ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

HAND TOOLS

TOOLS FOR AUTO RADIO REPAIR

R TOOLS SPEED WORK

AN OJIBWAY PUBLICATION

JUNE 1964

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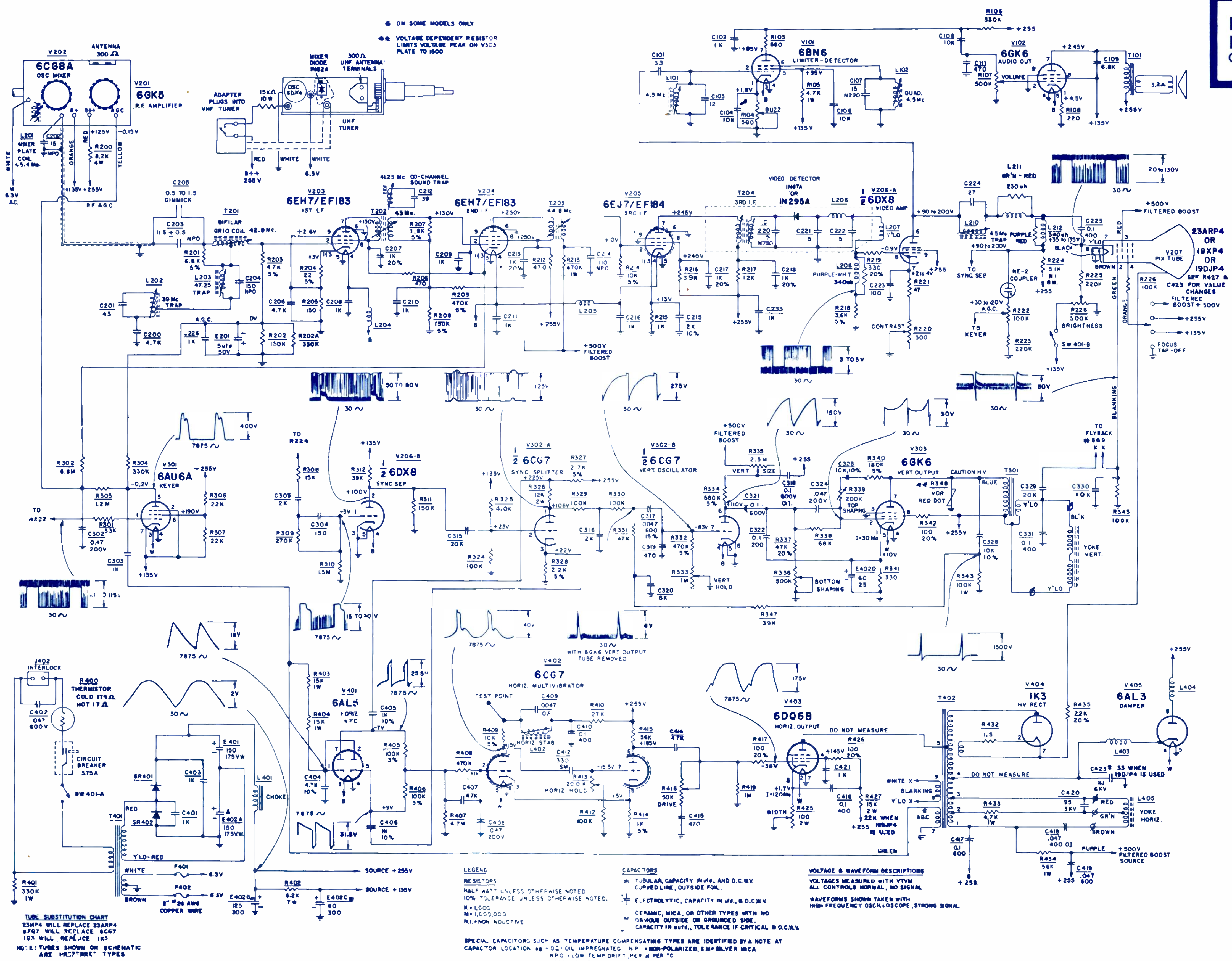
ELECTRONIC TECHNICIAN TEKFAX

