two bolts on the picture tube face strap and remove the tube. The reverse procedure should be adopted to replace the tube.

PYE VT 17

This set has a line hold fault. The tube has been on 25% boost for a few days. I shorted out the tube heater but did not replace this with any form of resistor and I am wondering if this could have any ill effects.

Before boosting, the picture slipped only occasionally, but now it slips very often and also pulls to the left of the screen. I have moved the booster transformer thinking that this might be a contributory cause to the fault, but this made no difference. I have replaced the e.h.t. rectifier, EY86, but with no effect.—A. Jamieson (Newport, Monmouthshire).

The fault is probably due to a defective PCF80 line oscillator valve at the back of the set, near the mains input plug.

EMERSON 700

On switching on, after this set had been working perfectly for some time, there was neither sound nor vision.

All the valves and the c.r.t. were lit, but the valve PY81 was red hot. I replaced the PY81 and EY86, but the new valve also glowed red hot.

I found that by removing the clip from the top of the PY81, the valve cooled down and sound came on, but the vision still was not present.—J. Miller (Dorchester, Dorset).

There is a 1000pF capacitor (C92) mounted on the line output transformer panel (left as viewed from the rear) with 100 μ F and 47pF ceramic capacitors. Change this 1000pF capacitor which appears to be shorted. A replacement should be rated at 1kV.

ULTRA VP1772

On first switching on the picture rolls and cannot be locked for more than half-an-hour. Also the whole picture has recently shifted from the centre of the screen to the left-hand side. Neither the picture shift or horizontal hold control will alter its position.

I would appreciate any help you could give me concerning this fault and I would also like to know the value of the resistor from pin 9 of the 30PL13.—H. White (Sheffield).

There are two capacitors connected from the anode circuit of the sync separator valve (pin 5 circuit of triode section of the 30FL1) to the frame oscillator. One is an 0.05 μ F and the other an 0.1 μ F. Check both by substitution. The other trouble could be caused by low emission of the 30P4 and/or U191. Also check the metal h.t. rectifier type D3-3-1YZ. The resistor connected to pin 9 of the 30PL13 is valued at 390k Ω , 1W.

EKCO T293

The vision side of this set went completely dead recently, but I found that the resistor R120 (51 Ω) was o/c and after replacing this component the set worked again for a time. I then found that when the set was switched on, the raster started to fade to just a faint flicker, the rate of fade increasing until now no raster can be obtained except for a very faint distorted picture that can barely be seen in a dark room. I also found that as the picture faded, the valve U25 (V11) gradually glowed more brightly. I replaced this with a new one, but this made no difference.—H. G. Gorbald (Streatham Hill, London, S.W.2).

These symptoms indicate a faulty line output transformer, which should be replaced.

MURPHY V240A

Originally the fault was a short internally in the 30L1, which shorted h.t. to earth. This valve was replaced. Then the line output valve, 20P4, glowed with purple flashes and so this was replaced also.

Now the h.t. is normal. There is a raster but this is not particularly bright. Maximum brightness is achieved when the brightness control is advanced to its mid-position, after which the raster disappears. However, there is no sound or picture. I have replaced the 30L1 and 30C1 valves with no results.—K. A. Davies (Pembroke).

The U25 e.h.t. rectifier is faulty and this will involve replacing the entire line output transformer can, and also the h.t. feed resistor in the tuner may have burned out.

BUSH TV 43

The picture quality of this set is not as it should be on ITV, being ragged at the edges and "snowy". Also, when the set is switched on in the ITV channel, the picture is present but the sound only comes on gradually after about five minutes. Adjustment to the fine tuning control will accelerate this but it must then be readjusted later on.

On this set, there is a coaxial socket, to which the aerial is at present connected, but there is also another socket, consisting of two holes, which I see from the service sheet, is for "balanced line". No ITV picture is received when the aerial is in this

socket, and to obtain a picture, a small piece of wire has to be connected from the coaxial socket to the top hole of the balanced line input.

I have some trouble occasionally with the tuner when on the ITV position, which can be cured for a short time only, by using a switch cleaner fluid. I have a Cyldon 13 channel tuner and I wonder if this could be fitted to improve matters. In this connection, could you tell me the wiring from the points "G" and "K" and where the shorter coaxial cable goes to.—T. Jones (Llanefydd, Denbigh).

The TV 43 tuner unit is subject to initial drift when first switched on. This is usually experienced only over the first 20 minutes or so and is, of course, due to variation of temperature.

The method of input where a short lead is connected from the BBC socket to the top tag of the Band III input, is correct.

The Band change contact should receive a little lubrication as well as cleaning. Change the PCC84 on the tuner unit as this should improve the Band III sensitivity.

The Cyldon tuner should be of the P38H type. The "G" tag should be connected to chassis, the "K" lead should go to the sensitivity control and

the i.f. output to the 560pF capacitor at present from pin 6 of the PCF80.

ULTRA Y73

The problem with this receiver is that when the brilliance control is turned right up the line scan disappears, leaving $\frac{1}{2}$ in. to 1 in. line down the centre of the screen. The brilliance control itself seems to be burning out so I would like to know the value of this component.—S. R. Woodcock (Muswell Hill, London).

This control is a 50k Ω , wire wound component. The 3.9k Ω resistor which is in series, may be increased to 10k Ω to limit the current if necessary.

QUERIES COUPON

This coupon is available until JANUARY 22nd, 1963, and must accompany all Queries sent in accordance with the notice on page 184.

PRACTICAL TELEVISION, JANUARY, 1963.

TEST CASE -2

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

? A receiver featuring mean-level vision a.g.c. suddenly ceases to operate on the contrast control. On the ITV channel the picture is far too contrasty for normal viewing, while on the BBC channel it appears as a negative and in neither case will the contrast control effect a cure.

What is the most likely cause of the trouble and what tests should be made to establish the cause?

See next month's PRACTICAL TELEVISION for the solution.

SOLUTION TO TEST CASE—1 (Page 140, last month)

The symptoms indicate that the e.h.t. voltage collapses due to the inability of the e.h.t. system to provide sufficient power to sustain full beam current at maximum brightness. Another way of looking at the problem is that the load presented to the e.h.t. system by the tube final anode circuit when the tube bias is decreased (e.g., for maximum brightness) heavily damps the e.h.t. circuits and thus causes a total collapse of e.h.t. voltage.

