NEW SERIES

Servicing TELEVISION RECEIVERS

No. 3.—BUSH MODELS TV22 AND T24

By L. Lawry-Johns

THESE are very reliable receivers but nevertheless still have their "usual" faults, fortunately comparatively few in number. The first is undoubtedly the PZ30; this is located in the screening box on the "top deck" chassis right-hand side.

The first thing to remember is that this valve is not only used as the H.T. rectifier, but one half is used as a booster diode; hence a defective valve can give some rather misleading symptoms. Those possessing a receiver of this type are advised to keep a spare PZ30. If, after the failure of one of these valves and when a new one has been fitted, a slight hum is present on sound, especially in the "minimum" position, and there is evidence of frame non-linearity, the 38 ohm resistor, in series with the reservoir capacitor, should be examined. The reason for this is, in the event of an internal short in the PZ30, A.C. is present on this capacitor, causing a heavy flow of current through it, thus burning out the series resistor.

When the "going off" of one of these sets is accompanied by a trace of smoke, or by a smell of burning, this is what has happened, and a new PZ30 and a new resistor will normally be the "size" of the repair.

The diagram will show clearly the position of this resistor in the circuit.

Line Output Transformer

The line output transformer is another source of likely trouble. However, failure of the line timebase is not the signal for a new transformer to be fitted. A defective PZ30 could also cause it, and the following points should also be suspected. A leaky C20 470 pF condenser (linearity correcting) wired across the T4 transformer (see diagram) will result in (a) no raster, (b) very small spark at anode of the EY51 (the valve not lighting up at all) and very weak line whistle. An internal short in the EY51 or an internal short (may be intermittent) in the tube. To check the tube remove the E.H.T. cap from the tube anode and check the operation of the timebase and E.H.T. with it, suspended safely away from any near-by chassis member.

The faults mentioned are due to overloading of the timebase, not to its non-operation, which may be caused by a leaky coupling condenser to the control grid of the line output valve, an open circuited resistor in series with the line hold control or failure of the valve itself.

Variable Gain

A frequent fault is variations in the gain of both sound and vision, and this is usually due to the 50 μF, 25 volt electrolytic condenser which is across the contrast control. It is a metal-cased type, and no difficulty should be found in locating it. A small drop in its efficiency causes large variations of gain. Another fault encountered several times on this model is a defective 100 pF coupling condenser on to the grid of V2 the mixer EF91. Depending upon the extent of the leak the symptoms may vary from a ragged picture with a small leak, to "snow storm" effects as the leak gets worse. When the condenser shorts out completely the picture vanishes with the mixer ceasing to operate. The position in the circuit is shown in the diagram and is marked with a star.

Other Models

Some variation may be found in these notes and in the circuit diagrams as they are designed to encompass the TV22a, TV24a and the console variants. Most variation will be found in the line timebase and the types of valve fitted, e.g. PL81 for PL38, etc., but there is little variation in the actual circuit of the supply and sound/vision strips.

A hum on these sets has often been traced to a loose 4 B.A. nut and bolt on the rear of the chassis. This holds the earthing clip of the audio output stage and also the tag to which the main fuse is earthed.

