H.G.CISIN'S

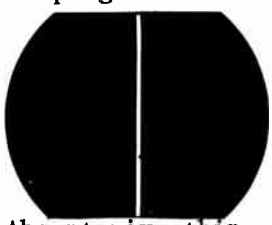
RAPID TROUBLE SHOOTING AND ALIGNMENT

TV CONSULTANT

TRADE MARK REG. U.S. PAT. OFF.

THE T V SERVICEMAN'S SILENT PARTNER

Absent pix, horiz. sloping lines 9-P



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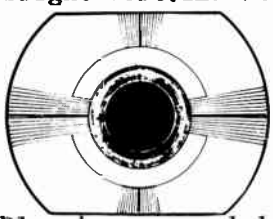

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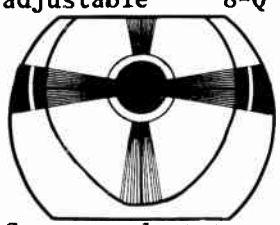

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By H.G.Cisin, Consulting Engineer

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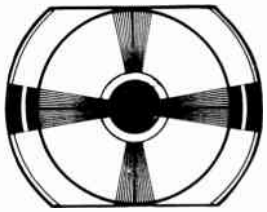

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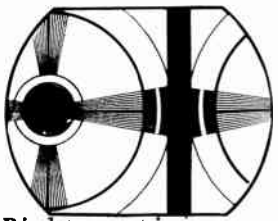

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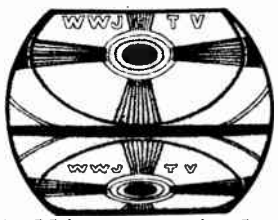

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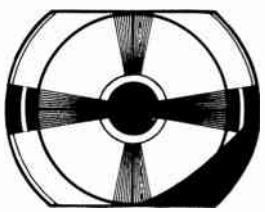

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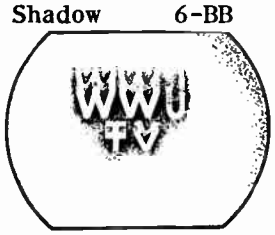

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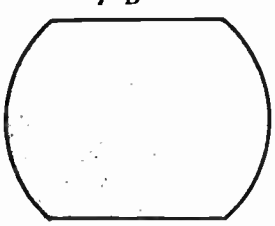

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TV CONSULTANT

By Harry G. Cisin

Introduction

This book is a modernized, enlarged edition of the famous RAPID TV TROUBLE SHOOTING METHOD. Over three hundred TV troubles are listed and classified -- more than double the number contained in the original edition.

As the television art develops and expands, new features and circuits are added and these in turn produce new faults, all of which are adequately listed and diagnosed in this book. As an aid in identifying picture faults, many new illustrations have been included.

An entirely new section in this book contains up-to-the-minute, streamlined ALIGNMENT METHODS, developed not in the laboratory, but in the shop under actual working conditions. Applications of these simple methods produce quick, practical results, permitting the TV set to be aligned in the shortest possible time. An important part of this section is that dealing with the correct way to use vacuum tube voltmeters, sweep generators and oscilloscopes.

The purpose of this book is to enable the serviceman to locate all TV faults in record-breaking time. Since the method is basic, it applies to all makes and models and hence diagrams are unnecessary. This book contains absolutely NO THEORY and NO MATHEMATICS -- not even a single formula. It is a practical book, written for practical men. There are hundreds of books on the theory and mathematics of television, but this is the only one which tells exactly how to find the fault and how to fix it.

Wherever possible, faults are located by preliminary checks which require no instruments! Many of the RAPID CHECKS use the picture tube itself in the place of expensive, complicated instruments. Where the use of instruments is really necessary, complete information is given as to their application.

Here's How The Cisin Method Works

LOOK AT THE TV PICTURE.....and identify your particular trouble from an alphabetical list of 213 picture troubles.

LOOK AT THE RASTER.....(the bright area visible on the picture tube when station is tuned out), and pick your raster trouble from an alphabetically arranged list of 76 raster troubles.

LISTEN TO THE SOUND.....Your sound trouble will readily be found in a third alphabetically arranged list.

Each trouble listed has a code number or code letter. When these are put together in any one of hundreds of different combinations, they supply the key (like the combination to a safe) which tells in which specific part of the television set to look for the trouble. This is called the "Classification". Step-by-step instructions then point the way to the defective part.

This highly efficient method should not be confused with photographic or so-called "Picture Guide" methods of servicing. The illustrations in this book are provided solely to help in identifying different types of picture troubles, but a picture alone tells only one third of the story.

This copyrighted method provides the correct diagnosis by combining three classes of symptoms -- picture, raster and sound conditions. For example, a weak picture as it would be shown in a photograph could be due to trouble in the low voltage power supply, in the

high voltage power supply, in the r.f. oscillator, or mixer circuits, in the picture i.f. section, in the video amplifier, in the picture tube or even in the antenna. This shows that a logical diagnosis is impossible by the sole use of the photographic method. However, if picture is weak, raster is weak and sound is normal, this combination of symptoms permits an accurate diagnosis. Normal sound shows that low voltage supply is O.K. The weak raster then gives the clue to the probable location of the trouble -- in the high voltage power supply or in the picture tube itself.

The Cisin method then tells the logical steps to take and the proper order in which to take them in order to determine the exact location of the defective part.

SECTION 1

RAPID TV TROUBLE SHOOTING METHOD

The CISIN TV TROUBLE SHOOTING METHOD enables you to recognize, classify, analyze, subclassify, diagnose and locate television troubles. It simplifies hitherto intricate procedure. In this new, copyrighted method, only three basic steps are employed to locate even the most obscure television troubles.

STEP NO. 1 consists of recognition of the nature of the trouble; then of classifying it as originating in one of eleven sections of the television receiver. These are known as the eleven primary classifications.

STEP NO. 2 calls for a careful inspection, both with the set "off" and then with the power "on". Thirteen special checks, lettered from "A" to "M", are made during this inspection for the purpose of discovering trouble at the source in the quickest, simplest possible manner, combining common sense with the senses of sight, smell, feeling and hearing.

STEP NO. 3 involves analyzing, subclassifying, diagnosing and locating the fault.

By means of Step No. 1, the fault has definitely been allocated to a certain section of the television receiver. A code number, applying only to the particular fault in question, has been assigned during Step No. 1. This code number not only tells where to look for the trouble, but by applying it in Step No. 3, it tells exactly which RAPID CHECKS are to be used, and in which order they are to be applied. When this has been done in accordance with the directions, the fault has been diagnosed and definitely located. Thereafter, the servicing job is completed by repairing or replacing the defective component.

In the average 24 tube television set, there are from 100 to 145 resistors, from 88 to 125 capacitors, approximately 27 high frequency transformers, peaking coils, and chokes, 9 low frequency transformers of various types, 7 potentiometers, a picture tube, power "on-off" and safety interlock switches, fuses, a speaker and a front end channel selector (tuner) usually incorporating a complicated switching arrangement. In addition, other parts often found include a focus magnet, a u.h.f. power socket, dial lights, TV-Phone switch, etc. In all, the average TV set very often utilizes over 300 components, any one of which may become faulty and thus interrupt or spoil the performance of the set. Furthermore, one faulty component often causes a second or even a third part to become defective and it is the job of the television serviceman to locate these trouble spots in the shortest possible time, if he is to remain in business.

Fortunately, each fault is accompanied by distinctive symptoms which, if correctly interpreted, actually point out the offending component. Up to the present time, however, TV trouble shooting has been conducted on a rather haphazard basis involving much unnecessary waste of time. The Cisin method herein explained is the first and only procedure for putting TV trouble shooting on a systematic, and scientifically practical basis.

The CISIN TV TROUBLE SHOOTING METHOD has been devised to help the serviceman locate actual TV troubles. Misadjustment of controls is not considered an actual trouble, since it is assumed that every serviceman knows how to manipulate the controls and get the set into proper working condition if incorrect adjustment is the only reason for failure to work properly.

Unless misalignment is definitely indicated by the analysis and sub-classification of Step No. 3, it is advisable not to undertake extensive realignment. A sweep generator with built-in marker, used in conjunction with an oscilloscope provides a rapid means of making an overall alignment check, but even

where the response curve is incorrect, this trouble may often be remedied merely by changing a tube and without the necessity of realignment. Where realignment is definitely indicated, simple directions for accomplishing this will be found in SECTION II, RAPID TV ALIGNMENT METHOD.

Before applying this RAPID TROUBLE SHOOTING METHOD, both time and money can be saved by making the following adjustments if possible, in order to make sure that the trouble symptom is not caused by a mere misadjustment:

(1) After set has been plugged in, adjust ion trap
(2) Adjust focus coil, focus magnet and/or focus control
(3) If picture is tilted, adjust deflection yoke
(4) Adjust vertical and horizontal hold controls for single stationary picture
(5) Adjust height control so as to just fill the picture mask
(6) Adjust vertical linearity control. Alternate readjustments of height and vertical linearity are usually necessary for best linearity
(7) Adjust horizontal drive control for best linearity
(8) If necessary, adjust horizontal linearity control. Alternate readjustments of drive control and horizontal linearity control may be necessary for best horizontal linearity
(9) Adjust width control until pattern just fills picture mask
(10) Adjust centering controls
(11) Check station selector on each channel, adjusting fine tuning control if provided
(12) Check contrast control
(13) Check brightness control
(14) Adjust sync lock frequency control, if set uses one
(15) Adjust sync lock phase control if necessary. Also a.g.c. threshold control.
(16) If set employs grounding springs, make sure these are making contact with picture tube shell.

If these adjustments fail to produce normal operation, then apply RAPID TV TROUBLE SHOOTING METHOD.

STEP NO. 1

Recognize and Classify

Recognition is accomplished by observation of the three important characteristics of a television set.

These are: the PICTURE, the RASTER and the SOUND. If any or all are absent, such absence in itself constitutes important symptoms of trouble and also an indication of its location.

The raster is inspected by removing the signal, either by disconnecting the antenna lead-in or by tuning to an unoccupied channel. Naturally, in order to listen to the sound it is necessary to tune back to an active channel.

PICTURE TROUBLE SYMPTOMS: Each alphabetically listed symptom below has been given a numerical designation. For example, picture symptom "intermittent, all channels" is designated as number "86".

RASTER TROUBLE SYMPTOMS: Each raster trouble symptom listed below is designated by a single letter or a two-letter combination. For example, "Intermittent" raster is designated as "IA".

SOUND TROUBLE SYMPTOMS: These are also given numerical designations (see listing below). For example, "Intermittent" sound is designated as "11".

Picture Trouble Symptoms

1 Absent all channels
2 Absent all channels, thin horizontal bright line.
3 Absent all channels, thin vertical bright line
4 Absent single channel
5 Airplane flutter
6 Background unstable
7 Barkhausen oscillations
8 Bars, diagonal, large number alternate dark and light
9 Bars, horizontal, alternate dark and light
10 Bas relief, engraved effect
11 Beat pattern (thin weaving meshed lines)
12 Blooming (expanded abnormally)
13 Blurred
14 Bright spot on screen after turning set off
15 Brightness (brilliance) and focus extremely slow in reaching normal level
16 Brightness excessive
17 Brightness insufficient
18 Brightness non-adjustable
19 Brown or yellowish area
20 Centering, horizontal, non-adjustable
21 Centering, vertical, non-adjustable
22 Compressed at left
23 Compressed at right
24 Compressed at bottom
25 Compressed at top
26 Contrast almost reversed
27 Contrast insufficient
28 Contrast reversed, one channel
29 Crescent shaped glow
30 Criss-crossed traces
31 Dark and light streaks, thin, moving horizontally
32 Darkened

33 Dark faint vertical bars at top left
34 Dark streaks across vertical wedges of station pattern
35 Darkened upper or lower half
36 Details absent all channels
37 Details absent one channel
38 Details poor all channels
39 Details poor one channel
40 Diagonal bars, large number, alternate dark & lt.
41 Double image, ghost
42 Double image, horizontally displaced interlace
43 Dwarfed, vertically and horizontally
44 Dwarfed horizontally
45 Dwarfed vertically
46 Echo effect (thin black and white lines after vertical picture lines)
47 Edges jagged, pie-crust effect
48 Edges wavy, sides
49 Edges wavy, top and bottom
50 Engraved effect
51 Enlarged (expanded abnormally)
52 Enlarged vertically
53 Fading, all channels
54 Fading, single channel
55 Faint
56 Focus defective
57 Fold-over, bottom
58 Fold-over, left side
59 Fold-over, right side
60 Fold-over, top
61 Ghosts
62 Ghosts, intermittent
63 Hazy or cloudy
64 Height insufficient
65 Height non-adjustable
66 Herringbone effect
67 Hold control, vertical, ineffective (rolling)
68 Horizontal bars, one dark, one light
69 Horizontal bars, four, alternate dark and light
70 Horizontal bars, sound bars
71 Horizontal white bars when station is tuned in
72 Horizontal bar, white at bottom
73 Horizontal blanking bar appears
74 Horizontal flashes
74.1 Horizontal line thin, bright wavy
75 Horizontal movement, hold control ineffective
76 Horizontal non-linearity
77 Horizontal pulling
78 Horizontal streaks, light and dark
79 Horizontal strips missing from picture
80 Horizontal tearing
81 Horizontal wedges of station pattern stronger than vertical wedges
82 Horizontal wedges weaker than vertical wedges
83 Hum bars, horizontal
84 Incomplete vertically
85 Interlace defective (moire effect)
86 Intermittent, all channels
87 Intermittent, one channel
88 Intermittent dark and/or light horizontal streaks
89 Intermittent dark horizontal streaks
90 Intermittent ghosts
91 Intermittent pulling
92 Intermittent horizontal and vertical instability
93 Intermittently vertically dwarfed
94 Ion spot or burn
95 Jagged at edges
96 Jittery
97 Jittery, vertically
98 Keystone effect, narrow at bottom
99 Keystone effect, narrow at left
100 Keystone effect, narrow at right
101 Keystone effect, narrow at top
102 Left portion on right side
103 Linearity, horizontal, non-adjustable
104 Linearity, vertical, non-adjustable
105 Meshed lines, thin, weaving
106 Moire effect, defective interlace
107 Momentary reduction in size, unstable
108 Moves up and down and side to side
109 Moves up and down and side to side with reduced height and width
110 Moves up and down, tears out vertically
111 Moves up and down (vertically) and cannot be stopped
112 Movement of actor to right, followed by rapid movement of shadow to left and vice versa
113 Multiple images horizontally
114 Multiple images vertically
115 Narrow at bottom
116 Narrow at left
117 Narrow at right side
118 Narrow at top
119 Narrows intermittently
120 Negative pattern
121 Noisy (streaked)
122 Non-adjustable brightness
123 Non-adjustable contrast
124 Non-adjustable focus
125 Non-adjustable horizontal hold
126 Non-adjustable vertical hold
127 Non-adjustable linearity, horizontal
128 Non-adjustable linearity, vertical
129 Non-adjustable height
130 Non-adjustable width
131 Normal picture
132 Not coincident with sound
133 Oscillations at top
134 Oscillations, Barkhausen
135 Pie-crust edges
136 Pin cushion effect
137 Pulling horizontally
138 Quality poor
139 Return traces (vertical) visible
140 Reversed brightness control
141 Reversed contrast
142 Reversed in horizontal plane
143 Ripple, vertical, left side
144 Ripple, changing only with volume control variation
145 Right half on left side
146 Ringing
147 Rolling (vertical)
148 "S" shaped at sides
149 Shading poor
150 Shading gradations where pix should be uniformly black or gray
151 Shadow
152 Smeared and indistinct
153 Smearing and streaking horizontally after large objects
154 Smearing, single channel
155 Snow all channels
156 Snow certain channels
157 Sound bars (horizontal bars)
158 Spread at right horizontally
159 Streaks, dark horizontal, across vertical wedge of station pattern
160 Streaks, light and dark, horizontally
161 Stretched at bottom
162 Stretched at left
163 Stretched at right
164 Stretched at top
165 Super-imposed portions of picture
166 Tearing, horizontally, following sound impulses
167 Tearing, horizontally, movement side to side
168 Tone reversal
169 Top half at bottom, wide black horizontal bar between halves
170 Trailing reflections, vertical portion

171 Trapezoid, narrow at bottom
172 Trapezoid, narrow at left
173 Trapezoid, narrow at right
174 Trapezoid, narrow at top
175 Two complete pictures, vertically
176 Three complete pictures, vertically
177 Unstable background
178 Unstable horizontal sync
179 Unstable, momentary reduction in size
180 Upside down
181 Venetian blind effect
182 Vertical dark faint line on left side, followed by light area (Barkhausen effect)
183 Vertical bars, large number, alternate dark and light
184 Vertical return lines strongly visible
185 Vertical bars, bright at left
186 Vertical bars, bright at left and horizontal non-linearity
187 Vertical bars, right side
188 Vertically dwarfed, vertical non-linearity
189 Vertically dwarfed, vertically linear
190 Vertical hold control ineffective
191 Vertical jitter
192 Vertically superimposed
193 Vertically non-linear
194 Vertically wavy at left
195 Vertical pattern wedge absent
196 Vertical return lines strongly visible
197 Vertical pattern wedge cut off, or very weak towards narrow part
198 Vertical wrinkles or ripples at left
199 Washed out and abnormally slow in appearing
200 Wavy vertical lines
201 Weak all channels
202 Weak certain channels
203 Weaving or pulling horizontally at normal contrast
204 Weaving or ripples when background changes
205 White following black
206 White horizontal bar at bottom
207 White horizontal bar at top
208 White horizontal lines
209 Width insufficient
210 Width non-adjustable
211 Width variable
212 Windshield wiper effect (vertical moving lines)
213 Width excessive

Raster Trouble Symptoms

A Absent
AA Absent, thin bright horizontal line
AB Absent, thin bright vertical line
B Barkhausen oscillations
BA Bars, horizontal, alternate dark and light
BB Bars, vertical, bright at left
BC Blooming
BD Bright spot on screen after turning set off
BE Brightness very slow in reaching normal level
BF Brightness excessive
BG Brightness insufficient
BH Brightness non-adjustable
BJ Brown or yellowish area
C Crescent shaped glow
CA Criss-crossed traces, scanning lines show greatly increased slope
D Dark horizontal streaks
DA Dark faint vertical bars at top left
DB Darkened upper or lower half
DC Dwarfed vertically and horizontally
DD Dwarfed horizontally
DE Dwarfed vertically
E Edges jagged, pie-crust effect
EA Edges wavy, sides
EB Edges wavy, top and bottom
EC Enlarged
ED Enlarged vertically
F Focus defective
FA Fold-over, bottom
FB Fold-over, left side
FC Fold-over, right side
FD Fold-over, top
FE Flashes, horizontal
H Height insufficient
HA Height non-adjustable
HB Herringbone effect
HC Horizontal bar, bright at bottom
HD Horizontal bar, bright at top
HE Horizontal centering non-adjustable
HF Horizontally sloping lines, thin, bright, wavy
HG Horizontal pulling
HH Horizontal lines of various shades when tuned to station (sloping)
I Incomplete
IA Intermittent
IB Intermittent bright horizontal streaks
IC Intermittent dark and/or light horizontal streaks
ID Intermittent pulling
IE Intermittent horizontal and vertical instability
IF Intermittently vertically dwarfed
J Jittery
K Keystone effect, narrow at bottom
KA Keystone effect, narrow at left
KB Keystone effect, narrow at right
KC Keystone effect, narrow at top
N Normal
NA Non-symmetrical
O Oscillations at top
P Pin-cushion effect at edges
R Return traces unequally spaced
RA Reversed brightness control
RB Ripple, vertical, left side
RC Ripple, changing only with volume control variation
RD Ringing
S Shadow
SA Squeezed or compressed horizontally
U Unstable, momentary reduction in size
V Vertical bars, bright at left
VA Vertical bars, right side
VB Vertical centering, non-adjustable
VC Vertically spread or compressed at top or bottom
VD Vertical height greatly decreased, more at one end than other
W Weak
WA White following black
WB Width insufficient
WC Width non-adjustable
WD Width variable, intermit.
WE White horizontal bars
WF White hor. bar at top
WG Width excessive

Sound Trouble Symptoms

1 Absent all channels
2 Absent single channel
3 Buzz
4 Crackling, snapping or frying
5 Distorted voice and music
6 Drifts or fades in and out
7 Excessively slow in reaching normal level
8 High pitched or shrill tone
9 Hum (source other than signal)
10 Hum, modulation (heard only with signal)
11 Intermittent (voice and music)
12 Intermittent (noise and static)
13 Microphonic
14 Motor-boating
15 Noisy
16 Normal
17 Not coincident with picture
18 Oscillations
19 Tone control non-adjustable
20 Volume non-adjustable
21 Weak all channels
22 Weak single channel
23 Whistle or buzz (high voltage buzz)
24 Whistle, very high pitched (15 kc)

Code Designations

The applicable Code Designation is obtained by combining PICTURE, RASTER and SOUND designations in this order. For example, if the picture designation was found to be "86", the raster to be "IA" and the sound to be "11" as in the above example, then the Code Designation is "86-IA-11".

Classification

This is accomplished by referring to the table of classifications shown below. In this table, all Code Designations are listed in numerical order. Alongside of each code designation is the corresponding "Classification". For example, alongside of code designation "86-IA-11" will be found the classification "1-E". The classification tells in which part or section of the television set the trouble is located

In this method, all TV troubles are classified as originating in one of eleven primary classifications.

These are:

1. Low voltage power supply
2. High voltage power supply
3. Front end, including r.f. amplifier, oscillator and mixer circuits
4. Sound section, including sound i.f., discriminator, audio section and speaker
5. Picture i.f. section plus video detector and including a.g.c. circuits
6. Video amplifier including picture tube
7. Synchronizing system
8. Vertical sweep circuits
9. Horizontal sweep circuits
10. Antenna and transmission line
11. Interference and transmitted sources of troubles

CODES - CLASSIFICATIONS

1-A-1	1-A
1-A-16	2-A, 6-AAA, 9-B
1-HF-16	8-E
1-HH-16	9-P
1-N-1	3-A, 5-B, 6-Q
1-N-16	5-A, 6-A
1-VD-16	8-F
2-AA-16	8-A
3-AB-16	9-A
4-N-2	3-G
4-N-16	3-H
5-N-16	5-K
6-N-16	6-J
7-B-16	9-L
8-N-16	11-D
9-BA-9	1-C, 6-KK
9-BA-16	6-K
9-N-10	3-E, 5-T
9-N-16	3-0, 5-L, 6-KKK
9-N-21	5-LL
10-N-16	5-M, 6-I
11-N-16	11-D
12-BC-16	2-F, 9-F
13-F-16	2-C, 6-L
13-N-16	3-CCC, 5-C, 6-B
13-N-21	3-C, 5-CC, 6-Q, 10-E
13-W-21	1-B
14-BD-16	6-R
15-BE-7	1-G
15-BE-16	6-S
16-BF-16	6-T
17-BG-1	1-B
17-BG-16	2-B
17-BG-21	1-B
17-N-16	6-U
18-BH-16	6-M
19-BJ-16	6-H
20-HE-16	9-Q
21-VB-16	8-Q
22-N-16	9-D
22-SA-16	9-G
23-N-16	9-E
24-N-16	8-R
24-VC-16	8-C
25-N-16	8-S
25-VC-16	8-T
26-N-16	11-D, 6-I
27-N-1	3-CC, 5-PP
27-N-16	5-P, 6-DD
27-N-21	3-CC, 5-PP
28-N-16	11-F
29-C-16	6-V
30-CA-16	8-V
31-D-15	11-A
31-D-16	11-A
31-N-16	11-A
32-N-1	3-CC, 5-PP
32-N-16	5-P, 6-DD
32-N-21	3-CC, 5-PP
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36-N-21	3-C, 5-CC 6-Q, 10-B
37-N-22	3-K, 10-F 10-C
38-N-16	3-CCC, 5-C 6-B
38-N-21	3-C, 5-CC, 6-Q, 10-E
39-N-22	3-K, 10-C
40-N-16	11-D
41-N-16	10-A
42-N-16	9-I
43-DC-16	2-H, 6-X
43-DC-21	1-B
44-DD-16	9-W
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46-N-6	3-L, 5-D, 6-YY
46-N-16	3-L, 5-D, 6-YY
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60-FD-16	8-T
61-N-16	10-A
62-N-16	11-H
63-N-16	3-CCC, 5-C 5-H, 6-U
63-N-21	3-C, 5-CC, 6-Q, 10-B
63-W-16	2-B
63-W-21	1-B
64-DE-16	8-D
65-HA-16	8-X
66-HB-16	11-B
67-N-16	7-B, 8-G
68-BA-9	1-C, 6-KK
68-BA-16	6-K
68-N-10	3-E, 5-T
69-BA-9	1-C, 6-KK
69-BA-16	6-K
69-N-10	3-E, 5-T
70-N-16	3-0, 5-L, 6-KKK
70-N-21	5-LL
71-N-16	3-P
72-HC-16	8-C
73-N-16	9-0
74-FE-4	2-D
74-FE-15	2-D
74.1-HF-16	8-E
75-N-16	7-C, 9-X
76-N-16	9-U
77-HG-16	6-NN
77-N-16	5-Q, 6-N, 6-G, 9-VV
77-N-21	10-D
78-FE-4	2-D
78-FE-15	2-D
78-E-16	2-G
78-N-15	11-A
79-N-13	3-I
79-N-15	3-I
80-N-16	7-D
80-N-21	5-I
81-N-16	5-F, 6-EE
82-N-16	5-E, 6-G
83-N-10	3-E, 5-T
83-BA-9	1-C, 6-KK
83-BA-16	6-K
84-I-16	8-L
85-R-16	8-P
86-IA-11	1-E
86-IA-16	2-E, 6-Z
86-N-6	3-M
86-N-11	3-M, 5-0, 6-CC
86-N-16	5-N, 6-C
87-N-6	3-N
88-IC-15	11-A
88-IC-16	2-G
89-IC-15	11-C
90-N-16	11-H
91-IC-15	11-I
92-IE-15	1-D
92-J-15	1-D
92-U-15	1-D
93-IF-16	8-Y
94-BJ-16	6-H
95-E-4	2-D
95-E-15	2-D
95-E-16	2-G, 9-K
96-N-16	9-J
97-N-16	7-B, 8-G
98-K-16	9-MM
99-KA-16	8-I
100-KB-16	8-H
101-KC-16	9-M
102-N-16	9-0
103-N-16	9-U
104-N-16	8-B
105-N-16	11-D
106-R-16	8-P
107-U-15	1-D
108-N-16	7-A
109-BG-1	1-B
109-BG-21	1-B
109-U-15	1-D
110-N-16	7-B, 8-G
111-N-16	8-G
112-N-16	9-Y
113-N-16	9-II
114-N-16	8-N, 8-0
115-K-16	9-MM
116-KA-16	8-I
117-KB-16	8-H
118-KC-16	9-M
119-WD-16	9-WW
120-N-16	5-M, 6-I
121-D-4	2-D
121-D-15	2-D, 11-C
121-N-10	3-J
122-BH-16	6-M
122-N-16	6-G
123-N-1	3-CC
123-N-16	5-M, 6-Y
123-N-21	3-CC
124-F-16	2-C, 6-L
124-W-16	2-C
125-N-16	9-II, 9-0
125-HH-16	9-P
126-N-16	8-G, 8-L
127-N-16	9-U
128-N-16	8-Z
129-HA-16	8-X
130-WC-16	9-S
131-N-1	4-A, 3-F
131-N-2	3-FF
131-N-3	1-H, 2-I, 3-D, 4-L, 5-R, 8-FF, 6-ZZ
131-N-5	4-C
131-N-7	4-M
131-N-8	4-N
131-N-9	1-H, 4-K
131-N-10	4-E
131-N-11	4-D
131-N-12	4-DD
131-N-13	4-F
131-N-14	4-I
131-N-17	3-B
131-N-18	4-H
131-N-19	4-J
131-N-20	4-G
131-N-21	4-B
131-N-23	2-I
131-N-24	9-Z
132-N-16	3-B
133-0-16	8-M
134-B-16	9-L
135-E-4	2-D
135-E-15	2-D
135-E-16	2-G, 9-K
136-P-16	6-VV
137-N-3	6-ZZZ
137-N-16	5-Q, 6-G, 6-N, 9-VV
137-N-21	10-D
137-HG-16	6-NN
138-F-16	2-C, 6-L,
138-N-16	3-CCC, 5-C, 5-H, 6-B, 6-G, 6-GG
138-N-21	3-C, 5-CC, 6-Q, 10-E
139-N-16	6-0
140-RA-16	6-MM
141-N-16	5-M, 6-I
142-N-16	6-P
143-RB-16	9-N
144-RC-10	1-F
144-RC-16	5-S, 6-ZZZ
145-N-16	9-0
146-BB-16	9-C
146-N-3	5-D
146-N-6	3-L, 5-D, 6-YY
146-N-16	3-L, 5-D, 6-YY
147-N-16	7-B, 8-G
148-EA-16	9-V
149-N-1	3-CC, 5-PP
149-N-21	3-CC, 5-PP
149-N-16	3-CCC, 5-P, 6-DD, 6-Y
150-N-16	5-C, 6-B
151-S-16	6-BB
152-F-16	6-L
152-N-16	3-CCC, 5-C, 6-B
152-N-21	3-C, 5-CC, 6-Q, 10-E
153-N-16	5-F, 6-E
154-N-22	10-F
155-N-16	5-J, 6-B, 3-CCC
155-N-21	3-C, 5-CC, 6-Q, 10-B
155-W-21	10-B
156-N-22	3-K, 10-C
157-BA-21	5-LL
157-N-16	3-0, 5-L, 6-KKK
158-N-16	9-D, 9-U
159-N-16	5-D
160-D-15	11-A
160-D-16	2-G
161-N-16	8-S
162-N-16	9-E, 9-U
163-N-16	9-D, 9-U
164-N-16	8-R
165-N-16	8-0, 9-II
166-N-16	5-I
167-HG-16	6-NN
167-N-16	7-C
168-N-16	5-M, 6-I
169-N-16	6-Z
170-N-16	3-L, 5-D, 6-YY
171-K-16	9-MM
172-KA-16	8-I
173-KB-16	8-H
174-KC-16	9-M
175-N-16	8-N
176-N-16	8-N
177-N-16	6-J
178-BE-7	1-G
178-N-16	7-C, 7-D
179-U-15	1-D
180-N-16	8-LL
181-N-16	11-G
182-B-16	9-L
183-N-16	11-D
184-N-16	6-0
185-BB-16	9-C
186-V-16	9-C
187-VA-16	9-T
188-DE-16	8-D
189-N-16	8-DD
190-N-16	8-G
191-N-16	7-B
192-N-16	8-0
193-N-16	8-B
194-RB-16	9-N
195-N-16	5-G, 6-F
196-N-16	6-0
197-N-16	5-G, 6-F
198-RB-16	9-N
199-BE-7	1-G
199-BE-16	6-S
200-RB-16	9-N
201-N-16	3-CCC, 5-C, 5-H, 6-B, 6-U
201-N-21	3-C, 5-CC, 6-Q, 10-B
201-W-16	2-B
201-W-21	1-B
202-N-16	3-H
202-N-22	3-K, 10-C
203-HG-16	6-NN
203-N-16	6-N, 9-VV
204-N-16	5-E, 6-GG, 6-J
205-N-16	6-D
206-HC-16	8-C
207-HD-16	8-J
208-FE-16	8-K
209-WB-16	9-R
210-WC-16	9-S
211-WD-16	9-WW
212-N-16	11-E
213-WG-16	9-ZZ

STEP NO. 2

Examine, Smell, Feel, Listen

This step calls for a careful inspection of the television set, both with it "on and "off". By means of the classification derived from Step No. 1, it is possible to confine the special checks outlined below to one particular section of the circuit known to contain the trouble. In the example given above under "Code Designation", the designation "86-1A-11" was found to be "1-E". It can be seen from the list in the above paragraph that classification number "one" places the trouble in the low voltage power supply. Therefore, this is the portion of the circuit which must be checked under Step No. 2. The letter "E" after the number "1" is not used in Step No. 2. However, it is required for subclassifying the trouble in Step No. 3.

Special (Step No. 2) Checks

Check "A" - If set is "dead", check "on-off" switch; check ballast resistors, check fuses, check power supply, check line cord, check safety (interlock) switch, check relay.

Check "B" - If the picture tube raster fails to appear, check ion trap, brightness control, high voltage lead, fuse in high voltage circuit.

Check "C" - With set disconnected, examine for charred, discolored, broken resistors.

Check "D" - With set disconnected, examine for puffed out, broken condensers or for condensers which have lost a considerable amount of wax. Look under condensers for melted wax.

Check "E" - With set disconnected, examine for broken leads, broken pigtails, unsoldered joints, poor connections, corroded joints, cold soldered joints, breaks in coils or other components.

Check "F" - With set connected, examine for unlighted tubes, for tubes which light up too brightly or which show cherry-red plates and for gassy tubes.

Check "G" - With set connected, examine for smoke from resistors, transformers, coils or other components.

Check "H" - With set connected, examine for high voltage sparking or corona discharge. This test is best made in darkened room.

Check "I" - With set connected, feel various components such as low voltage transformer and filter choke, resistors, electrolytic condensers, coils and similar parts which may show undue heating. Such heating in most cases is accompanied by smoke. It should be kept in mind, however, that a certain amount of heat is normal. Use extreme care in making this check to avoid shock. KEEP WELL AWAY FROM ALL HIGH VOLTAGE COMPONENTS. Also remember that so-called low voltages of 300 to 500 volts are capable of producing fatal shocks under certain conditions. In making test, use only one hand, keeping other hand in poclet or behind back and keeping test hand away from bare terminals or other non-insulated points.