By increasing the tube bias (by turning down the brightness control) the load is reduced and the e.h.t. voltage is restored. The time delay effect is a very important clue, however, since it means that the

heater of the e.h.t. rectifier valve also goes out when the e.h.t. voltage collapses—thereby requiring a little time to heat up again when the load is eased.

This symptom of poor e.h.t. regulation, as it is sometimes called, can be caused by a low emission e.h.t. rectifier valve, but in that case the heater would remain alight after the voltage has collapsed and the valve would probably glow purple on full load.

The experimenter should have observed these points before replacing the EY51. He would have, at least, seen the EY51 heater gradually dimmed and eventually extinguished as the brightness control was turned up.

These are fairly sure indications that the e.h.t. rectifier is capable of satisfying the full-load conditions of the tube and that the trouble lies in the line output stage or booster diode circuits.

Typical causes of the symptom are low emission of the line output valve or booster diode, increase in value of the screen feed resistor to the line output valve and poor insulation of the screen bypass capacitor—or a combination of all these things.

Note that in some receivers where the e.h.t. rectifier heater *remains alight* during the picture black out, maladjustment of the ion trap magnet on the tube neck may be responsible—and not the e.h.t. rectifier valve itself.

In such cases, the brightness control should be turned up just to the point where the picture starts to fade and then at that setting the ion trap magnet should be adjusted for maximum brightness.

Published on the 22nd of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, London, W.C.2, and printed in England by WATMOUGHS LIMITED, Idle, Bradford; and London. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A/asia), Ltd. South Africa and Rhodesia: CENTRAL NEWS AGENCY, LTD. East Africa: EAST AFRICAN STANDARD LTD. Subscription rate including postage for one year; Inland £1.5.0. Abroad £1.6.6 (Canada £1.5.0). Registered at the General Post Office for the Canadian Magazine Post.

TELEVISION TECHNICIANS
LINE OUTPUT TRANSFORMERS

SCAN COILS ETC.

LABORATORY TESTED

ALBA: T301, T304, T394, T484, T494, etc. 46/6
BUSH: TV11A, 11B, 12A, 12B, TVG12A, 12B, TBG12A, 12B 44/-
TVG36, TV32, TV33, TVG34, TVG34A, T39, TV36, TVG36, TV36C, TVG36C, TV43 88/6
TV53, TV56, TV57, TV58, TV62, TV63, TV66, TV67, etc. 94/-
TV80 with EY51 109/-
CORSON: 930 and T931, 933-4-5, 937, 938A, and F, 939 and A and F 61/6
943T, 940-948, 945, 945B 88/6
954F, 947, 949 88/6
DECCA: D17 and C 74/-
DM1, DM2C, DM3, DM4/U 74/-
DM5, DM14, DM17, 444, 555 68/6
DEFIANT: TR1453, TR1753 68/6
DYNATON:
EKO: TS93, TC8102, TS105, TS114, TRC124, TC138, TS183, TS193 54/-
TRC139, TC140, T141, TV142 78/6
T161, TC192, T164, T165, etc. 78/6
TC209, TV209, T231, T221, T231F, T348, T283, T284, T288, etc. 58/6
FERGUSON: 108T, 105T, 113T, 135T, 145T 65/6
941T-953T inclusive 58/6
991T-997T inclusive 68/6
208T-240T inclusive 68/6
309T, 308T 64/-
FERRANTI: 14T3, 14T8F 13TA 47/6
17K3 and F, 17T3 and F 47/6
17K4 and F, 178K4 and F 47/6
17T4 and F 47/6
14T5, 178K6, 17K5 47/6
G.E.C.: BT1251, BT1252, BT1746, BT1748, BT4743 48/6
BT4643, BT5147, BT5246-48 88/6
BT5348-BT5643R inclusive 48/6
and 88/6
H.M.V.: 1824 and A to 1831 inclusive 66/6
1840, 1841, 1842-1848 66/6
All models available.
INVICTA: T118, T119, T120 54/-
All other models available.
K.B.: LFT50, LVT60, LFT60, MV60 106/6
All models available.
MARCONI: All models available.
MASTERADIO: Most models in stock.
MONSIEUR: Most models in stock.
MURPHY: V200, V202C 56/-
V240, V250 94/6
PETO SCOTT, PHILCO: Most models in stock.
PAM: 908, 909, 952, 953, 958 54/-
PHILIPS: 1769U, 2168U 104/-
1100V, 1200V 74/-
1220U, 1236V, 1238V 74/-
114UF, 114UM, 115U 74/-
1437U, 1446U 74/-
Most models in stock.
PILOT: Most models in stock.
PYE: CTM4, FV4C, FV4COL 54/-
V4, VT4, V7, VT7 54/-
LV30, FV1, FV1C 68/6
C817F, CTM17F, CW17 68/6
CW17C, CW17CF, CW17K, etc. 68/6
Most models in stock.
RAYMOND: Most models in stock.
REGENTONE: All models available.
E.G.D.: 6017T, 7017, C54, etc. 58/6
Most models in stock.
SOBELL: TS17, T346 64/-
Most models in stock.
STELLA: ST6721U 104/-
ST8617U, ST8621U 104/-
ST8917U 104/-
ST8414U, ST8417U 74/-
ST8314U 74/-
ULTRA: 86 series, 186 series, with U25, etc., complete 78/6
Most models in stock.
VIDOR: CN4217-CN4281 inclusive 64/-
Post and Packing 3/6. C.W.O. Only
Also: Used O.P. Txs., Scan Coils, etc.
ALL GUARANTEED 90 DAYS
(All enquiries S.A.E.)

WYNDSOR TELEVISION
TECHNICAL DIVISION

ST. ALBANS RD., BARNET, HERTS.
BAR 1769

RATES: 4/- per line or part thereof, average five words to line, minimum 2 lines. Box No. 1/- extra. Advertisement must be prepaid and addressed to Advertisement Manager "Practical Television", Tower House, Southampton St., London, W.C.2.