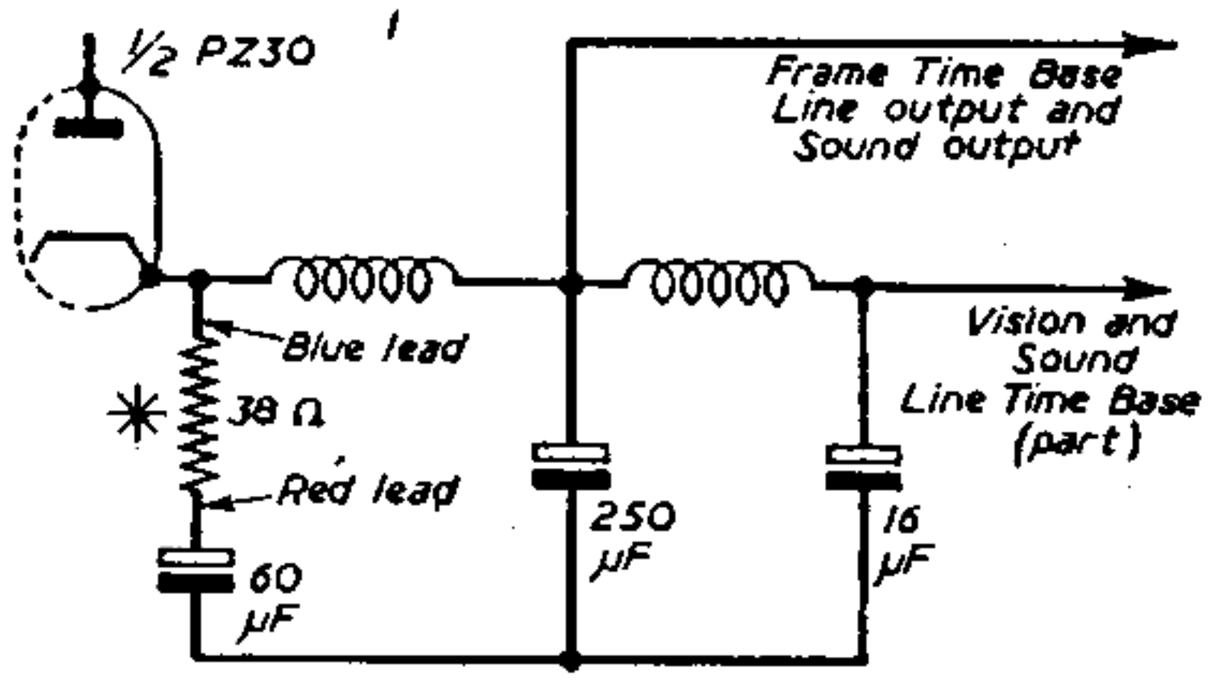


Fig. 1.—Showing how the series resistor and the 60µF condenser are wired direct to the PZ30 cathode.

It is situated just under the fuse-holder and should be inspected for tightness should hum be present. The first time this fault came in, it caused some heartaches and shows how the most baffling problems have the most simple answers sometimes.

If, after having repaired some fault on the receiver, and upon switching on no picture or a very weak

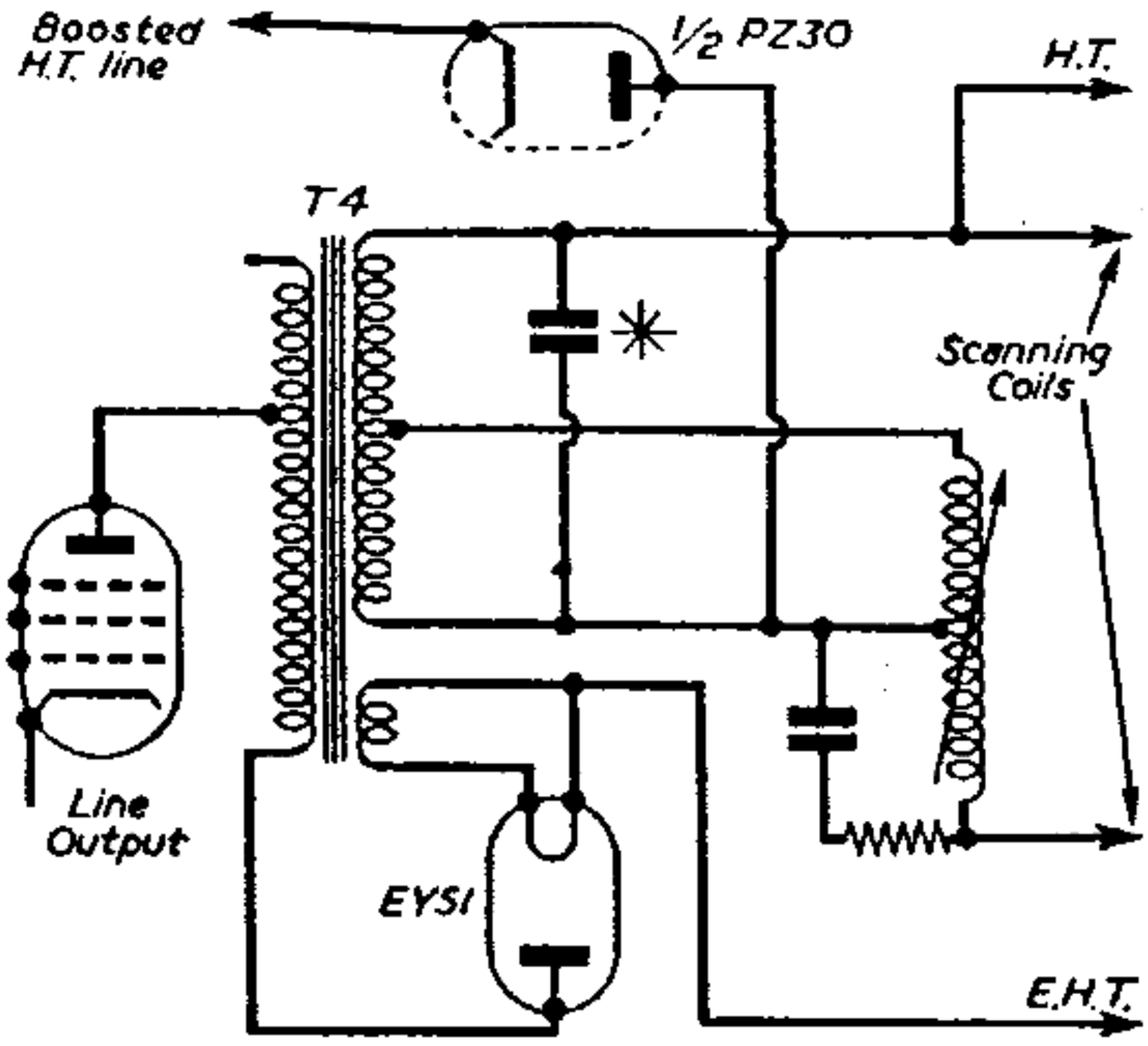


Fig. 2.—The condenser marked * is 470pF and is C20 referred to in the article.

raster is obtained, or the tube shows every sign of having lost its emission, remember the ion trap. The way these little items can work loose or be accidentally moved and cause momentary confusion is remarkable. Once again look for the simple things.