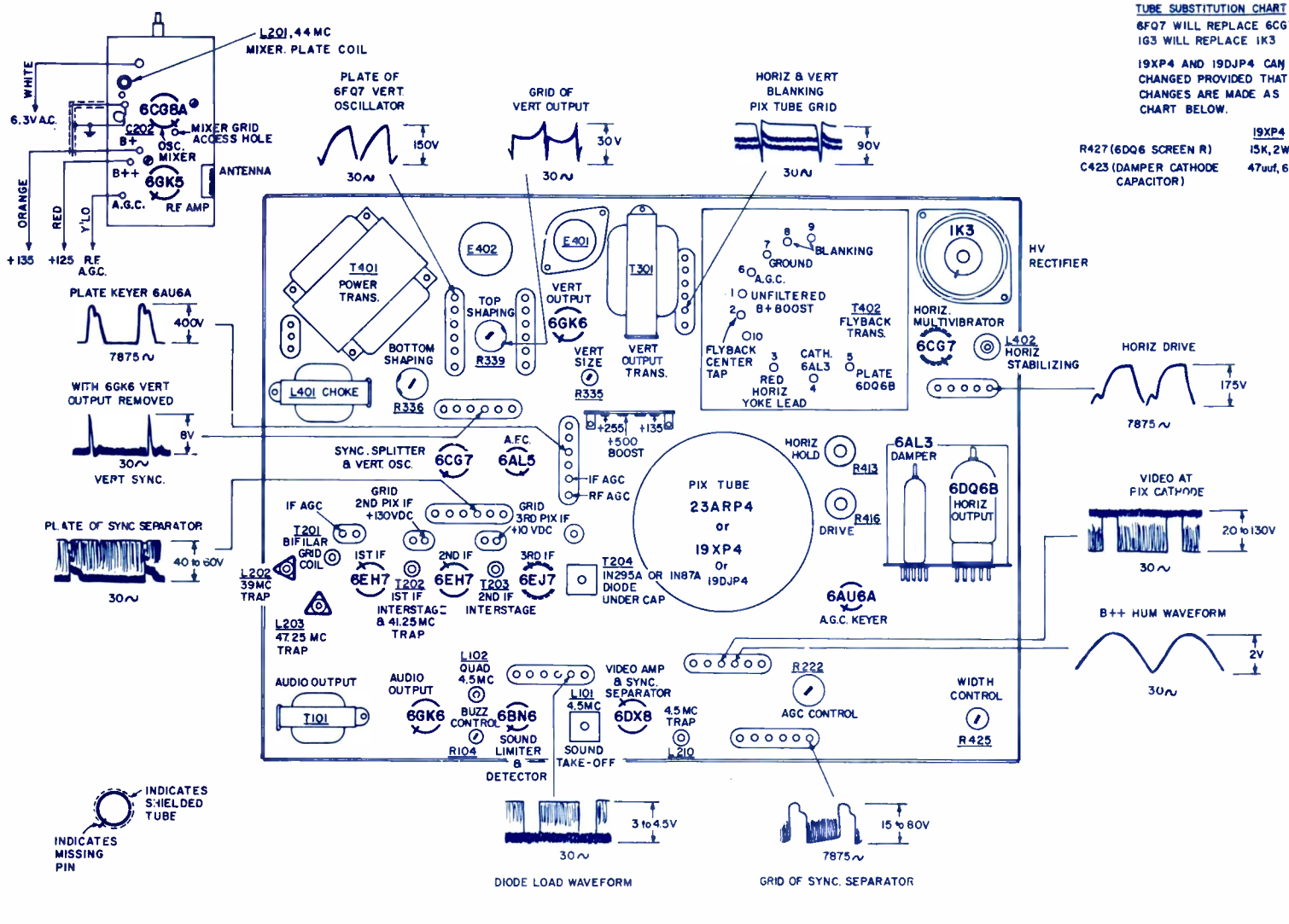
854

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR FIVE NEW SETS

ELECTRO-HOME
Chasiss SAFARI U

June 1964



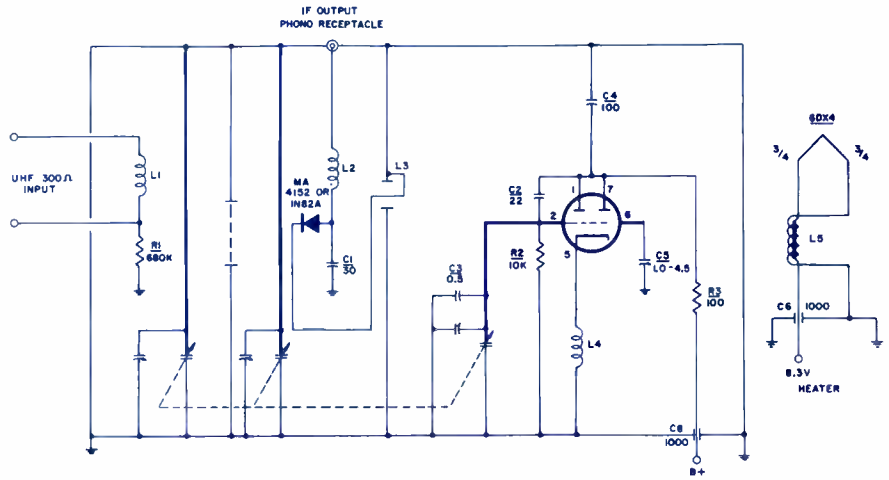


TUBE SUBSTITUTION CHART

6FQ7 WILL REPLACE 6CG7
1G3 WILL REPLACE 1K3

19XP4 AND 19DJP4 CAN BE INTERCHANGED PROVIDED THAT COMPONENT CHANGES ARE MADE AS SHOWN IN CHART BELOW.