SETS & COMPONENTS

BARGAIN OFFER

T.V. Tuners. 10, 16 and 38 M/cs. Brand new, less valves, 19/6, carriage paid. Valves if required, PCF80 and PCC84, 16/- pair.

OSBORN (ELECTRONICS) LTD.

382 Brockley Road, Crofton Park, S.E.4.

TUBES, 18 months' guarantee. Free advice on fitting. G. S. TELETUBES, 115 Meadow Street, Sheffield 3.

REBUILT RESCREENED TUBES! Famous make 12"/14", £4.5s.; 17", £4.15s.

ALL TUBES, 1 YEAR GUARANTEE!

NEW Valves, 12 months' guarantee! ECC81/2/3, EF80, PY82, EB91, 4/11; EY51, EY86, ECL80, PCF82, EZ81, 7/9; U25/U26, 6/30L2, PCL82, PL81, 9/11; 30L15, R19, PCC89, PL36, 30P4, 12/6; U801, 6CD6G, 50CD6G, 20L1, 20P4, U37, 10F1, X78-9, 18/-.

P. BEARMAN (Tubes)

3 PANK AVENUE, NEW BARNET HERTS. Tel.: Bar 1934

EXCEPTIONAL VALUE: Picture tubes, brand new, Mazda 19in., CME1901, Mullard 19in., AW47-90/91 £4/10/-; Mullard 23in., AW59/90, £6/10/-; carriage (insured) paid, 12 months guarantee. Note: all brand new. We also supply most other sizes completely regunned at £4/17/6, guaranteed 12 months. TOMLINS, 156 Lewisham Way, New Cross, SE14. TID 3857.

TELEVISION TUBES

TWELVE MONTHS' GUARANTEE

12in. MW 31-74 etc. 23.0.0
12in. CRM 121 etc. 24.0.0
14in. MW36-24 etc. 25.0.0
14in. CRM 141 etc. 25.5.0
15in. CRM 152 etc. 25.10.0
18in. MW 41-1 etc. 26.0.0
17in. MW 43-69 etc. 26.0.0
19in. C 19AH etc. 27.10.0
21in. AW 53-88 etc. 27.10.0
23in. 23 SP4 etc. 29.0.0
and ALL other types available.

Deposit £2 and £1 monthly, carriage 12/6. ALL orders despatched British Railways Passenger.

CASH BARGAINS:-

Latest BSR TD 2 tape decks, speed 3 1/2in., 5 1/2in. spools 28.13.9
Latest Collaro "Studio" tape transcriber decks, speeds 1 1/2in., 3 1/2in., 7 1/2in., spools 7in. 211.0.6
BSR UA14 four-speed auto-change record player decks 27.3.9
Two-speed record decks, 45 and 33 r.p.m. with 6 volt motor for transistor grams 25.18.9
Carriage on these items, 12/6.

CATHODE RAY TUBE SERVICE
35 Broomwood Rd., ST. PAUL'S CRAY, Kent. Orpington 21285

TELEVISION TUBE SHOP

We have the following
Unused, Guaranteed Tubes
in stock now

AW36-20, 21 25. 2.6
AW36-80 25. 7.6
AW43-80, 88 26. 7.6
AW53-80 27.12.6
C12A, C12B 24.12.6
C148M, FM 25. 5.0
C17BM, FM, HM 26. 7.6
C17LM, PM, SM 26.12.6
C21 HM, SM, TM 27.17.6
CME1402 25. 7.6
CME1702, 1703 26.12.6
CRM91, 92 24.12.6
CRM93 24. 2.6
CRM121, 2, 3, 4 24.12.6
CRM141, 2, 3, 4 25. 7.6
CRM152, 153 25.12.6
CRM171, 2, 3 26. 7.6
CRM211, 212 27.17.6
MW6-2 25.12.6
MW22-16 24. 2.6
MW31-16, 74 24. 2.6
MW36-24, 44 25. 2.6
MW41-1 26.12.6
MW43-64, 69 26. 7.6
MW43-80 26. 7.6
MW53-20 27.12.6
MW53-80 27.12.6
T901A 26.12.6
14KP4A, 141K 25. 2.6
171K, 172K, 173K 26. 7.6
6901A 26.12.6
7201A, 7203A 25. 2.6
7204A 25. 5.0
7401A 26. 7.6
7405A 26.12.6

All tubes tested before despatch and guaranteed for 12 months.

CARRIAGE 7/6, via B.R.S. or 12/6 via passenger train.

TERMS £2 down balance £1 per month.

Just arrived! Brand new 19 & 23in. tubes, will replace existing 17in. and 21in., 110° types. Prices: £8 and £12 respectively.

Shop Soiled Tubes (unused)

(Subject to Availability)

12in. 3/18, 3/31 45/-. Others 57/6
14in. CRM141, 2 67/6. Others 57/6
17in. CRM171, MW43-69, 43-64, 75/-. Plus Carriage. Guaranteed for 12 months.

TELEVISION TUBE SHOP

48 BATTERSEA BRIDGE ROAD
S.W.11 BAT 6859

South of the Bridge. Open Sats. until 4 p.m.

★ VALVES ★ by return of post

10% DISCOUNT. SPECIAL OFFER TO PURCHASERS of any SIX VALVES marked in black type (15% in dozen). Post: 1 valve, 6d., 2-11, 1/-.

NEW LOW PRICES GUARANTEED 3 MONTHS

Table listing various vacuum tube valves such as 0Z4, 1A5GT, 1A7GT, etc., with their respective prices and specifications.

4 watt AMPLIFIERS Further delivery of these excellent units to hand complete with amplifier 20P3 output and U9 rectifier. Easily converted into high gain unit...

TECHNICAL TRADING CO. Retail Shop 350-352 FRATTON RD., PORTSMOUTH

SETS & COMPONENTS (continued)

"HEATHKITS" can now be seen in London and purchased on H.P. Free Brochure. DIRECT TV REPLACEMENTS LTD., 138 Lewisham Way, SE14. TID 6666.

TV SPARES

LINE OUTPUT TRANSFORMERS TELEPHONE ORDERS SENT SAME DAY C.O.D.

Ekco T221, 231, 311, 284, 330, 283, TC208, TU209, T248, TC267, all 55/-. Ferranti T1001, T1002-5, etc., 55/-.