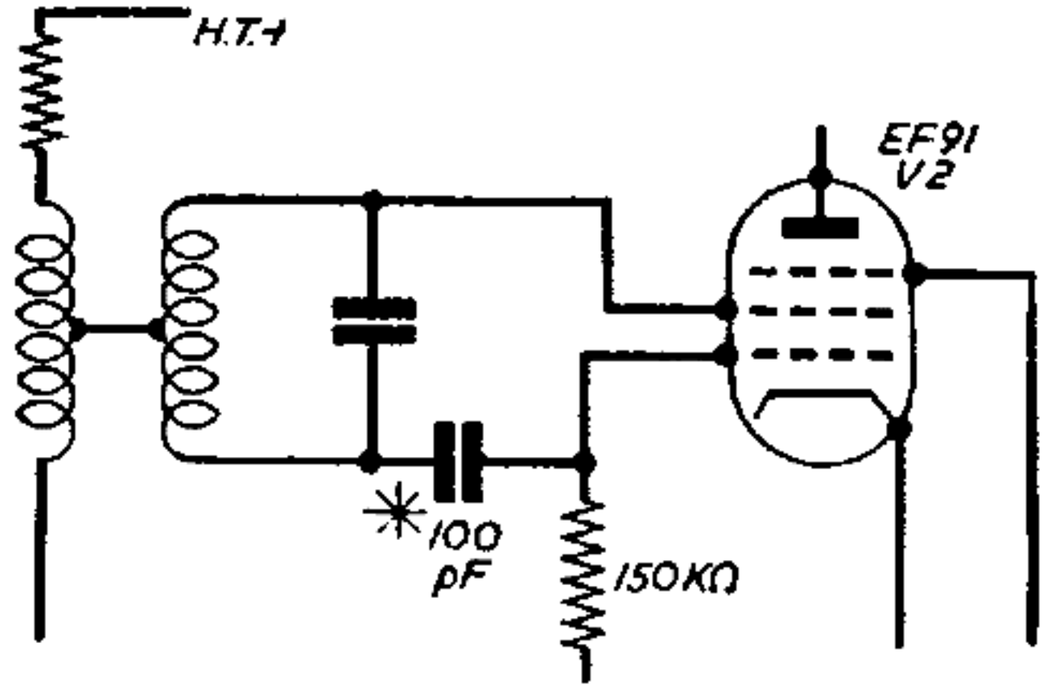


Fig. 3.—Frequency changer V2. This diagram shows how a leak in the 100 pF condenser can cause the symptoms described.

All-Station Television Receivers

Adjustable Tuning in New Bush Models

THE most striking feature of the new Bush Radio sets is that they are provided with adjustable tuning so that they are suitable for any station in the television band. The same model is, therefore, suitable for any district and in the areas of overlap between two stations, the choice between the two can be effected by a trial on site. The sets are available in two forms—a table model (TV22) with a 9-in tube and a console (TUG24) with a 12-in tube. Apart from the difference of tube size the receivers are identical.

The set is a superheterodyne having two signal-frequency circuits and an oscillator circuit. The latter is tuned by a movable composite core, part metal and part dust-iron, so that at one extremity the inductance is reduced and at the other it is increased. This is adjusted by a knob at the back of the set and it is necessary only to turn the control for maximum sound signal. The signal circuits are similarly variable by movable cores, but are of the screwdriver-adjustment type accessible at the back of the set. They are adjusted after the oscillator for maximum vision signal. The aerial used must, of course, be appropriate to the desired station.

The circuit of the frequency-changer is unusual in that a pentode is used as a combined oscillator and mixer, as shown in Fig. 1. The signal-frequency circuits are L_1 and L_2 and the oscillator is L_3, being a Colpitt's circuit with the valve capacitances acting to provide the capacitive tap for the cathode. The signal from the r.f. valve V_1 is fed into L_3 at a nodal point to minimize coupling between L_2 and L_3. The i.f. output at 19.5 Mc/s for sound and 16 Mc/s for vision is taken from the anode of V_2, the tuned circuit being L_5 and circuit capacitance. C_1L_4 is a trap tuned below the vision channel to eliminate possible interference from the sound channel of an adjacent transmitter.

The vision i.f. amplifier has two stages, the first being common to both vision and sound channels and having a combined sound-channel rejector and sound pick-out circuit. There are a diode detector, one v.f. stage, feeding the cathode of the c.r. tube, and a diode noise limiter.

On the sound side there are two i.f. stages, the first having a.g.c. bias, a diode detector, a series-diode noise limiter, and a pentode output stage.

Bush Radio Model TV22 television receiver.