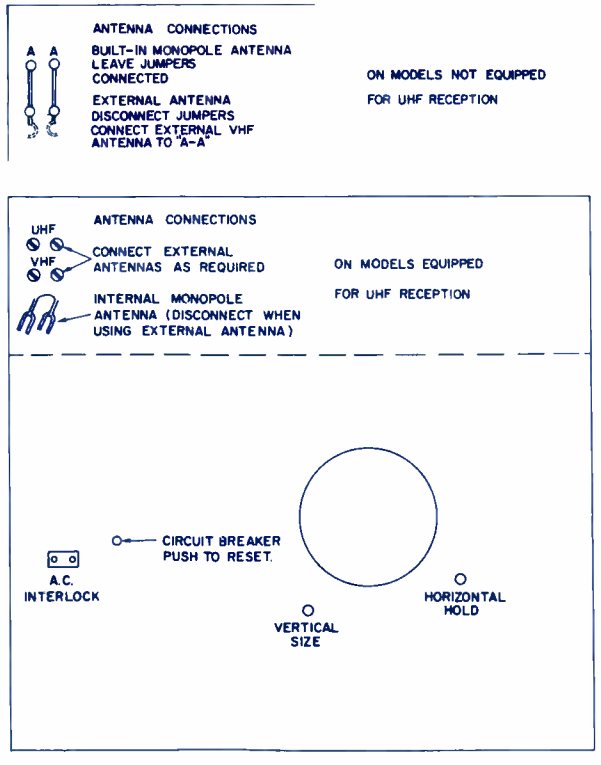
	19XP4	19DJP4
R427 (6DQ6 SCREEN R)	15K, 2W	18 K, 2W
C423 (DAMPER CATHODE CAPACITOR)	47uuf, 6kv	33uuf, 6kv