TV & RADIO PARTS

Ceramics all values, 9d. to 11d. each. High Voltage Pulse Ceramics, 1/6 ea. Silver Mica Capacitors all values, 1/-.

TELEVISION CONSUMER SERVICES LTD.

112 Camberwell Road, S.E.5 RODney 7917

SETS & COMPONENTS (continued)

NEW VALVES, fully guaranteed, individually checked. Huge stocks:— EBF80 7/6; ECL80 5/9; EY86 7/9; EZ40 6/6; PCC84 7/-; PCF82 7/-; PCL84 7/3; PL81 8/6; PY81 7/-; 6X4 5/-.

The K.E. rebuilt tube— your Scottish Re-gunner

12-14in. £4.17.6 } 12 months' guarantee
17in. £5.10.0 } 10/- allowance on old tube
21in. £7.10.0 } Free transit and insurance

Cash or cheque with order or C.O.D. Top quality coaxial cable 9d. per yd. or £2.10s. per 100 yards.

H. KINNEAR ENTERPRISES LTD. 25 St. Peter's Place, Edinburgh 3

A1 POST-FREE SERVICE for all Components. S.A.E. for reply. A1 RADIO COMPONENTS, 14 The Borough, Canterbury, Kent.

FOR SALE

1,000 TELEVISIONS, all makes, from £3 working, 10/- not. Callers only. 9 till 6, including Sats, 39 Whitehorse Lane, Stepney, London.

BRAND NEW Television Cabinets, 17in. size. Continental style, fully complete as used by Pye, only 30/- each plus 10/- carriage and packing.

TV TUNERS Ex-equipment, all i.f.s., less valves 12/6 including postage. Speakers. Ex-TV and radios, 7/6 including postage.

VALVE CARTONS at keen prices. Send 1/- for sample and list. J. & A. BOXMAKERS, 75a Godwin Street, Bradford 1.

EXCEPTIONAL TRANSISTOR portable Tape Recorder, value £6/19/6 complete with crystal microphone, earphone, spools, tape, batteries, instructions, presentation box (extra tapes 100 4/6), ideal gift, £6/19/6; satisfaction guaranteed. Postage, packing 2/6. TOMLINS, 156 Lewisham Way, New Cross, SE14.

(Continued on next page)

SALVAGED VALVES TESTED ON A MULLARD HIGH SPEED VALVE TESTER

- AC/P 2/6
- B96 2/6
- B929 4/-
- D1 2/6
- D83 2/6
- D77 2/6
- DAF91 4/-
- DD4 2/6
- DD41 2/6
- DDL4 2/6
- DF91 4/-
- DF77 4/-
- DK91 4/-
- EA50 1/3
- EB34 1/3
- EB41 1/3
- EBC33 2/6
- EBC41 4/-
- ECC35 2/6
- ECC84 2/6
- ECC81 4/-
- ECC82 4/-
- ECL80 4/-
- EF50 1/3
- EF80 2/6
- EP91 1/3
- KT38C 1/3
- KT61 2/6
- KT241 2/6
- LG3 2/6
- N308 4/-
- N329 4/-
- N339 4/-
- N369 4/-
- N379 4/-
- P41 2/6
- P61 2/6
- PCC84 5/-
- PCF80 5/-
- PCL82 4/-
- PCL83 5/-
- PEN45 2/6
- PEN46 2/6
- PL33 4/-
- PL81 5/-
- PL82 4/-
- PL83 4/-
- PL84 4/-
- PY31 4/-
- PY81 4/-
- PZ30 2/6
- SP41 1/3
- SP42 2/6
- SP61 1/3
- U81 4/-
- U251 4/-
- U329 2/6
- UF42 2/6
- VP4 4/-
- W77 2/6
- Z63 2/6
- Z66 2/6
- Z77 1/3
- Z90 1/3
- Z719 2/6
- 4TPB 2/6
- 6AL5 2/6
- 6AM6 1/3
- 6BW7 4/-
- 6BX6 2/6
- 6C6 4/-
- 6D6 4/-
- 6F12 1/3
- 6F13 1/3
- 6J5 2/6
- 6J7 2/6
- 6P25 2/6
- 6P28 2/6
- 8D3 1/3
- 9D6 2/6
- 10F1 4/-
- 10P13 4/-
- 10P14 2/6
- 12BH7 4/-
- 20F2 4/-
- 20P1 2/6
- 20P3 4/-
- 20P6 4/-
- 25L6 2/6
- 30C1 5/-
- 30C15 5/-
- 30L1 5/-
- 30PL1 4/-
- 30PL13 4/-
- 32 2/6
- 42 2/6
- 43 2/6
- 907 4/-

EXAMPLES
FULL CATALOGUE 9d.

VALVE HOLDERS
 American Octal 5/- doz.
 Noval 9d. each

RESISTORS
 Card of 1W Resistors, 72 valves covering complete 10% range. 24/- per card.
 Full range of separate Resistors, Condensers, etc.

VARIABLE CONDENSERS
 3-50pf concentric trimmers 3/- doz.

GEC CRT'S (SALVAGED)
SPECIAL OFFER
 12in. G.E.C. 7102 10/- ea
 Personal Callers Only

35 M/cs, 16 M/cs, 10 M/cs INCREMENTAL OR TURRET TUNERS LESS VALVES, EX-RECEIVERS 12/6.
 We can often supply for the actual set you want the tuner to fit. But cannot guarantee what channels are fitted.

TRANSFORMERS
 CRT Boost Transformers. 2V, 4V, 6V, 10V, 15V State which required. 12/6 ea.
 Heavy Duty Output Transformers, 6 ratios from 13:1 to 43:1 25/-ea.
 Miniature Output Trans. 3/9ea.
 Standard Output Trans. 4/-
 formers, Multi-match 10/-ea.
 Transistor Driver: 1-1 CT 10/-ea. 3.6-1 CT 12/6ea.
 Transistor Output: 6.6-1 CT 10/-ea. 9.2-1 CT 10/-ea.
 Microphone Transformers, ratio 65:1 35/-ea.

I.F. TRANSFORMERS
 Standard 465 kc/s .. 12/6 per pair
 Midget 465 kc/s .. 16/- per pair

AUTO TRANSFORMERS
 250W 87/6 ea.
 100W 27/6 ea.
 50W 20/- ea.