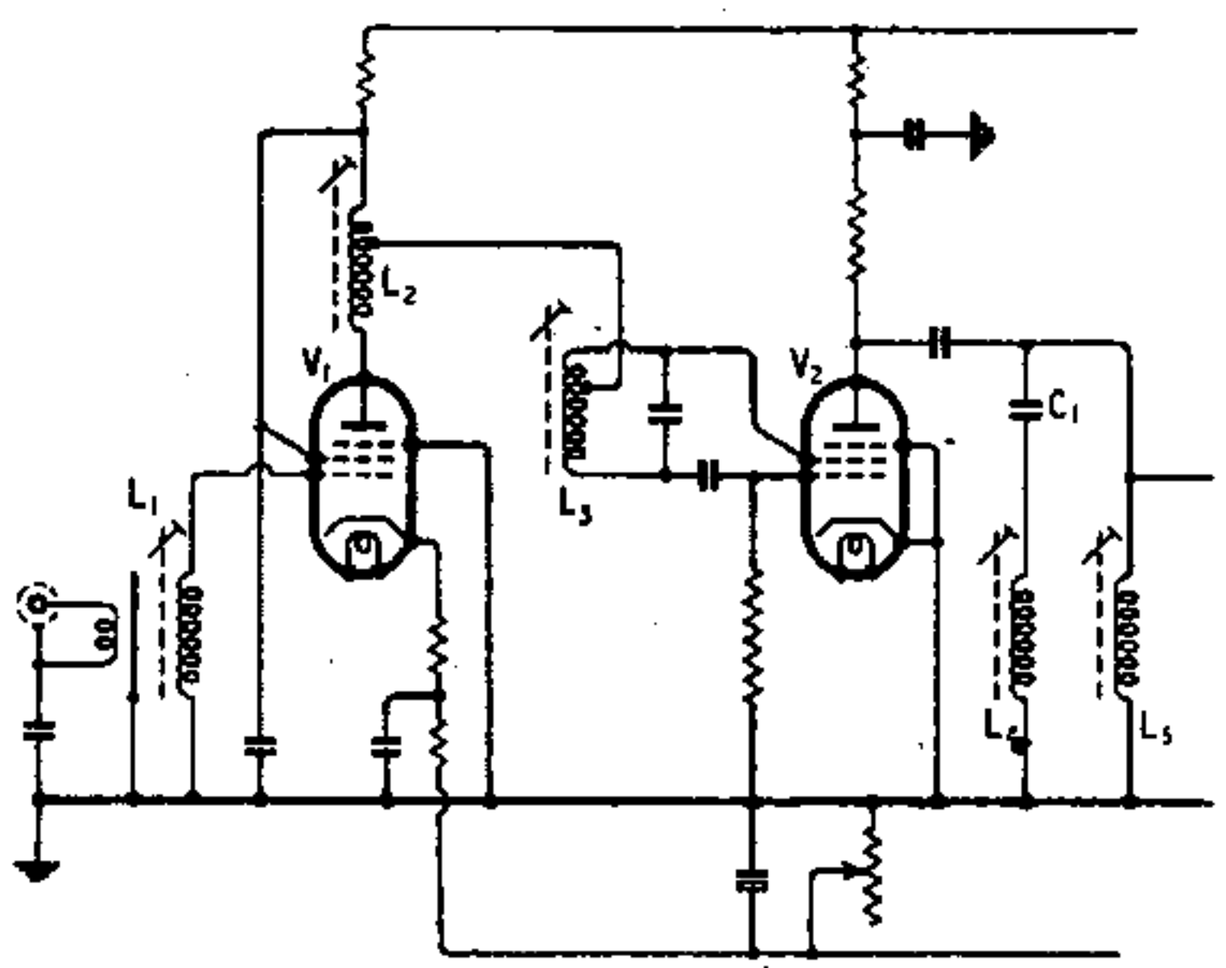
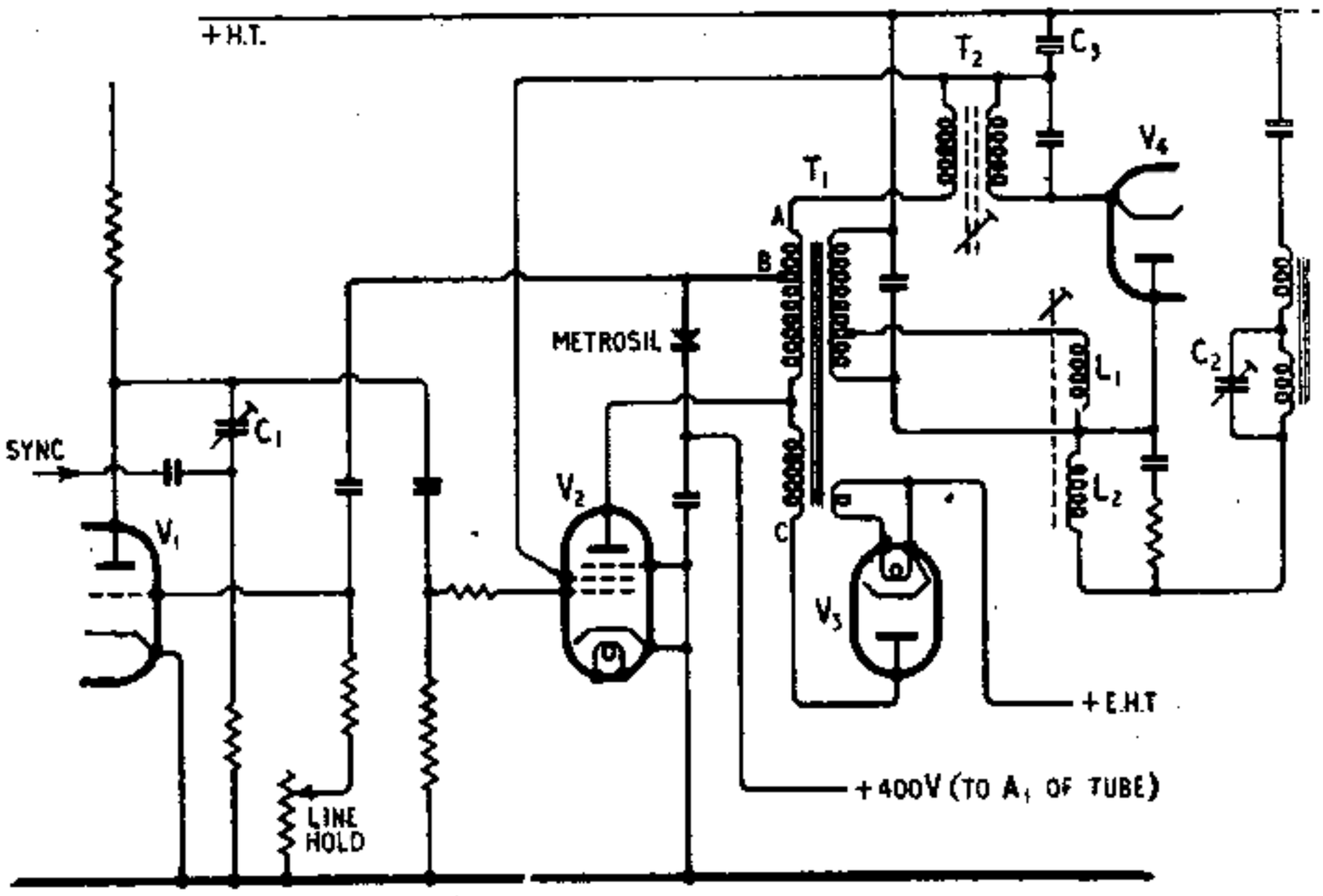