Check "J" - With set connected, check for unusual or suspicious odors. Corona discharge is accompanied by strong odor of ozone. Overheated transformers and chokes often give off an odor of burnt varnish. Faulty selenium rectifiers give off characteristic odor of rotten eggs. Other unduly heated components also give off unusual odors.

Check "K" - With set connected, listen for high voltage "hiss" which may or may not be accompanied with sparking. Listen for high frequency hum at transformers and chokes. Listen for frying sounds in components. Listen at speaker for 60 or 120 cycle hum and for raspy "buzz".

Check "L" - With set connected, examine glass tubes and neck of picture tube for unlit tubes. Examine high voltage rectifier tube (from bottom) for soft heater glow. Observe usual precautions when near high voltage section. Note that heater glow is barely visible in case of many miniature tubes and therefore this check should be supplemented with a more positive continuity test.

Check "M" - With set connected, <u>feel</u> tubes after set has been "on" for ten or fifteen minutes. Cold tubes lack heater voltage. Do not check high voltage rectifier or horizontal output tubes in this way, except after set is "off" and caps of tubes and high voltage condensers have been discharged.

NOTE: The CISIN copyrighted Rapid Trouble Shooting Method, with its accurate and highly efficient system of localizing TV faults to a particular section of the receiver, is based on the assumption that the trouble symptoms observed have appeared in a set which previously was in good working order. For example, in Classification 1-A, it is assumed that picture, raster and sound have been lost simultaneously in a television set previously operating satisfactorily. This rules out the chance of a defective tube in the sound section PLUS a defective tube in the high voltage section combining to cause absence of picture, raster and sound, since the odds against both unrelated tubes becoming defective at exactly the same time would be very great. If the tube in the high voltage section becomes faulty first, symptom would be picture and raster absent, with normal sound. If the tube in the sound section becomes defective first, picture and raster would be normal, with sound absent. In applying RAPID CHECKS, it is important that these be performed in the order given.

STEP NO. 3

Classifications

1- LOW VOLTAGE POWER SUPPLY

1-A SYMPTOMS — PICTURE Absent; RASTER Absent; SOUND Absent

CODE — 1-A-1

CAUSE — No low voltage

RAPID CHECKS — Apply following in order given: 21, 28, 4, 23, 7, 5a (tube rectifier), 12 (if selenium rectifier), 13 (power supply filter condensers), 44 (filter choke and adjacent leads); finally, if above checks do not reveal origin of fault, repeat 7 and, at the same time, disconnect various leads, one after another, which supply operating voltages to different sections of the set. When faulty section is disconnected, check 7 will reveal normal resistance reading. Faulty components may then be located by appropriate Rapid Check No. 5, or by checks 13, 18 or 45.

1-B SYMPTOMS — PICTURE Moves up and down and from side to side, with reduced height and width and reduced brightness, or blurred.

RASTER Reduced brightness and/or reduced size

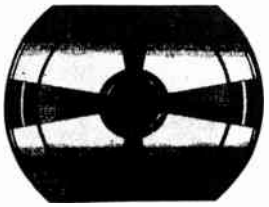
SOUND Weak or absent

CODES — 13-W-21, 17-BG-1, 17-BG-21, 43-DC-21, 55-W-21, 63-W-21, 109-BG-1, 109-BG-21, 201-W-21

CAUSE — Insufficient low voltage

RAPID CHECKS — 21, 5a, (tube rectifier), 12 (if selenium rectifier), 28, 23, 13 (check filter for leaky condenser).

1-C SYMPTOMS — PICTURE Horizontal bars, alternate dark and light usually accompanied by wavy edges and weaving, bending or pulling of picture; 60-cycle picture hum indicated by two bars, one light and one dark, or three bars, two identical with odd bar approximately twice width of other two. Four bars, two bright and two dark denote presence of 120-cycle hum.



1- LOW VOLTAGE POWER SUPPLY

1-C (Continued) RASTER Horizontal bars alternate dark and light usually accompanied by wavy edges.

SOUND Hum

CODES — 9-BA-9, 68-BA-9, 69-BA-9, 83-BA-9

CAUSE — Hum due to defective tubes in low voltage power supply or to poor filtering of power supply. Also see Classification 6-KK.

RAPID CHECKS — 29, 5a, 13

1-D SYMPTOMS — PICTURE Unstable, intermittent reduction in size, jittery.

RASTER Unstable, intermittent reduction in size, jittery

SOUND Noisy

CODES — 92-IE-15, 92-J-15, 92-U-15, 107-U-15, 109-U-15, 179-U-15

CAUSE — Line voltage fluctuation

RAPID CHECK — 28

1-E SYMPTOMS — PICTURE Intermittent or fading; RASTER Intermittent; SOUND Intermittent

CODES — 53-IA-11, 86-IA-11

CAUSE — Intermittent low voltage power supply

RAPID CHECKS — 46, 21, 5a (for tube rectifiers) or 12 (for selenium rectifiers) 7, 28

1-F SYMPTOMS — PICTURE Ripple (vertical wrinkle) changing only with volume control variation

RASTER Ripple changing only with volume control variation

SOUND Hum (heard only with signal)

CODE — 144-RC-10

CAUSE — Feedback from defective electrolytic by-pass in audio output circuit to low voltage power supply

RAPID CHECKS — 13, 29

1- LOW VOLTAGE POWER SUPPLY

1-G SYMPTOMS

PICTURE	Brightness and focus extremely slow in reaching normal level or washed-out appearance, unstable horizontal sync
RASTER	Brightness very slow in reaching normal level
SOUND	Excessively slow in reaching normal level

CODES 15-BE-7 178-BE-7 199-BE-7

CAUSE Insufficient low voltage

RAPID CHECKS 21, 5a (tube rectifier), 12 (if selenium rectifier), 28, 23, 13 (check filter for leaky condenser).

1-H SYMPTOMS

PICTURE	Normal
RASTER	Normal
SOUND	Buzz or hum

CODES 131-N-3 131-N-9

CAUSE Vibrating low voltage power transformer due to loose laminations, loose coil assemblies. Also see Classifications 3-D, 4-L, 5-T, 6-ZZ, 8-FF, 9-Y.

RAPID CHECKS 73, 74. Check by tightening holding bolts and wedging loose parts.

2- HIGH VOLTAGE POWER SUPPLY

2-A SYMPTOMS

PICTURE	Absent
RASTER	Absent
SOUND	Normal

CODE 1-A-16

CAUSE No high voltage. Also see Classifications 6-AAA, 9-B

RAPID CHECKS 1, 50, 6, 5b, 5c, 5aa, 45 (to resistor in lead to connection on side of picture tube), 44 (to same lead and to windings of high voltage transformer), 31, and 25.

2-B SYMPTOMS

PICTURE	Weak
RASTER	Weak (with brightness control full on)
SOUND	Normal

CODES 17-BG-16 63-W-16 201-W-16

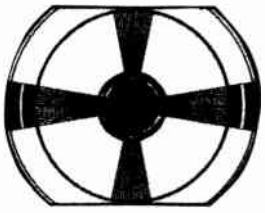
CAUSE Insufficient high voltage

RAPID CHECKS 24, 6, 5b, 5c, 5aa, 5ad, 45, 31

2- HIGH VOLTAGE POWER SUPPLY

2-C SYMPTOMS

PICTURE	Focus defective
RASTER	Weak, focus defective
SOUND	Normal



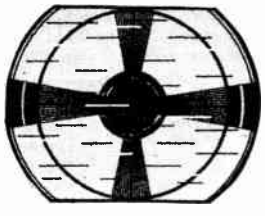
CODES 13-F-16 55-F-16 56-F-16 56-W-16 138-F-16 124-F-16 124-W-16 152-F-16

CAUSE Very weak high voltage. Also see Classification 6-L

RAPID CHECK 14

2-D SYMPTOMS

PICTURE	Noisy, streaked, horizontal flashes, or jagged edges, piecrust effect
RASTER	Dark horizontal streaks edges jagged, horizontal flashes
SOUND	Noisy, cracking, snapping or frying.



CODES 47-E-4 47-E-15 74-FE-4 74-FE-15 78-FE-4 78-FE-15 95-E-4 95-E-15 121-D-4 121-D-15 135-E-4 135-E-15

CAUSE Corona discharge or arc-over at high voltage supply, undesired coupling between high voltage supply and picture tube leads, especially in case of r.f. power supply, poor connection between outer conductive coating of glass pix tube and chassis, defective high voltage condenser, defective high voltage oscillator trimmer condenser in r.f. supply, sharp points in solder or wiring of high voltage supply circuits, poor soldering connections in these circuits. Also see Classification 11-C.

RAPID CHECKS 14, 6, check for sharp points, spray with anti-corona lacquer and check results.

2- HIGH VOLTAGE POWER SUPPLY

2-E SYMPTOMS
PICTURE Intermittent or fading
RASTER Intermittent
SOUND Normal

CODES 53-IA-16 86-IA-16

CAUSE Intermittent high voltage. Also see Classification 6-Z.

RAPID CHECKS 1, 46, 5b, 5c, 5aa, 5ad

2-F SYMPTOMS
PICTURE Enlarged, loss of brightness, distorted, blooming
RASTER Enlarged, expanded abnormally
SOUND Normal

CODES 12-BC-16 51-EC-16

CAUSE Low second anode potential at picture tube

RAPID CHECKS 24, 6, 5b, 5c, 5aa, 5ad, 45, 31

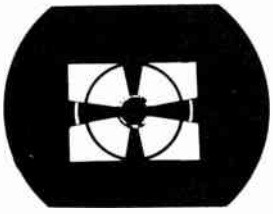
2-G SYMPTOMS
PICTURE Edges jagged, light and dark horizontal streaks
RASTER Edges jagged, dark horizontal streaks
SOUND Normal

CODES 47-E-16 88-IC-16 135-E-16
78-E-16 95-E-16 160-D-16

CAUSE Poor contact or poorly soldered joint in high voltage line from rectifier to picture tube second anode, poor picture tube cathode return contact

RAPID CHECKS 46, 50

2-H SYMPTOMS
PICTURE Dwarfed vertically and horizontally
RASTER Dwarfed vertically and horizontally
SOUND Normal



CODE 43-DC-16

CAUSE Excessive high voltage. Also see Classification 6-X.

RAPID CHECKS 5b, 5c, 5y

NOTE: If sound is not normal, but hum is present, see Classification 1-B. Also check yoke placement.

2- HIGH VOLTAGE POWER SUPPLY

2-I SYMPTOMS
PICTURE Normal
RASTER Normal
SOUND Whistle or buzz

CODE 131-N-23

CAUSE Electrostatic coupling between high voltage section and audio circuits. Poor grounding of conductive coating on glass picture tube, vibration of horizontal output terminal mounting board, or of other loose terminal mounts in high voltage section.

RAPID CHECK 82

3- FRONT END INCLUDING R.F. AMPLIFIER, OSCILLATOR AND MIXER (CONVERTER) CIRCUITS

3-A SYMPTOMS
PICTURE Absent all channels
RASTER Normal
SOUND Absent all channels

CODE 1-N-1

CAUSE R.F. amplifier section defective. Also see Classifications 5-B, 5-BB, 6-Q.

RAPID CHECKS 5h, 39, 19, 40, 41. If signal passes through all portions of circuit except r.f. amplifier section, this definitely locates the trouble in the r.f. circuit. Apply Rapid Checks 22, 49, 44 and 45 to r.f. circuit components.

3-AA SYMPTOMS
PICTURE Absent all channels
RASTER Normal
SOUND Absent all channels

CODE 1-N-1

CAUSE Defect in oscillator section

RAPID CHECKS 61, 41. Trouble definitely located at oscillator if picture i.f. frequency applied at mixer grid passes through this section, but picture carrier frequency applied at same place does not pass. Then apply Rapid Checks 5g, 22 (to osc.), 49, 44 and 45 to oscillator circuit components.

3-AAA SYMPTOMS
PICTURE Absent all channels
RASTER Normal
SOUND Absent all channels

CODE 1-N-1

CAUSE Defect in mixer section

3-AAA (Continued)

RAPID CHECKS 41, 40. Trouble definitely located at mixer if picture i.f. frequency passes through video i.f. section, but not through mixer. Then apply 5e and following checks to mixer circuit components: 49, 44, 45, 8 (to condenser between output of mixer and first pix i.f.).

NOTE: In intercarrier type sets, loss of picture and sound, with raster normal, may also be caused by defects in picture i.f. section, video detector, or video amplifier. See Classifications 5-A and 5-B.

3-B SYMPTOMS PICTURE Normal
RASTER Normal
SOUND Not coincident with picture. (Pix and sound come in at different points as fine tuning control is adjusted

CODES 131-N-17 132-N-16

CAUSE Oscillator incorrectly tuned or mis-aligned front end or both, defective or drifting oscillator tube or defective oscillator components

RAPID CHECKS Set fine tuning control at center of its span of rotation and readjust oscillator slugs for best operation on each channel. Apply checks 5g and 22, also checks 8 and 45 to all oscillator circuit components. If necessary apply Rapid Alignment Check No. 1

NOTE: Even in a correctly aligned set, it is possible that one or more of the weaker channels may show the following symptom. When oscillator is tuned for best sound, the picture is weakened slightly and vice versa. This is a normal symptom in a properly designed and aligned wide band set. If realignment of the i.f. is made on the one offending station, picture quality may then be adversely affected on the stronger stations.

3-C SYMPTOMS PICTURE Weak all channels (blurred, cloudy, details poor or absent, faint, hazy, indistinct, poor quality, snow)
RASTER Normal
SOUND Weak

CODES 13-N-21 55-N-21 152-N-21
36-N-21 63-N-21 155-N-21
38-N-21 138-N-21 201-N-21

3-C (Continued)

CAUSE Weak front end tube or tubes, incorrect operating voltages on front end tubes, r.f. or oscillator misalignment, defective component or poor contacts in tuner. Also see Classifications 5-CC, 6-Q, and 10-B.

RAPID CHECKS 5h, 22. Apply Special Check E (Step No. 2) to tuner, 19 (for weak oscillator output), 8 and 45 (to tuner components).

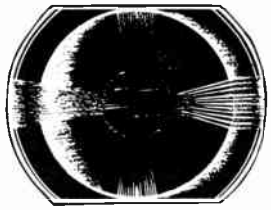
3-CC SYMPTOMS PICTURE Contrast insufficient, partially or completely inoperative, poor shading, darkened picture
RASTER Normal
SOUND Weak or absent

CODES 27-N-1 32-N-21 149-N-1
27-N-21 123-N-1 149-N-21
32-N-1 123-N-21

CAUSE Defective a.g.c., defective diode gating, defective divided bias control

RAPID CHECKS 5j, 22, 66, 67

3-CCC SYMPTOMS PICTURE Weak, darkened
RASTER Normal
SOUND Normal



CODES 13-N-16 55-N-16 149-N-16
36-N-16 63-N-16 152-N-16
38-N-16 138-N-16 155-N-16
201-N-16

CAUSE Defective oscillator tube, oscillator incorrectly aligned to operate below instead of above signal frequency, insufficient signal gain due to defective r.f. amplifier tube, or poorly aligned r.f. amp., insufficient translation gain due to defective mixer. Also see Classifications 5-C & 6-B.
NOTE: In most cases weak picture due to front end troubles is accompanied by weak

3-CCC CAUSE (Continued)

sound. However, in certain instances, normal sound will be obtained from a composite signal too weak to provide a suitable picture.

RAPID CHECKS 5g, 5e, 22. Examine r.f. response curve as explained in Rapid Alignment Check No. 1 for insufficient gain, also note whether pix carrier is correctly peaked. If these checks fail to reveal fault, trouble is located in pix i.f. or video amplifier.

3-D SYMPTOMS
PICTURE Normal
RASTER Normal
SOUND Buzz (continuous raspy sound)

CODE 131-N-3

CAUSE Amplitude modulation of FM carrier in r.f. amplifier or in mixer due to cross-modulation from pix carrier. May result from defective tubes, incorrect tube operating voltages, incorrect r.f. bias voltage, misalignment of r.f. stage. Also see Classifications 1-H, 2-I, 4-L, 5-R, 6-ZZ, 8-FF.

RAPID CHECKS 72, 5d, 5e, 5j, 22, 67, 66, Rapid Alignment Check No. 1

3-E SYMPTOMS
PICTURE Hum bars, horizontal
RASTER Normal
SOUND Hum (modulation) only heard when station signal is tuned in.

CODES 9-N-10 68-N-10 69-N-10 83-N-10

CAUSE Heater-cathode leakage in r.f., oscillator or mixer tubes, hum voltage in B-supply to these tubes. Also see Classification 5-T.

RAPID CHECKS 85, 86, 5d, 5e, 5g, 87

3-F SYMPTOMS
PICTURE Normal
RASTER Normal
SOUND Absent all channels

CODE 131-N-1

CAUSE Defective sound take-off coil or condenser. Also see Classification 4-A

RAPID CHECKS 44 (take-off coil), 8

3- FRONT END INCLUDING R.F. AMPLIFIER, OSCILLATOR AND MIXER (CONVERTER) CIRCUITS

3-FF SYMPTOMS
PICTURE Normal
RASTER Normal
SOUND Absent, one channel

CODE 131-N-2

CAUSE Severe r.f. misalignment on one channel

RAPID CHECK Apply Rapid Alignment Check No. 1 to defective channel.

3-G SYMPTOMS
PICTURE Absent one channel
RASTER Normal
SOUND Absent one channel

CODE 4-N-2

CAUSE R.F. coil open or shorted, oscillator coil open or shorted, open or shorted tuner contacts one channel, oscillator misaligned on one channel.

RAPID CHECKS 39, 40, 41. Try touching up alignment of oscillator. To locate open or shorted coils, apply check 44. Remove and check suspected channel section in turret type front end.

3-H SYMPTOMS
PICTURE Absent or weak, one channel
RASTER Normal
SOUND Normal

CODES 4-N-16 202-N-16

CAUSE Severe r.f. misalignment one channel

RAPID CHECK Apply Rapid Alignment Check No. 1 to defective channel.

3-I SYMPTOMS
PICTURE Horizontal strips missing, streaking
RASTER Normal
SOUND Noisy or microphonic

CODES 79-N-13 79-N-15

CAUSE Intermittent oscillator operation at audible or sub-audible rate. Sometimes referred to as "squegging". Due to excessive increase in resistance of grid leak resistor. (Oscillator) There is possibility that trouble may originate in oscillator tube.

RAPID CHECKS Apply Rapid Check 20 (front end tubes, especially oscillator), also check for loose tube socket or shield base, loose or dusty fine tuning condenser. Apply 45 to grid leak resistor. 5g

3- FRONT END INCLUDING R.F. AMPLIFIER, OSCILLATOR AND MIXER (CONVERTER) CIRCUITS

3-J SYMPTOMS
PICTURE Noise (streaked)
RASTER Normal
SOUND Hum (modulation)

CODE 121-N-10

CAUSE Heater-cathode leakage in one or more front end tubes, high ripple voltage supplied to plate, screens or grids of these tubes.

RAPID CHECKS 5h, 29

NOTE: Pix will be affected in all cases where faulty tube amplifies both sound and pix signals, with effect on picture greater than on sound due to limiting action of FM circuit. It is possible for sound to be unaffected on certain stronger stations, even with r.f. heater-cathode leakage or excessive ripple in d.c. voltage supply.

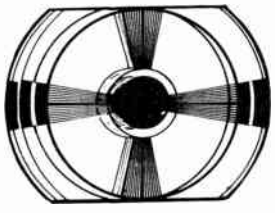
3-K SYMPTOMS
PICTURE Weak on one channel
RASTER Normal
SOUND Weak on one channel

CODES 37-N-22 156-N-22 202-N-22
39-N-22

CAUSE Dirty contacts at tuner on faulty channel, defective component in tuner at faulty channel, incorrectly aligned r.f. amplifier (faulty channel only). See Classification 10-C.

RAPID CHECKS First make certain this is not a trouble originating in transmitter, or due to faulty antenna. Check tuner parts associated with faulty channel applying to checks 44, 45, 8. Check r.f. alignment of faulty channel.

3-L SYMPTOMS
PICTURE Thin black and white lines, especially noticeable after vertical picture lines. (Echo or ringing effect)



RASTER Normal
SOUND In some cases, sound is normal, in others sound drifts or fades in and out

3- FRONT END INCLUDING R.F. AMPLIFIER, OSCILLATOR AND MIXER (CONVERTER) CIRCUITS

3-L (Continued)

CODES 46-N-6 146-N-6 146-N-16
46-N-16

CAUSE Regeneration (undesired oscillations) due to low level of pix carrier relative to sound carrier in cases of severe r.f. misalignment, to open screen, plate or grid by-pass condenser in front end tube(s), in rare case to defective front end tubes. Also see Classifications 5-D and 6-YY.

RAPID CHECKS 91. Apply Rapid Alignment Check No. 1, especially if trouble is present on all channels. Check in pix i.f. and video sections first, applying checks 83 and 84. Apply Checks 8 (to front end by-pass condensers), 5h.

3-M SYMPTOMS
PICTURE Intermittent or fading all channels
RASTER Normal
SOUND Drifts or fades in and out

CODES 53-N-6 53-N-11 86-N-6
86-N-11

CAUSE Oscillator drift, worn detents, dust or dirty or worn switching or trolley contacts in tuner, defective front end tubes or sockets, or poorly soldered connections in tuner. Also see Classifications 5-O and 6-CC

RAPID CHECKS 5h, check for obstructed ventilation openings which might cause overheating and resultant oscillator drift, 45 (for lowered grid-bias (resistor), 22 (for abnormally high plate voltage), 8 (for open r.f. by-pass condenser in oscillator circuit), inspect and clean tuner contacts, check socket and other connections.

3-N SYMPTOMS
PICTURE Intermittent or fading
RASTER Normal
SOUND Intermittent or fading single channel

CODES 54-N-6 87-N-6

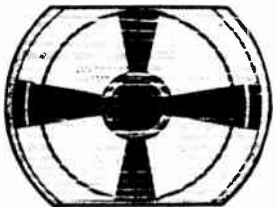
CAUSE Dirty or corroded or otherwise poor contacts on tuner (defective channels only), intermittent contact or poorly soldered joint at tuning inductance of defective channel

RAPID CHECKS Apply 46 to various components of defective channel

3- FRONT END INCLUDING R.F. AMPLIFIER, OSCILLATOR AND MIXER (CONVERTER) CIRCUITS

3-0 SYMPTOMS

PICTURE Horizontal bars, alternate dark and light (sound bars)
RASTER Normal
SOUND Normal



CODES 9-N-16 70-N-16 157-N-16

CAUSE Defective oscillator tube, oscillator misalignment or fine tuning defect or misadjustment, microphonic r.f. amplifier tube. Note that sound bars vary both in brightness and number as volume and pitch of sound signals change. Also see Classifications 5-L and 6-KKK.

RAPID CHECKS 5g, 5d. Check oscillator fine tuning control.

3-P SYMPTOMS

PICTURE Horizontal white bars only when station is tuned in
RASTER Normal
SOUND Normal

CODE 71-N-16

CAUSE Short circuit between heater and cathode in oscillator tube, defective oscillator components

RAPID CHECKS 5g, 49 (by-pass condensers which might produce short circuit)

4- SOUND SECTION INCLUDING SOUND I.F., DISCRIMINATOR, AUDIO SECTION AND SPEAKER

4-A SYMPTOMS

PICTURE Normal
RASTER Normal
SOUND Absent all channels

CODE 131-N-1

CAUSE Defective speaker, defective tubes in sound section, incorrect or absent operating voltages on sound section tubes, open circuits or faulty components in sound section, misalignment of sound i.f. and/or discriminator. Also see Classification 3-F.

4- SOUND SECTION INCLUDING SOUND I.F., DISCRIMINATOR, AUDIO SECTION AND SPEAKER

4-A (Continued)

RAPID CHECKS 10, 35. These two checks will definitely show whether defect or trouble is in sound section up to and including discriminator or in section following discriminator. If in latter, apply following checks: 5q, 5r, 9, 64, 8 (condenser between audio amplifier and audio output tubes), 45 (grid resistors in this section), 49 (by-pass condensers this section).

If in sound section up to and including discriminator, apply following checks: 5o, 5p, 22 (all i.f. tubes), then 8, 44, 45 and 49 for components in this section. If these checks do not reveal fault, apply Rapid Alignment Check No. 3.

4-B SYMPTOMS

PICTURE Normal
RASTER Normal
SOUND Weak all channels

CODE 131-N-21

CAUSE Weak tubes in sound section, incorrect alignment, defective speaker, incorrect operating voltages, faulty components. Check especially for shorted cathode by-pass condenser, incorrect value cathode resistor in audio amplifier or audio output stages.

RAPID CHECKS 5o, 5q, 5p, 5r, 65, 9, 22, 49, 44, 45

4-C SYMPTOMS

PICTURE Normal
RASTER Normal
SOUND Distorted voice and music

CODE 131-N-5

CAUSE Defective speaker, defective tubes, incorrect operating voltages, incorrect alignment of sound i.f. and/or discriminator, faulty components in sound section

RAPID CHECKS 9, 5q, 5r, 22, 65, 49, 44, 45

4-D SYMPTOMS

PICTURE Normal
RASTER Normal
SOUND Intermittent (voice and music)

CODE 131-N-11

CAUSE Open grid (first audio or output tubes), leaky condenser in audio section, defective tube or poorly soldered connection or defective socket in sound section.

RAPID CHECKS 46 (at first audio and audio output) 5o, 5p, 5r, 49, 44, 45, 5q

4- SOUND SECTION INCLUDING SOUND I.F., DISCRIMINATOR, AUDIO SECTION AND SPEAKER

4-DD SYMPTOMS — PICTURE: Normal; RASTER: Normal; SOUND: Intermittent (noise and static)

CODE: 131-N-12

CAUSE: Defective limiter stage, especially voltage reducing resistors in plate supply circuit, defective sound section tubes especially limiter and/or ratio detector (or discriminator), incorrect limiter voltages, defective electrolytic condenser in ratio detector circuit, defective resistor shunting this electrolytic condenser, poorly soldered or unsoldered joints or defective sockets in sound section.

RAPID CHECKS: 78, 5o (limiter tube(s) only), 22 (limiter tube), 5p, 5q, 5r, 13 (electrolytic condenser in ratio detector circuit), 45, 46

4-E SYMPTOMS — PICTURE: Normal; RASTER: Normal; SOUND: Hum, modulation (heard only with signal)

CODE: 131-N-10

CAUSE: Heater-cathode leakage in sound i.f. tube(s), hum voltage in screen or plate supply of these tubes, hum due to defects becomes more noticeable if limiter action is defective or if sound i.f. and discriminator are misaligned. Intercarrier sets should be aligned exactly at 4.5 mc. for least hum.

RAPID CHECKS: 5f, 22, 29 (applied to plate and screen supply of sound i.f. amplifier tubes) 78, Rapid Alignment Check No. 3.

4-F SYMPTOMS — PICTURE: Normal; RASTER: Normal; SOUND: Microphonic

CODE: 131-N-13

CAUSE: Microphonic tube in sound section, loose slugs in sound i.f. transformer

RAPID CHECKS: 20 (tubes in sound section), check slugs.

4- SOUND SECTION INCLUDING SOUND I.F., DISCRIMINATOR, AUDIO SECTION AND SPEAKER

4-G SYMPTOMS — PICTURE: Normal; RASTER: Normal; SOUND: Volume non-adjustable

CODE: 131-N-20

CAUSE: Defective volume control potentiometer

RAPID CHECK: 45 (apply to volume control)

4-H SYMPTOMS — PICTURE: Normal; RASTER: Normal; SOUND: Oscillations

CODE: 131-N-18

CAUSE: Feedback, improper operating voltages in sound section, incorrect sound i.f. alignment, defective screen by-pass condensers, poor ground connections, grid leads too close to plate leads.

RAPID CHECKS: 22, Rapid Alignment Check No. 3, 49, 78

4-I SYMPTOMS — PICTURE: Normal; RASTER: Normal; SOUND: Motor-boating

CODE: 131-N-14

CAUSE: Same as 4-H, also incorrect resistance values of grid and plate resistors in audio section

RAPID CHECKS: 22, 49, 45, Rapid Alignment Check No. 3.

4-J SYMPTOMS — PICTURE: Normal; RASTER: Normal; SOUND: Tone control non-adjustable

CODE: 131-N-19

CAUSE: Defective tone control potentiometer, open tone control condenser

RAPID CHECKS: 45 (to tone control potentiometer) 8 (to tone control condensers)

4-K SYMPTOMS — PICTURE: Normal; RASTER: Normal; SOUND: Hum (source other than signal)

CODE: 131-N-9

4- SOUND SECTION INCLUDING SOUND I.F., DISCRIMINATOR, AUDIO SECTION AND SPEAKER

4-K (Continued)

CAUSE Defective tubes in audio section (first audio or output), defective discriminator tube, poor ground connection on shielded volume control cable, open by-pass condenser in audio section, leaky electrolytic condenser in B-supply circuits to audio amplifier, unshielded audio input leads or circuits too close to a.c. power supply leads or circuits. Also see Classification 1-H.

RAPID CHECKS 80, 5p, 5q, 5r, 44 (shield to ground), 49 (audio by-pass condensers), 13 (electrolytic by-pass condensers in audio section).

4-L SYMPTOMS PICTURE Normal
RASTER Normal
SOUND Buzz

CODE 131-N-3

CAUSE Defective sound i.f. tubes, especially limiter tube, defective ratio detector (discriminator), incorrect operating voltages, faulty limiter operation, especially incorrect screen and plate voltages, misalignment of sound i.f. or ratio detector, faulty components in ratio detector, especially electrolytic condenser or its shunting resistor. Other causes may be vibrating audio output transformer, unsoldered or poorly soldered connections in audio section. Defective speaker.

RAPID CHECKS 5o, 5p, 22, 78, Rapid Alignment Check No. 3, 13, 46. Check for broken condenser in base of discriminator. In intercarrier sets, tune primary of discriminator (or ratio detector) for best volume on weak signal and secondary for least buzz on strong signal. In intercarrier sets using gated-beam detection, set bias control for least buzz while aligning set.

NOTE: For buzz due to vibrating components in other parts of TV set or induced or conducted into audio circuits but originating in other sections of the TV receiver, see Classifications 1-H, 3-D, 5-T, 6-ZZ, 8-FF, 9-Y. Buzz currents flowing through sound i.f. can often be reduced or eliminated by correcting defective limiter. Locate sources of buzz by applying Rapid Checks 81 and 82.

4-M SYMPTOMS PICTURE Normal
RASTER Normal
SOUND Excessively slow in reaching normal level

4- SOUND SECTION INCLUDING SOUND I.F., DISCRIMINATOR, AUDIO SECTION AND SPEAKER

4-M (Continued)

CODE 131-N-7

CAUSE Defective crystal diode in ratio detector or discriminator, slow heating tube(s) in sound section

RAPID CHECKS 11, 5o, 5p, 5q, 5r

4-N SYMPTOMS PICTURE Normal
RASTER Normal
SOUND High pitched or shrill tone

CODE 131-N-8

CAUSE Open condenser or shorted resistor or both in de-emphasis network (in output circuit of ratio detector or discriminator)

RAPID CHECKS 8, 45

5- PICTURE (VIDEO) I.F. SECTION

5-A SYMPTOMS PICTURE Absent all channels
RASTER Normal
SOUND Normal

CODE 1-N-16

CAUSE Defective pix i.f. tubes, incorrect pix i.f. operating voltages, defective components in pix i.f. circuits, open resistor in contrast control circuit, leaky coupling condenser causing positive grid bias on i.f. tubes, defective a.g.c. causing excessive negative bias, defective video detector, very bad pix i.f. misalignment. Also see Classification 6-A.

RAPID CHECKS Check to make certain trouble is in pix i.f. and not in video amplifier. Apply checks 34, 41. Latter locates defective pix i.f. stage or stages. Then apply 5f (only in defective stages). Then apply checks 22, 5 i, 11 (if crystal video detector is used), 5j, 44, 45, 49, 67, 66 at defective i.f. stages, contrast control and a.g.c., finally, apply Rapid Alignment Check No. 2.

NOTE: In intercarrier sets, similar causes would usually result in absence of sound although it is possible for a defective crystal detector to obstruct picture signal while passing the 4.5 mc. beat frequency signal.

5-B SYMPTOMS
PICTURE Absent all channels
RASTER Normal
SOUND Absent all channels

(Above symptoms apply to intercarrier sets only)

CODE 1-N-1

CAUSE Same as Classification 5-A.

RAPID CHECKS Same as Classification 5-A.

5-C SYMPTOMS
PICTURE Weak, blurred, faint etc. all channels
RASTER Normal
SOUND Normal

CODES
13-N-16 55-N-16 138-N-16
36-N-16 63-N-16 150-N-16
38-N-16 123-N-16 152-N-16
201-N-16

CAUSE Same as Classification 5-A. Also see Classifications 3-CCC and 6-B

RAPID CHECKS Same as Classification 5-A

5-CC SYMPTOMS
PICTURE Weak, blurred, faint, etc. all channels
RASTER Normal
SOUND Weak all channels

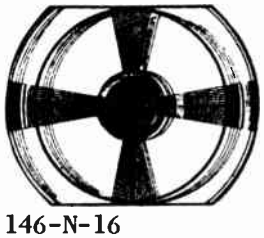
(Intercarrier sets only)

CODES
13-N-21 55-N-21 152-N-21
36-N-21 63-N-21 201-N-21
38-N-21 138-N-21

CAUSE Same as Classification 5-A. Also see Classifications 3-C, 6-Q.