TRANSISTORISED FAULT FINDER
 Enables faults to be located quickly. Consists of a two-transistor, multi-vibrator in a box. Complete with battery. 22/6

CRYSTALS
GENUINE MULLARD. Boxed.
 OA5 6/- OA81 3/-
 OA70 3/- OA86 3/-
 OA79 3/- OA91 3/6

TRANSISTORS
 OC16W 48/- OC75 8/-
 OC19 48/- OC72 8/-
 OC26 25/- OC76 8/-
 OC44 11/- OC78 8/-
 OC45 10/- OC81 8/-
 OC70 8/6 OC82 18/-
 OC71 8/6 OC170 17/6

TERMS: C.W.O. or C.O.D.
 Orders under 41, P. & P. 1/3.
 Open till 11 p.m. most days.

3d. stamp for list or 9d. for full catalogue
 Dept. PTA
Arion Television
 Maxted Road, S.E.15 NEWX 7125

WANTED

WANTED: NEW VALVES and Transistors, any quantity. S. N. WILLETS, 43 Spon Lane, West Bromwich, Staffs. Tel.: WBS 2392.

A PROMPT CASH OFFER for your surplus brand new Valves and Transistors. R.H.S., Beverley House, Mannville Terrace, Bradford 7.

NEW VALVES WANTED EY51, ECL80, PCC84, PCF80, PCL93, PL81, PCL82, PY81, R19, U801, 30P4, etc. Best cash prices by return. **DURHAM SUPPLIES**, 175 Durham Road, Bradford 8, Yorks.

SERVICE SHEETS and New Valves purchased for cash. **HAMILTON RADIO (P)**, Western Road, St. Leonards, Sussex.

VALVES WANTED

IMMEDIATE CASH SETTLEMENT
 Boxed or loose, but must be new.

Phone, write or call

Radio Facilities Ltd.

38 Chalcot Road, London N.W.1

PRImrose 9090

The valve specialists

SERVICE SHEETS

SERVICE SHEETS, U.S. models Coloured TV, Transistorised TV, Recorders, Stereo, Hi-Fi, Multiplex, Radios, Kits, including 1963, 5/- each. Enquiries, S.A.E., **BRAZIER'S TV**, Astwood Lane, Astwood Bank, Redditch, Worcs.

WHY TOLERATE DELAY when we can supply your Radio or TV Service Sheet by return of post at 4/- each, plus postage List 1/-. Also Manuals for sale and hire. List 1/-. S.A.E. with inquiries, please. Mail orders only to S.P. DISTRIBUTORS, 44 Old Bond Street, London, W.1.

SERVICE SHEETS

For all makes of Radio and Television—1930-1962. Prices from 1/-. Free fault-finding guide with all Service Sheets. Please send S.A.E. with enquiries. Catalogue of 6000 models. 1/6.

Special offer of 125 Radio/TV Sheets covering many popular models, 20/-.

HAMILTON RADIO

Western Road, St. Leonards, Sussex

SERVICE SHEETS, Radio and TV, 4/- each. List 1/-. All orders dispatched on day received. Also Manuals for sale and hire. List 1/-. S.A.E., please. **SULTAN RADIO**, Pantiles Chambers, Tunbridge Wells, Kent.

SERVICE SHEETS, also Current and Obsolete Valves for sale. **JOHN GILBERT TELEVISION**, 1b Shepherd's Bush Road, London. W.6. Tel.: SHE 8441. Nr. Goldhawk Rd. Station.

FAULTFINDER FILES, showing common faults that each receiver is prone to and other useful servicing information, 2/- each. List 9d., plus postage. Mail orders only. S.P. DISTRIBUTORS, 44 Old Bond Street, London, W.1.

SERVICE SHEETS

(continued)

SERVICE SHEETS, Radio, TV, 5,000 models. List 1/-. S.A.E. enquiries: TELRAY, 11 Maudland Bk., Preston.

TRADE SERVICE SHEETS offered by retired engineer. If I haven't got it you won't get it! All 4/- each by return. Please include large S.A.E. Mail orders only. **ETZIONI**, 80 Merrion Avenue, Stanmore, Middx.

SERVICE SHEETS (30,000), 3/- each with S.A.E. **DARWIN**, 19 George Street, St. Helens, Lancs.

BOOKS & PUBLICATIONS

FIND TV SET TROUBLES in minutes from that great book "The Principles of TV Receiver Servicing," 10/6 all book houses and radio wholesalers. If not in stock from: Secretary, I.P.R.E., 20 Fairfield Rd., London, N8.

PIN-POINT TV TROUBLES IN TEN MINUTES. The title can be imitated, but the contents never! The book that really tells you how to fix televisions. Over 340 Cross indexed pages. MUST be able to earn you more than its cost within two weeks or your money refunded! Price 33/- incl. postage. Write for free trial to: **SIM-TECH BOOKS**, West End, Southampton, Hants.

A BRAND NEW Down-to-earth PRACTICAL BOOK for the EXPERIMENTER AND SERVICE MAN.

RADIO AND TELEVISION TEST INSTRUMENTS 2/6

Learn how test instruments work! how they are made! how to connect them and —MOST IMPORTANT— the results to expect on normal and faulty circuits.

By post (please add 1/3d. for P. & P.) from

GORDON J. KING.

"Kingsford", South Furzeham Road, Brixham, Devon.

EDUCATIONAL

THE INCORPORATED Practitioners in Radio and Electronics (I.P.R.E.) Ltd. Membership Conditions booklet 1/-. Sample copy of I.P.R.E. Official Journal 2/- post free. Secretary, 20 Fairfield Road, London, N.8.



Ry repairing Radio and TV Sets as a job or as a spare time business. Our practical course will show you the way. No previous experience is required.

SEND FOR FREE BOOK TODAY!

RADIOSTRUCTOR

Dept. G78

READING, BEFKS.

(Continued on next page)

EDUCATIONAL (continued)

BECOME "Technically Qualified" in your spare time. Guaranteed Diploma and Exam. home-study Courses in Radio/TV, Servicing and Maintenance, R.T.E.B., City and Guilds, etc. Highly informative 120-page Guide—Free! N.I.E. (Dept. 468), 148, Holborn, London, E.C.1.