Fig. 1. The signal-frequency and oscillator circuits are shown here. A single-valve pentode frequency-changer is used with the screen-grid acting as the anode of a Colpitt's oscillator.

Fig. 2. This diagram shows the line-scan circuit which includes a current-saving diode V_4. It also provides h.t. boost. The first and second anodes of the tube both derive their voltages from the line fly-back.



In the synchronizing and scanning circuits economy is effected by using triode pentodes. In one the pentode section acts as a sync separator while the triode is part of the line time-base and in the other the triode is the frame blocking oscillator and the pentode the frame-scan output valve.

The line output valve and the triode referred to above form a multivibrator for generating the line saw-tooth. This is shown in Fig 2, and it will be seen that V_1 and V_2 form a normal type of multivibrator; C_1 is the capacitance across which the saw-tooth is developed, and is adjustable as an amplitude control, while R_1 provides a sharp pulse on fly-back. The total voltage across A and C of the transformer T_1 reaches about 9 kV on fly-back and is rectified by V_3 for the tube supply, the reservoir capacitance being provided by the capacitance between the internal and external coatings of the tube itself. A portion AB of the transformer voltage is rectified by a Metrosil unit to provide about 400 V for the first anode of the tube.

A "damping diode" V_4 is used to give both current saving and h.t. boost. It is controlled by a voltage developed in T_2. For efficiency in this type of circuit it is necessary that V_2 and V_4 should conduct alternately, V_4 over the first part of the scan and V_2 over the second part. Some overlap is necessary to avoid critical adjustments, of course, but V_4 should be non-conductive for the major part of the time that V_2 is functioning. Accordingly T_2 introduces into the cathode circuit of V_4 a voltage derived from the anode current of V_2 which ensures that the diode is cut off over the proper interval and that its operating conditions are controlled during its conductive period. The latter is necessary for a linear scan and T_2 has an adjustable core which forms the main linearity control, a second control being afforded by C_1 in controlling the saw-tooth amplitude applied to V_2. The mean "automatic-bias" voltage of the diode is developed across C_3 and applied as h.t. boost to the pentode V_2 so that this valve operates at a considerably higher voltage than that of the h.t. line.