RAPID CHECKS Same as Classification 5-A.

5-D SYMPTOMS
PICTURE Echo effect (sometimes called "ringing") thin black and white lines after vertical picture lines.
RASTER Normal
SOUND Normal, or in intercarrier sets, in some cases buzz or fading in and out



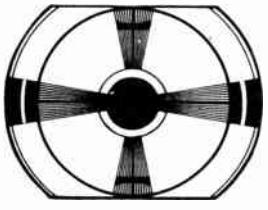
CODES
46-N-16 146-N-16
(intercarrier) 46-N-3 146-N-3
46-N-6 146-N-6

5-D (Continued)

CAUSE Regeneration due to misalignment pix i.f. or open or reduced capacitance of plate, screen or grid by-pass condenser in pix i.f. section, poor lead dress, poor grounding of shields, increased resistance of load resistors paralleling tuned circuits in pix i.f., defective coupling networks, sometimes defective pix i.f. tubes. Also see Classifications 3-L and 6-YY

RAPID CHECKS Rapid Alignment Check No. 2, then 49, rearrange leads, check shield grounds, 45 (load resistors and coupling networks), 5o.

5-DD SYMPTOMS
PICTURE Dark horizontal streaks across vertical station patterns (often accompanied by symptoms of Classification 5-D)
RASTER Normal
SOUND Normal (In intercarrier sets buzz or fading may be heard)

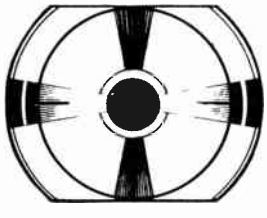


CODES 34-N-16 (Intercarrier) 34-N-3 34-N-6

CAUSE Same as Classification 5-D

RAPID CHECKS Same as Classification 5-D

5-E SYMPTOMS
PICTURE Horizontal wedges of station pattern much weaker than vertical wedges (often accompanied by horizontal weaving or ripple when background changes).
RASTER Normal
SOUND Normal



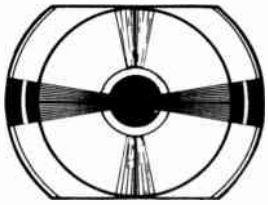
CODES 82-N-16 204-N-16

5-E (Continued)

CAUSE — Poor low frequency response due to pix i.f. misalignment (Pix i.f. carrier lower than 50%). Also see Classifications 6-GG and 6-J.

RAPID CHECKS — Rapid Alignment Check No. 2

5-F SYMPTOMS — PICTURE: Horizontal wedges of station pattern much stronger than vertical wedges, smearing and streaking after large objects
RASTER: Normal
SOUND: Normal

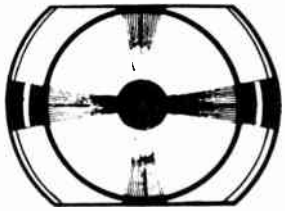


CODES — 81-N-16 153-N-16

CAUSE — Excessive low frequency response due to pis i.f. misalignment. Also see 6-E and 6-EE.

RAPID CHECK — Apply Rapid Alignment Check No. 2

5-G SYMPTOMS — PICTURE: Vertical wedge station pattern cut off towards narrow portion.
RASTER: Normal
SOUND: Normal



CODE — 195-N-16

CAUSE — Poor high frequency response due to narrow band width caused by incorrect tuning of associated sound trap or alignment of pix i.f. to single peak. Also see Classification 6-F

RAPID CHECK — Rapid Alignment Check No. 2

5-H SYMPTOMS — PICTURE: Quality poor, weak, blurred, etc.
RASTER: Normal
SOUND: Normal

5-H (Continued)

CODES — 63-N-16 123-N-16 201-N-16 138-N-16

CAUSE — Incorrect pix i.f. alignment, incorrect value damping resistors shunting tuned i.f. circuits, open by-pass condensers, leaky coupling condensers, excessive negative bias on i.f. tubes, defective a.g.c.,defective i.f. tubes, regeneration in i.f. amplifier; defective video detector, incorrect adjustment of adjacent sound trap. Also see Classifications 3-C, 3-CC, 3-CCC, 5-C, 6-Q.

RAPID CHECKS — Rapid Alignment Check No. 2. Also apply appropriate checks given in Classification 5-A.

NOTE: Similar trouble causes in intercarrier sets would also weaken the sound.

5-I SYMPTOMS — PICTURE: Tearing horizontally, following sound impulses
RASTER: Normal
SOUND: Weak all channels

CODES — 80-N-21 166-N-21

CAUSE — Incorrect adjustment of associated sound traps

RAPID CHECK — Rapid Alignment Check No. 2

5-J SYMPTOMS — PICTURE: Snow
RASTER: Normal
SOUND: Normal, or weak in intercarrier sets

CODES — 155-N-16 155-N-21

CAUSE — Same as Classification 5-A
Also see Classification 10-B

RAPID CHECKS — Same as Classification 5-A

5-K SYMPTOMS — PICTURE: Airplane flutter (successive building up and fading of signal when plane passes)
RASTER: Normal
SOUND: Fades in and out

CODE — 5-N-6

CAUSE — Defect in keyed a.g.c., defective a.g.c. tube(s), defective condensers or resistors in keyed a.g.c. circuit, open line

5-K CAUSE (Continued)

supplying horizontal pulse to plate of a.g.c. tube, incorrect a.g.c. threshold adjustment

NOTE: Sets not provided with some form of keyed a.g.c. are subject to airplane flutter unless this type of a.g.c. is installed.

RAPID CHECKS 67, 66, 5j, 8, 45, 44

5-L SYMPTOMS PICTURE Bars, horizontal, alternate dark and light (sound bars)
RASTER Normal
SOUND Normal

CODES 9-N-16 70-N-16 157-N-16

CAUSE Misaligned or defective associated or adjacent sound trap(s) or sound take-off, microphonic tube in picture i.f. amplifier, speaker leads too close to video detector tubes. If set omits sound traps, pix i.f. may need realignment. Note that sound bars vary both in brightness and number as volume and pitch of sound signals change. Also see Classifications 3-0 and 6-KKK

RAPID CHECKS With set in operation, adjust each trap and note effect on sound bars. Apply checks 44, 8 (to trap inductances and sound take-off), Rapid Alignment Check No. 2, 5f, check dress of speaker leads.

5-LL SYMPTOMS PICTURE Bars, horizontal, alt. dark and light (sound bars)
RASTER Normal
SOUND Weak

(Above symptoms apply to intercarrier sets only)

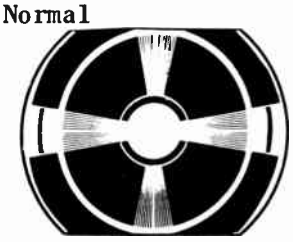
CODES 9-N-21 70-N-21 157-N-21

CAUSE Microphonic tube in picture i.f. amplifier, speaker leads too close to video detector tube, microphonic video amplifier tube before sound take-off. Also see 'Classifications 3-0 and 6-KKK

RAPID CHECKS 5f, 5k (to tubes before sound take-off), check dress of speaker leads.

5- PICTURE (VIDEO) I.F. SECTION

5-M SYMPTOMS PICTURE Engraved effect (negative picture)
RASTER Normal
SOUND Normal



CODES 10-N-16 50-N-16 141-N-16 123-N-16 168-N-16

CAUSE Overloading of pix i.f. amplifier due to defective a.g.c. tube or circuit, defective pix i.f. tube, contrast control defective or misadjusted. Also see Classification 6-I.

RAPID CHECKS 5j, 5f, 67, 66, 8 and 45 (a.g.c. circuit)

5-N SYMPTOMS PICTURE Intermittent or fading
RASTER Normal
SOUND Normal

CODES 53-N-16 86-N-16

CAUSE Defective pix i.f. amplifier tube, circuit components or sockets, poor connections or loose contacts in pix i.f., defective video detector. Also see Classification 6-C.

NOTE: All above defects in circuits after sound take-off only.

RAPID CHECKS 5f, 5i, 11 (if crystal video detector is used), visual inspection for poor connections, 8 and 45 (pix i.f. circuits), 46

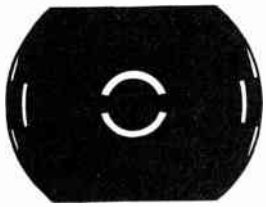
5-O SYMPTOMS PICTURE Intermittent or fading
RASTER Normal
SOUND Intermittent (voice and music)

CODES 53-N-11 86-N-11

CAUSE Same defects as 5-N, but occurring in pix i.f. amplifier before sound take-off. Same defects as 5-N in intercarrier sets. Also see Classifications 3-M and 6-CC.

RAPID CHECKS Same as in Classification 5-N

5-P SYMPTOMS
PICTURE Darkened, shading poor
RASTER Normal
SOUND Normal



CODES 27-N-16 32-N-16 149-N-16

CAUSE Bias voltage excessive or insufficient in picture i.f. amplifier only, due to defective a.g.c. tube, operating voltages or incorrect threshold adjustment of bias. Also see Classifications 6-G and 6-Y

RAPID CHECKS 67, 66, 5j, 22, 8 and 45 (a.g.c. circuits)

5-PP SYMPTOMS
PICTURE Darkened, shading poor
RASTER Normal
SOUND Weak or absent

CODES 27-N-1 32-N-1 149-N-1
27-N-21 32-N-21 149-N-21

CAUSE Excessive bias voltage which cuts off picture i.f. amplifier and also r.f. amplifier, insufficient bias on picture i.f. amplifier and r.f. amplifier caused by defective a.g.c. tube, operating voltage or circuits, incorrect threshold adjustment of bias. Same symptoms in intercarrier sets. Also see Classification 3-CC.

RAPID CHECKS 67, 66, 5j, 22, 8 and 45 (a.g.c. circuit)

5-Q SYMPTOMS
PICTURE Horizontal pulling
RASTER Normal
SOUND Normal

CODES 77-N-16 137-N-16

CAUSE Poor low frequency response due to defects or misalignment in pix i.f. amplifier, heater-cathode leakage in pix i.f. tubes, excessive bias on i.f. amplifier tubes due to defective a.g.c. Also see Classifications 6-G and 6-N

RAPID CHECKS 68, 5f, 5j, 22, 67, Rapid Alignment Check No. 2

5-R SYMPTOMS
PICTURE Normal
RASTER Normal
SOUND Buzz (continuous raspy sound)
(Intercarrier sets)

5- PICTURE (VIDEO) I.F. SECTION

5-R (Continued)

CODE 131-N-3

CAUSE Amplitude modulation of FM carrier in picture i.f. amplifier tube(s) due to defective tubes, incorrect operating voltages, incorrect pix i.f. bias, incorrect setting of a.g.c. switch or threshold adjustment, misalignment of pix i.f. stages. Trouble is aggravated by poor sound section alignment. Also see Classifications 1-H, 2-I, 3-D, 4-L, 6-ZZ, 8-FF, 9-Y.

RAPID CHECKS 5f, 22, 67, Rapid Alignment Check No. 2

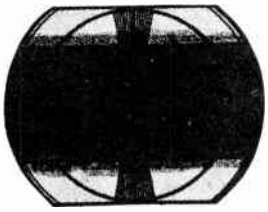
5-S SYMPTOMS
PICTURE Ripple (vertical wrinkle)
RASTER Ripple changing only with volume control variation
SOUND Normal

CODE 144-RC-16

CAUSE Audio output lead too close to pix i.f. lead, microphonic tube in pix i.f. which vibrates along with speaker. Also see Classification 6-ZZZ.

RAPID CHECKS Move audio output lead to new position. Check No. 20.

5-T SYMPTOMS
PICTURE Hum bars, horizontal
RASTER Normal
SOUND Hum (modulation) only heard when station is tuned in. In some cases not audible



CODES 9-N-10 68-N-10 83-N-10
69-N-10

CAUSE Heater-cathode leakage in picture i.f. tube(s), hum voltage in B-supply to these tubes. Also see Classification 3-E.

RAPID CHECKS 85, 86, 5f, 87

6- VIDEO AMPLIFIER INCLUDING PICTURE TUBE

6-A SYMPTOMS
PICTURE Absent all channels
RASTER Normal
SOUND Normal

CODE 1-N-16

CAUSE Defective video amplifier tube(s), incorrect operating voltages, defective d.c. restorer tube, defective components video amplifier or d.c. restorer circuits, defective contrast control (if in video amplifier section), poor contact to picture tube grid, defective picture tube. Also see Classification 5-A.

RAPID CHECKS First localize trouble at video amplifier by applying 37, then 38. If picture signal is observed at output of video detector, but picture fails to show on picture tube, this definitely places trouble in video amplifier. Fault can be further localized by observing retrace lines. If these can be "stopped", this shows that sync separator is working, hence trouble is between point where sync is taken off and the picture tube. Apply following checks: 5k, 5-1, 22 (video amplifier and d.c. restorer), 8 (condensers in video amplifier), 44, 45, 46 (at picture tube grid), 15, 5ab.

6-AA SYMPTOMS
PICTURE Absent all channels
RASTER Normal
SOUND Absent all channels

(These symptoms apply to intercarrier sets only)

CODE 1-N-1

CAUSE Defective video amplifier tube(s), incorrect operating voltages at same, defective video amplifier components, defective contrast control (if in video section before sound take-off). Also see Classifications 3-A, 5-B, 6-Q.

RAPID CHECKS Localize picture troubles at video amplifier by applying check 37. If picture signal is present at video detector output, trouble must be located in video amplifier, between video detector and sound take-off, 8 (condensers in video amplifier up to sound take-off). Apply following checks: 5k, 22 (video amplifier tubes to sound take-off) 44, 45.

6-AAA SYMPTOMS
PICTURE Absent all channels
RASTER Absent all channels
SOUND Normal

6- VIDEO AMPLIFIER INCLUDING PICTURE TUBE

6-AAA (Continued)

CODE 1-A-16

CAUSE Reversed ion trap (front at back or upside down, wrong ion trap, incorrectly adjusted ion trap), open in brightness control circuit (cathode return), incorrect operating voltages at picture tube, defective picture tube. Also see Classifications 2-A and 9-B.

RAPID CHECKS To rule out high voltage trouble, first apply Rapid Check No. 1. To rule out open picture tube cathode return, apply Rapid Check No. 50. Then apply 24, 25 to check second anode and accelerating grid voltages respectively. To check for excessive picture tube grid bias, apply 22 between grid and cathode of pix tube. Apply checks 76, 15 and 5ab.

6-B SYMPTOMS
PICTURE Weak or snow or shading gradations
RASTER Normal
SOUND Normal

CODES
13-N-16 55-N-16 155-N-16
36-N-16 150-N-16 201-N-16
38-N-16 152-N-16

CAUSE Same as Classification 6-A. Also see Classifications 3-CCC, 5-C, 5-H, 6-U

RAPID CHECKS Same as Classification 6-A

6-BB SYMPTOMS
PICTURE Shadow
RASTER Shadow
SOUND Normal

CODE 151-S-16

CAUSE Defective ion trap, defective deflection yoke, misadjusted ion trap or deflection yoke not concentric with neck of tube or not close enough to bell of tube. Focus assembly not concentric with neck of tube. If shadow appears at right or left and cannot otherwise be removed, raster can sometimes be moved by small variations in screen voltage at horizontal output tube.

RAPID CHECKS 76, visually check adjustment of deflection yoke and focus assembly, check for defective ion trap and defective yoke by substitution. Apply 24 (focus voltage) if tube uses this type of focusing.

6-C SYMPTOMS
PICTURE Intermittent or fading
RASTER Normal
SOUND Normal

6-C (Continued)

CODE 53-N-16 86-N-16

CAUSE Intermittent contacts in video amplifier or pix tube sockets, poorly soldered connections in video amplifier circuits, defective video amplifier tubes, defective picture tube. Also see Classification 5-N.

RAPID CHECKS 5k, 46 (to suspected sockets), 5ab

6-CC SYMPTOMS PICTURE Intermittent or fading
RASTER Normal
SOUND Intermittent

(Above symptoms apply to intercarrier sets only)

CODES 53-N-11 86-N-11

CAUSE Intermittent contacts in video amplifier tube sockets up to sound take-off, defective video amplifier tubes up to same point, poorly soldered connections in video amplifier.

RAPID CHECKS 5k, 46 (to suspected sockets)

6-D SYMPTOMS PICTURE White following black (trailing reversal) noticeable after letters and circles, often trailing completely across image
RASTER Normal
SOUND Normal

CODE 205-N-16

CAUSE Low frequency phase shift (phase distortion), which causes low frequencies of picture signal to be delayed in reaching screen. Due to same troubles which cause poor low frequency response. These include open or greatly reduced capacity coupling condensers in video amplifier, reduced capacity cathode by-pass condensers in video amplifier, open or reduced capacity by-pass condenser in cathode circuit of picture tube, greatly lowered resistance of video detector load resistor or first video amplifier grid resistor, increased resistance of cathode resistors in video amplifier.

RAPID CHECKS 56, 8, 45

6- VIDEO AMPLIFIER INCLUDING PICTURE TUBE

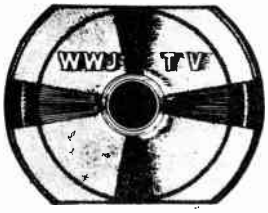
6-DD SYMPTOMS PICTURE Darkened, with normal contrast adjustment. May be accompanied by horizontal pulling and trailing reversal
RASTER Normal
SOUND Normal

CODES 27-N-16 32-N-16 149-N-16

CAUSE Poor low frequency response caused by open or greatly reduced capacity following condensers in video amplifier: coupling condensers, cathode by-pass condensers, by open or greatly reduced capacity by-pass condenser in cathode circuit of picture tube, by greatly lowered resistance of video detector load resistor or first video amplifier grid resistor, by increased resistance of cathode resistors in video amplifier by excessive bias on video amplifier tubes. Also see Classification 5-P

RAPID CHECKS Change in background brilliance from bottom to top of picture is an indication of poor low frequency response. Apply checks 56, 8, 45, 22 (to measure grid bias of video amplifier tubes).

6-E SYMPTOMS PICTURE Smearing and streaking horizontally after large objects
RASTER Normal
SOUND Normal



CODE 153-N-16

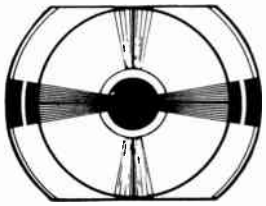
CAUSE Excessive low frequency response with phase shift caused by greatly increased value of video detector load resistor, open coupling condenser to grid of picture tube blocking high frequencies but allowing low frequencies to reach grid via d.c. restorer circuit. Also see Classification 5-F

RAPID CHECKS 8, 45

6-EE SYMPTOMS PICTURE Horizontal pattern wedges stronger than vertical wedges (usually accompanied by smearing of both wedges)

6-EE SYMPTOMS (Continued)

RASTER Normal
SOUND Normal

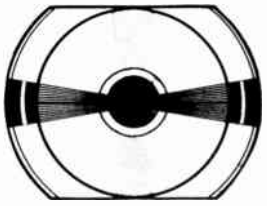


CODE 81-N-16 153-N-16

CAUSE Same as Classification 6-E. Also see Classification 5-F.

RAPID CHECKS Same as Classification 6-E

6-F SYMPTOMS PICTURE Vertical pattern wedge absent or weak and blurred
RASTER Normal
SOUND Normal



CODES 195-N-16 197-N-16

CAUSE Poor high frequency response due to open plate by-pass condensers in video amplifier, shorted series peaking coil, open shunt peaking coil (where paralleled by resistor). Also see Classification 5-G

RAPID CHECKS 44 (peaking coils), 13 (plate by-pass condenser).

6-G SYMPTOMS PICTURE Horizontal pattern wedges weaker than vertical wedges
RASTER Normal
SOUND Normal

CODE 82-N-16

CAUSE Poor low frequency response. Also see Classifications 6-D, 6-DD.

RAPID CHECKS Same as Classification 6-DD

6-GG SYMPTOMS PICTURE Horizontal weaving or ripple when background changes
RASTER Normal
SOUND Normal

6- VIDEO AMPLIFIER INCLUDING PICTURE TUBE

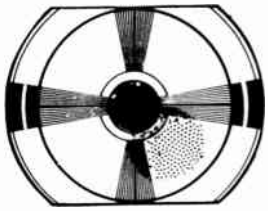
6-GG (Continued)

CODE 204-N-16

CAUSE Poor low frequency response. See Classifications 6-D, 6-DD. May also be caused by excessive high frequency response. See Classification 6-YY. Also see Classifications 5-E and 6-J.

RAPID CHECKS 56, 8, 45

6-H SYMPTOMS PICTURE Brown or yellowish spot (ion spot). In rectangular tubes spot appears at center of an "X".
RASTER Normal except for spot
SOUND Normal



CODES 19-BJ-16 94-BJ-16

CAUSE Burned coating inside picture tube due to absence of ion trap (where required), misadjusted ion trap, use of incorrect or weak ion trap, unusual amount of afterglow, brightness control turned too far clockwise while adjusting ion trap, use of weaker magnet at rear of tube when using double magnet ion trap.

RAPID CHECKS 76, check for correct ion trap (double magnet trap with straight gun, single magnet with tilted or bent gun). See Classification 6-R for afterglow check

6-I SYMPTOMS PICTURE Engraved effect
RASTER Normal
SOUND Normal

CODES 10-N-16 120-N-16 168-N-16
50-N-16 141-N-16

CAUSE Defective video amplifier tubes or incorrect operating voltages on same, or defective video detector, defective peaking coils. Also see Classification 5-M.

RAPID CHECKS 5k, 5i, 44 (peaking coils)

6-J SYMPTOMS PICTURE Unstable background
RASTER Normal
SOUND Normal

6-J (Continued)

CODES 6-N-16 177-N-16

CAUSE Defective d.c. restorer

RAPID CHECKS 51, 22, 42, 43, 8, 44, 45

6-K SYMPTOMS PICTURE Hum bars, horizontal
RASTER Bars, horizontal, alternate dark and light
SOUND Usually normal, but sometimes audible hum is present

CODES 9-BA-16 68-BA-16 83-BA-16 69-BA-16

CAUSE Heater-cathode leakage in video amplifier tube(s), video detector, d.c. restorer or picture tube, hum voltage in B-supply to these tubes, faulty electrolytic by-pass condenser in video amplifier circuit. If before sync take-off, edges (vertical) will be wavy.

RAPID CHECKS 85, 86, 5k, 5i, 5-1, 5ab, 87, 13

6-KK SYMPTOMS PICTURE Bars, horizontal, alternate dark and light (hum bars)
RASTER Bars, horizontal, alternate dark and light
SOUND Hum (source other than signal)

(Above symptoms refer to intercarrier sets only)

CODES 9-BA-9 68-BA-9 83-BA-9 69-BA-9

CAUSE Hum introduced into video amplifier before sound take-off by leaky electrolytic by-pass condenser. If before sync take-off, edges will be wavy. Also see Classification 1-C

RAPID CHECKS 13, 87, 86

6-KKK SYMPTOMS PICTURE Bars, horizontal, alternate dark and light (sound bars)
RASTER Normal
SOUND Normal

CODES 9-N-16 70-N-16 157-N-16

CAUSE Microphonic tube in video amplifier.

NOTE: In intercarrier sets, faulty 4.5 mc. sound take-off may cause sound bars, but sound will be weak.

RAPID CHECK 20

6- VIDEO AMPLIFIER INCLUDING PICTURE TUBE

6-L SYMPTOMS PICTURE Non-adjustable focus, faint or blurred
RASTER Focus defective
SOUND Normal

CODES 13-F-16 56-F-16 138-F-16 55-F-16 124-F-16 152-F-16

CAUSE Defective focus control potentiometer, defective resistor or condenser in focus control circuit, open focus coil, shorted turns in focus coil, incorrectly positioned focus coil, insufficient voltage at accelerating grid or second anode of picture tube, gassy or otherwise defective picture tube. Where electrostatic focusing is used, trouble may be due to defective focus (rectifier) tube, incorrect focus voltage, defective filter network, incorrectly positioned or demagnetized ring magnet. Also see Classification 2-C

RAPID CHECKS 76 (to make certain trouble is not due to ion trap misadjustment), also check to make sure trouble is not due to focus coil or focus control misadjustment, to poor low frequency response, or to excessive or low current drain from low voltage power supply. Note whether focus can be adjusted to affect horizontal scanning lines. These are not affected by low frequency response. Apply Rapid Checks 44, 45, 8, 24, 5ab, and 5ad.

6-M SYMPTOMS PICTURE Non-adjustable brightness
RASTER Non-adjustable brightness
SOUND Normal

CODES 18-BH-16 122-BH-16

CAUSE Defective picture tube cathode or grid circuits, open or leaky by-pass condenser in brightness control circuit may cause non-uniform illumination, defective picture tube, incorrect picture tube operating voltages

RAPID CHECKS 76 (to be certain ion trap is not at fault). Check brightness control potentiometer and associated resistors and by-pass condensers. Apply checks 44, 45, 18, 49, 5ab, 22 (between control grid and cathode with brightness control set at maximum and minimum), 25 and 24.

6-MM SYMPTOMS PICTURE Reversed brightness control
RASTER Reversed brightness control
SOUND Normal

CODE 140-RA-16

6-MM (Continued)

CAUSE Shorted coupling condenser between plate of video output tube and grid of picture tube. Also see Classification 2-F as this symptom is also a sign of insufficient high voltage.

RAPID CHECK 8

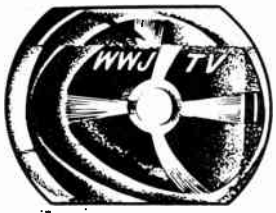
6-N SYMPTOMS PICTURE Weaving or pulling horizontally with contrast control at normal setting
RASTER Normal
SOUND Normal

CODES 77-N-16 203-N-16

CAUSE Excessive bias on video amplifier tube(s), defective video amplifier tube(s) or defective d.c. restorer tube(s). Also see Classification 5-Q.

RAPID CHECKS 44, 45 (Check for increased resistance of cathode resistors), 42, 43, 5k, 5-1, 22 (check operating voltages)

6-NN SYMPTOMS PICTURE Pulling or weaving or tearing horizontally
RASTER Horizontal pulling
SOUND Normal



CODES 137-HG-16 167-HG-16 203-HG-16

CAUSE Hum in B-supply to video amplifier tube(s) or picture tube, hum in high voltage supply to picture tube, misadjusted ion trap, focus coil or defective yoke, magnetized shell of metal type picture tube, stray magnetic field near picture tube from poorly positioned speaker, transformer or filter choke. Also see Classification 9-VV.

RAPID CHECKS 68, 87, (hum in B-supply is usually accompanied by hum bars and hum from speaker), 76, check adjustment of focus coil and deflection yoke, check positioning of speaker or other components suspected of producing interfering magnetic field, check metal shell (with set turned off and high voltage condenser discharged) for magnetization by turning picture tube. Changed direction of pulling in this case is evidence of magnetization.

6- VIDEO AMPLIFIER INCLUDING PICTURE TUBE

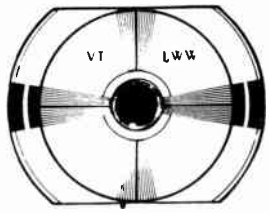
6-O SYMPTOMS PICTURE Vertical return lines strongly visible
RASTER Normal
SOUND Normal

CODES 139-N-16 184-N-16 196-N-16

CAUSE Loss of low frequencies resulting in defective vertical blanking, incorrectly adjusted ion trap.

RAPID CHECKS First try to blank out return lines by adjusting contrast and brightness controls. Then apply following: 56 and other checks given for poor low frequency response in Classification 6-DD. Note that loss of low frequencies may also be due to front end or picture i.f. troubles. 76.

6-P SYMPTOMS PICTURE Reversed in horizontal plane (mirror effect)
RASTER Normal
SOUND Normal



CODE 142-N-16

CAUSE Reversed leads to horizontal deflection coils

RAPID CHECKS Unsolder leads to horizontal coils and resolder in reverse sequence.

6-Q SYMPTOMS PICTURE Absent, weak, blurred, faint, etc.
RASTER Normal
SOUND Weak all channels

(Above symptoms refer to intercarrier sets only)

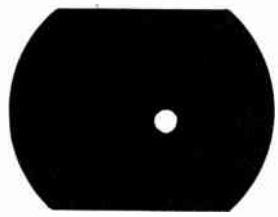
CODES 13-N-21 38-N-21 138-N-21
36-N-21 55-N-21 152-N-21
63-N-21 201-N-21

CAUSE Defective video amplifier tube(s), incorrect operating voltages at same, defective video amplifier components, defective contrast control. Also see Classifications 3-C and 5-CC

NOTE: Above defects only in tubes and circuits before sound take-off.

RAPID CHECKS 37. If pix signal is present at video detector output, trouble is in video amplifier between detector and sound take-off. Apply following Rapid Checks: 5k, 22, 44, 45.

6-R SYMPTOMS
PICTURE Bright spot on screen after turning set off (afterglow)
RASTER Bright spot on screen after turning set off
SOUND Normal



CODE 14-BD-16

CAUSE High voltage filter condensers hold charge after set is turned off causing spot. Trouble is inherent in the design of many TV sets.

RAPID CHECKS In many sets, afterglow may be eliminated by turning brightness control full on an instant before set is turned off. The increased anode current then rapidly drains charge from high voltage filter condenser(s). In some sets, a slight readjustment of ion trap will remedy or alleviate this trouble.

6-RR SYMPTOMS
PICTURE Vertically wavy at left
RASTER Normal
SOUND Normal

CODE 151-S-16

CAUSE Defective condenser across half of horizontal deflection coil.

RAPID CHECK 8

6-S SYMPTOMS
PICTURE Brightness (brilliance) and focus extremely slow in reaching normal level
RASTER Brightness (brilliance) and focus extremely slow in reaching normal level
SOUND Normal

CODES 15-BE-16 199-BE-16

CAUSE Defective picture tube

RAPID CHECKS 15, 5ab

6-T SYMPTOMS
PICTURE Brightness excessive
RASTER Brightness excessive
SOUND Normal

CODE 16-BF-16

6- VIDEO AMPLIFIER INCLUDING PICTURE TUBE

6-T (Continued)

CAUSE Defective brightness control potentiometer, defective resistor or condenser in brightness control circuit, leaky condenser connected to control grid or cathode of picture tube. Insufficient bias on picture tube.

RAPID CHECKS 45, 8, 22 (between cathode and control grid of picture tube)

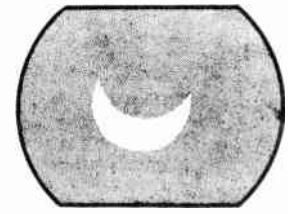
6-U SYMPTOMS
PICTURE Brightness insufficient, hazy or cloudy
RASTER Normal
SOUND Normal

CODES 17-N-16 63-N-16

CAUSE Defective video amplifier tube(s), defective video detector, incorrect tube operating voltages, defective picture tube or defective operating voltages. Also refer to Classifications 3-CCC, 5-C, 5-H.

RAPID CHECKS 5k, 5i, 11 (if crystal detector) 22, 5ab, 24, 25

6-V SYMPTOMS
PICTURE Crescent shaped glow
RASTER Crescent shaped glow
SOUND Normal

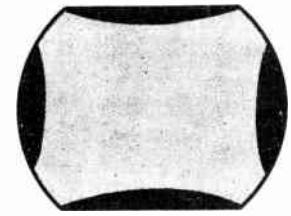


CODE 29-C-16

CAUSE Ion trap reversed

RAPID CHECK 76

6-VV SYMPTOMS
PICTURE Pin-cushion effect
RASTER Pin-cushion effect
SOUND Normal



CODE 136-P-16

CAUSE Defect in horizontal deflection yoke such as shorted turns, mismatched yoke (between yoke

6-VV CAUSE (Continued)

and horizontal output transformer) defective horizontal output tube, defective high voltage rectifier tube. Curved or cylindrically faced rectangular tubes such as 17LP4 will show this effect at edges. It may be corrected by use of special magnets at tube flare.

NOTE: Defects in deflection yoke also cause characteristic raster shapes called barrel effect, keystone effect, trapezoidal effect, etc.

RAPID CHECKS 44, replace yoke if necessary, 5z, 5b. In case of 17LP4, 21KP4A, etc. readjust magnet positions, replace weakened magnets and if necessary readjust centering ring.

6-W SYMPTOMS PICTURE Darkened, upper or lower half
RASTER Darkened, upper or lower half
SOUND Normal

CODE 35-DB-16

CAUSE 60-cycle a.c. at grid of picture tube. See Classification 6-K

RAPID CHECKS 85, 86, 5k, 5i, 5-1, 5ab, 87, 13

6-X SYMPTOMS PICTURE Dwarfed, vertically and horizontally
RASTER Dwarfed
SOUND Normal

CODE 43-DC-16

CAUSE Deflection yoke placed too far away from bell (flare) of picture tube. Also see Classification 2-H

RAPID CHECKS Readjust deflection yoke to correct position.

6-Y SYMPTOMS PICTURE Non-adjustable contrast
RASTER Normal
SOUND Normal

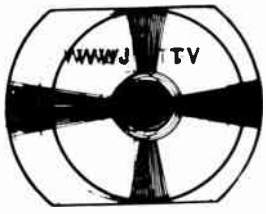
CODE 123-N-16

6-Y (Continued)

CAUSE Defective contrast control or associated resistors or condensers (contrast control in video amplifier section). Also see Classification 5-M.