"HOW AND WHY" of Radio and Electronics made easy by a new non-maths. practical way. Postal instructions based on hosts of experiments and equipment building carried out at home. New courses bring enjoyment as well as knowledge of this fascinating subject. Free brochure from: Dept. 12, P.T. **RADIO-STRUCTOR**, Reading.

RES/CAP. BRIDGE 39/6 p. & p. 2/6
Checks all types of resistors, condensers 6 RANGES
Built in 1 hour. Direct reading **READY CALIBRATED**
Stamp for details of this and other kits.
RADIO MAIL (Dept. VG)
Raleigh Mews, Raleigh Street, Nottingham

PADGETTS RADIO STORE
OLD TOWN HALL,
KNOWLER HILL,
LIVERSEDGE, YORKS.
Telephone: Cleckheaton 2866

Complete TV Sets Untested. 14in. G.E.C. BT1746, all channels, £2.10.0. Bush TV43 14in., all channels, £2.10.0. Philips 1446U and Stella ST8414U, 14in., £2.10.0. Coils 2 and 10 only. Carr. on each 10/-. B.R.S. Well packed, but sent at owner's risk.

TV Converters. Less valves and knobs. coils fitted 2 and 10. Ekco, Ultra, Pye, Murphy, Marconi and Philips, etc. 2/6-Post 2/3. Cydon converters complete 16/-Post 2/3. All types coils fitted 2 and 10.

P.M. Speakers, all 3 ohms. Removed from TV sets, perfect condition. Rola 6 x 4in., 5/-; Goodmans 7 x 4in., 6/-; Philips 5in. round, 5/-; 6in. Speakers, 3/-; 6 for 15/-. Post extra on any speaker 2/-, up to six can be sent for 3/6.

Valves removed from TV Sets. All post free. All tested on a Mullard valve tester and are 100% as new. They carry a three months' guarantee. We also have a large stock of old type radio valves and other TV valves not listed.

ECL80	4/-	10P13	5/-	PZ30	4/-
ECC82	5/-	10P14	5/-	PCF80	4/6
EL38	4/-	20D1	3/-	PCC84	4/6
EY51	2/6	20P1	5/-	PL83	5/-
EBF80	4/6	20L1	5/-	PL33	4/-
EB91	9d.	185BT	8/6	B36	4/-
EF91	9d.	U281	5/-	N37	5/-
6F1	1/-	U282	5/-	L63	3/-
6F13	2/-	U801	8/6	6J5	3/-
8LD20	5/-	U329	5/-	27SU	5/-
6SN7	2/9	KT36	5/-	U12	4/-
6Y6	2/6	PL81	5/-	EF80 only	
6G6	2/6	PL82	5/-	1/6 or 10/-	per doz.
6SS7	2/-	PY81	4/-	Grade 2, 6d.	
10C2	5/-	PY82	5/-	or 4/-per doz.	
10F1	1/-	PY80	5/-		

Perfect Reclaimed Tubes. 6 months' guarantee, 12in. 17/-. 14in. 30/-. Carr. and Ins. 7/6.

TV Tubes Rebuilt and refaced. 12 months' guarantee. Old glass not required, 12, 14, 15, 16, 17in., any make at the special trade price of £3.15.0. Carr. and Ins. 7/6.

Complete TV Chassis for Spares. Less valves. 12in., four for 10/-, carr. B.R.S. 7/6. 14in. chassis, four for 15/-, carr. 8/6; 12in. and 14in. chassis, your choice with scan coils, less valves, untested, 10/- each, carr. 7/-.

For Callers Only. TV chassis, mixed lot, 1/- each. Saturdays up to 5.30.

VALVES SAME DAY SERVICE NEW! TESTED! GUARANTEED!

SETS		1R5, 1S5, 1T4, 3S4, 3V4, DAF91, DF91, DK91, DL92, DL94 ..	Set of 4 for 19/-
		DAF96, DF96, DK96, DL96	4 for 26/6