Picture width is controlled by L_1 and L_2, which have ganged cores so that the inductance of one is increased as the other is reduced. L_1 is in shunt with a tapping on the secondary of T_1, and as it is reduced it absorbs more and more current from the deflector coil. L_2 is in series with the deflector coil and maintains the total effective inductance substantially constant so that changes in picture width do not affect the fly-back time, the e.h.t. voltage, the focus or the linearity. In order to reduce radiation the whole of the line-scan valves and transformers are screened.

The frame coils have their centre tap "earthed" through a resistance. The line coils have one of the pair shunted by the capacitor C_2. This provides a balance condition and minimizes shock excitation of the frame coils by the line fly-back and prevents a damped sinusoidal current from being developed in them to produce a spurious deflection.

The set has series-connected heaters and a half-wave rectifier and is designed for a.c. or d.c. mains of 200–250V. It has 15 valves, of which five are double-types, so that there are 20 electron streams. The panel controls are Sound Volume, with a combined on-off switch, and Picture Brightness. Frame and Line Hold controls also appear on the front, but as pre-set controls with coin slots. The other pre-set controls are visible at the back.

In a bakelite cabinet with a 9-in tube the set is priced at 42 gns, including tax. In a wooden console cabinet with a 12-in tube it costs 76 gns.

BUSH RADIO

Service Instructions

Supplementary Sheet to be used in Conjunction with the TV22, TV24 and TUG24 Service Instructions.

Component numbers refer to the numbers on the circuit diagram.
It is advisable to have an accurately calibrated signal generator, a 0-10 KV EHT meter, and a general purpose test meter such as the AVO model 7.
Since the receivers are of AC/DC design, check that the chassis is at earth potential before commencing to trace a fault.
IMPORTANT.—Do not alter the tuning core adjustments unless any of valves V 1-V 9, vision and sound, or any tuning inductances are replaced, or unless a check with the signal generator shows that this is necessary. Alignment procedure should then be carried out in accordance with the instructions in the Service Manual.

PRELIMINARY TESTS

Check that the heater chain is continuous. The resistance, as measured across the main input plug with the switch in the "on" position, should be approximately 480-580 ohms.
The resistance to earth of the HT line is between 27000 and 33000 ohms.

Before taking readings of any of the valve voltages, make sure that the heater and HT tappings on the ballast resistor are correctly set.

TUBE FAULTS

THE MAJORITY OF THESE TUBE FAULTS ARE NOT COMMON, BUT ARE INCLUDED BECAUSE THEY CAN GIVE MISLEADING SYMPTOMS.

1. NO PICTURE.

If HT, EHT, grid and cathode voltages are normal the emission of the tube may be low or the heater of the tube may be s/c.

The EHT should not be less than 7.0 KV, and the grid voltage should vary between 0-90V depending on the setting of the brilliance control.

Cathode volts should be between 40-95 volts varying with the setting of the contrast control.

The first anode volts should be approximately 200; but if a low range electrostatic voltmeter is not available, a rough check can be made with a high resistance meter (1000 ohms per volt), which should indicate approximately 15 volts on the 1000 volt range, measured to HT line.

If the tube heater is low resistance, the voltage across the heater pins will be low, usually about two volts.
To check for a "soft" tube, disconnect the anode and, if the EHT rises to normal, discard the tube. If very soft, a blue glow will be apparent round the electrode assembly.

NOTE.—With a normal tube, the EHT should not be less than 7.0 KV at normal brilliance, but will fall to about 3.0 KV with the brilliance control at maximum.

Check that the tube is not down to air—indicated by a white deposit round the gettering.

2. NO CONTROL OF BRILLIANCE.

If the brilliance increases when the brilliance control is turned toward minimum, reject tube for grid/cathode s/c. If brilliance increases and a hum bar is apparent on the picture when the brilliance control is turned toward minimum, reject the tube for a heater/cathode s/c.

NOTE.—In cases of a complete short-circuit between the heater and cathode of the tube, the cathode volts on the tube will also be very low.
Check VR 6 for o/c at bottom end.

3. CIRCULAR PATCH OF DISCOLORATION AT CENTRE OF TUBE.

Fault known as "ion burn." Will become worse as receiver is used. Is not detrimental to the actual operation of the reeeiver.

4. DRIFTING FOCUS.

If usual checks for poor focus have been made (EHT, 1st Anode, HT), fault may lie in the tube. It usually occurs within first few minutes of switching on, and can also be caused by intermittent PL 38.

5. POOR FOCUS.

Check first anode voltage, which should be 210 volts with respect to HT. (Electrostatic Meter.)

6. VARYING BRILLIANCE.

Usually caused by a varying heater/cathode leak.

7. COLOUR OF SCREEN PATCHY.

Caused by "poisoning" of the chemicals used in the manufacture of the screen.

8. SHADOWS.

If at one corner of the picture, it is caused by incorrect gun assembly.
Check position of deflector coils and ensure that they are pushed hard up to the shoulder of the tube.

9. POOR CONTRAST.

Usually this is a vision unit fault (paras. 22, 24, 27), but can be caused by tube insensitivity.