RAPID CHECKS 45, 8

6-YY SYMPTOMS PICTURE Ringing, echo effect, trailing reflections after vertical portions such as letters (thin white line or area following black and vice versa)
RASTER Normal
SOUND Normal



CODES 46-N-16 146-N-16 170-N-16

CAUSE Excessive high frequency response at certain frequencies due to over-peaking of video amplifier caused by increased resistance or open load resistor shunting peaking coil, too high inductance peaking coil, reduced resistance of plate circuit load resistor in video amplifier, incorrectly set peaking switch, changed position of peaking coil with respect to metal chassis. Also see Classifications 3-L and 5-D.

RAPID CHECKS 45, 44, check for incorrect inductance peaking coil by replacing with one of known correct value, if set employs peaking switch in cathode circuit of video output tube, open this switch. Overpeaking may also be reduced by removing bypass condenser which shunts cathode resistor in video output amplifier. Try changing positions (with respect to chassis) of peaking coils and separating them from other components.

6-Z SYMPTOMS PICTURE Intermittent, fading all channels
RASTER Intermittent
SOUND Normal

CODES 53-IA-16 86-IA-16

CAUSE Loose or poorly soldered connection at picture tube socket, defective pix tube socket, defective picture tube, intermittent contact in brightness

6- VIDEO AMPLIFIER INCLUDING PICTURE TUBE

6-Z CAUSE (Continued)

control or its associated circuit. Also see Classification 2-E.

RAPID CHECKS Check picture tube socket, apply following checks: 46, 5ab.

6-ZZ SYMPTOMS
PICTURE Normal
RASTER Normal
SOUND Buzz (continuous raspy sound)

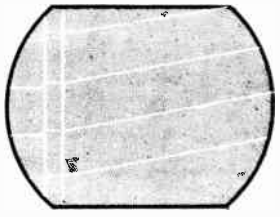
(Above symptoms apply to intercarrier sets only)

CODE 131-N-3

CAUSE Amplitude modulation of FM carrier in video amplifier tubes which amplify both sound and picture signals caused by defective tubes, incorrect operating voltages including incorrect bias.

RAPID CHECKS 5k, 22

6-ZZZ SYMPTOMS
PICTURE Ripple or wrinkle (vertical changing only with adjustment of volume control
RASTER Ripple, changing only with volume control variation
SOUND Normal



CODES 144-RC-16

CAUSE Audio output lead too close to video amplifier or picture tube lead, microphonic tube in video amplifier which vibrates along with speaker. Also see Classification 5-S.

NOTE: Ripple will appear on raster without station signal, since normal noise in speaker has same effect as sound.

RAPID CHECKS Move audio output lead to new position. Apply Rapid Check No. 20.

7- SYNCHRONIZING SYSTEM

7-A SYMPTOMS
PICTURE Moves up and down and side to side
RASTER Normal
SOUND Normal

CODE 108-N-16

CAUSE Defect in sync circuit between sync take-off point and input to vertical and horizontal oscillator

RAPID CHECKS 5m, 5n, 53. Check 53 indicates whether loss of sync is due to poor alignment or other defects in the r.f., i.f. or video amplifiers. If trouble is in the sync circuit and not due to tubes apply Rapid Check No. 32 which isolates defective sync amplifier stage. Then apply Rapid Check No. 22 and component checks 44, 45, 8 and 49.

7-B SYMPTOMS
PICTURE Moves up and down (rolling), vertically jittery, sometimes tears vertically
RASTER Normal
SOUND Normal

CODES 67-N-16 110-N-16 191-N-16
97-N-16 147-N-16

CAUSE Defect in sync circuit <u>after</u> horizontal sync take-off due to defective resistors and/or condensers, defective tube(s). Also see Classification 8-G.

RAPID CHECKS Check coupling condensers, (8) check resistors and condensers of integrating circuits (45 and 49). Apply Rapid Checks 5n, 22. Check waveform at output and input of integrator. (32, Figs. "M" and "N")

7-C SYMPTOMS
PICTURE Moves side to side, sometimes tearing horizontally
RASTER Normal
SOUND Normal

CODES 75-N-16 167-N-16 178-N-16

CAUSE Defects in circuit confined to horizontal sync signal up to input of horizontal oscillator due to defective tube(s), resistors or condensers. See Classification 9-X.

RAPID CHECKS If set uses RCA-type horizontal sync lock, apply Rapid Check No. 33, then 5w, 5ac. If set uses old style G.E. phase-detector horizontal sync control system replace horizontal sync amplifier tube and check sync waveform at input and output of

7-C RAPID CHECKS (Continued)

this stage. Apply Rapid Check 5w. Check a.f.c. transformer. Replace d.c. amplifier tube. Check filter network for changed values of resistance and capacitance. Most modern sets have some form of horizontal sync control. Sync pulse can best be checked by noting the wave form up to and including the control system.

If set uses newer type G.E. phase detector system, employing horizontal sync discriminator with locked-in cathode-coupled multivibrator and negative comparison pulse obtained from the horizontal output circuit, check adjustment of horizontal stabilizing control (also called ringing coil and lock adjustment) replace double diode discriminator and double triode horizontal multivibrator tubes. Check hold control, check waveform at plate of multivibrator using Rapid Check No. 88.

If set employs early model Synchroguide horizontal sync control check three waveforms as shown in Rapid Check 89. The early Synchroguide control employs a single 6SN7GT tube functioning as a.f.c. and blocking oscillator. Frequency is controlled by slug tuning as in the newer type Synchroguide circuits. An additional frequency control trimmer is connected to the control grid of the oscillator. This will help to distinguish early model from late model as it is not used on the latter. Both old and new models are provided with locking range and hold controls. If Rapid Check 89 discloses that horizontal pulse is absent, check for open coupling condenser in this circuit. Note that grid resistor at control grid of blocking oscillator has a tolerance of only one percent. Also note that a negative coefficient resistor is used in series with the horizontal hold control and this can be replaced only with an identical resistor. Check with accurate ohmmeter.

If set uses later model Synchroguide horizontal sync control, check for waveforms shown in Rapid Check 90. This circuit, which is used in a great many present-day sets uses a 6SN7GT tube as a combined horizontal a.f.c. and horizontal blocking oscillator. It is characterized by the fact that it employs an additional tunable inductance in its output circuit for waveform adjustment. If negative pulse from damping tube is absent, check for open coupling condenser, check hold control, frequency slug adjustment on blocking oscillator and wave form adjustment slug on stabilizing network. Follow manufacturer's adjustment directions. In all systems of horizontal frequency control, it is good servicing practice to try out several new tubes in the control circuits when set shows symptoms of lack of synchronism.

7-D SYMPTOMS PICTURE Horizontal tearing or pulling
RASTER Normal
SOUND Normal

7-D (Continued)

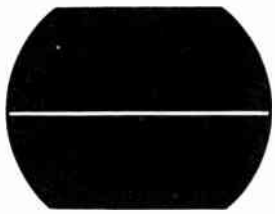
CODES 77-N-16 137-N-16 178-N-16 80-N-16

CODES Defects in circuit fed exclusively by horizontal sync signal up to input of horizontal oscillator, but only observed in sets which lack horizontal a.f.c. For other causes of tearing or pulling in such sets, see Classifications 5-Q, 6-N, 6-NN, 9-VV

RAPID CHECKS 5m, 5n, 22, 45, 49

8- VERTICAL SWEEP CIRCUITS

8-A SYMPTOMS PICTURE Absent all channels, thin horizontal bright line
RASTER Absent. Thin bright horizontal line
SOUND Normal

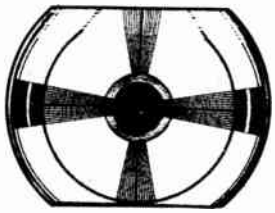


CODE 2-AA-16

CAUSE No vertical deflection due to inoperative oscillator, defective tubes or components in vertical sweep circuits.

RAPID CHECKS 16, 17. If oscillator is inoperative (fails to show sawtooth) apply following checks: 5s, 22, 44, 45. Check discharge condenser (8), also coupling condenser between plate of oscillator (or discharge section) and grid of vertical output tube. If oscillator is O.K., apply Rapid Check No. 30, proceeding finally to vertical deflection coils. This check will localize the fault at one particular point in the vertical sweep circuit. For example, the wave may be observed at the grid of the vertical output tube, but not at the plate. Tube is checked first (5u) then voltage checks are applied (22). Absence of plate voltage would indicate open in plate supply line (open transformer primary or open series resistor). (44,45) Same voltage at both sides of primary would indicate shorted primary. Absence of waveform at deflection coils would indicate open secondary or open deflection coils (both halves).

8-B SYMPTOMS PICTURE Vertically non-linear, Vertical linearity non-adjustable
RASTER Normal
SOUND Normal



CODES 104-N-16 193-N-16

CAUSE Defective linearity control, shorted turns in vertical output transformer or vertical deflection coils, defective vertical sweep tubes or incorrect operating voltages, incorrect value sawtooth making condenser or resistor in plate circuit of discharge tube, open or defective filter condensers in cathode and/or plate circuits of vertical output tube.

RAPID CHECKS 5v, 44, 45, 22, 8, 13, 18

8-C SYMPTOMS PICTURE White horizontal bar at bottom, fold-over or compressed at bottom
RASTER Horizontal bar, bright, at bottom, vertically compressed at bottom, fold-over at bottom
SOUND Normal

CODES 24-VC-16 57-FA-16 206-HC-16 72-HC-16

CAUSE Shorted or leaky coupling condenser between discharge tube and vertical output amplifier, vertical output grid leak resistor greatly lowered in value, overloaded vertical amplifier, defective vertical output tube or incorrect operating voltages on this tube.

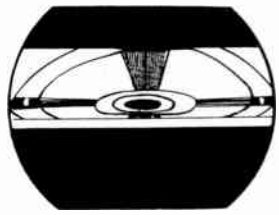
NOTE Fold-over at bottom could be caused by lowered line voltage or by other causes of insufficient low voltage. However, foldover in such cases would also be accompanied by symptoms outlined in Classification 1-B.

RAPID CHECKS 18, 5u, 22, 45

8-D SYMPTOMS PICTURE Dwarfed vertically (too small vertically) usually accompanied by vertical non-linearity

8- VERTICAL SWEEP CIRCUITS

8-D SYMPTOMS (Continued)
RASTER Dwarfed vertically
SOUND Normal



CODES 45-DE-16 64-DE-16 188-DE-16

CAUSE Weak vertical output tube, insufficient drive due to low amplitude sawtooth waveform discharge tube, lowered operating voltages, defective height control, faulty vertical discharge condenser, open electrolytics in plate and cathode circuits of vertical output tube

RAPID CHECKS 5t, 5u, 22, 45, 8, 18, 13

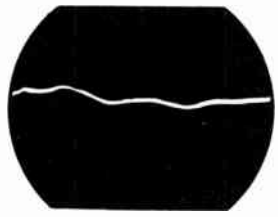
8-DD SYMPTOMS PICTURE Dwarfed vertically, vertically linear
RASTER Normal
SOUND Normal

CODE 189-N-16

CAUSE Weak vertical oscillator tube incorrect operating voltages, defective components in vertical oscillator circuit

RAPID CHECKS 5s, 22, 8, 45

8-E SYMPTOMS PICTURE Horizontal line, thin bright wavy, picture absent
RASTER Horizontal line, thin bright wavy
SOUND Normal



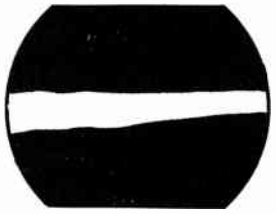
CODES 1-HF-16 74.1-HF-16

CAUSE Open in half of vertical deflection coil and both damping resistors across coils.

RAPID CHECK 44 (to coils and resistors)

8- VERTICAL SWEEP CIRCUITS

8-F SYMPTOMS PICTURE Absent all channels
RASTER Vertical size greatly decreased, more at one end than other
SOUND Normal



CODE 1-VD-16

CAUSE Open circuit in one half of vertical deflection coil

RAPID CHECKS 44 (to deflection coil -- first removing damping resistor)

8-FF SYMPTOMS PICTURE Normal
RASTER Normal
SOUND Buzz

CODE 131-N-3

CAUSE Coupling from vertical sweep section to audio section. Also see Classifications 3-D and 4-L

RAPID CHECK 71

8-G SYMPTOMS PICTURE Moves up and down (vertically) and cannot be stopped. May tear vertically, hold control ineffective, rolls
RASTER Normal
SOUND Normal

CODES 111-N-16 126-N-16 190-N-16
97-N-16 147-N-16 191-N-16

CAUSE Vertical oscillator cannot be brought to 60 cycles due to incorrect resistance and condenser time constants, incorrect operating voltages at oscillator and discharge tube, defective grid resistor or condenser in vertical oscillator circuit, defective hold control, defective oscillator tube

RAPID CHECKS 60, 8, 18, 45, 5s, 5t, 22

8-H SYMPTOMS PICTURE Trapezoid (narrow at right, keystone effect)
RASTER Trapezoid (narrow at right, keystone effect)
SOUND Normal

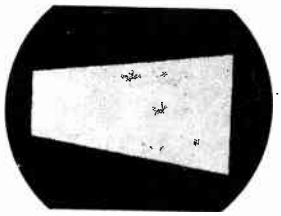
CODES 100-KB-16 117-KB-16 173-KB-16

CAUSE One of the vertical deflection coils shorted

RAPID CHECK 44

8- VERTICAL SWEEP CIRCUITS

8-I SYMPTOMS PICTURE Trapezoid (narrow at left, keystone effect)
RASTER Trapezoid (narrow at left, keystone effect)
SOUND Normal

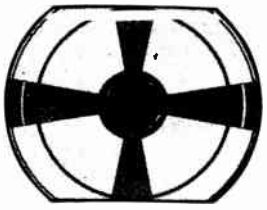


CODES 99-KA-16 116-KA-16 172-KA-16

CAUSE One of the vertical deflection coils shorted

RAPID CHECK 44

8-J SYMPTOMS PICTURE White horizontal bar at top
RASTER Horizontal bar, bright at top
SOUND Normal



CODE 207-HD-16

CAUSE Defective vertical output tube (heater-cathode leakage)

RAPID CHECK 5u

8-K SYMPTOMS PICTURE White horizontal lines
RASTER Flashes, horizontal
SOUND Normal

CODE 208-FE-16

CAUSE Intermittent heater-cathode leakage in vertical output amplifier

RAPID CHECK 5u

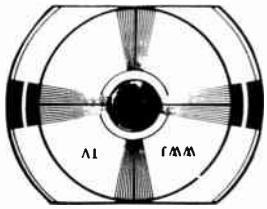
8-L SYMPTOMS PICTURE Incomplete vertically
RASTER Incomplete
SOUND Normal

CODE 84-I-16

CAUSE Open in vertical hold control circuit, height control defective

RAPID CHECKS 44, 45 (to all fixed resistors in hold control circuit, and to hold control and height control potentiometers)

8-LL SYMPTOMS PICTURE Upside down
RASTER Normal
SOUND Normal



CODE 180-N-16

CAUSE Leads to vertical deflection yoke reversed

RAPID CHECK Unsolder vertical deflection coil leads and reverse them.

8-M SYMPTOMS PICTURE Dark faint vertical bars or oscillations at top left
RASTER Oscillations at top left
SOUND Normal

CODES 33DA-16 133-0-16

CAUSE Both damping resistors open across vertical deflection coils, resistors ordinarily prevent damped oscillations in horizontal deflection circuit from being coupled into vertical coils

RAPID CHECKS 45

8-N SYMPTOMS PICTURE Two complete pictures vertically, or three complete pictures
RASTER Normal
SOUND Normal

CODES 114-N-16 175-N-16 176-N-16

CAUSE Two pictures caused by 30-cycle vertical sweep instead of 60-cycles; three pictures caused by 20-cycle vertical sweep.

RAPID CHECKS 45 (for increased value of oscillator grid resistor), 18(for leaky grid condenser)

8-O SYMPTOMS PICTURE Vertically superimposed
RASTER Normal
SOUND Normal

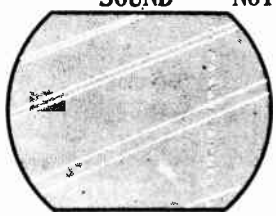
CODES 114-N-16 165-N-16 192-N-16

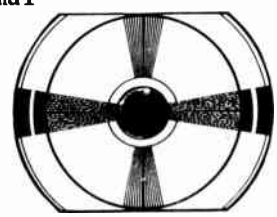
CAUSE Vertical sweep too rapid caused by too short RC time constant in vertical oscillator. May be due to shorted oscillator grid resistor or greatly reduced value grid resistor. Grid condenser may have too low value

RAPID CHECKS 45, 8

8- VERTICAL SWEEP CIRCUITS

8-P SYMPTOMS PICTURE Moire effect (interlace defective), produces wavy horizontal wedge in station pattern
RASTER Return traces unequally spaced
SOUND Normal



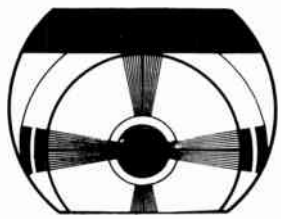


CODES 85-R-16 106-R-16

CAUSE Pairing due to lack of interlace caused by defective resistors and condensers in integrating network. Possible stray coupling into vertical deflection circuits

RAPID CHECKS 8, 44, 45, 68

8-Q SYMPTOMS PICTURE Centering vertically non-adjustable
RASTER Centering vertically non-adjustable
SOUND Normal



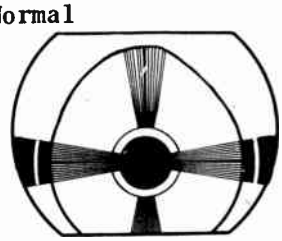
CODE 21-VB-16

CAUSE Defective centering control potentiometer or defective or misadjusted centering adjustments. Where potentiometer is by-passed by condenser, check for defective condenser.

RAPID CHECKS 44, 8, 18. Check centering adjustments

NOTE: If potentiometer centering controls are not used, adjust deflection assembly and focus coil in accordance with manufacturer's instructions.

8-R SYMPTOMS PICTURE Compressed at bottom, stretched at top
RASTER Normal
SOUND Normal



CODES 24-N-16 164-N-16

8-R (Continued)

CAUSE Vertical sawtooth wave deficient in low frequencies causing rapid movement of beam downward at start of picture and slowing down near the bottom of picture. Open cathode by-pass condenser in vertical amplifier or defective coupling condenser (too low in value) in vertical sweep circuit will slow down scanning beam towards bottom of picture due to loss of low frequencies. Trouble may also be due to open resistor or condenser in sawtooth maker (resistor-condenser in series between ground and plate of discharge tube). Also see Classification 8-B.

RAPID CHECKS 8, 45 Also see checks in Classification 8-B

8-S SYMPTOMS PICTURE Compressed at top stretched at bottom
RASTER Normal
SOUND Normal

CODES 25-N-16 161-N-16

CAUSE Vertical sawtooth wave deficient in high frequencies causing slowing up of scanning beam at start (top) of picture and speeding up at bottom. May be due to defect in linearity control, incorrect bias at vertical output tube, defective output tube over compensation for low frequency loss. Also see Classification 8-B.

RAPID CHECKS 45 (linearity control), 22 (vertical output tube) 5u, check compensation circuit if used, also checks given in 8-B

8-T SYMPTOMS PICTURE Fold-over at top
RASTER Fold-over at top
SOUND Normal

CODE 60-FD-16

CAUSE Vertical output grid resistor greatly increased in value -- possibly open-circuited, greatly increased value or open vertical output grid coupling condenser.

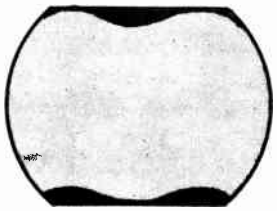
RAPID CHECKS 45, 8

8-U SYMPTOMS PICTURE Edges (top and bottom) wavy

8- VERTICAL SWEEP CIRCUITS

8-U (Continued)

RASTER Edges (top and bottom) wavy
SOUND Normal

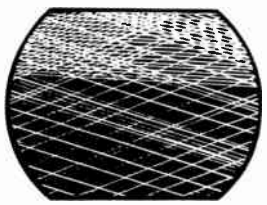


CODE 49-EB-16

CAUSE 60-cycle or 120-cycle hum in vertical deflection system

RAPID CHECKS 30, 18 (for leaky or defective electrolytic condenser) or 13, 18 (for other by-pass condensers in vertical sweep circuits.

8-V SYMPTOMS PICTURE Criss-cross traces
RASTER Criss-cross traces, scanning lines show greatly increased slope
SOUND Normal



CODE 30-CA-16

CAUSE Open condenser or resistor in vertical sawtooth maker in plate circuit of vertical oscillator or discharge tube

RAPID CHECKS 8, 45

8-W SYMPTOMS PICTURE Enlarged vertically
RASTER Enlarged vertically
SOUND Normal

CODE 52-ED-16

CAUSE Shorted by-pass condenser in cathode circuit of vertical oscillator or defect in vertical height and linearity controls.

RAPID CHECKS 18, 45

8-X SYMPTOMS PICTURE Non-adjustable height
RASTER Height non-adjustable
SOUND Normal

8- VERTICAL SWEEP CIRCUITS

8-X (Continued)

CODES 65-HA-16 129-HA-16

CAUSE Defective height control

RAPID CHECK 45

8-Y SYMPTOMS PICTURE Intermittent, vertically dwarfed
RASTER Intermittent, vertically dwarfed
SOUND Normal

CODE 93-IF-16

CAUSE Intermittent in vertical sweep circuit due to defective components, poorly soldered joints, defective tubes

RAPID CHECKS 46, 5v

8-Z SYMPTOMS PICTURE Top portion at bottom, bottom at top, wide black horizontal bar between
RASTER Normal
SOUND Normal

CODE 169-N-16

CAUSE Defective or misadjusted hold control

RAPID CHECK 45

9- HORIZONTAL SWEEP CIRCUITS

9-A SYMPTOMS PICTURE Absent all channels thin bright vertical line
RASTER Absent, thin bright vertical line
SOUND Normal

CODE 3-AB-16

CAUSE No horizontal deflection

NOTE: These symptoms will occur only in sets which have power supply separated from high voltage supply. See Classification 9-B for sets using horizontal fly-back and

9- HORIZONTAL SWEEP CIRCUITS

9-A CAUSE (Continued)

similar high voltage power supplies depending on horizontal oscillator

RAPID CHECKS 5aa, 5c, 22 (to all horizontal sweep circuit tubes) 8, 18 (to condensers in horizontal sweep circuit), 44 and 45 (to resistors, controls, blocking oscillator transformer, horizontal output transformer and horizontal deflection coils).

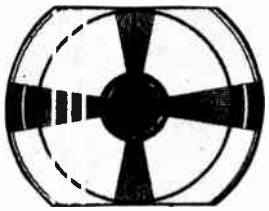
9-B SYMPTOMS PICTURE Absent all channels
RASTER Absent all channels
SOUND Normal

CODE 1-A-16

CAUSE Defect in horizontal sweep circuit resulting in absence of high voltage. Also see Classifications 2-A and 6-AAA

RAPID CHECKS Apply Rapid Checks suggested under Classification 2-A. Also apply Rapid Check No. 48.

9-C SYMPTOMS PICTURE Vertical bars, bright at left (also called "ringing") sometimes accompanied by horizontal non-linearity
RASTER Bars, vertical, bright at left
SOUND Normal



CODES 146-BB-16 185-BB-16 186-V-16

CAUSE Defective damping tube or defective components in damping circuit, defective horizontal discharge tube (or oscillator, when no separate discharge tube is used), incorrect plate voltage at horizontal discharge tube, leaky coupling condenser between horizontal oscillator and horizontal discharge tube.

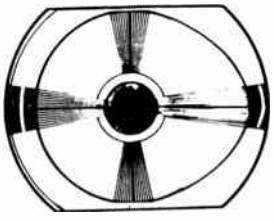
NOTE: If bright bar appears at center of raster or picture, check adjustment of drive control.

RAPID CHECKS 5c, 5x, 5y, 22, 18, 8, 45

9-D SYMPTOMS PICTURE Compressed at left, spread or stretched at right
RASTER Normal

9-D SYMPTOMS (Continued)

SOUND Normal

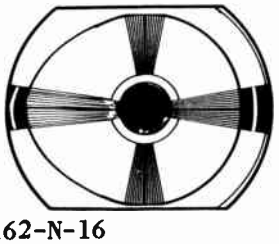


CODES 22-N-16 158-N-16 163-N-16

CAUSE Open screen by-pass condenser in horizontal output tube; if size is enlarged and brightness is reduced check for leaky coupling condenser at grid of horizontal discharge tube. If accompanied by bright vertical bar at left, check for open resistor in horizontal drive circuit or open peaking control or for open condenser in horizontal drive circuit. Other possible causes are defective horizontal output tube or incorrect operating voltages at this tube, lowered resistance of horizontal output tube grid resistor, incorrect or faulty cathode resistor, or faulty condenser across cathode resistor at horizontal output tube, defective horizontal output transformer

RAPID CHECKS 18, 44, 45, 8, 5z, 22

9-E SYMPTOMS PICTURE Compressed at right, spread or stretched at left
RASTER Normal
SOUND Normal



CODES 23-N-16 162-N-16

CAUSE Open linearity adjustment resistor shunting damper tube, faulty damper tube, defective horizontal linearity coil, defective condensers at either end of linearity coil, mismatched horizontal output transformer and horizontal deflection coils or defective horizontal output transformer.

RAPID CHECKS 5c, 44, 45, 8

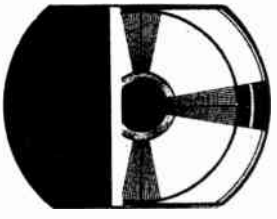
9-F SYMPTOMS PICTURE Blooming (abnormal expansion when brightness control is turned up)
RASTER Blooming
SOUND Normal

CODES 12-BC-16 51-EC-16

CAUSE Insufficient second anode voltage at picture tube. Increased resistance of high voltage filter resistor.

RAPID CHECKS 24, 45

9-G SYMPTOMS PICTURE Fold-over, left side
RASTER Fold-over, left side
SOUND Normal



CODE 58-FB-16

CAUSE Defective damper tube or horizontal oscillator tube, leaky coupling condenser between horizontal discharge and horizontal output tubes, open filter condenser at cathode of damper tube, increased value or open of sawtooth maker condenser, shorted width coil.

NOTE: Fold-over may also be caused by improper adjustment of the phase control in synchrolock horizontal a.f.c. systems.

RAPID CHECKS 5c, 5x, 18, 8, 44

9-H SYMPTOMS PICTURE Fold-over, right side
RASTER Fold-over, right side
SOUND Normal

CODE 59-FC-16

CAUSE Horizontal sawtooth wave having poor high frequency response causing beam to retrace prior to blanking due to reduced capacity sawtooth maker condenser, greatly lowered value horizontal output grid resistor or leaky condenser shunting this resistor. Also may be caused by defective parts in any portion of horizontal sweep circuit or by misadjustment of horizontal

9-H CAUSE (Continued)

sync locking systems or linearity, width and drive controls.

RAPID CHECKS 45, 8

9-I SYMPTOMS PICTURE Double image, horizontally displaced interlace (horizontal displacement of first and second fields)
RASTER Normal
SOUND Normal

CODE 42-N-16

CAUSE Reduced grid leak resistor value (horizontal output tube), defective horizontal drive (peaking) control, defective horizontal output tube or other defective tubes in horizontal sweep circuit, incorrect operating voltages on these tubes.

RAPID CHECKS 45, 8, 5z, 5y, 5x, 5w, 22

9-II SYMPTOMS PICTURE Multiple (overlapping) images, horizontally superimposed portions of picture
RASTER Normal
SOUND Normal

CODES 113-N-16 125-N-16 165-N-16

CAUSE Incorrect horizontal oscillator frequency due to incorrect adjustment of inductance slug in oscillator tank circuit, defective condenser in same circuit, defective horizontal oscillator tube, or incorrect operating voltages on same, defective horizontal hold control, defective horizontal stabilizing control in phase detector a.f.c. system, defective horizontal frequency trimmer or locking range trimmer in old type synchroguide system, defective synchroguide negative coefficient resistor, defective automatic frequency control tubes in any a.f.c.system.

RAPID CHECKS Check all frequency adjustments, following manufacturer's directions wherever possible. Apply 8, 18, 45, 5w, 5x, 22.

NOTE: When replacing defective resistors or condensers in oscillator circuit, note required tolerance and also if special negative resistance or temperature compensating components are required. If so, use only with exact and accurate replacements.

9- HORIZONTAL SWEEP CIRCUITS

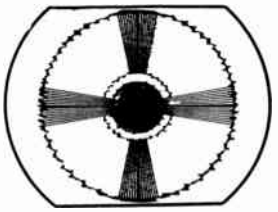
9-J SYMPTOMS PICTURE Jittery (horizontally)
RASTER Normal
SOUND Normal

CODE 96-N-16

CAUSE Same as Classification 9-I

RAPID CHECKS Same as Classification 9-I

9-K SYMPTOMS PICTURE Edges jagged, pie-crust effect
RASTER Edges jagged, pie-crust effect
SOUND Normal

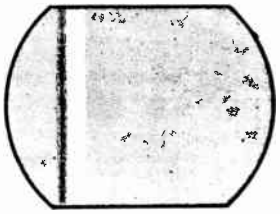


CODES 47-E-16 95-E-16 135-E-16

CAUSE Screen grid not by-passed in horizontal oscillator due to open or defective condenser. Also see Classification 2-G

RAPID CHECK 8

9-L SYMPTOMS PICTURE Vertical dark faint line or lines on left side, followed by light area (Barkhausen oscillations)
RASTER Barkhausen oscillations
SOUND Normal



CODES 7-B-16 134-B-16 182-B-16

CAUSE Interference due to oscillations set up in horizontal output tube and picked up by tuner

RAPID CHECKS Tune to high frequency channel, turn contrast to maximum and apply checks 5z and 22. If necessary, try several tubes or a specially designed anti-Barkhausen tube as made by several tube manufacturers. Reduce horizontal drive and check linearity adjustment. Check positioning of leads in horizontal output circuit and try changing lead-dress. Remove lead-in from neighborhood of high voltage section and change position of indoor antenna. Fasten magnet, such as ion trap, to side of horizontal output tube, moving magnet to best position to eliminate trouble.

9-M SYMPTOMS PICTURE Trapezoid, narrow at top (keystone effect)
RASTER Trapezoid, narrow at top
SOUND Normal

CODES 101-KC-16 118-KC-16 174-KC-16

CAUSE One section (half) of horizontal deflection coil shorted due either to short circuit in coil or to shorted condenser shunting coil

RAPID CHECKS 44, 18, Note that horizontal coils are above and below neck of tube and that narrowed portion of trapezoid points toward defective coil section.

9-MM SYMPTOMS PICTURE Trapezoid, narrow at bottom (keystone effect)
RASTER Trapezoid, narrow at bottom
SOUND Normal

CODES 98-K-16 115-K-16 171-K-16

CAUSE One section (half) of horizontal deflection coil shorted due either to short circuit in coil or to shorted condenser shunting coil.

RAPID CHECKS 44, 18. Note that horizontal coils are above and below neck of tube and that narrow portion of trapezoid points toward defective coil section.

9-N SYMPTOMS PICTURE Ripple (wrinkle) vertical, left side, wavy vertical lines
RASTER Ripple, vertical left side
SOUND Normal

CODES 143-RB-16 194-RB-16 200-RB-16 198-RB-16

CAUSE Leaky or incorrect value condenser across half of horizontal deflection coil section

RAPID CHECKS 18, 44

9-O SYMPTOMS PICTURE Right portion on left side, left portion on right side, horizontal blanking bar appears between them. (This appears as a vertical black bar)
RASTER Normal
SOUND Normal

CODES 73-N-16 102-N-16 125-N-16 145-N-16

CAUSE Misadjusted or defective phase control (synchrolock a.f.c.) Generally results from open condenser across primary (diode

9-O CAUSE (Continued)

tube side) of horizontal discriminator or a defective shaping network (incorrect resistor-condenser values) in the oscillator plate circuit. Defective tube(s) or defective hold control in horizontal a.f.c. system (any type). Defective or misadjusted horizontal lock circuit in phase detector and synchroguide a.f.c. systems.

RAPID CHECKS First check adjustments of controls mentioned above. Then apply checks 8, 45 and 5w.

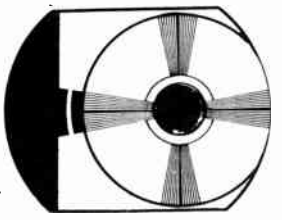
9-P SYMPTOMS PICTURE Absent all channels
RASTER Horizontal sloping lines of various shades when tuned to station, otherwise normal
SOUND Normal

CODES 1-HH-16 125-HH-16

CAUSE Lack of horizontal sync with inability to control horizontal oscillator, defective horizontal oscillator tube, or incorrect operating voltages, defective temperature compensating resistors or condensers in oscillator circuit, defective hold control, defective circuit or incorrect adjustment of automatic frequency control system.

RAPID CHECKS 5w, 5x, 5y, 22, 8 and 45. Also check horizontal a.f.c. system applying either 33, 88, 89 or 90 according to the system employed.