1A7GT	11/-	6LD20	8/-	30P4	12/6	EBC33	5/-	EY51	7/6	U25	12/-
1D5	7/6	6P25	8/-	30PL13	12/3	EBC41	8/-	EY86	7/-	U26	9/3
1H5GT	9/-	6P28	11/6	35A5	15/9	EBF80	8/-	EZ40	6/9	U50	5/6
1N5GT	9/-	6Q7C	6/-	35L6GT	8/3	EBF89	8/9	EZ41	7/-	U52	4/6
1R5	6/-	6Q7GT	8/-	35Z3	15/-	EBL21	13/6	EZ80	6/3	U78	4/6
1S4	8/-	6SL7GT	5/9	35Z4GT	5/6	EBL31	17/-	EZ81	6/8	U191	14/6
1S5	5/3	6SN7GT	4/9	50L6GT	7/9	ECC40	13/6	GZ32	8/8	U281	10/6
1T4	3/6	6U4GT	9/9	185BT	21/6	ECC81	4/9	KT61	9/8	U282	15/-
1U5	5/9	6V6G	4/6	AZ1	12/6	ECC82	4/9	KT71	8/-	U291	16/8
2P	22/6	6V6GT	7/3	AZ31	9/6	ECC83	7/-	MU14	6/8	U301	17/-
3A5	9/-	6X4	4/6	B36	7/6	ECC84	7/9	MX40	13/6	U801	21/-
3Q4	7/-	6X5GT	6/9	CBL1	12/-	ECC85	7/9	N18	7/-	UABC80	6/6
3S4	6/-	6/30L2	9/-	COH35	13/6	ECC86	9/-	N37	11/-	UAF42	8/3
3V4	7/-	7B6	9/-	CL33	12/3	ECC87	8/6	PCC84	7/6	UBC41	7/8
5U4G	4/6	7B7	8/-	CY1	12/6	ECC88	7/3	PCF89	9/3	UBF80	8/3
5V4G	8/-	7C5	7/9	CY31	8/6	ECH42	8/9	PCF80	7/9	UBF89	8/-
5Y3GT	6/-	7C6	7/6	DAC32	9/-	ECH81	7/9	PCF82	8/-	UBL21	14/6
5Z4G	9/-	7H7	7/6	DAF91	5/3	ECL80	7/6	PCF86	12/-	UCC84	13/3
6AL5	3/9	7S7	9/-	DAF96	7/6	ECL82	9/-	PCF82	9/-	UCC85	7/6
6AM6	3/6	7Y4	6/-	DCC90	9/-	ECL86	10/-	PCL83	10/6	UCF80	14/6
6AQ5	6/3	10C1	12/-	DF33	9/-	EF9	15/-	PCL84	10/-	UCH21	13/6
6AT6	6/-	10C2	16/6	DF91	3/6	EF37A	6/9	PCL85	10/6	UCH42	8/-
6BA6	5/9	12AT6	7/-	DF96	7/6	EF39	4/6	PENA4	11/-	UCH81	8/9
6BE6	5/9	12AT7	4/9	DH76	4/9	EF40	11/6	PEN36C	8/6	UCL82	9/9
6BG6G	14/6	12AU7	4/9	DH77	6/-	EF41	7/9	PL36	11/6	UCL83	13/3
6BH6	6/3	12AX7	4/9	DH81	9/-	EF42	7/6	PL81	9/6	UF41	7/6
6BJ6	5/9	12K7GT	4/9	DK32	11/-	EF80	4/9	PL82	7/-	UF89	7/-
6BW6	8/-	12K8GT	9/6	DK91	8/-	EF85	5/9	PL83	7/6	UL41	8/-
6CD6G	27/3	12Q7GT	4/9	DK92	7/6	EF86	8/9	PL84	8/6	UL84	6/6
6F1	10/-	19B6G	14/6	DK96	7/6	EF89	7/-	PL820	12/6	URIC	8/-
6F13	9/6	20F2	17/-	DL33	8/-	EF91	3/6	PX4	10/-	UU7	9/-
6F14	9/6	20L1	17/6	DL35	9/6	EL33	9/6	PX25	9/-	UY21	11/-
6K7G	1/11	20P3	18/9	DL32	6/-	EL41	9/6	PY32	11/6	UY41	6/6
6K7GT	5/-	20P4	20/-	DL94	7/-	EL42	9/-	PY80	7/6	UY85	6/6
6K8G	5/-	20P5	15/9	DL96	7/6	EL84	6/6	PY81	7/-	YP45	9/6
6K8GT	9/-	25L6GT	7/-	DM70	6/6	EM34	7/3	PY82	6/6	YP41	5/-
6K25	12/6	25Z4G	7/6	EAB80	4/9	EM80	8/-	PY83	7/9	W76	4/9
6L6G	6/6	27SU	17/6	EAF42	8/6	EM81	8/6	PZ30	12/6	WAF	3/9
6L18	10/-	30L15	11/-	EB91	3/9	EM84	9/6	TH21C	15/-	Z77	3/6

Post 6d. per valve extra.
Any Parcel Insured Against Damage in Transit 6d. extra.
Any C.O.D. Parcel 3/- extra.

READERS RADIO

24 COLBERG PLACE, STAMFORD HILL LONDON, N.16 STA. 4587

NYLON - P.T.F.E.

ROD, BAR, SHEET, TUBE, STRIP, WIRE
No Quantity too small
List on application

**ALUMINIUM, LIGHT ALLOYS
BRASS, COPPER, BRONZE**

H. ROLLET & CO., LTD.

6 CHESHAM PLACE, LONDON, S.W.1
BELGRAVE 4300

Works:
36 ROSEBERY AVE., LONDON, E.C.1
Branches at Liverpool, Manchester, Birmingham, Leeds

BBC - ITV - F.M. AERIALS

B.B.C. (BAND 1). Telescopic loft, 19/8. External, S/D, 26/3.
I.T.V. (BAND 3). 3 Element loft array, 14/-, 5 Element, 32/8. Wall mounting, 3 Element, 33/9. 5 Element, 41/3.
COMBINED B.B.C. + I.T.V. Loft 1+3 Element, 41/3. 1+5 Element, 48/9. Wall mounting, 1+3 Element, 56/3. 1+5 Element, 63/8. Chimney and mast mounting units also available.
F.M. (BAND 2). Loft "H", 28/-. 3 Element loft, 52/6. S/D loft, 12/6. External S/D, 26/3. State channel when ordering. C.W.O. or C.O.B. P.P. 2/6. Coaxial cable, 8d. yd. Coaxial plugs, 1/3. Send 6d. stamps for illustrated lists.

K.V.A. ELECTRONICS (Dept. P.T.)
3B, Godstone Road, Kenley, Surrey.

JUST PUBLISHED PRINCIPLES OF COLOUR TELEVISION

40 illustrations in full colour, which will be of the greatest assistance to all types of reader, from the student and electronics enthusiast to the advanced engineer.
16/- G. N. Patchett. Postage 6d.

PIN POINT TV TROUBLES IN 10 MINUTES. A Coyne Publ. 31/6. Postage 1/-.

THE RADIO AMATEUR'S HANDBOOK, by A.R.R.L. 1962 ed. 36/-. Postage 2/-.

A BEGINNER'S GUIDE TO TELEVISION, by F. J. Camm. 7/6. Postage 6d.

USING AN OSCILLOSCOPE, by D. W. Easterling. 6/6. Postage 6d.

SERVICE VALVE EQUIVALENTS, an R.S.G.B. Publ. 3/-. Postage 6d.

RADIO VALVE DATA, 7th Ed. Compiled by "WW". 6/-. Postage 10d.

TELEVISION SERVICING HANDBOOK, by G. J. King. 30/-. Postage 1/6.

COMPLETE CATALOGUE 1/-.

THE MODERN BOOK CO.
BRITAIN'S LARGEST STOCKISTS of British and American Technical Books
19-21 PRAED STREET LONDON, W.2
Phone: PADdington 4185
Open 6 days 9-6 p.m.

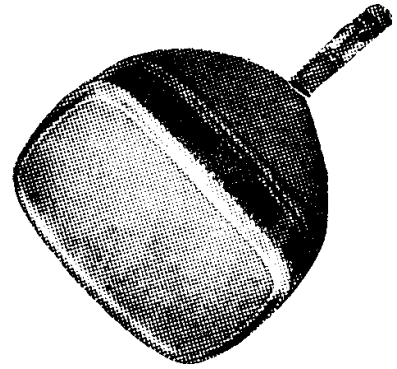
REBUILT TUBES!