10. VARIATION OF PICTURE SIZE OR SPARK INTERFERENCE ON VISION AND SOUND.

Caused by internal arcing of the tube between anode connection and graphite, or between electrodes, usually when tube is soft.
A flaw in the glass in the neck of the tube will allow arcing to take place to deflector coils or focus magnet.

RECEIVER FAULTS

1. NO EHT.

Since the EHT is derived from the line time base fly-back, there will be no EHT is the line time base is faulty.

If the line time base is working, a faint high-pitch whistle will be heard in the vicinity of the line transformer. If it can be established that the line time base is operating and there is no EHT, check the EHT rectifier for low emission.

Check the rectifier anode winding on T 4 for s/c and o/c.

2. LOW EHT.

Check for s/c turns or s/c primary section T 4.
Check Metrosil for s/c (voltage across Metrosil : line time base working 65v when measured on AVO model 7, 1000 volt range, to chassis).

3. NO LINE TIME BASE (AND NO EHT).

An oscilloscope is the most speedy method of determining whether the oscillator is working, but if such equipment is not available, start by checking the oscillator stage, ECL 80, PL 38, PZ 30. If this is operating a very faint whistle will be heard. If not check T 4 for o/c and s/c, C 16 o/c, s/c or leakage. Check V 3, V 4 and V 5.

Check C 17 for o/c, R 22 for o/c and C 21 for s/c.

NOTE.—If there is no HT on V 4, T 4, check V 6A for o/c cathode. It is inadvisable to check any voltage in the anode circuit components of V 4 (PL 38) because the high peak voltage developed by the line fly-back may damage the meter. Voltages are in order of 2Kv-3Kv.

4. EHT NORMAL BUT NO LINE DEFLECTION.

Check C 24 for o/c.
Check L 3 for s/c or o/c. This will cause low EHT.

5. INSUFFICIENT WIDTH.
Check C 21 for o/c, C 20 for o/c. C 21 will cause low EHT, C 20 high EHT.
If the picture is wide at the top and narrow at the bottom (Key-Stone), check one half of L 3 for s/c, Check V 3 and V 4 for low emission.

6. EXCESSIVE WIDTH.
Check for low EHT.
Check Metrosil for s/c.

7. PICTURE DISPLACED TO THE LEFT.
If the picture cannot be centred by movement of the focus magnet, check C 24 for s/c.

8. PICTURE EXPANDS AND DISAPPEARS WHEN BRILLIANCE CONTROL TURNED TOWARDS MAXIMUM.
Check EY 51 valve for low emission.

9. POOR LINE HOLD.
Check C 15 for leak.
Check C 15, C 14 for low capacity.
Check C 14 for o/c.
Check V 3 for low emission or heater/cathode leak.
Check R 14 for high resistance (Receiver unit).

10. NO FRAME TIME BASE.
Check V 2.
Check C 8, C 7, C 4, C 6 for s/c, o/c or leakage.
Check T 3 and L 1 for o/c, VR 4 for o/c.

11. BAD FRAME LINEARITY.
Cramped at extreme top. Check C 6 for s/c.
Cramped at extreme bottom. Check C 8 for leak.
Cramped from centre to bottom. Check C 5 for s/c.
Check V 2.

12. LOW FRAME AMPLITUDE.
Cramped at top and excessive bottom amplitude. Check C 6 for s/c and leak and V 2. (Main chassis.)

13. POOR FRAME HOLD.
Check C 4, C 11 for leak.

14. NO FRAME HOLD.
Check Westector for o/c. Observing polarity its resistance should be approximately 3000 ohms.
Check C 9, C 11 for s/c. C 10, R 11 o/c.

15. POOR FRAME HOLD AND LINE HOLD.
Check V 3, V 5 on main deck, V 6 and associated components on R.F. deck. Check alignment of vision unit.

16. LOW FRAME AMPLITUDE AT LEFT OR RIGHT OF PICTURE.
Check for s/c in one half of frame deflector coil L 1.

17. BARRELLING OR PINCUSHION SHAPE OF PICTURE.
Check V 4, V 6A for heater/cathode leak.

18. BAD FRAME JITTER AT TOP OF PICTURE.
Check gap of choke L 5.
Check C 26 for low capacity.
This effect may not be apparent when the width control is at minimum.
NOTE.—If the gapping paper is punctured, jitter will appear.

19. NO FRAME AMPLITUDE CONTROL.
Check C 5 for o/c.

20. NORMAL RASTER BUT NO PICTURE OR SOUND.
Since V 1 and V 2 are common to sound and vision, this symptom will indicate a fault in these two stages, or in the HT supply to the vision and sound unit. A fault in the aerial lead, aerial or plug would produce similar symptoms.
Check V 1, V 2, V 3 for low emission, o/c electrodes or s/c heaters. (Receiver unit.)
Check L 1-7 for o/c.
Check for normal valve voltages.
Inject appropriate frequency into V 1 and V 3 grid to determine which stage is at fault.
NOTE.—With the receiver working normally, injection of a signal modulated at 400 c/s will produce eight horizontal bars on the raster at normal frame frequency setting.