9-Q SYMPTOMS PICTURE Centering, horizontal non-adjustable
RASTER Horizontal centering non-adjustable
SOUND Normal



CODE 20-HE-16

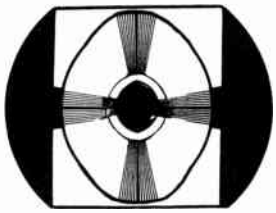
CAUSE Defective or misadjusted horizontal centering control, incorrect d.c. potential applied to deflection coils (in sets using this method of centering), weak centering magnet. Where no specific centering device is provided, adjust focus device. Where picture tube employs electrostatic focusing, center by changing position of centering magnet, adjusting field to required strength.

9-Q (Continued)

RAPID CHECKS 45, 8, 18 (horizontal centering control and associated resistors and condensers), check d.c. voltage used for centering. Check for weak centering magnet by replacement.

NOTE: If picture is tilted in addition to being off center, adjust deflection coil yoke.

9-R SYMPTOMS PICTURE Width insufficient
RASTER Width insufficient
SOUND Normal



CODES 209-WB-16 44-WB-16

CAUSE Defective horizontal output tube, defective discharge tube, defective damper tube, incorrect operating voltages on these tubes, defective cathode by-pass condenser at horizontal discharge tube (open or capacity too low), defective or misadjusted width control, defective deflection coil

RAPID CHECKS 5z, 5y, 5c, 22, 8, 45, 44

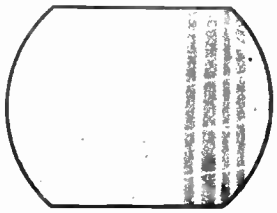
9-S SYMPTOMS PICTURE Width non-adjustable
RASTER Width non-adjustable
SOUND Normal

CODES 130-WC-16 210-WC-16

CAUSE Faulty horizontal width control or associated circuit

RAPID CHECKS 44, 45, 8, 18

9-T SYMPTOMS PICTURE Vertical bars, right side
RASTER vertical bars, right side
SOUND Normal



CODE 187-VA-16

CAUSE Defective horizontal oscillator tube

RAPID CHECK 5x

9- HORIZONTAL SWEEP CIRCUITS

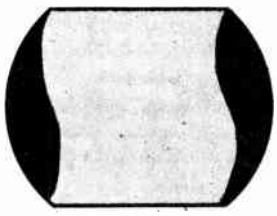
9-U SYMPTOMS PICTURE Horizontal non-linearity
RASTER Normal
SOUND Normal

CODES 76-N-16 127-N-16 162-N-16
103-N-16 158-N-16 163-N-16

CAUSE Defective horizontal output tube, defective discharge tube, defective damping tube(s), incorrect tube operating voltages, defective horizontal output transformer, defective horizontal linearity, drive and width controls, defective capacitor by-passing cathode of damper tube. Also see Classifications 9-D and 9-E.

RAPID CHECKS 5z, 5y, 5c, 44 (to output transformer windings and variable controls), 45 (to all resistors in damper, drive and linearity control circuits), 8 and 18 (to condensers in these circuits).

9-V SYMPTOMS PICTURE Edges wavy at sides, "S" shaped at sides.
RASTER Edges wavy at sides
SOUND Normal

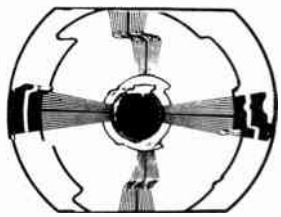


CODES 48-EA-16 148-EA-16

CAUSE 60-cycle hum in horizontal deflection system due to heater-cathode leakage of tubes in this portion of circuit, or 120-cycle hum due to defective plate or screen supply filter condenser in horizontal deflection circuit.

RAPID CHECKS 5aa, 84

9-VV SYMPTOMS PICTURE Horizontal pulling, weaving or bending, accompanied by wavy edges (sides)
RASTER Normal
SOUND Normal



CODES 77-N-16 137-N-16 203-N-16

CAUSE Variation in sync phase due to heater-cathode leakage in horizontal a.f.c. tubes, or in any other tubes in horizontal deflec-

9-VV CAUSE (Continued)

tion system. Note that no hum bars are present and that in the absence of signal, raster is normal. If accompanied by too much contrast, unstable sync lock system is indicated. Also see Classifications 5-Q, 6-G, and 6-N.

RAPID CHECKS 5w, 5aa. Check adjustment of horizontal a.f.c. system.

9-W SYMPTOMS PICTURE Dwarfed horizontally
RASTER Dwarfed horizontally
SOUND Normal

CODES 44-DD-16 209-WB-16

CAUSE Defective width control, defective horizontal discharge and output tubes or incorrect operating voltages on these tubes, defective horizontal drive control, abnormally high voltage at second anode of picture tube. Also see Classification 9-R.

RAPID CHECKS 5y, 5z, 22, 45 (to controls) 24.

9-WW SYMPTOMS PICTURE Width intermittently variable
RASTER Width intermittently variable
SOUND Normal

CODES 119-WD-16 211-WD-16

CAUSE Defective damper, horizontal discharge or horizontal output tubes, faulty width coil or yoke connections, faulty condenser across half of horizontal deflection coil, faulty drive control trimmer

RAPID CHECKS 5c, 5y, 5z, 46, 8

9-X SYMPTOMS PICTURE Horizontal movement, hold control ineffective
RASTER Normal
SOUND Normal

CODE 75-N-16

CAUSE Same as Classification 9-II. Also refer to Classification 7-C

RAPID CHECKS Same as Classification 9-II.

9-Y SYMPTOMS PICTURE Movement of actor to right, followed by rapid movement of shadowy form to left, and vice versa.
RASTER Normal
SOUND Normal

CODE 112-N-16

CAUSE Defective horizontal blanking

RAPID CHECKS Set horizontal hold control at mid-point and check phasing adjustment. If latter is not used, try readjustment of horizontal hold control. Finally try checks suggested under Classification 7-C.

9-Z SYMPTOMS PICTURE Normal
RASTER Normal
SOUND Whistle, very high pitched (15 kc)

CODE 131-N-24

CAUSE Vibrating horizontal output transformer core or coils, shorted turns in horizontal output transformer

RAPID CHECK Replace transformer

9-ZZ SYMPTOMS PICTURE Width excessive
RASTER Width excessive
SOUND Normal

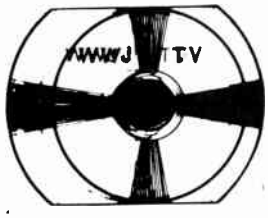
CODE 213-WG-16

CAUSE Excessive voltage of horizontal sawtooth wave due to incorrect tube operating conditions in horizontal sweep circuit, defective width control, defective drive control

RAPID CHECKS 22 (to horizontal sweep circuit tubes), 44 (to width coil), 8 (to drive control), 45 (to width control potentiometer)

10- ANTENNA AND TRANSMISSION LINE

10-A SYMPTOMS PICTURE Ghosts
RASTER Normal
SOUND Normal



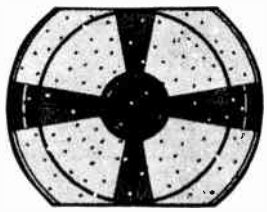
CODES 41-N-16 61-N-16

10-A (Continued)

CAUSE Reflections from surrounding buildings, reflections due to transmission line mismatch, transmission line pickup

RAPID CHECKS 69. If found to be due to reflections from surrounding structures, rotate (orient) antenna for less reflection. Try relocating antenna or elevating it. Substitute a more highly directive antenna. Another remedy is to use a resistance "pad" between the transmission line and the set terminals. For 300-ohm set input and 300-ohm transmission line, use three 125-ohm resistors on each side of the line, with 50-ohm resistors shunted across the ends of the middle 125-ohm resistors. Use carbon resistors only. The pad can be used only with strong signals. Apply Check 77. If trouble is due to transmission line mismatch, match line to set and if necessary use matching stub between line and antenna. Transmission line pickup results in ghost to left of desired signal. Check with either longer or shorter transmission line.

10-B SYMPTOMS PICTURE Snow or weak all channels
RASTER Normal
SOUND Weak all channels



CODES 155-N-21 201-N-21

CAUSE Insufficient signal pickup. Also see Classifications 3-C, 5-CC and 6-Q.

RAPID CHECKS Check set in another locality where reception is known to be good. If due to antenna installation, check lead-in for open or for imperfect connections to antenna, increase height of antenna, use stacked bi-conical with reflectors and directors. Rotator will also give better results. Apply Rapid Check 77. Match transmission line directly to set and, if necessary, use matching transformer at antenna. Use booster.

10-C SYMPTOMS PICTURE Weak and/or snow one or more channels
RASTER Normal
SOUND Weak

CODES 37-N-22 39-N-22 156-N-22 202-N-22

CAUSE Weak signal pick-up one or more channels. See Classification 3-K.

10- ANTENNA AND TRANSMISSION LINE

10-C (Continued)

RAPID CHECKS Adjust fine tuning on weak channel to make sure trouble is outside set. Reorient antenna, turning it broadside to weak station. Elevate antenna. Use a more highly directive antenna such as a Yagi, or a separate highly directive antenna for offending channel. Increased gain can also be obtained by stacking. Apply Rapid Check No. 77. Use booster.

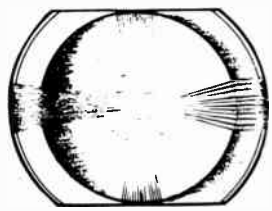
10-D SYMPTOMS PICTURE Horizontal pulling (usually accompanied by snow)
RASTER Normal
SOUND Weak

CODES 77-N-21 137-N-21

CAUSE Insufficient signal pickup

RAPID CHECKS Apply same checks as in Classification 9-B.

10-E SYMPTOMS PICTURE Smeared and indistinct quality poor, blurred, details absent all channels
RASTER Normal
SOUND Weak



CODES 13-N-21 38-N-21 138-N-21 152-N-21

CAUSE Very bad mismatch between receiver and transmission line, incorrectly oriented antenna, use of an unbalanced transmission line with set employing center-tapped (balanced) input coil. Also see Classifications 3-C, 5-CC and 6-Q.

RAPID CHECKS Use transmission line of impedance specified by set manufacturer. Apply Rapid Checks 65 and 77.

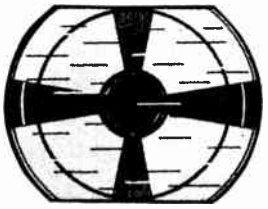
10-F SYMPTOMS PICTURE Smearing, details absent, one channel
RASTER Normal
SOUND Weak, one channel

CODES 37-N-22 154-N-22

CAUSE Same as Classification 10-E Smearing due to transmission line mismatch very often affects only one or two channels.

RAPID CHECKS Same as Classification 10-E

11-A SYMPTOMS PICTURE Thin, dark and/or light streaks, horizontal
RASTER Dark streaks, intermittent (in some cases normal)
SOUND Noisy (in some cases normal)

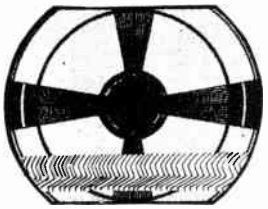


CODES 31-D-15 31-N-16 88-IC-15
31-D-16 78-N-15 160-D- 15

CAUSE Automobile or other ignition interference

RAPID CHECKS Relocate antenna away from source of trouble. Useshielded line.

11-B SYMPTOMS PICTURE Herringbone effect
RASTER Herringbone effect
SOUND Normal

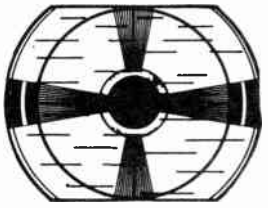


CODE 66-HB-16

CAUSE Diathermy, x-ray apparatus, r.f. signal generators

RAPID CHECKS The characteristic pattern, plus the fact that it occurs at odd intervals localizes this trouble. Shielding of offending apparatus is best remedy.

11-C SYMPTOMS PICTURE Dark horizontal streaks
RASTER Dark horizontal streaks
SOUND Noisy



CODES 89-IC-15 121-D-15

CAUSES Home and business appliances which use brush type motors, electric razors or other vibrating devices, electrical devices which arc, fluorescent lights. Also see Classification 2-D.

11- INTERFERENCE AND TRANSMITTED SOURCES OF TROUBLE

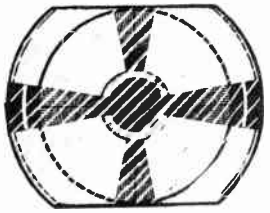
11-C (Continued)

RAPID CHECKS This type of interference usually appears on a number of channels. Streaks appear at random in different positions. If very strong, dark dashes are followed by white. This signifies that noise pulses are overloading the receiver. Check for offending device by elimination, first of one suspected device, then another, etc. When located, apply shielding, filter and other conventional interference remedies. Use of a shielded coaxial transmission line will often help reduce noise pickup.

11-D SYMPTOMS PICTURE Beat pattern (thin weaving meshed lines), bars diagonal or vertical, large number, alternate dark and light, contrast almost reversed.

NOTE: Not all of these symptoms will be present at same time

RASTER Normal
SOUND Normal



CODES 8-N-16 26-N-16 105-N-16
11-N-16 40-N-16 183-N-16

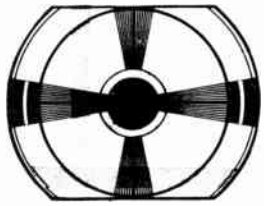
CAUSE Interference due to radio frequency pickup. This may be caused by interference from neighboring TV sets, from local FM broadcast stations, from harmonic of sound i.f. signal, from local AM broadcast stations, adjacent channel interference, diathermy interference. See Classification 11-B.

RAPID CHECKS The higher the frequency of the interfering signal, the greater the number of dark and light vertical bars. If possible to count number of dark vertical bars, beat frequency in megacycles may be ascertained by dividing this number by 53. Interference pickup may be by video amplifier (low audio frequencies up to 4.5 mc), by the picture i.f. amplifier (in the range of the pix i.f.), or by the r.f. amplifier (in the TV channel, in its image band, or even in other bands). Apply Rapid Check No. 63 to determine whether interference is being picked up by video amplifier. If due to r.f. pickup, adjacent channel interference may be eliminated by proper adjustment of traps provided for this purpose. R.F. (image) interference may be prevented in many instances by means of a ¼-wavelength stub of 300-ohm transmission line connected at the set terminals in parallel

11-D RAPID CHECKS (Continued)

with the incoming transmission line. Stub should be open at its far end and should be cut to ¼-wavelength of the interfering frequency. Value in inches is approximately 2450 divided by frequency in megacycles. Interference from local FM may be eliminated by installation of commercial FM traps. Where local AM interference is experienced check input circuits of TV set for open coils or shorted capacitors. To reduce interference from neighboring sets, try relocating or reorienting antenna or increasing its height; if practical install a wire mesh shield between set antenna and radiating antenna.

11-E SYMPTOMS PICTURE Windshield wiper effect. Vertical moving bar. Also sometimes both vertical and horizontal moving bars. In latter case may be referred to as "frame" effect.
RASTER Normal
SOUND Normal



CODE 212-N-16

CAUSE Cross-modulation interference from another channel. The dark moving vertical bar is caused by the slow movement of the horizontal blanking and sync signals of the offending channel. The dark moving horizontal bar is caused by the vertical blanking signals of the interfering channel.

RAPID CHECKS Try reorienting antenna, try "pad" described in Classification 10-A, or try use of quarter wave stub described in 11-D.

11-F SYMPTOMS PICTURE Reversed contrast (one channel)
RASTER Normal
SOUND Normal

CODE 28-N-16

CAUSE Excessively strong signal

RAPID CHECKS Try indoor antenna. Use resistance pad as described in Classification 10-A

11-G SYMPTOMS PICTURE Venetian blind effect
RASTER Normal
SOUND Normal

CODE 181-N-16

CAUSE Slight frequency differences between carriers of television stations occupying same channel. Usually noticeable in fringe areas located between co-channel stations. Differences of up to several thousand cycles in the two carrier frequencies produce horizontal bars which move up and down as the carrier frequency of either station is varied.

RAPID CHECKS This trouble will eventually be eliminated by automatic synchronization between offending co-channel stations. Can be minimized by re-orientation of antenna to favor desired station and discriminate against undesired one.

11-H SYMPTOMS PICTURE Intermittent ghosts
RASTER Normal
SOUND Normal

CODES 62-N-16 90-N-16

CAUSE This condition is rather unusual, but may occur where some large metal object such as a tank used to store gas in large cities, periodically rises between set antenna and transmitting channels.

RAPID CHECKS 91, to make sure trouble is not due to echo effect or ringing. If found to be due to reflection, relocate antenna. If due to echo effect, refer to Classifications 5-M and 6-I. Intermittent echo effect could also be caused by defective resistors in r.f. amplifier or mixer grid circuits.

11-I SYMPTOMS PICTURE Intermittent pulling
RASTER Dark streaks, intermittent
SOUND Noisy

CODE 91-IC-15

CAUSE Certain types of interference such as strong automotive and airplane ignition interference, especially in fringe areas.

RAPID CHECKS Check a.g.c. applying checks 67, 66. Check position of a.g.c. threshold control, try booster and other means to increase signal-to-noise ratio such as use of a stacked antenna, increasing height of antenna and other expedients mentioned in Classification 10-C.

SECTION 2

RAPID TV ALIGNMENT METHOD

A television set should never be realigned unless it is definitely known that such procedure is actually necessary. Many of the picture and sound symptoms which are associated with incorrect alignment may also be caused by other troubles. Even a faulty response curve does not furnish absolute proof of the need for realignment. Very often trouble symptoms can be corrected or a faulty response curve may be made normal, merely by judicious tube substitution. However, when other remedies fail, and all indications point to the need for realignment, application of the Rapid Alignment Checks described in this section will enable the serviceman to perform these adjustments with ease.

Most television sets rarely if ever need r.f. realignment, except where the set owner has tampered with front end alignment adjustments. Front end misalignment (r.f. mixer, oscillator) generally involves both picture and sound trouble symptoms. These symptoms may be present on only one channel, on several channels or on all channels, depending upon the design of the tuner or on other factors. Picture i.f. misalignment involves picture trouble symptoms on all channels with sound and raster normal, except in the case of intercarrier sets, where sound will also be affected. Sound section misalignment will cause symptoms restricted to sound only on all channels, with raster and picture normal.

TROUBLE SYMPTOMS WHICH INDICATE NEED FOR REALIGNMENT

Symptom	Section Which May Need Realignment
Faint or blurred picture	R.F. Amp., Picture I.F. Amp.
Poor synchronization	" " " " " " "
Inadequate blanking	" " " " " " "
Echo effect or ringing	" " " " " " "
Horizontal streaks across vertical pattern wedges	" " " " " " "
Horizontal wedges weaker than vertical wedges	" " " " " " "
Horizontal wedges stronger than vertical wedges	" " " " " " "
Vertical wedges cut off towards narrow portions	" " " " " " "
Horizontal pulling or tearing	" " " " " " "
Sound bars in picture	Sound take-off or associated sound traps
Sound weak or sound absent	Sound take-off, associated sound traps, sound i.f. amp, ratio detector or discriminator
Distorted sound	Sound i.f., ratio detector or discriminator
Diagonal lines across picture	Lower adjacent sound traps
Poor picture quality	Adjacent traps
Picture and sound do not track	Oscillator
Sound not maximum, with fine tuner at center of rotation	Oscillator

The Meaning of Alignment

The television receiver contains a number of resonant circuits (circuits containing inductance and capacity), which are tunable either by changing the inductance usually by means of a trimmer or a variable condenser. In some sets inductance is changed by slightly compressing or expanding coil turns. Each of these resonant circuits must be accurately tuned in order for the TV set to function properly. If the set owner had to make these adjustments, present-day television would be out of the question. Fortunately, these numerous circuits can be pre-tuned at the factory -- this is cal "alignment" -- and once this is done, the set will function normally and the set owner merely has to operate a few basic controls. However, if for any reason whatsoever, any of these semi-permanently tuned circuits goes out of adjustment, then the TV set must be realigned (resonant circuits retuned) by a serviceman who has the knowledge, skill and necessary equipment to do the job.

Sections of TV Set Which May Need Realignment

1 -- The traps. These are: associated sound trap, adjacent sound trap, adjacent picture trap and in some sets a 4.5 mc trap.
2 -- Sound take-off
3 -- I.F. amplifier
4 -- Sound discriminator or ratio detector or other FM detector
5 -- Picture i.f. amplifier and mixer
6 -- Oscillator
7 -- R.F. stage or stages

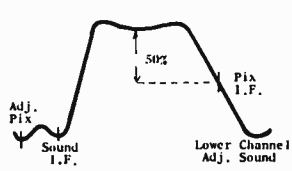
The sequence of alignment may be set in the order given above, except if manufacturer gives a preferable sequence for his particular model.

Instruments Needed for Alignment

1 -- SWEEP GENERATOR. This is an r.f. oscillator or generator which can be tuned to any desired frequency used in television reception merely by setting a dial at a given point on a calibrated scale. It differs from the ordinary signal generator used in radio work, however, since it contains built-in means (either mechanical or electronic) by which a frequency variation above and below the frequency to which it is set, is emitted at a fixed rate of change and over a suitable range of frequencies. To make this a little clearer, assume that the dial is set at 41.25 megacycles. A second dial known as "sweep width" can be set to cause the frequency to vary a definite amount above and below the 41.25 center frequency. For example, if this second dial is set at 10 megacycles, the frequency will increase over a continuous band, from 41.25 mc. to 46.25 mc., then decrease back to 36.25 mc. and automatically continue to do this at a 60-cycle rate. In other words, every sixtieth of a second, the sweep generator sends out a series of r.f. signals covering a 10 mc. band, around the selected center frequency of 41.25 mc. All frequencies emitted are of equal voltage.

When the signals from the sweep generator are injected into a television set, for example at the input to the picture i.f. amplifier and an oscilloscope is connected to the output of the video detector, the voltages which pass through the i.f. amplifier will appear in rapid succession on the screen of the tube at various vertical levels. Some frequencies will pass through the i.f. amplifier with greater ease than others, depending upon the tuning of the resonant circuits in the amplifier. These will produce higher vertical lines on the scope than those frequencies which have a hard time getting through the amplifier.

If the scope beam is swept horizontally across the screen at the same rate as the signal is being swept back and forth in the generator, a waveform will appear on the screen which will show exactly how well the i.f. amplifier is able to pass the various frequencies through it. This waveform is called a "response curve." A typical picture i.f. response curve is shown below.



Pix I.F. Response

The oscilloscope may be made to sweep horizontally in unison with the sweep generator signal, by connecting a cable between a jack marked "sweep output" and the "H" terminal of the scope (with internal sweep of scope turned "off").

Aside from its use in front end, pix i.f. and sound alignment, the sweep generator is extremely useful in furnishing suitable r.f. signals for signal tracing.

2 -- MARKER GENERATOR. The marker generator is an amplitude modulated generator capable of providing a single AM signal of any needed frequency for the purpose of marking the response curve with a "pip" or a slight depression, thus enabling the serviceman to determine the exact frequency at any point on the response waveform. Accurate alignment is impossible without a marker generator. In many cases this device is incorporated as a part of the sweep generator. Where a separate marker generator is used, it is connected to the same points in the TV set as the sweep generator, but the signal should be fed through a small condenser and series isolating resistor to prevent the marker from affecting the shape of the response curve.

As an example of the way in which the marker is used, assume that it is necessary to adjust a pix i.f. response curve so that it will have a flat top between 42.25 mc. and 45 mc. By means of the marker generator these two frequencies are readily identified on the response waveform seen on the scope and therefore adjustments can readily be made at the i.f. amplifier which will give the desired waveform. The marker generator must be accurately calibrated, otherwise worthwhile alignment cannot be performed. For this purpose, most marker generators include in their construction a means of calibration. A crystal-controlled oscillator is often used for this purpose. However, where this is not available, it is usual practice to calibrate the marker by heterodyning its output against a signal known to be accurate. Such signals can be picked up on a short wave receiver from the National Bureau of Standards transmitter at Washington, D.C. Any well designed crystal controlled frequency meter, such as the surplus Signal Corps meters, will serve as a calibrator, if it covers the necessary frequency range.

The principle involved is to beat the signal from the generator to be calibrated against a signal from an accurate crystal controlled oscillator which serves as a standard. Harmonics may be used, thus extending the range of the calibrator. The calibrator is usually equipped with a suitable short wave receiver with provision for substitution of earphones for loud speaker. The output of the instrument to be calibrated is loosely coupled to the output of the calibrator. As the two r.f. signals approach each other in frequency, the difference

frequency comes within the audio range and can be heard on the earphones or loud speaker. The closer the two frequencies come to each other, the lower the pitch of the audible note, until finally the note disappears as the two frequencies coincide and then with further change in the frequency of the generator being calibrated, the pitch of the beat note rises again. Thus, it is very easy to find the exact point at which the two generators are emitting identical frequencies. This is sometimes referred to as the zero beat method of calibration.

3 -- OSCILLOSCOPE. This instrument utilizes a cathode ray tube, and, in some ways, its operation resembles that of the TV set itself. When the CRT (cathode ray tube) is energized by correct voltages, it emits a stream of electrons which are projected at enormous speed until they strike the inside face of the tube. This stream of electrons converges at the face of the tube, which is coated with a substance which lights under the impact of the electron stream. The oscilloscope contains means for moving the electron stream from side to side by means of a circuit similar to the horizontal sweep circuit of a TV set. This circuit connects to plates within the tube, known as horizontal deflection plates, which, through electrostatic action, attract or repel the electron stream horizontally, as the voltage on the plates changes. A second set of plates within the CRT, called vertical deflection plates, causes the electron beam to be moved up or down according to the voltage changes between them. The "V" or vertical post of the scope connects through an amplifier to one of the vertical plates. The other vertical plate is also connected to the output of the amplifier in a balanced arrangement. When a changing external voltage is applied between the "V" post and scope "ground", it is amplified and reaches the vertical plates, where it causes the beam to move up or down as the voltage increases or decreases. By means of the horizontal sweep circuit within the scope, the beam may be swept from side to side as the external voltage causes it to rise and fall. Only the sweep from left to right is visible, as the return from right to left is blanked out. The scope contains means for using an external horizontal sweep and also includes an amplifier for increasing the strength of the horizontal sweep signal.

The most important use of the oscilloscope in television servicing is to permit the serviceman to see the actual r.f. and picture i.f. response waveforms. It can also be used instead of a vacuum tube voltmeter in trap alignments and it can be used to great advantage in locating faults by signal tracing and for aligning the sound i.f. amplifier and sound detector.

Aside from the above mentioned uses, the oscilloscope has many other applications in advanced servicing. For example, it can be accurately calibrated to read peak-to-peak voltages, which can be readily reduced to r.m.s. or effective voltages, merely by multiplying peak-to-peak voltage by 0.3535. It can also be used to determine frequency by comparison with a known frequency.

4 -- VACUUM TUBE VOLTMETER (VTVM). As its name implies, this instrument uses the amplifying functions of the vacuum tube to permit meter measurements of voltage, without requiring extremely high sensitivity meter movements. Ordinary meters which could possibly do such work, would be far too delicate to handle and in addition would unduly load the circuit to which they were connected. The VTVM on the other hand has negligible loading effect on the circuit under test. When used with suitable probes, it can be used to measure voltages of any frequency encountered in television servicing.

Another important advantage is the fact that a minute voltage can cause considerable needle deflection. This instrument can be used to measure a.c. or d.c. voltages and when measuring the latter will indicate positive or negative polarity. By means of high voltage probes, it can be used to measure TV second anode voltage up to 30,000 volts. The VTVM can be obtained combined with an ohmmeter which will measure resistances from 0.2 ohm up to 1000 megohms. This is an important advantage in TV servicing.

The high frequency probes used with vacuum tube voltmeters employ a miniature tube or a crystal within the probe itself. This rectifies the r.f. signal, thus bringing rectified d.c. to the meter input. In this way it is possible to avoid the loading effect of the comparatively high capacity cable used to conduct the signal from the point of measurement to the meter.

Practical Pointers on the Use of TV Test Equipment

Even mediocre instruments, properly used can produce worthwhile results. Here are a few hints on the proper use of TV test instruments.

WARM-UP TIME -- USE OF SHORT SHIELDED LEADS -- SUITABLE GROUNDING

Allow fifteen to twenty minutes warm-up time before using sweep or marker generators.

Make sure that all test instruments, as well as TV chassis are properly grounded together, preferably using a metal bench. Ordinary hookup wire is not suitable for good grounding. Use metal braid as used by electricians for carrying heavy currents.

Use shielded leads, as short as possible for all connections between TV set and instruments, being sure that the shields are grounded.

WEAK SIGNALS GIVE BETTER RESPONSE CURVES

Use as weak a signal as possible in testing. This applies both to the sweep generator and to the marker generator. Too strong a signal will overload the stages under test and

give incorrect response curves. As pix i.f. amplifier or sound amplifier is tuned to better alignment, response at scope becomes greater. Always reduce strength of signal generator rather than scope amplification, to keep response curve at suitable amplitude.

When using scope amplifier, prevent overloading by keeping amplitude as low as possible.

METHOD OF ELIMINATING EXTRANEOUS OSCILLATIONS

To get rid of oscillations in video i.f. response curve, remove local oscillator. If necessary, also remove vertical oscillator and disable horizontal oscillator by grounding control grid to chassis. Do not remove horizontal oscillator tube for this purpose (as suggested in several TV service books written by theorists without practical experience), since in most sets if the horizontal oscillator tube is removed without also removing the horizontal output tube, the latter may be seriously damaged.

In the pix i.f. alignment of any set, where the signal generator is moved back from the input stage nearest the video detector stage-by-stage to the input of the mixer, oscillations may come through the preceding stages and clutter up the response curve. To avoid this difficulty, follow this procedure: When the stage nearest the video detector is being aligned, shunt 1000 mmf condensers between the control grids and chassis of all preceding stages. Naturally, as the signal generator input is moved back to a preceding stage, the 1000 mmf condenser is removed.

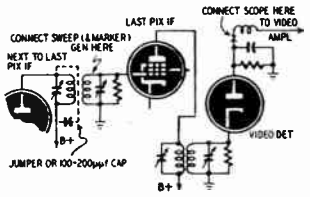
It is often possible to prevent frequency disturbances from showing on response curves, by connecting a 1000 mmf condenser between the vertical ("V") post of the scope and ground. This method applies where scope is used as an indicator of signals injected by sweep generator, but should not be used to observe video signals brought into the receiver from an antenna. As an emergency substitute for a high frequency probe, an isolating resistor of from 5000 to 15,000 ohms in series with the V post of the scope and point under observation, is sometimes added to the 1000 mmf shunted condenser, thus forming an RC filter. This arrangement is helpful where scope is connected across a high impedance point.

CORRECT BIAS AN IMPORTANT FACTOR IN PIX I.F. ALIGNMENT

Incorrect bias on the i.f. tubes while making a pix i.f. alignment (or on r.f. tubes when making a front end alignment), may make the difference between success and failure. The best plan is to follow the manufacturer's instructions as to bias requirements when aligning. If these are not available, set the bias at a value which will give normal operating conditions in the customer's home, since a set in a fringe area would operate normally with much less bias than one in a strong signal area. If the service shop is in the same area as the customer the correct bias can be ascertained by checking the bias for several stations on a similar set which is operating correctly. With sets employing a.g.c. use "bias box" described in Rapid Check No. 66.

PRECAUTION NECESSARY WHEN ALIGNING OVERCOUPLED PIX I.F. AMPLIFIER

When aligning an overcoupled i.f. amplifier, the primary of the transformer ahead of the control grid to which the signal is applied, will absorb energy in a manner similar to an absorption trap, putting a dip in the response curve. The remedy is to shunt the primary with a jumper or with a 100 - 200 mmf condenser as shown in the accompanying illustration. When alignment is finished, the shunt is removed. This applies to an alignment procedure employing a sweep generator and an oscilloscope. If an overcoupled system is aligned with an AM signal generator and a VTVM the primary is shunted with a jumper or low value resistor (500 to 1000 ohms), while the secondary is being tuned to a maximum voltage reading. The shunt is then taken off the primary and put across the secondary, while the primary is tuned to a maximum.



Keeping overcoupled transformer primary from acting as absorption trap.

STRONG MARKER MAY SPOIL RESPONSE WAVEFORM

If strong marker signal spoils response curve and it cannot be weakened sufficiently by marker attenuator, connect high side of marker generator to set chassis. If signal is still too strong, operate marker generator near TV set, but without any connection between them. If marker generator is incorporated within sweep signal generator, turn marker generator "off" except when locating required frequency position on the response curve. Put pencil marks directly on face of scope to show location of desired frequencies, then turn marker generator off and observe the response curve, taking care not to change the horizontal position of the response curve.

If marker signal is too weak, and a separate marker generator is used, the signal may be injected into the video i.f. amplifier several stages ahead of the stage being aligned, thus obtaining additional amplification. This, of course, applies where the stages nearest the video detector are being aligned.

TAKE ADVANTAGE OF TV SET VIDEO AMPLIFIER IF SCOPE LACKS SUFFICIENT AMPLIFICATION

If scope indications are too weak and maximum scope amplification has been reached, the scope may be connected beyond the first video amplifier, or in fact at any point in the video amplifier, even to the grid of the cathode ray tube. Use a 0.1 mfd blocking capacitor in series with the lead from the scope to protect against high d.c. voltage at the scope terminals. Place the capacitor at the point where the lead connects to the receiver, to avoid extra shock hazards near scope posts.

HOW TO INTERPRET RESPONSE CURVE INDICATIONS

To determine whether response curve is authentic, turn sweep generator to the "off" position. If curve remains, an extraneous signal is being picked up.