You're safe when you buy from
RE-VIEW LTD!

- ★ Each tube is rebuilt with a completely new gun assembly and the correct voltage heater.
- ★ Each tube comes to you with a guarantee card covering it for a year against all but breakage.
- ★ Each tube is delivered free anywhere in the U.K. and insured on the journey.
- ★ Each tube is rebuilt with experience and know-how. We were amongst the very first to pioneer the technique of rebuilding television tubes.

RE-VIEW (LONDON) LTD.

173 STAFFORD ROAD, WALLINGTON,
SURREY. Tel. WALLington 4382



HERE IS WHAT YOU PAY:

12in.	£4.10.0
14in.	£4.15.0
15in.	£5. 0.0
17in.	£5. 0.0
21in.	£7. 0.0

Cash or cheque with order, or cash on delivery

FREE TO AMBITIOUS ENGINEERS

— THE LATEST EDITION OF ENGINEERING OPPORTUNITIES

Have you sent for your copy?

ENGINEERING OPPORTUNITIES is a highly informative 156-page guide to the best paid engineering posts. It tells you how you can quickly prepare at home for a recognised engineering qualification and outlines a wonderful range of modern Home Study Courses in all branches of Engineering. This unique book also gives full details of the Practical Radio & Electronics Courses, administered by our Specialist Electronics Training Division—the B.I.E.T. School of Electronics, explains the benefits of our Employment Dept. and shows you how to qualify for five years promotion in one year.

We definitely Guarantee "NO PASS—NO FEE"

Whatever your age or experience, you cannot afford to miss reading this famous book. If you are earning less than £25 a week, send for your copy of "ENGINEERING OPPORTUNITIES" today—FREE.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (Incorporating E.M.I. Institutes)
(Dept. SE/20), 29 Wright's Lane, London, W.8

WHICH IS YOUR PET SUBJECT?

Mechanical Eng.,
Electrical Eng.,
Civil Engineering,
Radio Engineering,
Automobile Eng.,
Aeronautical Eng.,
Production Eng.,
Building, Plastics,
Draughtsmanship,
Television, etc.

GET SOME LETTERS AFTER YOUR NAME!

A.M.I. Mech. E.
A.M.I.C.E.
A.M.I. Prod. E.
A.M.I.M.I.
A.I.O.B.
A.F.R. Ae.S.
B.Sc.
A.M. Brit. I.R.E.
City & Guilds
Gen. Cert. of Education
Etc., etc.

PRACTICAL EQUIPMENT

Basic Practical and Theoretic Courses for beginners in Radio, T.V., Electronics, Etc., A.M. Brit. I.R.E. City & Guilds Radio Amateurs' Exam. R.T.E.B. Certificate P.M.G. Certificate Practical Radio Radio & Television Servicing Practical Electronics Electronics Engineering Automation

INCLUDING TOOLS!

The specialist Electronics Division of B.I.E.T. (Incorporating E.M.I. Institutes) NOW offers you a real laboratory training at home with practical equipment. Ask for details.

B.I.E.T. SCHOOL OF ELECTRONICS

POST COUPON NOW!

Please send me your FREE 156-page "ENGINEERING OPPORTUNITIES"
 (Write if you prefer not to cut page)
 NAME.....
 ADDRESS.....

 SUBJECT OR EXAM THAT INTERESTS ME (SE/20).



THE B.I.E.T. IS THE LEADING ORGANISATION OF ITS KIND IN THE WORLD

REBUILT AND RESCREENED CATHODE RAY TUBES

Complete with all new components excepting glass

FOR QUALITY, RELIABILITY AND SERVICE BUY FROM BRITAIN'S
LARGEST GROUP OF INDEPENDENT MANUFACTURERS OF REBUILT
CATHODE RAY TUBES

SUFFOLK TUBES LIMITED

1/3 UPPER RICHMOND ROAD

PUTNEY, S.W.15.

Tel: Vandyke 4304/5267

MIDLAND TUBES LIMITED

37 GEORGE STREET

MANCHESTER, 1.

Tel: Central 4568/9

VIDIO REPLACEMENTS LTD

25 ADDINGTON SQUARE

CAMBERWELL, S.E.5

Tel. Rodney 7550/7559

ALL TYPES

KEEN PRICES

PROMPT DELIVERY

12 MONTHS' GUARANTEE

WRITE FOR BROCHURE

Winter Trading Co. Ltd.

95 Ladbroke Grove
London, W.11
and Branches

Weston Hart Ltd.

236/8 Fratton Road
Portsmouth
Tel: Portsmouth 24125

Lawsons Ltd.

36 Cornhill
Bury St. Edmunds, Suffolk
Tel: Bury St. Edmunds 3304

J. H. Sunderland

11 Clements Street
Rochdale, Lancs.
Tel: Rochdale 48484

Wizard Productions

16 Withy Grove
Manchester
Tel: Dea 2772

Chester Radio

11 City Road
Chester
Tel: Chester 24727

Taylor's

162 Eastney Road
Milton, Portsmouth
Tel: Portsmouth 35000

Millards Southern Rentals

3 High Street
Aldershot, Hants.
Tel: Aldershot 20408

Lucketts of Banbury

57a/58a High Street
Banbury, Oxon
Tel: Banbury 2813

Electrical Marketing Co. Ltd.

12A College Square North
Belfast 1
Tel: Belfast 33340

R.E.D. Ltd.

Waltham Street
Crewe
Tel: Crewe 4364

Fylde Television Services

460 Talbot Road
Blackpool
Tel: Blackpool 31159

Hi-Lite Ltd.

89 Southbourne Grove
Southbourne, Bournemouth
Tel: Bournemouth 44344

R. Watson

Leathern Bittel
Wavenden, Woburn Sands, Bucks
Tel: Woburn Sands 2027

R.E.S. Ltd.

17/19 Paynes Lane
Coventry
Tel: Coventry 28781

J. Wildbore Ltd.

6-12 Peter Street
Oldham
Tel: Mai 4475