21. NORMAL RASTER AND SOUND BUT NO VISION.
Check V 4, V 5, V 6. Inject signal into grid V 4 to determine stage fault. Check for s/c heater.
Rotation of the contrast control should vary V 6 anode voltage between 70-130 volts depending upon signal input.
If the video amplifier grid volts are high (9 volts or more) self oscillation is occurring, and the probable cause is a faulty cathode decoupling condenser.
NOTE.—Normal video grid voltage varies between 0-6 volts approximately.

22. INTERMITTENT VARIATION OF VISION GAIN.
Check V 1, V 2, V 3, V 4, V 5, V 6.
Check cathode bias resistor for variation in resistance by moving resistor as much as possible without damage.
Check screen and cathode decoupling condensers in the same manner.
NOTE.—A variation of a few ohms will cause an appreciable change in gain and a faulty aerial connection will cause variation in signal. Intermittent heater cathode s/c in cathode ray tube can give similar symptoms.

23. PICTURE UNSTABLE.
This fault gives the appearance of oscillation on the picture.
Check screen and cathode decoupling condensers for o/c.
Check for o/c bottom end of grid coil.

24. NO CONTROL OF CONTRAST.
If there is no control of contrast check C 4 for s/c.

25. BAND OF LIGHT ACROSS PICTURE.
If a band of light two or three inches wide appears across the centre of the picture check V 1-V 6 for heater/cathode leak. (Vision and sound unit.)
NOTE.—If leak occurs in V 1, V 2, V 3 there will also be hum on sound (on AC mains only).

26. POOR DEFINITION.
Poor definition can give the appearance of bad focusing. It can, however, be caused by the vision receiver, and the bandwidth should be checked according to the instructions given in the Service Manual.
Check V 1-V 6 by substitution. If V 5 is faulty, poor definition is sometimes accompanied by lack of sync.
Check L 14 for o/c.
Check cathode ray tube and deflector coils by substitution.
Check C 19.

27. POOR CONTRAST : LACK OF HIGHLIGHTS.
Check V 5, V 6, R 16.
Check operation of vision interference suppressor control and components.

28. FLICKER ON SCREEN AT NORMAL BRILLIANCE.
This fault is sometimes accompanied by popping noises in the speaker.
Check cathode ray tube anode to capacity coating for "brushing."
Check T 4 for arcing.
Check cathode ray tube for internal arcing.
Check EY 51 for "brushing" to screening of line amplifier shield.

29. HUM ON SOUND ONLY.
Check V 1 (main deck), V 7, V 8, V 9 for heater/cathode s/c.
Check C 27 for low capacity.

30. BRILLIANCE UNCONTROLLED.
Check VR 6 for o/c.
Check vision for self oscillation.

31. NO BRILLIANCE (See Receiver Faults 1).
Check cathode ray tube anode voltage 7 Kv approximately.
Check cathode ray tube 1st anode voltage. (See Para. 1.)
Check Metrosil s/c and o/c. (See Para. 2.)
Check cathode ray tube, and video stage.
Check C 21 for s/c.
Check that anode lead to PL 38-V 4- is on.
NOTE.—If anode lead is off and short-circuits to screening can, this will cause C 21 to disintegrate, the reason being the polarity change across this component.

32. MODULATION OF FRAME : WHEN VOLUME OF SOUND IS AT MAXIMUM.
This can be greatly reduced by dressing R 10, R 9, C 8 and leads away from V 1.

33. WHITE LINE DOWN CENTRE OF PICTURE.
NOTE.—With no signal applied this condition is normal. With signal applied this fault is due to wrong setting of TC 1.
To re-adjust TC 1 :—
Adjust brilliance and contrast for normal picture.
NOTE.—Adjustment of horizontal form may necessitate resetting of TC 1.
Adjust line hold to produce sync. bar (right-hand side of picture), turn line hold slightly anti-clockwise to remove sync. bar (i.e., right to left movement).
Reduce brilliance to low level and adjust TC 1 for maximum brilliance. (This condition will offer maximum width.)
Reset brilliance for normal level.
Check that line sync. bar can be obtained.
Check for re-appearance of white line. If still appears slight re-adjustment of TC 1 required.

34. PULLING (Line sync.).
This condition can be improved where field strength of signal applied to the vision unit is extremely excessive to that required (i.e., Contrast control being reasonably retarded), by changing C 15 250 pf silver mica for 100 pf silver mica.

35. RINGING OF LINE DEFLECTOR COIL L 3.
This effect produces black and white vertical line down left-hand side of picture.
Adjustment of TC 2 required as follows :—Remove signal input—adjust width to bring raster within the mask—adjust TC 2 for minimum condition of ringing.

36. WHITE LINES DOWN LEFT-HAND SIDE.
Connect 10pf from grid of sync. sep. to chassis.
Decouple grid of CRT with 0.1 mfd. to chassis.
Increase C23 to 680pf.
Move components C19, R23, R24 to top of chassis next to CRT.