Response curve may appear on scope upside down instead of in position shown by manufacturer. Whether curve is right side up or upside down depends upon where scope is connected in circuit and the number of stages of amplification in scope, since each stage of amplification inverts the signal by 180 degrees.

To determine whether the response curve seen on the scope is rising or falling from zero level, change the frequency setting of the sweep generator until a straight line appears. Then as the generator is turned back to the correct frequency, the exact way in which the amplitude changes can be observed, since it will go either upward or downward from the straight line, in this way disclosing the true response curve direction.

USE OF SERIES CONDENSERS WITH SIGNAL GENERATORS

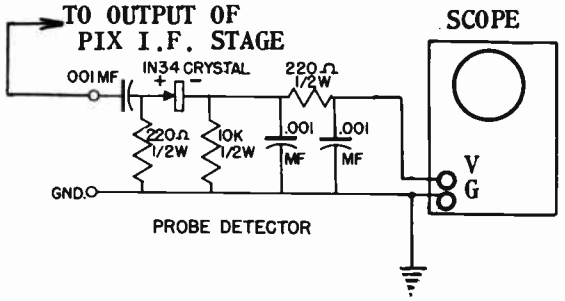
When sweep generator or marker generator are connected to the grid circuit of a TV set, a condenser in series between grid and "high" side of generator is always desirable. Condenser values range from 1000 mmf to 100 mmf. This practice prevents a change in grid bias and averts undue loading of grid. If connection is made to a plate circuit supplied with d.c., the series condenser serves as a blocking condenser, thus keeping the d.c. from getting back into the generator.

HIGH OUTPUT SWEEP GENERATOR AND SENSITIVE SCOPE NEEDED FOR CERTAIN ALIGNMENT WORK

Certain alignments involve only a single stage which produces very little amplification. For example, in aligning an r.f. stage, using the method where the signal is injected at the receiver input and the scope is connected to the mixer grid, even with careful attention to matching of generator to receiver input, it may be impossible to obtain a usable or even visible indication on the scope. When the scope is connected to the mixer grid, an isolating resistor of about 10,000 ohms is generally recommended. Success with this alignment then depends upon the use of a scope having high sensitivity and a sweep generator having adequate output. With some types of front ends the manufacturer recommends that the scope be connected to the output of the tuner. In some instances it may be necessary to remove first pix i.f. tube and shunt grid resistor of this tube with a 1000 ohm resistor to prevent back coupling from the set.

USE OF DIODE PROBE DETECTOR

If, at any time, it is necessary to view the response of a single pix i.f. stage other than the one nearest to the detector, this may be done if the sweep generator has sufficient output and the scope has sufficient sensitivity by using a diode probe detector between the point of signal take-off. A popular form of crystal probe is shown below. The rectifier in this case is of series type. Some probes employ a miniature diode tube instead of a crystal in which case heater current must be supplied.



Use of Diode Probe Detector

LEAD-IN SHOULD BE REMOVED WHILE ALIGNING PIX I.F.

When aligning the pix i.f. section of a TV receiver, it is advisable to remove the transmission line from the set input connectors and to tune the set to an unassigned channel. In some cases, it may be desirable to nullify the effects of the local oscillator. If the sweep generator connection must be made at the mixer grid and a dual function tube is used which includes oscillator in the same envelope as mixer, the oscillator action may be stopped by clipping a shorting jumper between oscillator grid and chassis.

INJECTING SIGNAL AT MIXER WHERE GRID IS INACCESSIBLE

With certain makes of front ends, as for example, the DuMont Inputuner, it is difficult to make connection to the control grid of the mixer for alignment purposes. A simple expedient is to wrap a few turns of hook-up wire around the mixer tube shield and connect this wire to sweep generator. It is important when this is done, to raise the shield away from the chassis, to prevent grounding of injected signal.

SPECIAL PRECAUTIONS NEEDED WHEN ALIGNING TRANSFORMERLESS SETS

Sets which do not use a transformer for the low voltage supply, but instead use a system of voltage doubling or tripling to supply the tubes with the needed operating voltages, are known as transformerless receivers. Many of these sets have a direct connection to one side of the power supply line, which could be a source of danger while aligning. For this reason, makers of such sets recommend the use of an isolation transformer between the set and the a.c. supply line when the set is to be aligned or when any test is to be performed calling for the use of an oscilloscope. When making these tests, the receiver chassis should never be grounded unless the isolation transformer is used. Isolation transformers are available commerically and are made especially for the above purpose.

Sets of the transformerless type generally have a number of tube heaters connected in series "strings". If during the process of alignment, it becomes necessary to remove a tube, the heater current would then be removed from the other tubes in that string. To obviate this difficulty, the removed tube should be replaced with a special "dummy" tube with all pins clipped except the heater connection pins.

REPLACE SHIELDS BEFORE ALIGNING TV SET

It is necessary that alignment be made under actual operation conditions and for this reason, all tube shields should be in place, well grounded to the chassis, before starting to align a TV receiver. Shielding is often placed over portions of the circuit in such a way that the alignment adjusting slugs or trimmers cannot be reached without removing the shield. In such cases, a dummy shield must be constructed, with holes cut in the shield to permit the necessary adjustments. After these have been completed, the dummy is removed and the original shield is replaced. In the RCA 630TS, 630CTS and 9TS30 model TV sets, a shield covers the base of the discriminator tube socket. This shield should not be removed during the sound i.f. alignment, but instead the pigtail lead of a 1 meg resistor should be bent into a small hook, put through the alignment hole in the shield and hooked between the two 100,000 ohm resistors (diode load resistors). The d.c. probe from the VTVM is then connected to the other end of the 1 meg resistor.

LOW-LOSS ALIGNMENT TOOLS

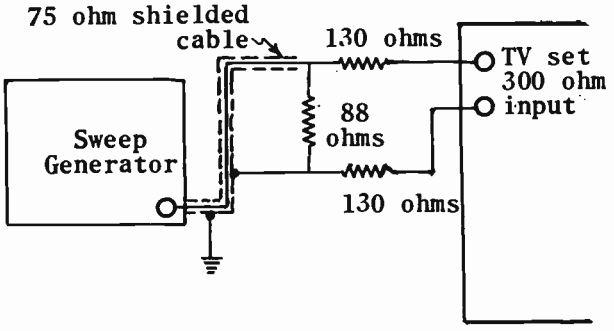
It is obvious that non-metallic low-loss alignment tools should be used, rather than metal screw drivers. A tiny bit of metal in the end of a non-metallic alignment tool does no harm and gives the tool longer life, but an all metal screw driver, even if it has a non-metallic handle, will often affect the alignment adversely.

NECESSITY OF TUNING ADJACENT TRAPS

Even if set is to be used in localities where there is no chance of adjacent channel interference, it is necessary to tune adjacent traps. Mistuning of the adjacent sound trap may cause the pix i.f. carrier to appear too far down on the slope of the response curve, resulting in poor low frequency response with consequent picture defects.

MATCHING SWEEP GENERATOR TO TELEVISION RECEIVER

When the sweep generator is connected to the TV set, the output of the generator should be matched to the input of the receiver. If this is not done, a weakened signal due to mismatch may not be able to pass through the stage or stages to be tested. Furthermore, in some cases, mismatch may affect the shape of the response curve. Very often, the sweep generator has an unbalanced output of considerably lowered impedance than the receiver input and in most cases the receiver has a balanced input. These discrepancies can be reconciled by means of a resistor matching pad. The illustration shows how to match an unbalanced 75-ohm generator output to a balanced 300-ohm TV receiver input. The principle involved is that the receiver must "look" into a 300-ohm impedance, whereas the generator "looks" into a 75-ohm impedance.



Method of Matching Sweep Generator to TV Set

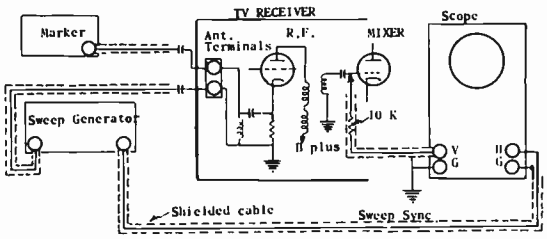
RAPID ALIGNMENT CHECK NO. 1 - TO PERFORM OVERALL ALIGNMENT CHECK OF FRONT END

If manufacturer's instructions for this alignment are available, follow them. Tune each channel separately, if front end is equipped with slugs or trimmers for this purpose. In some General Electric TV models, tuning adjustments are made by squeezing or spreading turns on the individual inductance coils. Some front ends provide slugs for tuning the oscillator on each channel separately, as well as a fine tuning control and an additional trimmer shunted around the fine tuning control, for making adjustments to all channels at the same time. Some Standard front ends provide three trimmers which take care of the r.f., mixer tuning on all channels.

The following is the general procedure: First tune oscillator on all channels. The most rapid method is to inject a calibrated frequency modulated sound carrier for each channel, connecting the signal generator to the antenna terminals (lead-in) terminals of the set (through a matching pad if necessary.) The fine tuning control is set to mid-position and each oscillator slug is tuned for maximum sound from speaker. If station signal is available, the signal generator may be dispensed with for the oscillator tracking. In this case, the fine tuning control is set to mid-position, the station signal is tuned in and the oscillator slug or adjustment is carefully turned until maximum sound is obtained from speaker. Of course, methods which depend upon speaker response can only be used after sound section has been aligned.

To align the r.f. and mixer sections, the sweep generator is connected to the set input terminals and a sensitife oscilloscope is connected to the control grid of the mixer through a suitable probe or if this is not available through a 10,000 ohm isolating resistor. Some

manufacturers suggest that scope be connected to plate of mixer, rather than grid. If separate marker generator is used, connect it to same places as sweep generator. In order to synchronize the scope sweep with that of the sweep generator, a shielded cable is connected between the "sweep sync" plug of the generator and the "H" and ground posts of the oscilloscope. The internal sweep of the scope is then turned to the "off" position. The illustration shows the method of connecting the instruments for this alignment.



Method of Connecting Instruments for Overall R.F. Alignment Check

The set is then tuned to the channel to be aligned and the sweep generator is set at the picture carrier frequency of that channel, the generator sweep being set to about 10 megacycles. After the response curve has been obtained on the scope, the phase control is adjusted to make duplicate curves overlap. Then reduce amplitude of signal from sweep generator to smallest value which will give a response curve. Signal strength may then be increased, but not past point where an increase in amplitude will cause a change in the waveform of the response curve. Wherever possible, however, use weakest signal capable of giving a readable-response curve.

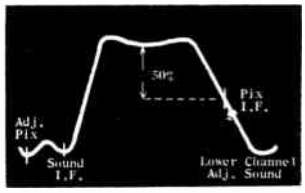
The final step is to set the marker generator to the picture carrier frequency, increasing the marker signal strength until it causes a pip or depression on the response curve. Its position should be noted or marked in pencil on the curve. The purpose of r.f. mixer alignment is to obtain highest possible gain and still maintain the desired bandwidth. Hence, the adjustments in the tuner which control resonant frequency must be located and turned until the peaks are in the proper place and as high as possible. The bandwidth control must also be adjusted to obtain suitable spread. In general the response shown in the accompanying waveform illustration should be obtained, with pix and sound markers at the two peaks and with dip between them not to exceed 30 percent. If this curve is not obtained, manipulate the mixer and r.f. slug or trimmer adjustments until an approximation to it is reached. If response curve shows only slight variation from normal and set operation indicates the need for only slight touching up, this may be done without making the various "pre-set" adjustments. Where a complete front end realignment is to be performed, various pre-set adjustments must be turned to their center positions, except those specified by the manufacturer as requiring special positioning.

NOTE: It is not advisable to align the r.f. section unless such alignment is definitely known to be necessary.

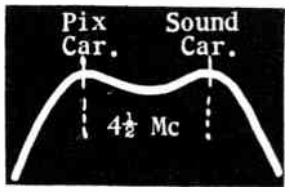
With regard to antenna matching units found on many TV sets, these are very stable and are accurately adjusted at the factory. Most manufacturers suggest that servicemen refrain from aligning this unit, and that instead it be returned to the factory for realignment or replacement if necessary. When out of alignment, noticeable loss of signal will occur on Channel 2. Changing the adjustment of the FM trap does not affect the alignment of the antenna matching unit.

RAPID ALIGNMENT CHECK NO. 2 - TO PERFORM OVERALL PIX I.F. ALIGNMENT CHECK

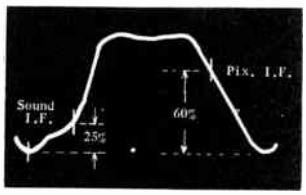
Connect sweep generator to grid of mixer using the precautions suggested above in section on "Practical Pointers on the Use of TV Test Equipment". Set the sweep generator to pix i.f. and the sweep of the generator to 10 megacycles. Connect the oscilloscope to the output of the video detector. If separate marker generator is used, connect as shown in the accompanying illustration. Sweep the scope externally by means of 60-cycle sine wave frequency taken from the sweep generator. Obtain the pix i.f. overall response curve similar to that shown in the illustration below. By means of the marker generator, locate on the overall response curve the pix i.f. carrier, the associated sound i.f. carrier and also the lower channel sound i.f. carrier and the upper channel pix i.f. carrier. A response curve, similar to that shown in the illustration should be obtained, except with sets using the intercarrier circuit. Intercarrier sets do not trap out the associated sound frequency from the pix i.f. stages, but merely reduce this to about 1/5 the maximum response as illustrated. Hence, at the sound carrier i.f. in the intercarrier overall response curve, there should be a sound shelf of about twenty percent of the maximum amplitude.



Overall Pix I.F. Response Curve

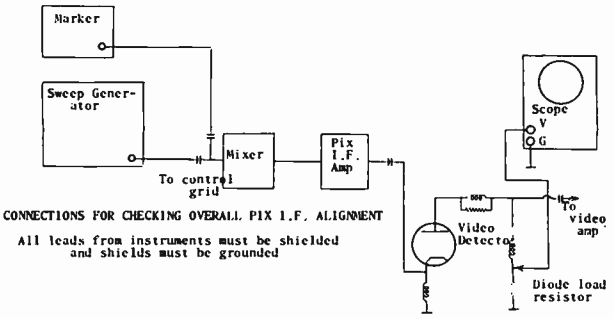


Overall R.F. Response Curve



Intercarrier Pix I.F. Response Curve

Having obtained the overall i.f. response curve and located the necessary marker positions, traps are then adjusted so that i.f. response is minimum at trap frequencies. If the response curve shows need of minor touch-up, the various pix i.f. slugs are then adjusted to obtain the desired overall response waveform. However, if a complete realignment job is indicated, following procedure is suggested.

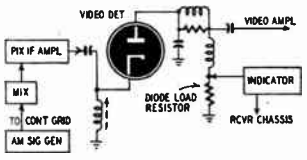


CONNECTIONS FOR CHECKING OVERALL PIX I.F. ALIGNMENT

All leads from instruments must be shielded and shields must be grounded

METHOD OF ALIGNING TRAPS

Traps should be aligned before performing i.f. alignment. If performed after, response curve will be spoiled. Connect VTVM to output of video detector and marker generator to control grid of mixer as illustrated. If control grid cannot be reached, connection may be made by winding a wire around tube shield as explained previously, or by removing mixer tube and winding a fine wire around control grid pin, then replacing tube and connecting generator to other end of wire. In many sets high voltage may be eliminated by disabling horizontal oscillator as explained above. In tuning a trap, a frequency of the value which it is desired to suppress is injected into the input of the pix i.f. and then the trap is adjusted until minimum voltage is indicated on the VTVM. Start with the sound traps and sound take-off, with marker generator set to sound i.f. carrier. As the traps are adjusted, voltage indication will become less and less. At the point where the voltage stops falling and starts to rise, the trap is adjusted. While performing this alignment, it will be necessary to shift to a lower and lower scale on the VTVM. The other traps are aligned in a similar manner, setting the marker generator in each case to the trap frequency.



The traps are aligned first, using apparatus and connections shown.

Note: Any amplitude modulated signal generator may be used in place of marker generator, provided it has necessary frequency range. Vacuum tube voltmeter is preferable for use as an indicator, although scope may also be used.

METHOD OF ALIGNING PIX (VIDEO) I.F. AMPLIFIER AND MIXER

There are two general types of pix i.f. amplifiers, the stagger tuned and the overcoupled. In each type, the overall response curve is identical, but separate methods of alignment are necessary.

STAGGER TUNED I.F. ALIGNMENT

In aligning a stagger tuned i.f amplifier, use the same instruments shown above for trap alignment. First, adjust bias of set to normal operating value. The VTVM is left connected to the video detector output during this entire alignment. To start, the marker generator is connected to the control grid of the i.f. stage immediately preceding the video detector. It is set to the frequency specified by the manufacturer for that particular stage. The slug in the single-tuned transformer is then adjusted until a maximum reading is obtained on the VTVM. Use 1000 mmf condensers to prevent oscillations if these are observed, as explained above under "Practical Pointers".

The marker generator is next connected to the control grid of the i.f. tube in the next preceding stage and the slug tuner for this stage is again adjusted for maximum VTVM reading after generator has been set to specified frequency for this stage. This process is continued for each stage, until finally the marker is connected to the control grid of the mixer, with its frequency set to the value specified by the manufacturer and the slug in the plate coil of the mixer i.f. stage is tuned for maximum indication on the VTVM. The overall response curve is then checked by connecting the sweep generator and scope according to the directions given for Rapid Alignment Check No.2.

OVERCOUPLED I.F. ALIGNMENT

In aligning an overcouplied i.f. amplifier, use the detailed instructions usually provided by the set manufacturer. Commence by aligning the stage closest to the video detector, checking the response. Then each preceding stage is aligned, moving back towards the mixer. When the stage furthest from the video detector has been completed, the response curve is the sum total of the combination of each separate stage and this should be the desired overall response waveform. In performing this alignment, the oscilloscope is connected to the output of the video detector in place of the VTVM and is left there throughout the job.

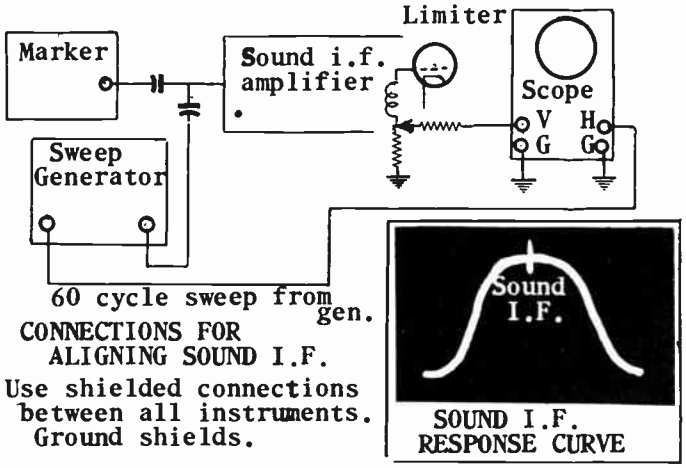
The sweep and marker generators are connected to the control grid of the pix i.f. tube in the stage immediately preceding the video detector. The sweep generator center frequency should be set at such value that the entire response curve will be visible when sweep is set to 10 megacycles. This frequency is generally about mid-way between the extremes to be observed. In making connections and performing this alignment, observe all precautions as to bias, grounding, removal of oscillations and especially precautions for aligning overcoupled

pix i.f. amplifiers, as outlined above under the heading "Practical Pointers". Finally apply the marker frequencies for the stage under test and compare resulting response with that specified by the manufacturer, making slug adjustments if necessary. To make this single stage alignment, it will be necessary to use an oscilloscope having excellent sensitivity and a sweep generator having strong output.

Sweep and marker generators are next connected to the control grid of the pix i.f. tube an additional stage back from the video detector. Once again a response curve is obtained and again adjustments are made at this stage to make the response waveform coincide with that specified by the manufacturer for this stage. This process is repeated, working toward the mixer, for each preceding stage until all waveforms coincide with those specified. A slight change in the adjustment of the traps may be necessary after the overall response curve has been obtained to give a minimum amplitude to the rise (overshoot) just beyond trap frequency.

RAPID ALIGNMENT CHECK NO. 3 - TO CHECK ALIGNMENT OF SOUND I.F. AND SOUND DETECTOR

Using a 0.005 mfd. isolating condenser, connect the high side of the sweep generator to the control grid of the first sound i.f. tube, as shown below. Connect low side to chassis. Connect the marker generator (if separate generator is used) at the same point, using similar isolating condenser. Set sweep generator to sound i.f. and set sweep to about 1 megacycle. Connect oscilloscope to the limiter between secondary of i.f. transformer and resistor. Set marker to i.f. frequency. Sweep scope externally by means of 60-cycle sweep from sweep generator ("horizontal or sync sweep jack"). Adjust all sound i.f. slugs for maximum amplitude and symmetry as indicated in accompanying illustration. During above alignment, tuner should be set to any unused channel.



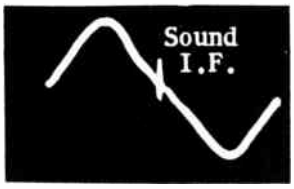
CONNECTIONS FOR ALIGNING SOUND I.F.

Use shielded connections between all instruments. Ground shields.

SOUND I.F. RESPONSE CURVE

ALIGNING DISCRIMINATOR

Leaving sweep generator and marker connected as above, connect oscilloscope to high side of volume control. Adjust the two discriminator slugs so that sound i.f. marker will appear at the center of the "S" curve as indicated, Adjust primary for maximum amplitude between upper and lower peak and adjust secondary for the straightest line between two peaks. The best adjustment is obtained when the sound i.f. is at the center of a straight line with maximum distance between peaks. During this alignment tuner should be at any unused channel.



"S" Curve

Aligning Intercarrier System

INTERCARRIER SOUND I.F. ALIGNMENT

Connect high side of sweep generator to control grid of video amplifier tube preceding sound take-off, with a 0.005 mfd. condenser in series. In sets which have direct coupling from video detector to video output, with sound take-off in output circuit of video detector, high side of sweep generator is connected to control grid of video output tube, through 1000 ohm resistor. Connect low side of generator to chassis or in case of transformerless sets, to B-minus. Loosely couple marker generator to same point. Connect "V" terminal of scope to terminal of ratio detector tube which is tied to minus side of electrolytic condenser. Low side of scope to chassis or B-minus. Temporarily disconnect the electrolytic condenser from circuit. Set both sweep generator and marker generator frequencies at 4.5 mc., with sweep deviation at about 1 mc. Turn channel selector to any unused channel. Sweep scope externally from sweep generator. Adjust sound take-off slugs, sound i.f. stages (if extra i.f. stage is used) and primary of ratio detector transformer for maximum amplitude and symmetry as shown. Ratio detector transformers, if not coded, are usually made with secondary on bottom, primary on top. If coded green and red, secondary is on top, primary on bottom.

ALIGNING 4.5 MC TRAP

In intercarrier sets utilizing a 4.5 mc trap, connect high side of marker generator through 0.005 mfd. condenser to input of trap. Set generator to 4.5 mc with 400-cycle modulation. Connect oscilloscope through crystal detector probe to plate of video amp. after trap, with low side of scope to chassis or B-minus. Sweep scope internally and adjust trap slug for minimum 400-cycle indication on scope.

ALIGNING INTERCARRIER SOUND DETECTOR

Alignment of discriminator is same as for non-intercarrier sets. If ratio detector is employed, leave sweep generator and marker connected same way as when aligning intercarrier sound i.f. Reconnect electrolytic condenser in ratio detector circuit and connect high side of scope to high side of volume control, low side to chassis or B-minus. Adjust secondary of ratio detector transformer slug so that 4.5 mc marker occurs at center of "S" curve. Then slightly adjust primary slug again for longest and straightest line between peaks of "S" curve.

SECTION 3

INSTALLATION AND SERVICING UHF UNITS

Installation, as far as the TV serviceman is concerned consists of:

1 -- Addition of UHF converter to customer's present VHF set.

2 -- Installation of UHF channel strips in sets previously equipped with tuner made for this purpose by set manufacturer.

ADDITION OF UHF CONVERTER TO VHF SET

While manufacturers of UHF converters state that addition of this unit is no more difficult than adding a booster, this is not actually the case. First, in localities where signal is not strong enough to work without UHF antenna, same must be provided, in addition to the regular antenna used for VHF reception. These antennas are available in various designs. The folded dipole, Double-V and Yagi are similar to the antennas used for VHF, but shorter in order to be resonant at the higher frequencies. Newer types include Corner Reflector, Slot, Colinear Array, and Stacked Bowtie.

Location of UHF antenna is very important. Reception can often be greatly improved merely by moving antenna to a point a slight distance from previous location. Antenna should also be carefully turned until best possible reception is attained. As with other TV antennas, it should be located as high as possible and at a point where it is in the "line-of-sight" of the transmitters of the channels to be received. Greater care must be exercised in installing the transmission line, particularly as to insulation from metal roof or other metallic objects, since the chances of losses are increased with higher frequencies.

The converter should be installed as close to the television set as possible. Connecting cables and leads should be kept at a minimum length. Some UHF converters obtain their tube operating voltages from the set to which they are attached. Others, as for example the RCA model P, have a self-contained power supply and must be plugged into a source of 117-volt, 60-cycle alternating current. UHF converters usually provide a switching arrangement for turning power on or off the converter, for changing from the VHF antenna to the UHF antenna. Therefore, the installing of a converter will include connecting of lead-ins from each antenna to the converter as well as a connection from the balanced output of the converter to the antenna terminals of the TV receiver. After installation has been completed and ready for test, the VHF tuner is switched to the high frequency channel designated by the maker of the converter as the correct one for use with his unit. Among the UHF converters made by various TV manufacturers for use with VHF sets are the Crosley, Stromberg-Carlson, RCA, G.E., Philco, Westinghouse, Arvin, etc. A recent addition to this list is the Kingston, which is stated to be adaptable for use with many different makes.

INSTALLATION OF UHF CHANNEL STRIPS

Several makers of turret type tuners, which use removable coil strips have produced units capable of UHF reception without the need for additional tubes. One such device is made by Zenith and is usable with TV sets only of that make. To convert a Zenith set from VHF to UHF, it is merely necessary to remove the VHF channel strips from the tuner drum and replace them with special UHF strips of the channels it is desired to receive. No other changes need be made on the TV set. Since there are 13 channel strips on the Zenith drum, this represents the limit of the number of UHF channels which could be received without changing strips.

The Zenith strip contains two crystals but no tubes. It is housed in a small metal

NOTE: UHF band for television extends from 470 to 890 megacycles. There are provisions for 70 bands, each 6 mc in width. All frequencies between 300 mc and 3000 mc are designated as UHF (ultra high frequency). All frequencies between 30 mc and 300 mc are known as VHF (very high frequency).

die-casting, having three separate cavity resonators, in the form of hollow metallic cylinders. Small solenoids, wound with flat strips are mounted within the cavities and provide the necessary inductances. Instead of a conventional condenser, the necessary tuning capacity is provided by the capacity between the top of the coil and the cavity plus the capacity between the turns of the coil (distributed capacity) plus the capacity resulting from an adjustable screw which enters the top of the coil.

Another company which manufactures the Standard type turret tuner, has produced several UHF units. The Standard tuner also uses removable coil strips. This company has produced a tubeless converter strip which can be inserted into any Standard turret drum in place of the VHF strips. Tuned strips are available for each UHF channel. The strips are made two in a set. One strip contains pre-selector circuits, crystal mixer, harmonic selector and i.f. grid inductor. The other contains crystal bias network, harmonic generator, loading resistor and i.f. transformer. In converting a VHF set to UHF, it is merely necessary for the serviceman to remove a pair of unwanted strips from the turret drum and insert the desired channel UHF strips. After connecting the UHF antenna, the set is ready for UHF reception.

The same company which makes the Standard turret tuner also produces a complete unit capable of continuously tuning to all existing VHF channels as well as the entire 70 UHF channels. This completely shielded unit includes a preselector, mixer and oscillator in the UHF portion. The VHF portion, located directly in back of the UHF section, resembles the Standard 12-channel Cascode VHF tuner. A unique feature of this unit is the mechanism which automatically indicates (through small dial opening) the channel to which the device is tuned. It is probable that units of this kind will be used by many television manufacturers.

SERVICING UHF UNITS

While UHF units, both converters and complete UHF-VHF sets, present the same trouble symptoms ordinarily associated with VHF front ends, the troubles are more difficult to locate and to remedy for several reasons. These are:

1 -- When working with the higher frequencies certain types of trouble will occur which would cause no difficulty on the VHF bands. For example, a broken connection in a VHF circuit is one of the simplest repairs to make, but special precautions are required for this repair to a UHF circuit. The new connection must be exactly the same length as the original one. No sharp corners or turns are permissible. It must be replaced in exactly the same position relative to other wires and to the chassis. The soldering must be perfect both mechanically and electrically, and in addition must be performed with a minimum amount of solder, without the use of flux and it must present a smooth appearance, as points probably would affect the operation of the circuit.

2 -- When replacing broken sockets, mounting boards or other insulating parts, only low loss parts made especially for UHF work, can be employed.

3 -- When replacing resistors and condensers, special care must be taken to make certain that correct tolerances are observed, that temperature compensating components are replaced with those of exactly the same specifications and that condensers have exactly the same characteristics not only as to tolerance, capacitance and rating, but also as to temperature coefficient, capacitance drift and insulation resistance.

4 -- Positions of coils relative to each other or to chassis must not be changed.

5 -- Several resistors must never be substituted for a single resistor even though they make up the same total value, nor should a single resistor be used to take the place of several resistors in parallel.

6 -- If a condenser having extremely small capacity is used in parallel with one having comparatively large capacity, the small capacity condenser must not be omitted from the circuit. Very often the larger condenser, because of its high inductance will not by-pass UHF, and the small condenser is used in parallel for this purpose.

7 -- Wire wound resistors must never be used to replace carbon resistors.

8 -- Due to fact that inductances are so critical in UHF circuits, it is preferable to replace entire unit rather than to attempt to replace coils such as grid inductor, harmonic selector, preselector coils, etc.

9 -- UHF circuits very often contain entirely new components or new applications of old components insofar as the experience of the TV serviceman is concerned. Therefore, difficulty will be experienced until he has familiarized himself with these features. For example, he will find new types of resonant tuned circuits, quite different from the coil-condenser combination. In this class are the cavity resonator of the Zenith UHF converter and the "tuned line" used in the Kingston converter. Even the use of a crystal as a mixer may not be recognized.

TRACING FAULTS IN UHF CONVERTERS

Faults can readily be localized to the UHF converter, since set can be checked separately on VHF channels. General procedure for faulty operating of converter is to replace tubes if used, apply Rapid Check No. 11 to crystals or still better, check by replacement with crystal known to be in good operating condition. In replacing crystal, use great care not to overheat crystal while soldering and be sure to observe correct polarity when installing.

Certain types of UHF converters are sus-

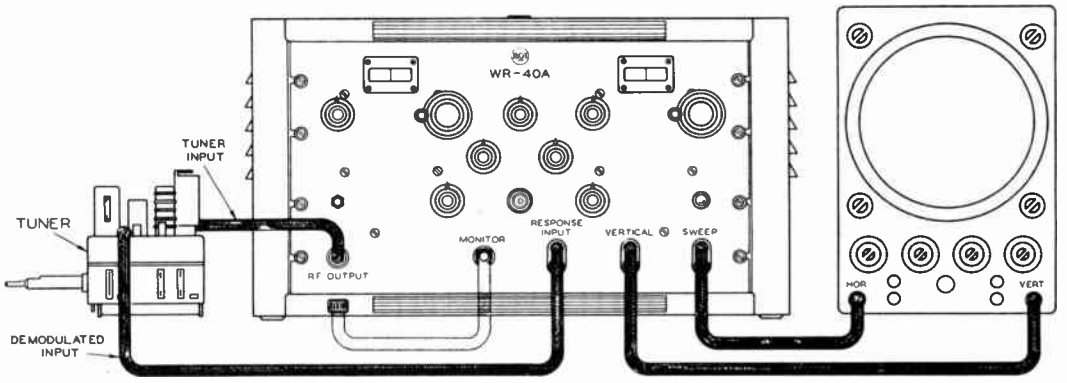
ceptible to spurious responses. Sometimes such troubles can be eliminated by switching the VHF tuner to another channel and adjusting the i.f. output trimmer according to the channel selected.

Where trouble developes in a single channel of the UHF tuner of the replaceable strip type, and this is of such a nature that it cannot be rapidly located and repaired, it is probably cheaper from the standpoint of time saving to replace the defective strip with a new one.

TEST INSTRUMENTS FOR UHF

The only new piece of test equipment needed for tracking and servicing UHF receivers and converters, aside from a suitable UHF antenna, is a UHF sweep generator. Several such generators are available. The RCA model WR-40A has a continuously variable range of from 470 to 890 mc and a continuously variable sweep range of from 0 to 45 mc. It contains a built-in marker generator as well as a crystal calibrator. The illustration below shows the way in which the UHF sweep generator is interconnected with a UHF tuner and oscilloscope under test.

The r.f. output of the generator is connected to the input of the tuner. The demodulated r.f. output of the tuner is then fed back to the demodulated voltage input terminals of the sweep generator, where the marker pips are added to the demodulated r.f. signal. The combined signal is then fed to the vertical input of the oscilloscope. The horizontal sweep frequency for the scope is also obtained from the lower right-hand terminal of the sweep generator panel. Monitoring of the output signal of the sweep generator can be performed by transferring the r.f. output cable from the tuner input to the monitoring terminal on the sweep generator.



Connections for Using
the UHF Sweep Generator with a UHF Tuner and Oscilloscope

SECTION 4

RAPID CHECKS

RAPID CHECK NO. 1 - TO CHECK FOR HIGH VOLTAGE
Insert a small neon lamp in a piece of insulated fiber tubing about ten inches long. When the lamp is placed near the high voltage rectifier it will glow if high voltage is present. Lamp will glow brightest near cap of tube. The higher the voltage, the brighter the glow. Intermittent high voltage will be indicated by intermittent glow. Lamp will also glow near cap of horizontal output tube such as 6BG6.

RAPID CHECK NO. 2 - TO CHECK FOR HIGH VOLTAGE (EMERGENCY CHECK)
Hold high voltage lead (lead which snaps into button on side of tube momentarily near chassis. Absence of spark indicates lack of high voltage. Length of spark gives rough indication of amount of voltage present. CAUTION: This test possesses an element of danger. Keep one hand in pocket while making test and hold wire only by rubber suction fastener. Never draw prolonged spark as this may damage filter resistor in high voltage line.

RAPID CHECK NO. 3 - TO CHECK FOR LOW VOLTAGE (EMERGENCY CHECK)
This check should only be used in an actual emergency, when no voltmeter is available. Using insulated screw driver, short from output of filter choke (low voltage filter circuit) to chassis with blade of screw driver for an instant only. Absence of spark indicates lack of low voltage. Intensity of spark is a rough indication of the amount of voltage.

RAPID CHECK NO. 4 - TO CHECK TUBE FOR HEATER VOLTAGE
Feel tube after set has been turned "on" for about 15 minutes. Cold tube indicates absence of heater voltage. WARNING: Do not use for checking high voltage tubes.

RAPID CHECK NO. 5 - TO CHECK FOR DEFECTIVE TUBE
Substitute another tube, one which is known to be in good operating condition. For example, if vertical sweep oscillator tube is suspected as cause of lack of vertical sweep and horizontal sweep is O.K. and uses the same type tube, interchange the two tubes and note whether this remedies the vertical sweep at the expense of the horizontal. Substitution is nearly always preferable to the use of a tube checker in servicing TV sets. There are certain places, however, where other tests must precede substitution of tubes. The high voltage rectifier tube should not be replaced with another tube until RAPID CHECK NO. 6 of the high voltage condenser has been made. Low voltage rectifier tubes should not be replaced with substitutes until RAPID CHECK NO. 7 has been made. When making substitution tube checks, it must be remembered that the trouble may be due to more than a single faulty tube. Therefore, where possible, several tubes in a section should be substituted, one after another, until a complete new set has been tried. For example, several sync separator tubes may be bad, and replacing one at a time and putting the same tube back immediately after each replacement would then fail to reveal the trouble. It must also be kept in mind that trouble may be caused by a combination of defective tube and defective component, in which case, substitution of the tube alone would not eliminate the trouble.

RAPID CHECK NO. 5 a - Replace low voltage rectifier tubes
5 b - Replace high voltage rectifier tube or tubes
5 c - Replace damper tube or tubes
5 d - Replace r.f. amplifier tube
5 e - Replace mixer tube
5 f - Replace all pix i.f. tubes
5 g - Replace oscillator tube
5 h - Replace all front end tubes (r.f., mixer & oscillator tubes)
5 i - Replace video detector tube
5 j - Replace a.g.c. tube(s)
5 k - Replace video amplifier tubes
5-l - Replace d.c. restorer
5 m - Replace sync separator tubes
5 n - Replace sync phase inverter and/or sync amplifier tubes
5 o - Replace all sound i.f. tubes
5 p - Replace sound discriminator or ratio detector tube
5 q - Replace audio frequency amplifier tubes
5 r - Replace audio output tube
5 s - Replace vertical oscillator tube
5 t - Replace vertical discharge tube
5 u - Replace vertical output tube
5 v - Replace all vertical sweep circuit tubes
5 w - Replace horizontal a.f.c. system tubes
5 x - Replace horizontal oscillator tube
5 y - Replace horizontal discharge tube
5 z - Replace all horizontal output tube(s)
5aa - Replace all horizontal sweep circuit tubes
5ab - Replace picture tube
5ac - Replace reactance tube
5ad - Replace focus tube
5ae - Replace combined oscillator control--horizontal oscillator tube.

RAPID CHECK NO. 6 - TO CHECK HIGH-VOLTAGE CONDENSER FOR SHORT OR LEAKAGE

Turn ohmmeter to highest resistance scale and check resistance between top of condenser (high side) and chassis (ground). If ohmmeter needle moves to the left, condenser should be replaced before performing RAPID CHECK NO. 5b.

RAPID CHECK NO. 7 - TO CHECK LOW VOLTAGE SYSTEM FOR SHORT, OR PARTIAL SHORT

Turn ohmmeter to R times 10,000 and measure resistance between output of low voltage filter choke and chassis. If reading shows a lower resistance than that of the combined series resistances (bleeder) between these two points, there is a short or partial short in the low voltage system. This must be located and removed before performing RAPID CHECK NO. 5a.

RAPID CHECK NO. 8 - TO CHECK A COUPLING OR BY-PASS CONDENSER FOR AN OPEN

Shunt condenser with another of equal capacitance, turn set "on" and note whether normal operation is restored.

RAPID CHECK NO. 9 - TO CHECK P.M. SPEAKER

Replace with a speaker known to be O.K.

RAPID CHECK NO.10 - TO CHECK ENTIRE AUDIO SYSTEM FROM FIRST AUDIO TO SPEAKER IN A SINGLE CHECK

Put finger on grid of first audio. Hum in speaker indicates normal operation of this entire section. For a stronger signal, clip a wire to the ungrounded 6.3 volt heater terminal, connect a .001 mfd or .01 mfd condenser to other end of wire and touch other end of condenser to the grid of the first audio tube.

RAPID CHECK NO.11 - TO CHECK GERMANIUM CRYSTALS SUCH AS 1N64, 1N60, 1N34, ETC.

Use ohmmeter, set to R times 1. Forward resistance should read between 100 and 350 ohms. With ohmmeter set to R times 10,000, backward resistance should read at least 200,000 ohms. WARNING: When replacing crystals, be sure to observe polarity marking.

RAPID CHECK NO.12 - TO CHECK 100-WATT SELENIUM RECTIFIER

Use ohmmeter set to R times 100,000. Forward resistance should read about 2½ megohms and backward resistance should read about 5 megohms. A selenium rectifier which "pops" while in use gives out a characteristic disagreeable odor of rotten eggs.

RAPID CHECK NO.13 - TO CHECK ELECTROLYTIC CONDENSER

Unsolder all connections from at least one side of condenser, making sure that unsoldered terminal is free of all connections or grounds. In the case of a multi-section condenser having a common ground, each section terminal must have connections removed separately in order to make test. Set ohmmeter to R times 100,000 and connect across condenser. Needle will first swing far to left and then in the case of a good condenser, will gradually return to the right, reaching a reading of about 1.5 megohms after three or four minutes and in about five minutes more reaching a reading of 5 megohms or more. When leads from ohmmeter are reversed, a similar set of readings is obtained. The above-noted readings are for a condenser having a low power factor of less than 10%. Many condensers have a power factor up to 50% and still are efficient as filters. These condensers will show the same swing far to the left,but the needle will not return as far to the right. However condensers which show a final reading of less than 50,000 ohms should be replaced, while those which show a reading between 50,000 and 500,000 ohms should be checked further on a regular condenser checker.

RAPID CHECK NO. 14 - TO CHECK FOR CORONA

Listen for characteristic hiss. Watch in dark for corona discharge. Note whether characteristic ozone odor is present.

RAPID CHECK NO. 15 - TO CHECK FOR DEFECTIVE PICTURE TUBE

Examine for unlighted heater. Using an ohmmeter, check for continuity across heater terminals; also for shorts between various terminals, making sure there is no heater-cathode leakage. Surest check is to replace with tube known to be O.K. If available, use picture tube checker. Alternate check is to note whether all operating conditions are normal. In this method, ohmmeter check is supplemented with voltmeter check. With pix tube socket removed from picture tube, check socket terminal voltages. Note whether movement of brightness control potentiometer affects grid or cathode voltages. If operating conditions are correct, effect should be noticeable. Using vacuum tube voltmeter and a.c. probe, check for video voltage at grid or cathode terminal of picture tube socket. This check should be made with set tuned to a strong channel. Alternate and preferable check is to view the video signal with a scope. With picture tube socket replaced, measure high voltage as explained in RAPID CHECK NO. 24. Vary brightness control. If operating conditions are correct, this should affect high voltage. If above checks show that video signal is present and that all operating conditions are correct, but picture tube gives a washed-out blurry indistinct picture, with poor brightness and sluggish action, it is fair to assume that picture tube is at fault. Tube should then be removed and checked further by replacement or in checker.

RAPID CHECK NO. 16. - TO CHECK VERTICAL OSCILLATOR

Connect oscilloscope between plate of oscillator tube and chassis and examine for characteristic saw-tooth waveform.

RAPID CHECK NO. 17 - TO CHECK ENTIRE VERTICAL SWEEP CIRCUIT FROM AMPLIFIER TO DEFLECTION COILS

Unsolder coupling condenser at grid of vertical amplifier tube and put finger on grid. (Set turned "on".) If deflection circuit is in working order, a non-linear vertically de-

flected raster will be seen, due to the 60--cycle sine wave deflecting voltage supplied by touching the grid.

RAPID CHECK NO. 18 - TO CHECK FOR LEAKY OR SHORTED TUBULAR CONDENSER

Check visually, looking for melted wax or puffed out condenser. When found, such a condenser should have all leads disconnected from one side and should be tested further for short or leakage by means of an ohmmeter.

RAPID CHECK NO. 19 - TO CHECK FOR NON-OSCILLATING FRONT END OSCILLATOR

Check with vacuum tube voltmeter for negative grid voltage. No grid voltage means no oscillation.

RAPID CHECK NO. 20 - TO CHECK FOR MICROPHONIC TUBE

Tap tube and watch for jittery picture, noise flash in picture and/or listen for microphonic sound in loud speaker. Replace with another tube and recheck.

RAPID CHECK NO. 21 - TO CHECK LOW VOLTAGE POWER SUPPLY

Use a d.c. voltmeter. Set meter to 500 volt scale or higher. Connect common (negative) lead to chassis. Connect positive lead to output of low voltage power supply. In most cases, this latter connection is readily accessible at the positive terminal of the input filter condenser. Where set employs a selenium rectifier, connect the positive terminal of the meter to the selenium terminal marked "plus" and connect negative terminal to chassis or common negative point.

RAPID CHECK NO. 22 - TO CHECK OPERATING VOLTAGES OF AMPLIFYING TUBES

Use a d.c. voltmeter. Do not bother to check heater voltages, which should be checked by inspection (for lighted heater) or by RAPID CHECK NO. 4, or for continuity by RAPID CHECK NO. 44. Set voltmeter to high scale initially and reduce scale as necessary. Connect common lead to chassis and touch positive lead to socket terminal to be checked. Take readings with set "on" and with tube in socket. If defective tube is suspected, make a second check with tube removed from socket. Check particularly plate voltage, screen voltage and cathode voltage. Check control grid voltage, which should be reasonably negative with respect to cathode voltage. Wherever possible, compare readings with voltages recommended by manufacturer of set. Note that in many instances, voltage readings will vary according to the setting of controls such as contrast control, height control, etc. In general, take readings with controls set for maximum voltage. Plate voltages are generally higher than screen voltages. DO NOT CHECK OPERATING PLATE VOLTAGE OF HORIZONTAL OUTPUT TUBE SUCH AS 6BG6. DO NOT CHECK OPERATING VOLTAGES OF HIGH VOLTAGE RECTIFIER TUBES WITH METER EXCEPT IF INSTRUMENT IS DESIGNED FOR SUCH USE.

RAPID CHECK NO. 23 - TO CHECK OPERATING VOLTAGES OF LOW VOLTAGE RECTIFIER TUBES

Use an a.c. voltmeter and check from plate to plate of a full wave rectifier tube, also checking from each plate to secondary center-tap. Using an a.c. voltmeter check from plate to chassis in case of a half wave rectifier tube. If the rectifier tube employs a filamentary cathode, check d.c. voltage between one side of filament and chassis. If rectifier tube uses a separate cathode, check d.c. voltage between cathode and chassis. Always connect common d.c. voltmeter lead to chassis, except in a.c.-d.c. type sets which employ an isolated chassis, in which case common lead is connected to common negative return.

RAPID CHECK NO. 24 - TO CHECK SECOND ANODE OR FOCUS VOLTAGE OF PICTURE TUBE

Use high-voltage voltmeter, if available. Connect negative lead to chassis. Turn back rubber suction cup, and connect other lead to terminal on side of picture tube. Make all connections with set "off". Turn set "on" and take reading without touching connections. It is possible to measure up to 20,000 volts with a voltmeter designed for use up to only 1,000 volts. This is done by means of a voltage divider connected between the high voltage point and the chassis. The divider consists of twenty 1-megohm resistors connected in series. The meter is connected between the chassis and the top of the resistor connected to the chassis. A reading of 950 volts on the meter then indicates an actual reading of 19,000 volts at the second anode.

RAPID CHECK NO. 25 - TO CHECK ACCELERATING GRID VOLTAGE OF PICTURE TUBE

Use a d.c. voltmeter, setting scale to about 500 volts. Connect negative lead to chassis. Locate accelerating grid socket terminal (from Pix tube chart) and trace connection to nearest terminal point. Connect positive meter lead to this point.

RAPID CHECK NO. 26 - TO CHECK POTENTIAL DIFFERENCE BETWEEN PICTURE TUBE CONTROL GRID AND CATHODE

Use a d.c. voltmeter and set scale to about 100 volts. Trace control grid and cathode connections and connect meter between them. Cathode often connects to center arm of brightness control. Control grid connection can be located quite readily in most cases by tracing from the plate circuit of the output video amplifier tube.

RAPID CHECK NO. 27 - TO CHECK POTENTIALS ON DIODE DAMPER

Use a d.c. voltmeter with scale set to about 500 volts. Measure voltages at cathode(s) and plate(s), by connecting common voltmeter lead to chassis and positive lead, first to cathode socket terminal and then to plate socket terminal. For correct operation, cathode should be from 55 to 275 volts higher

than plate voltage, depending on design of set.

RAPID CHECK NO. 28 - TO CHECK LINE VOLTAGE

Use a.c. voltmeter with scale set to 300 volts. Measure voltage across primary of low voltage transformer.

RAPID CHECK NO. 29 - TO CHECK LOW VOLTAGE POWER SUPPLY FOR HUM

Connect ground terminal of oscilloscope to chassis. Connect vertical (high) terminal of scope to output of low voltage filter choke. Sweep at about 30 cycles. If perfectly filtered, scope should show a horizontal straight line, even with gain increased. Hum will show up as a sine wave (two waves will appear with 30 cycle sweep) of considerable amplitude. Increased filtering will reduce or eliminate the sine wave, and remove the hum.

RAPID CHECK NO. 30 - TO CHECK VERTICAL SWEEP OSCILLATOR AND BALANCE OF VERTICAL SWEEP CIRCUIT WITH OSCILLOSCOPE

Fig.-A-

Connect ground terminal of scope to chassis. High vertical terminal is connected to input (grid) of vertical oscillator tube. Normal indication at grid of multivibrator tube is shown in Fig.-A-. Single wave form can be obtained with 60 cycle sweep on scope. A 30 cycle sweep on scope will result in two wave forms.

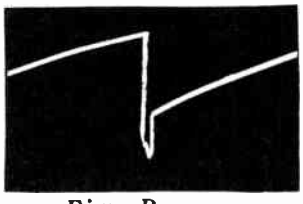


Fig.-B-

With high vertical terminal of scope connected to output of vertical oscillator (other terminal to chassis) sawtooth waveform shown in Fig.-B- appears with scope sweep of 30 cycles. The same waveform should appear at the grid of the next tube (vertical output). The same waveform inverted and greatly increased in amplitude (peak to peak voltage) should appear at the plate of the vertical output tube. With scope connected across vertical deflection coils, the wave form will be nearly the same as that across the plate of the output tube, except for a considerable decrease in voltage (height of wave).

In checking the vertical sweep oscillator and balance of the vertical sweep circuit with an oscilloscope, it is unnecessary to use an antenna or to apply an external signal, since the oscillator generates its own signals. The characteristic modified sawtooth waveforms should be attainable all the way from the vertical oscillator to the vertical deflection coils. If the waveform is lost at a certain point in the circuit, this indicates a fault at that particular point. For example, if the waveform is obtained at the output of the vertical oscillator, but disappears at the input of the vertical amplifier, the trouble has definitely been traced to this portion of the circuit. Thus the loss of signal may have been caused by an open coupling condenser between the plate of one tube and the grid of the next. While checking the vertical oscillator with the scope, the hold control can be checked by rotating it. This should cause an increase or decrease in the number of waveforms appearing on the scope. Similarly, the height control may be checked to observe whether this causes an increase and decrease in the magnitude of the wave as it is rotated back and forth.

Through observation of wave form, trouble in this section will be localized to a particular stage. The final step is to locate the offending component. First apply RAPID CHECK NO. 5 to the stage which is giving trouble. Then apply No. 22. Absent or incorrect operating voltages immediately give warning of a defective component. If plate voltage is absent, check voltage at plate load resistor or primary of transformer. Voltage present on B-plus side of resistor or primary and absent on plate side indicates an open in resistor or primary winding. Identical voltage on each side of plate load resistor or primary winding indicates shorted resistor or primary winding.

If voltage is absent at B-plus side of resistor or transformer winding, trace back along the B-plus supply line with voltmeter for open series resistor or potentiometer. Resistors, transformer windings or potentiometers which show indication of short or open circuit are then checked with current "off" for continuity or correct resistance values. Incorrect resistance values may be the cause of incorrect operating voltages at the tube.

If screen grid voltage is absent, follow a procedure similar to that applied in the case of plate voltage. To check for open screen by-pass condensers, shunt another condenser around it and observe whether waveform improves. To check for shorted screen by-pass condenser, condenser must be unsoldered at one end and it may then be tested with an ohmmeter. A leaky by-pass condenser is tested most effectively by substitution method.

If there is a resistor in the cathode circuit, a voltage reading should be possible between cathode and chassis. Absence of such reading indicates open or shorted resistor. Make final check with ohmmeter. If ohmmeter indicates a short, check shunting condenser. Plate voltage must always be at a higher voltage than the cathode. The screen grid is generally lower in voltage than the plate and the grid is negative with respect to the cathode.

RAPID CHECK NO. 31 -TO CHECK HORIZONTAL SWEEP OSCILLATOR AND BALANCE OF SWEEP CIRCUIT WITH OSCILLOSCOPE

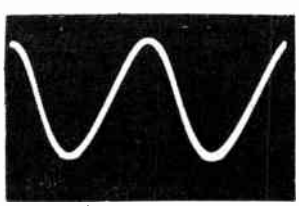


Fig.-C-

Connect ground terminal of scope to chassis. High vertical terminal is connected to grid of horizontal oscillator. Scope sweep is set at approx. 7,875 (half of horizontal

sweep frequency), in order to get two figures on scope. The normal indication for a set employing a discriminator frequency control is shown in Fig.-C-and consists essentially of a 15,750 cycle sine wave. Absence of this wave indicates a fault at the horizontal oscillator.

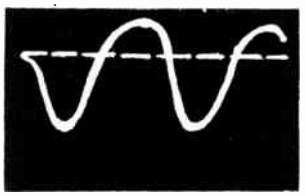


Fig.-D-

Fig.-D- shows the waveform obtained from the same set at the output of the horizontal oscillator. The high side of scope is here connected to the plate of the oscillator tube. This is essentially, a distorted sine wave with positive peaks flattened out or clipped.

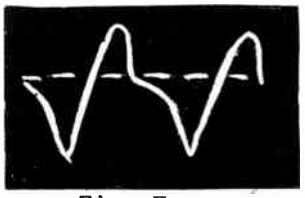


Fig.-E-

Fig.-E- shows the waveform obtained by connecting scope to the input (grid) of the horizontal discharge tube. It will be noted that the wave has become more peaked. This change in waveform is accomplished by the short time constant differentiator. Failure to obtain change in waveform indicates leaky or shorted differentiator condenser or increased resistance or open in differentiator resistor.

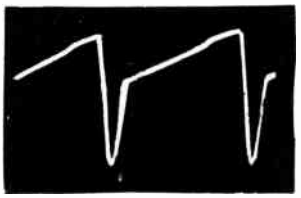


Fig.-F-

Fig.-F- shows the waveform obtained by connecting scope to the plate (output) of the horizontal discharge tube. The typical modified (distorted sawtooth waveform now appears. Absence of peak in the sawtooth indicates trouble in the in series in the plate peaking resistor(s) supply circuits.

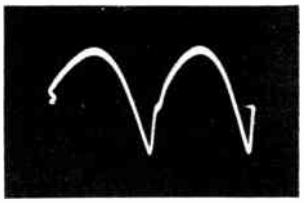


Fig.-G-

Fig.-G- indicates waveform at cathode of damper tube, with scope connected to junction point of cathode, horizontal linearity control, and filter condenser.

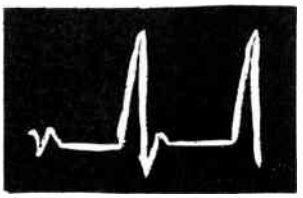


Fig.-H-

Fig.-H- is a picture of the waveform (normal) obtained at the plate (cap) of the horizontal output tube. The voltage at this point is high and dangerous and this reading should not be attempted, unless proper precautions are taken. These include precautions against shock as well as precautions against injury to scope. To protect scope, connect a 50 mmf. condenser and a .003 mf. condenser in series from plate cap of 6BG6 to chassis, placing a .003 condenser nearest chassis. Connect scope across the .003 mf. condenser. This waveform shows the pulse followed by the rapidly damped wave.

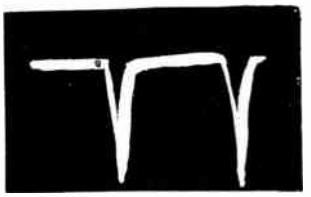


Fig.-I-

Fig.-I- shows waveform at input to horizontal deflection coils. A voltage divider consisting of a 50 mmf. condenser and a .002 mf. condenser in series is connected between the leads coming from horizontal deflection coils and the scope is connected across the .002 condenser.

RAPID CHECK NO. 32 - TO CHECK SYNC CIRCUITS WITH OSCILLOSCOPE

In checking sync circuits with an oscilloscope it is necessary to have antenna connected to the set in order to obtain the sync pulses. The check consists in tracing (by means of the scope,) the sync pulses through the various stages of amplification, with the accompanying removal of picture information, until the vertical pulse finally arrives at the integrator and the horizontal pulse is traced to the input of the sync discriminator. The set should be tuned to the strongest available channel.

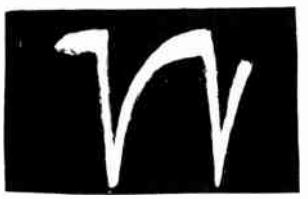


Fig.-J-

Fig.-J- shows the horizontal sync pulse at the input (grid) of the first sync separator. In this particular instance, the sync pulses were taken off at the anode of the d.c. restorer. Two horizontal pulses are obtained by sweeping the scope with 7,875 cycles. If desired, the vertical pulse may also be inspected at this point by changing the scope sweep to 30 cycles, but this is unnecessary insofar as tracing the signal is concerned. In passing from the grid to the plate of the first sync amplifier the signal will retain its characteristics but will increase considerably in amplitude, provided the amplifying tube is operating properly. However, the signal (pulse) will be inverted. No change will be observed in the pulse at the input to the second sync. amplifier, except a slight decrease in height.

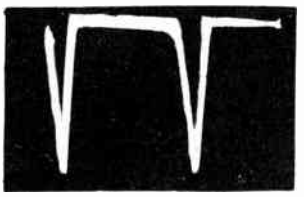


Fig.-K-

Fig.-K- shows the horizontal waveform obtained by connecting the scope to the plate of the second sync amplifier. The picture information has now disappeared. In the set under observation, the horizontal sync pulse was taken off at the plate of the third sync amplifier, passed through a very low capacity condenser and brought into a sync lock or sync discriminator circuit. The vertical sync pulse was brought from the same plate of the third sync amplifier through an integrating circuit to the grid of a vertical blocking oscillator.

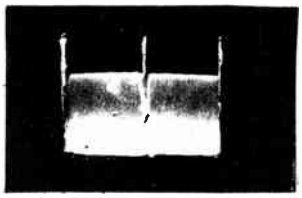


Fig.-L-

Fig.-L- shows two vertical pulses at the plate of the third sync amplifier. The horizontal pulse at this point is identical in waveform with Fig.-K- except that it is inverted and of less amplitude.

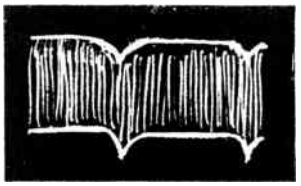


Fig.-M-

Fig.-M- shows the vertical pulse at the input to the integrator. Both Fig.-L- and Fig.-M- are obtained by sweeping the scope with 30 cycles. The horizontal pulse is also present at this point, but is of no importance.

Fig.-N-

Fig.-N- shows the vertical pulse at the output of the integrator.

Fig.-O-

Fig.-O- shows vertical pulse at the grid of a vertical oscillator in a set employing a blocking oscillator. Note the difference between Fig.-A- obtained from a set using a multivibrator.

RAPID CHECK NO. 33 - TO CHECK SYNC DISCRIMINATOR WAVEFORMS

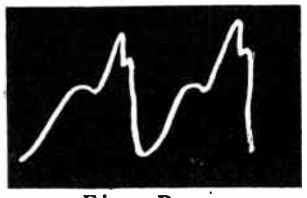


Fig.-P-

Fig.-P- shows horizontal waveform with scope connected at the junction of two load resistors in the cathode circuit of the discriminator diodes. Scope is connected between this point and chassis, with sweep set at 7,875 cycles. Antenna is connected to set and set is tuned to a strong channel. (This check - sync lock system)

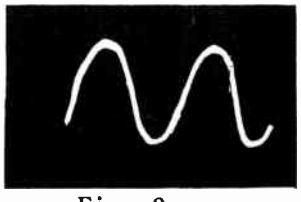


Fig.-Q-

Fig.-Q- shows horizontal waveform at cathode of horizontal sync discriminator. Fig.-R- shows horizontal waveform at one discriminator plate. Fig.-S- shows horizontal waveform at other discriminator plate. Note that pulses in both Fig.-R- and Fig.-S- reach same level, indicating that discriminator is correctly adjusted. The waveforms of Figs. -R- and -S- also show whether horizontal oscillator is functioning and whether horizontal sync pulse is getting through to this point. (Sync lock system)

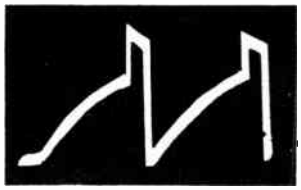


Fig.-R-

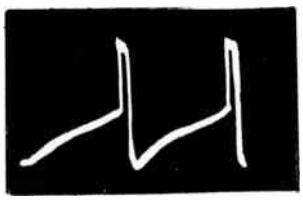


Fig.-S-

RAPID CHECK NO. 34 --TO CHECK VIDEO AMPLIFIER FROM OUTPUT OF VIDEO DETECTOR TO GRID OF PICTURE TUBE --- ALSO VERTICAL LINEARITY CHECK

Attach an audio oscillator through a 50,000 ohm isolating resistor to the grid of the first video amplifier. If any external bias is applied to this grid, an isolating capacitor will also be needed. If the video amplifier is working, horizontal bars will appear on the picture tube. As the frequency is increased, the number of bars also increases. At the same time VERTICAL LINEARITY may be checked by noting the spacing of the black bars up and down the screen. If evenly spaced, linearity is O.K. If unevenly spaced at top, linearity is poor at the start of the vertical sweep.

RAPID CHECK NO. 35 - TO CHECK SOUND SECTION FROM FIRST SOUND I.F. TO OUTPUT OF DISCRIMINATOR

Connect sweep signal generator through 100 mmf. condenser to grid of first sound i.f. Set sweep generator at sound i.f. frequency. Set sweep at 2 mc. Connect oscilloscope to high side of volume control. The familiar "S" curve will be obtained if scope is swept with a 60 cycle sine wave. Trouble in any sound i.f. stage can be located rapidly by working back with signal generator from last sound i.f. towards first sound i.f. As this is done, the "S" curve should increase in amplitude, unless there is trouble in one of the i.f. stages.

RAPID CHECK NO. 36 - TO CHECK SOUND SECTION FROM FIRST SOUND I.F. TO SPEAKER

Apply signal from sweep generator to grid of first sound i.f. as in RAPID CHECK NO. 35. A clear audio signal should be heard.

RAPID CHECK NO. 37 - TO CHECK PICTURE SIGNAL FROM ANTENNA CONNECTIONS TO OUTPUT OF VIDEO DETECTOR

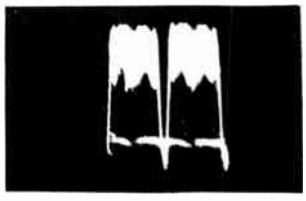


Fig.-T-

Connect antenna to set and tube in strong channel. Oscilloscope should be connected at output of video detector. With scope sweep set at 7,875, the picture information of two lines and two horizontal pulses will be seen, as in Fig.-T-. By changing the scope sweep to 30 cycles, the picture information of several fields may be seen together with the vertical pulse.

Fig. -U-

Increase in scope horizontal gain, will spread out the signal and permit inspection of the vertical pulse and equalizing pulses. This waveform is shown in Fig.-U-.

RAPID CHECK NO. 38 - TO CHECK PICTURE SIGNAL FROM VIDEO DETECTOR TO GRID OF PICTURE TUBE.

Essentially the same waveforms shown in Figures -T- and -U- may be observed at the input of the video amplifier, the output of the video amplifier, the input to the video output tube, the output of the video output tube and the grid of the picture tube. Of course, the signals will be inverted as they pass from the grid to the plate circuits of each tube and the gain will increase with each stage until the signal reaches the maximum peak voltage needed to correctly excite the grid of the picture tube. By tracing the composite signal from stage to stage, a fault in this section is readily located.

RAPID CHECK NO. 39 - TO CHECK PATH OF PICTURE I.F. SIGNAL FROM ANTENNA TO PICTURE TUBE

Connect sweep signal generator to antenna connection of set. Sweep at 12 megacycles. Set generator to pix carrier frequency. If signal path through entire set is O.K., horizontal bar will be seen on picture tube. Bar shows a complicated pattern.

RAPID CHECK NO. 40 - TO CHECK PATH OF PICTURE I.F. SIGNAL FROM MIXER GRID TO PIX TUBE

Connect sweep signal generator to control grid of mixer. Set sweep at 10 to 12 megacycles. Set generator to pix I.F. frequency. If path is O.K. bar will appear on picture tube as in RAPID CHECK NO. 39.

RAPID CHECK NO. 41 - TO CHECK I.F. SIGNAL THROUGH PICTURE I.F.

Connect sweep signal generator to grid of mixer. Set generator at pix I.F., sweep at 10 megacycles. Connect oscilloscope at output of video detector. Typical I.F. response curve will be obtained if pix I.F. is O.K. By working back from I.F. stage before detector, faults in the pix I.F. strip can be located readily.

RAPID CHECK NO. 42 - TO CHECK WAVEFORM AT CATHODE OF D.C. RESTORER

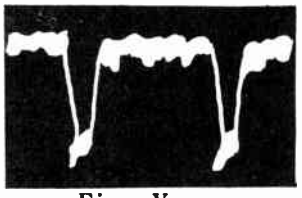


Fig.-V-

Connect oscilloscope between cathode of d.c. restorer and chassis. Set scope sweep to 7,875 cycles. Waveform shown in Fig.-V- should appear if set is tuned in to operating channel. This waveform is almost identical with waveform obtained at grid of picture tube. It shows two picture lines with horizontal pulses.

RAPID CHECK NO. 43 - TO CHECK WAVEFORM AT PLATE OF D.C. RESTORER

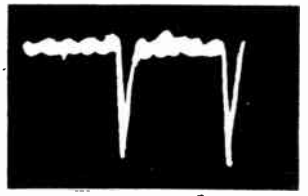


Fig.-W-

Connect oscilloscope between plate of d.c. restorer and chassis. Set scope sweep to 7,875 cycles. Waveform as shown in Fig.-W- should appear if set is tuned in to operating channel. This shows the horizontal pulse, with most of picture information suppressed. The vertical pulse may be seen by changing the scope sweep to 30 cycles.

RAPID CHECK NO. 44 - TO CHECK FOR CIRCUIT CONTINUITY AND RESISTANCE OF LOW RESISTANCE COMPONENTS

With set disconnected, check for continuity through low resistance component of circuit with ohmmeter set to R times 1. Connect ohmmeter across suspected part of circuit and note whether pointer swings to "shorted" position. An open will be definitely indicated if meter pointer fails to move as the ohmmeter resistance range is increased to maximum. If the pointer moves and gives a high resistance reading, this indicates a partial short, such as might be caused by a poorly soldered connection or a leaky condenser. Actual low resistance of low resistance components may also be checked.

RAPID CHECK NO. 45 - TO CHECK HIGH RESISTANCE COMPONENTS

With set disconnected, switch ohmmeter to a suitable high setting and connect it across suspected component. Ohmmeter reading will show exact value of resistance. If measuring a certain resistor, say one having 50,000 ohms resistance, and no reading is obtained, keep increasing ohmmeter resistance range in order to determine whether resistor is "open" or whether resistance has increased unduly.

RAPID CHECK NO. 46 - TO CHECK WITH OHMMETER FOR INTERMITTENT

With set disconnected, test for intermittent, poorly soldered or cold soldered joint by connecting ohmmeter between suspected portions of circuit and tapping or moving connecting wires, pigtails or other movable portions of the circuit. If ohmmeter needle moves or indicates changes in resistance as the parts are moved, poorly soldered joints or other similar causes of intermittents will thus be located.

RAPID CHECK NO. 47 - TO MAKE OVERALL CHECK OF ENTIRE VERTICAL SWEEP CIRCUIT.

Connect oscilloscope across a portion of vertical deflection coils. A voltage divider should be used consisting of a 50 mmf. condenser and a 0.003 mf condenser in series across the vertical coils. The waveform shown in Fig.-B- will be noted when the scope is swept at 30 cycles. If this is obtained, it indicates that vertical sweep section is O.K.

RAPID CHECK NO. 48 - TO MAKE OVERALL CHECK OF ENTIRE HORIZONTAL SWEEP CIRCUIT

Use a voltage divider similar to that used in RAPID CHECK NO. 47, but connected across horizontal deflection coils. With scope sweep at 7,875 cycles waveform shown in Fig.-I- should be obtained if this section is O.K.

RAPID CHECK NO. 49 - TO CHECK FOR DEFECTIVE BY-PASS CONDENSER

One terminal of by-pass condenser must first be disconnected from rest of circuit. RAPID CHECK NO. 44 will promptly disclose shorted or leaky condenser. Replacement of suspected condenser is quickest way to determine "open" by-pass condenser, noting change in operation.

RAPID CHECK NO. 50 - TO CHECK FOR OPEN PICTURE TUBE CATHODE RETURN

If high voltage lead shows strong spark to chassis, but very weak or no spark to fastener on side of picture tube, this is an indication of an open picture tube cathode return.

RAPID CHECK NO. 51 - TO CHECK FOR INTERFERENCE SOURCES

Short dark dashes occuring in only a few horizontal strips indicate that interference operates on 60 cycle source. Black dashes followed by white streaks indicate overloading by noise pulses. Disconnect electric appliances and devices one by one, checking for disappearance of interference. Interference from short wave transmitters, TV stations, diathermy and other industrial equipment is tunable except that diathermy may appear on several adjacent channels.

RAPID CHECK NO. 52 - TO CHECK FOR "PAIRING" OR LACK OF INTERLACE

Remove antenna or tune to channel having no signal. Turn brightness "up" and examine return traces on raster. These slanting white lines should be evenly spaced. If "paired", this indicates poor interlacing. Lack of interlace is also evidenced on station pattern when wavy or moire effect is noted on the horizontal wedge. This trouble may be caused by defective integrating network, but in some cases is due to poor station transmission. Latter can be determined readily by tuning to several stations.

RAPID CHECK NO. 53 - TO CHECK STRENGTH OF SYNC SIGNALS

Tune in a station or a station pattern and adjust vertical hold control carefully until lower half of picture is at top and upper half is at bottom. The dark strip between the halves should contain the sync signal. Reduce the contrast and increase the brightness until the sync signal just approaches black. The blanking and the darker portions of the picture should then appear gray. The vertical sync signal will be observed as the dark portion closer to the top of the blanking strip. If the sync signal is only slightly darker than the blanking signal, this indicates insufficient amplitude. If sync signal cannot be seen and entire area shows gray, this indicates absence of sync. The horizontal sync signal may be observed in the same way by adjusting the sync lock phase control until the picture is split in half vertically, with the blanking and horizontal sync signal in the center. With reduced contrast and increased brightness, the normal sync can be made just black, while the blanking pulse and darker picture portions will appear gray. It is generally sufficient to view only the vertical sync signal.

RAPID CHECK NO. 54 - TO CHECK VERTICAL BLANKING SIGNAL

Carefully adjust vertical hold control until vertical blanking signal shows as a wide dark horizontal area between two portions of the picture. Reduce the contrast and increase the brightness until sync is a very dark gray. A comparison should then be made between the shade of the blanking signal and that of the darkest picture elements. If the picture elements are darker than the blanking area, this indicates vertical blanking trouble.

RAPID CHECK NO. 55 - TO CHECK HIGH FREQUENCY RESPONSE

Tune in a station pattern. Note the vertical wedges. The further down (or up) towards the narrow portion, the lines can be seen distinctly, the better the high frequency response.

RAPID CHECK NO. 56 - TO CHECK LOW FREQUENCY RESPONSE

Tune in a station pattern and observe horizontal and vertical wedges. If the vertical wedge is black, while the horizontal wedge is gray, this is an indication of poor low frequency response.

RAPID CHECK NO. 57 - TO CHECK VERTICAL RESOLUTION AND HORIZONTAL RESOLUTION

Tune in a station pattern and observe horizontal wedge. Note that the lines in the wedge become closer towards the narrow portion. The closer to the center these lines can be seen, the better the vertical resolution. Horizontal resolution is checked by observing the vertical wedges. The closer to the narrow portions of the wedge the separate lines can be observed, the better the horizontal resolution.

RAPID CHECK NO. 58 - TO CHECK VERTICAL LINEARITY

Adjust vertical hold control until picture moves (rolls) vertically slowly from bottom upward. When the vertical linearity is good, the blanking bar will have the same width in all positions. If the picture is squeezed at the top and stretched at the bottom, the blanking bar will be too thin at top and too wide at bottom.

RAPID CHECK NO. 59 - TO CHECK FOR BOTH VERTICAL AND HORIZONTAL LINEARITY

Tune in station pattern and observe circles. If circles are round, vertical and horizontal linearity are both O.K. If squeezed at right or left or both, or expanded right and left, the set lacks horizontal linearity. If circle is squeezed top and/or bottom, the set lacks vertical linearity. Note that non-linearity thus indicated may also be due to poor trans-

mission. Therefore, this check should be made on more than one channel.

RAPID CHECK NO. 60 - TO DISTINGUISH BETWEEN FAULTY SYNC AND FAULTY VERTICAL OSCILLATOR FREQUENCY

Tune in a station, but first eliminate the vertical sync pulse by opening the coupling condenser connection from the sync amplifier, sync separator portion of the circuit to the integrator. Then, carefully adjust vertical hold control. If one complete picture can be held in place by such adjustment, this shows that oscillator can be tuned to 60 cycles, and hence is O.K. Therefore, fault must be in sync. On the other hand, if it is impossible to obtain a complete picture, even with most careful adjustment of the hold control, oscillator is at fault.

RAPID CHECK NO. 61 - TO CHECK PATH OF PICTURE CARRIER FREQUENCY SIGNAL FROM GRID OF MIXER TO PICTURE TUBE

Connect sweep signal generator to control grid of mixer. Switch tuner to any convenient channel. Set sweep at 10 to 12 megacycles. Set generator at picture carrier frequency of channel to which set is tuned. If path of signal is uninterrupted, horizontal bar will appear on picture tube.

RAPID CHECK NO. 62 - TO CHECK SPEAKER OUTPUT TRANSFORMER

Check plate voltage of sound output tube. If voltage is obtained on B-plus side of the primary, but not at plate, primary is open. If voltage is the same on both sides of the primary, primary is shorted. Check secondary with power off. Unsolder one terminal of secondary from connection which goes to speaker voice coil. Using low resistance scale on ohmmeter, check for continuity across secondary. At the same time, check voice coil for open circuit by reading its resistance which should be between 3 and 12 ohms.

RAPID CHECK NO. 63 - TO DETERMINE WHETHER INTERFERENCE PICKUP IS TAKING PLACE IN VIDEO AMPLIFIER

Remove the last pix I.F. tube. If this does not eliminate the interfering signal from the picture tube, the interference is being picked up by the video amplifier.

RAPID CHECK NO. 64 - TO CHECK FOR STRAY COUPLING BETWEEN HORIZONTAL DEFLECTION CIRCUIT OR HIGH VOLTAGE CIRCUIT AND VERTICAL DEFLECTION CIRCUIT

Tune in station pattern and observe whether horizontal wedge shows wavy effect. Carefully move horizontal deflection circuit leads away from vertical deflection circuits, using insulated rod for this purpose and note whether wavy effect disappears. Check for high voltage coupling around vertical deflection circuits by means of RAPID CHECK NO. 1. If neon lamp glows, move wiring until glow near vertical circuits is eliminated.

RAPID CHECK NO. 65 - TO DETERMINE WHETHER "GHOST" IS DUE TO REFLECTION FROM SURROUNDING STRUCTURE OR TO TRANSMISSION LINE MISMATCH

View picture while antenna is being rotated. If the ratio of intensity of ghost signal to desired signal remains constant, the "ghost" is due to transmission line mismatch. This type of ghost is generally quite close to the desired signal, in some cases being so close that it makes the picture appear to be poor in quality and to have lost definition. On the other hand, ghosts due to reflection from surrounding structures are usually considerably separated from the original signal.

RAPID CHECK NO. 66 - TO CHECK A.G.C. CIRCUIT USING EXTERNAL BIAS

Connect the two end terminals of a 25,000 ohm wire-wound potentiometer to the terminals of a 7.5 volt dry battery, also connecting the positive battery terminal to the TV chassis or B-minus connection of the set by means of a suitable lead. Connect the arm of the potentiometer to a 1000 ohm carbon resistor and the other end of the resistor by means of two suitable leads, to the a.g.c. controlled grids of the r.f. amplifier and the video i.f. amplifier respectively. For test purposes, the same bias voltage may be used for r.f. and i.f. A 0.05 mfd. condenser should be shunted between the leads to the grids and the lead to the chassis in order to prevent pick-up of hum. By means of this set-up, sometimes referred to as a "bias box", it is possible to override the a.g.c. voltages derived from the TV signal. In some cases, however, it may be desirable to disconnect input and output leads of the a.g.c. circuit while using the "bias box". If picture is present, but defective and trouble has its origin in a.g.c. circuits, manipulation of the external bias potentiometer may eliminate this fault, thus permitting prompt diagnosis. If the a.g.c. circuit output impedance of the set under test is only two or three thousand ohms or less, the above circuit should be modified by using an additional 1½ volt battery in series with the 7½ volt one, with the 1½ volt cell at the negative end. The 25,000 ohm potentiometer is removed from the circuit and instead a 750 ohm potentiometer is connected around the 1½ volt cell. The arm of this potentiometer is connected to a 750 ohm carbon resistor replacing the 1000 ohm resistor. All other connections are the same, except that the lead from the set is arranged to clip on the positive terminal of the 7½ volt battery. In this arrangement, the voltage may be reduced in steps of 1½ volts by moving the clip, while the 750 ohm potentiometer permits fine control.

RAPID CHECK NO. 67 - TO CHECK A.G.C. VOLTAGES

Use sensitive d.c. voltmeter, preferably a VTVM, employing isolating probe to prevent resistive and capacitive loading of grids controlled by a.g.c. Measure a.g.c. voltage at output of a.g.c., then at grids of controlled r.f. and i.f. tubes, first with weak signal and then with strong signal.

RAPID CHECK NO. 68 - TO DETERMINE WHETHER PICTURE PULLING IS A RASTER DEFECT OR A FAULT CAUSED BY IMPROPERLY FUNCTIONING SYNC CIRCUITS

Tune in a station signal and move picture to the left with horizontal centering means until right edge of raster is brought into view. Increase brilliance and at same time decrease contrast, so that sync voltage produces a dark gray edge just approaching black. It will then be possible to see the right edge of raster, leading edge of horizontal sync signal and right edge of picture. If raster edge is straight, with leading edge of horizontal sync signal curved, this is conclusive evidence that there is no pulling in the raster and that the defect is in the horizontal sync circuit.

RAPID CHECK NO. 69 - TO DETERMINE APPROXIMATE LOCATION OF PICTURE PULLING FAULT KNOWN TO BE DUE TO IMPROPERLY FUNCTIONING HORIZONTAL SYNC

Apply RAPID CHECK NO. 53 to determine the relative strength of sync, blanking and picture signals. If sync amplitude is normal with respect to blanking and picture signal amplitudes, this indicates that the location of the picture pulling fault is in the sync separator circuit or in the a.f.c. circuit. Apply RAPID CHECKS 5m, 5n and 5w. In this case, break the circuit which brings the sync signal to the horizontal a.f.c., permitting the horizontal oscillator to function without control. Picture may be stopped momentarily by horizontal hold control and horizontal frequency adjustment at least long enough to find out if picture pulling is still in evidence. If so this clearly proves that source of trouble is in the a.f.c. circuit. If picture pulling is eliminated, this indicates that trouble is located in sync circuits prior to a.f.c. circuit.

If sync amplitude is low, apply RAPID CHECKS 5n, 5m and 22. Also check coupling condensers for open circuits in path of sync signal, applying RAPID CHECK NO. 8. If tubes and condensers check O.K., check r.f. and video i.f. alignment (See RAPID TV ALIGNMENT SECTION) to determine whether loss of sync amplitude is a result of poor low frequency response accompanying misalignment. If alignment is found to be O.K., apply RAPID CHECKS 5f, 5h and 22. Next apply RAPID CHECKS 5k and 22, checking video amplifier tubes and voltages up to point where sync is taken off. Finally, apply RAPID CHECK NO. 67.

RAPID CHECK NO. 70 - TO CHECK RELATIVE SENSITIVITY OF TV SET

Tune set to weakest channel and compare picture detail with that obtained on receiver known to give satisfactory operation. Both sets should be operated under identical conditions. If no suitably weak channel is available, use resistance pad as described in Classification 10-A, connecting pad between transmission line and set terminals.

RAPID CHECK NO. 71 - TO DETERMINE WHETHER BUZZ IS BEING COUPLED INTO AUDIO SECTION FROM THE VERTICAL SWEEP CIRCUIT

First, disable audio output tube by shorting control grid to chassis. If buzz continues, it is caused by mechanical vibrations, rather than by coupling into audio circuits.

Next remove shorting wire from grid of audio output tube and vary vertical hold control. If pitch varies, coupling is probably taking place between the two sections. Remove vertical output tube. If buzz stops, it has originated in this portion of the vertical sweep circuit. If buzz continues, remove vertical oscillator. If this stops buzz, trouble is located at oscillator.

RAPID CHECK NO. 72 - TO DETERMINE IF BUZZ IS DUE TO PICTURE SIGNAL GETTING INTO AUDIO SECTION

Tune in a strong channel and listen closely to buzz. If buzz pitch and volume change as picture scenes change, buzz is due to picture signals in audio section.

RAPID CHECK NO. 73 - TO DETERMINE WHETHER BUZZ ORIGINATES IN POWER TRANSFORMER

After TV set has been "off" for 15 minutes, turn power "on" and listen for buzz. If buzz is audible in the few seconds before set starts operating (that is, before picture and sound come in) transformer is at fault.

RAPID CHECK NO. 74 - TO CHECK FOR SHORTED TURNS (PARTIAL SHORT) IN LOW VOLTAGE POWER TRANSFORMER

Disconnect all secondary windings and operate transformer for a short period without load. Excessive heating indicates a partial short in a secondary winding. Replace with transformer known to be O.K.

RAPID CHECK NO. 75 - TO DETERMINE WHETHER TRANSFORMER IN VERTICAL SWEEP CIRCUIT IS A SOURCE OF BUZZ CAUSED BY MECHANICAL VIBRATION.

Short control grid of audio output tube to chassis, vary vertical hold control and listen for pitch variations. If tone changes are audible, this definitely places source of mechanical buzz in vertical sweep circuit. If buzz continues after vertical output tube is removed or disabled, this shows that vertical output transformer is not the source of the trouble. However, if buzz is stopped, it may be due to vibrating vertical output transformer or to buzzing vertical deflection coils. In nine cases out of ten, the output transformer is the offender. Remedies: Tighten transformer clamps or bolts, so that laminations are prevented from vibrating; wedge coils tightly to core, or if above cannot be done, replace with new transformer. If buzz continues with output tube disabled, check vertical oscillator blocking transformer, if

set employs one, by taking out vertical oscillator tube. Stoppage of buzz in this case places blame on the blocking transformer.

RAPID CHECK NO. 76 - TO CHECK ADJUSTMENT AND PLACEMENT OF ION TRAP

Place rear magnet of ion trap over flags in neck of picture tube. Move trap slightly backward and forward and rotate slowly at same time. Turn brightness control counter-clockwise about one-quarter rotation. Adjust focus control for best focus, then readjust trap for maximum brightness at which good focus can be obtained. To check for defective trap, replace with one known to be good.

Single trap must not be used where tube manufacturer's specifications call for double magnet trap and vice versa. Following table gives placement of various type ion traps.

2-ring type PM (permanent magnet) -- arrow same side as pix tube high voltage connection -- heavier ring nearest pix tube socket. (Fig.-X-)

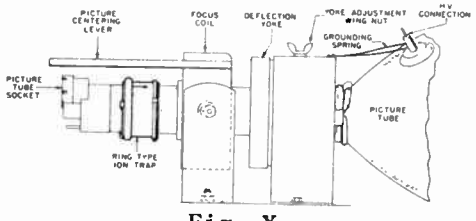


Fig.-X-

Clamp-Type PM -- black clamp nearest pix tube socket -- trap magnets usually positioned side opposite high voltage tube connection. (Fig.-Y-)

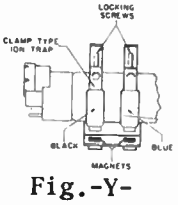


Fig.-Y-

Double-Bar PM -- blue colored bracket towards screen of pix tube. Arrow same side as high voltage connection. (Fig.-Z-)

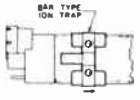


Fig.-Z-

Friction Clamp Type Double Bar PM -- black clamp must be furthest away from pix tube screen. Magnets must be positioned opposite to the high voltage connection. (Fig.-AA-)

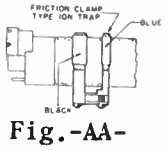


Fig.-AA-

Single-Bar PM (with part No.) -- Part No. towards tube base -- magnet opposite high voltage connection.

Single-Bar PM (arrow) -- arrow pointed to high voltage connection.

Bar magnet and ring magnet (both PM) -- ring nearest pix tube screen. Bar magnet opposite high voltage connection.

Electromagnetic (EM) -- large coil nearest pix tube socket. Regulate coil current by potentiometer on set chassis. Turn fully clockwise at start of adjustment. (Fig. -AB-)

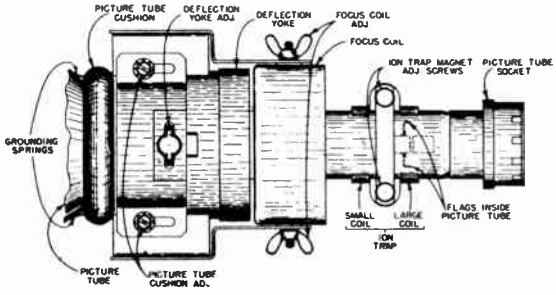


Fig.-AB- Typical arrangement of focus coil, deflection yoke and other parts. Note electromagnetic type ion trap.

NOTE: In case of pix tubes employing metal tubes with no high voltage connection on side of tube, use position between pins 3 and 4 on tube base as reference point.

RAPID CHECK NO. 77 - TO CHECK LEAD-IN MATCHING

Transmission line matching may be improved in many instances, especially on the higher frequency channels, by the simple expedient of wrapping a piece of tin foil around the lead-in, sliding the tin foil up and down until a position is found which improves the picture. Use a piece of foil about $4\frac{1}{2}$ inches by $8\frac{1}{2}$ inches, wrapping the smaller dimension loosely in two or three turns around the lead-in. The $8\frac{1}{2}$ inch length is then moved from the input terminals of the TV set to the point where the transmission line enters the house. It should be left in position at the place which gives the best results for a particular station. If reception on more than one station is to be improved, it will be necessary to slide the foil back and forth in the same way until best position for each station is obtained.

RAPID CHECK NO. 78 - TO DETERMINE IF LIMITER IS OPERATING PROPERLY

Connect signal generator between control grid of limiter tube and chassis, operating it at sound i.f. frequency. Connect scope or VTVM to output of limiter (to lead which goes to mid-point of discriminator transformer). Common ground to chassis. Vary output of generator. Amplitude of wave seen on scope, or voltage measured on meter should remain almost constant over a wide variation of input signal amplitude. Defective limiter shows variation in output voltage.

RAPID CHECK NO. 79 - TO CHECK FOR UNDESIRED OSCILLATIONS IN SOUND I.F. AMPLIFIER

With set "on", mixer tube removed and VTVM across grid resistor of limiter, check negative voltage. If a reading of more than a few volts is obtained, sound i.f. amplifier is generating oscillations.

RAPID CHECK NO. 80 - TO DETERMINE WHETHER HUM IN AUDIO SECTION ORIGINATES IN CIRCUITS PRECEDING OR FOLLOWING VOLUME CONTROL

If movement of volume control changes strength of hum, fault is located in circuits preceding control. If movement of volume control has no effect on hum, fault is located in circuits following control.

RAPID CHECK NO. 81 - TO TRACE SOURCE OF BUZZ BY PROCESS OF ELIMINATION

Various sections of the TV set in which "buzz" may originate can readily be disabled, one after another until the source of the buzz is disclosed. To do this, remove vertical oscillator section step-by-step until exact location of trouble is found. If buzz continues, disable horizontal oscillator by shorting control grid to chassis. In most sets, this will also disable high voltage. Do not remove horizontal oscillator as this may result in damage to the horizontal output tube. However, if both tubes are removed at same time, this provides an alternate method of disabling these circuits. If buzz continues, remove picture i.f. tube nearest video detector and finally remove limiter or sound i.f. tube nearest discriminator. If undesired sound still persists, it is probably in the nature of hum rather than buzz, although there is still the possibility of a buzz from a vibrating power transformer.

RAPID CHECK NO. 82 - TO IDENTIFY BUZZ ORIGINATING IN HIGH VOLTAGE SECTION

Turn contrast and brightness controls slowly counter-clockwise. If intensity of buzz is reduced, this indicates high voltage section origin. For final check, disconnect high voltage lead from side of picture tube. Buzz will stop, if originating in high voltage section.

RAPID CHECK NO. 83 - TO CHECK FOR OSCILLATIONS IN PICTURE I.F. AMPLIFIER

Remove front end tubes and measure direct current voltage across video detector load resistor with vacuum tube voltmeter. If meter shows reading over 1¼ volts, this is a sign of oscillation.

RAPID CHECK NO. 84 - TO CHECK FOR OSCILLATIONS IN FRONT END.

First perform Rapid Check No. 83. If oscillations are not -being generated in pix i.f. amplifier, put back front end tubes, leave VTVM connected to video load detector and again read d.c. voltage. To prevent acceptance of external signal, connect a wire across antenna terminals. A reading above 1¼ volts indicates oscillations in front end.

RAPID CHECK NO. 85 - TO DETERMINE IF HUM BARS ARE CAUSED BY CATHODE-HEATER LEAKAGE OR POORLY FILTERED B-SUPPLY

Since cathode-heater leakage is caused by 60-cycle a.c., there will be an alternation of a dark horizontal area or bar and an alternation of a light horizontal area in the picture if this frequency current reaches the picture tube grid. The bar areas of light and dark are equal, but sometimes there is a wide bright area in the middle portion of the picture, with narrow areas of one-half width above and below the bright area. In other instances, the wide center area is the dark area. In the case of hum bars due to poorly filtered B-supply, these are four bars, alternately dark and light.

RAPID CHECK NO. 86 - TO DETERMINE IF HUM BARS ARE DUE TO TROUBLE IN TUBES PRECEDING VIDEO DETECTOR OR IN TUBES FOLLOWING IT.

If hum bars still show on raster when last picture i.f. tube is removed hum trouble is localized to video detector, video amplifier, d.c. restorer tubes, or picture tube. On the other hand, if removal of one of the tubes in the front end or the picture i.f. amplifier causes the hum bars to disappear from the raster, the trouble is then localized to the stage from which tube was removed.

RAPID CHECK NO. 87 - TO CHECK B-SUPPLY AT ANY POINT FOR HUM

Connect ground terminal of scope to set chassis. Connect vertical (high) terminal of scope to plate, screen or other B-supply point to be checked for hum. In order to isolate scope terminal from d.c. voltage, connect a 0.1 mfd condenser in series in the line between high terminal of scope and point being checked. Sweep at about 30 cycles. Hum will show as a sine wave (two waves will appear with 30-cycle sweep). If scope is calibrated, the amplitude of the sine wave may be measured. Increased filtering will reduce or eliminate the sine wave, and remove the hum.

RAPID CHECK NO. 88 - TO CHECK LATE MODEL PHASE DETECTOR A.F.C. SYSTEM

NOTE: In waveform checks 88, 89 and 90, antenna is left connected to set with set tuned to a strong channel.)

Late model phase detector a.f.c. systems use a horizontal sync discriminator and a locked or stabilized cathode-coupled multivibrator. Negative and positive sync pulses are applied to the cathode of one diode and to the plate of a second diode respectively of the discriminator. A phase inverter provides the two opposite polarities from the arriving sync pulse. The other plate and cathode of discriminator are connected together and receive a negative sawtooth pulse from the horizontal output circuit. The output of the discriminator is taken from the mid-point of two 100,000-ohm resistors connected in series between the discriminator plate and cathode receiving the horizontal sync pulses. The output voltage from the discriminator feeds the grid of the multivibrator, supplying the bias which regulates the frequency of this oscillator.

The waveform of the negative sawtooth pulse is shown in Fig.-AF-. This is obtained by setting the scope sweep frequency at 7875 cycles and connecting the "V" (high vertical) terminal of the scope to the tie point of the

discriminator plate and cathode and the ground terminal of the scope to the chassis. If sawtooth waveform is not obtained, check coupling condenser leading to the horizontal output circuit.

The waveforms at the discriminator plate and cathode (opposite ends of the two series 100,000 ohm resistors) are shown in Figures -AC- and -AD-.

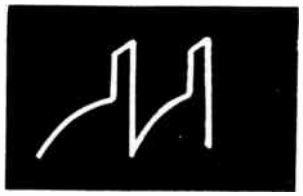


Fig.-AC-

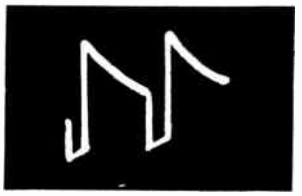


Fig.-AD-

Waveform -AC- was obtained by connecting the scope between discriminator plate and chassis, Waveform -AD- by connecting scope between discriminator cathode and chassis, with the scope sweep in both cases at 7875 cycles.

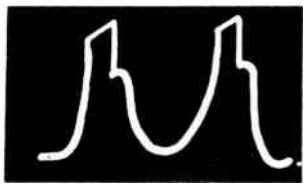


Fig.-AE-

The waveform at the plate of the horizontal oscillator is shown in Fig. -AE-. This was obtained by connecting the high vertical terminal of the scope to the horizontal multivibrator plate (the one to which the horizontal lock adjustment circuit is connected) and the ground terminal of the scope to the chassis. Scope sweep is set at 7875 cycles in order to obtain two horizontal pulses on the scope screen. Note that square wave ordinarily obtained from a multivibrator is here combined with a sine wave produced by the resonant lock adjustment circuit.

RAPID CHECK NO. 89 - TO CHECK EARLY MODEL SYNCHROGUIDE A.F.C. SYSTEM WAVEFORMS

Early model synchroguide a.f.c. systems are characterized by absence of slug tuned waveform adjustment connected to center point of blocking oscillator transformer, and by the fact that an additional frequency control trimmer is connected to the control grid of the horizontal oscillator. Also by the fact that the negative control pulse is fed from the horizontal deflection coil circuit, rather than from damper circuit as in the late model Synchroguide systems.

The negative pulse from the horizontal sweep output can be seen by connecting the scope to the coupling condenser ,which feeds this pulse to the control grid circuit of the a.f.c. tube. The high vertical terminal of the scope should be connected to the side of the condenser furthest from the control grid, with the ground terminal of the scope connected to the chassis. The scope sweep is then set at 7875 cycles. Waveform will appear as shown in Fig.-AK-. If pulse cannot be obtained check through circuit from horizontal sweep output for an "open".

Fig.-AF- shows the horizontal waveform at the midpoint of the blocking oscillator transformer. It will be noted that this is a negative sawtooth, obtained by sweeping scope at 7875 cycles, connecting high side to blocking oscillator transformer and ground terminal to chassis.

Fig.-AF-

The waveform at the control grid of the a.f.c. tube is a combination of the sawtooth wave, the negative pulse and the sync pulse. This is shown in Fig.-AG- and is obtained by connecting high vertical terminal of scope to the control grid of the a.f.c. tube section, ground terminal to chassis, and sweeping scope at 7875 cycles.

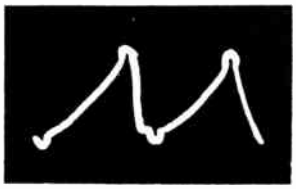


Fig.-AG-

RAPID CHECK NO. 90 - TO CHECK LATE MODEL SYNCHROGUIDE A.F.C. SYSTEM WAVEFORMS

Fig.-AH- shows horizontal waveform at the control grid of the horizontal a.f.c. tube. Scope is connected between this point and chassis, with sweep set at 7875 cycles. Fig.-AI- shows horizontal waveform at the midpoint of the horizontal blocking transformer with high vertical terminal of scope connected to midpoint through a low capacity probe, ground terminal of scope connected to chassis and with scope sweep set at 7875 cycles.

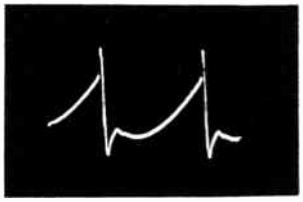


Fig.-AH-

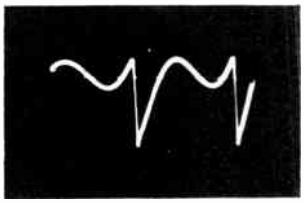


Fig.-AI-

Both peaks of each wave (i.e. peak of pulse and peak of sine wave), should be of equal height when horizontal hold control is turned back about ¼ turn from full clockwise position, bringing picture into sync. If the two peaks are not identical in height, change horizontal waveform adjustment by turning slug until same height is obtained, readjusting hold control if necessary to keep picture in synchronism. Fig. -AJ- shows horizontal waveform at the control grid of horizontal oscillator. Set scope sweep at 7875, with high terminal of scope connected to control grid and ground terminal of scope to chassis. The waveform obtained from damping tube by the a.f.c. tube should appear as a negative pulse, as shown in Fig.-AK-. To view this, connect

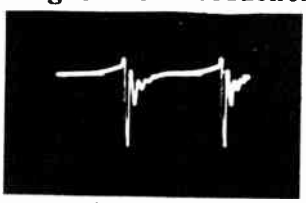


Fig.-AJ-

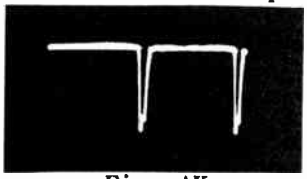


Fig.-AK-

the high terminal of the scope to the far side of the condenser which feeds pulse from damper, with ground terminal of scope connected to chassis and scope sweep set at 7875 cycles. If pulse is absent, check condenser for open, or for greatly decreased capacity.

RAPID CHECK NO. 91 - TO DETERMINE WHETHER GHOST IS TRUE OR PSUEDO

Ghosts due to reflection are distinguished from ghosts due to echo effect (psuedo ghosts) since latter are closer spaced, equally spaced with each succeeding image weaker than preceding one.

CONSULTATION SERVICE

We can supply postpaid a Tube Location Guide showing the function, type number and exact position of every tube in the television set, provided you send name and model number of the set together with $1 to cover cost.

If you are unable to obtain a schematic diagram of a TV or radio set, we will supply these diagrams for $2 per diagram, or if unobtainable will refund money.

If you desire personal consultation service in connection with any unusual difficulty experienced with a particular model TV or radio receiver, we will furnish a written opinion for $5 per receiver.

FACTS ABOUT THE AUTHOR

H. G. Cisin, the author of TV CONSULTANT is well known in the engineering profession as a radio and television inventor, as an electronic consulting engineer and as a prominent technical author and educator.

Although Mr. Cisin is considered to be one of the foremost electronic engineers in the country, his uncanny ability to translate complex technical subjects such as television into simple, everyday language which the average serviceman can understand, has made him the most popular author in the field of television and electronics.

He is the holder of six U.S. patents with numerous others still pending. Perhaps the most famous of his inventions is the basic AC-DC circuit which makes your present-day small radio possible. Among the concerns he has licensed under his patents are: RCA and its various licensees, AT&T, Western Electric Company and the Bell Telephone Companies and many others, He is also the inventor of the three-way portable radio receiver, of various power supplies used in television sets and of other important radio and television devices.

He is the author of THE TELEVISION DOCTOR, RAPID TV TROUBLE SHOOTING METHOD (COMBINED WITH RADIO TROUBLE SHOOTER), PRACTICAL ELECTRICAL ENGINEERING, TV TERMS SIMPLY EXPLAINED, RADIO TELEPHONE HANDBOOK, RADIO ENCYCLOPEDIA, as well as hundreds of technical articals on radio and TV which have appeared in magazines and newspapers in this and other countries.

Mr. Cisin, who learned TV servicing the hard way by actually working on hundreds of faulty TV sets at a service organization's test bench, has trained thousands of television technicians, many of them now holding important positions in this field. Although he is an engineering graduate of Cornell University, he has concentrated his efforts on teaching television to men with little formal education and this no doubt, accounts for his ability to write understandably about this subject.

Mr. Cisin is a licensed professional engineer and holds many other licenses in the engineering field including a first class FCC license and various teacher's licenses.

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