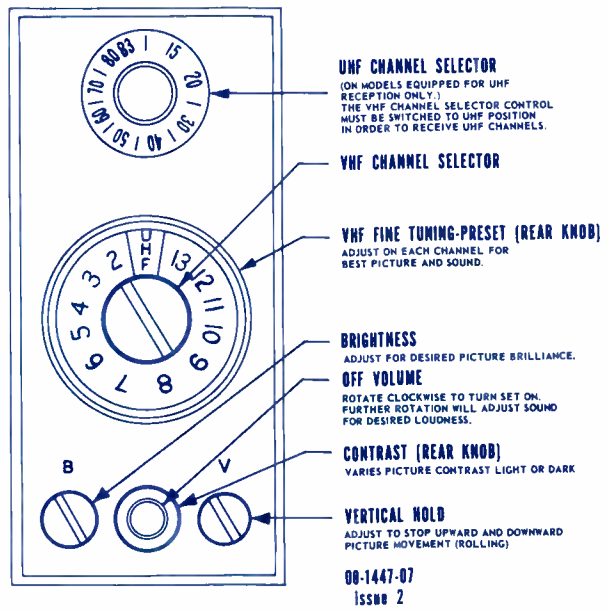


ELECTROHOME
Chassis SAFARI U

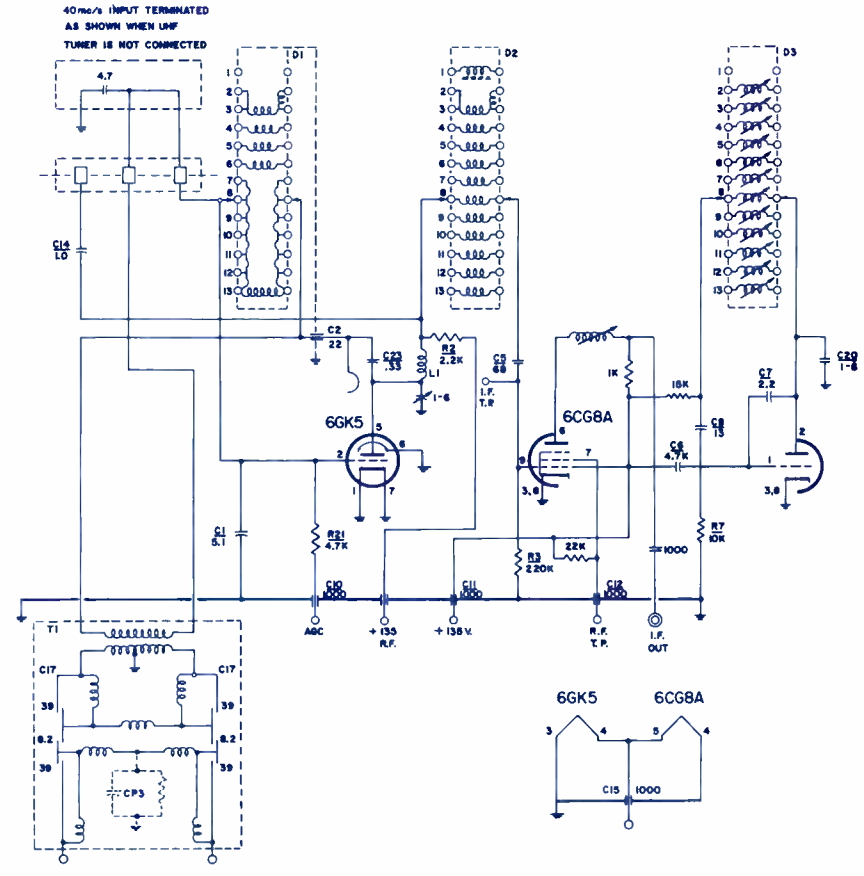
ELECTRONIC TECHNICIAN
TEKFAX
854

June 1964



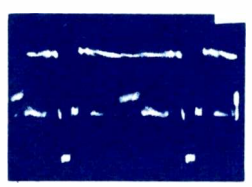


08-1447-07
Issue 2

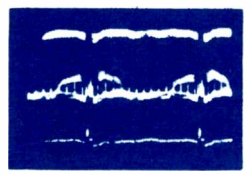


OSCILLOSCOPE WAVEFORM PATTERNS

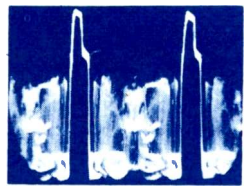
These waveforms were taken with the receiver adjusted for an approximate peak-to-peak output of 3.5 volts at the video detector. Voltage readings taken with raster just filling screen and all controls set for normal picture viewing. The voltages given are approximate peak-to-peak values. The frequencies shown are those of the waveforms—not the sweep rate of the oscilloscope. All readings were taken with a Model ES-550B Precision oscilloscope.



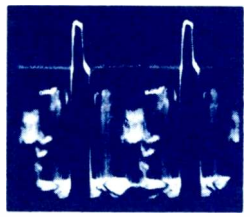
1 3.5 volts p/p, 15,750 c.p.s.



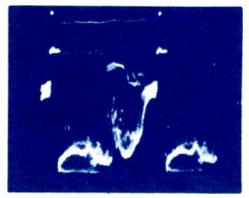
2 3.5 volts p/p, 60 c.p.s.



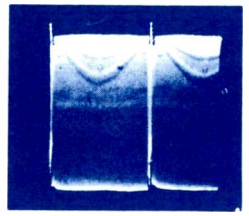
3 100 volts, p/p, 15,750 c.p.s.



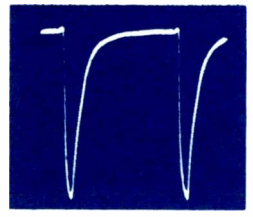
4 80 volts p/p, 15,750 c.p.s.



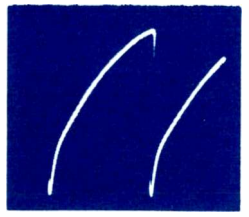
5 80 volts p/p, 60 c.p.s.



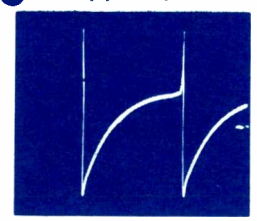
6 50 volts p/p, 60 c.p.s.



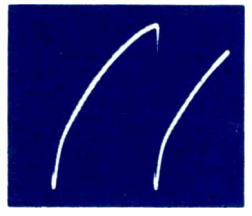
7 50 volts p/p, 15,750 c.p.s.



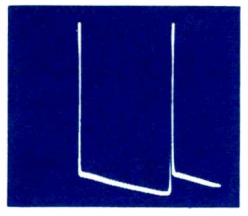
8 40 volts p/p, 60 c.p.s.



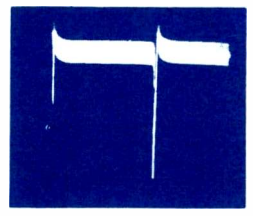
9 60 volts p/p, 60 c.p.s.



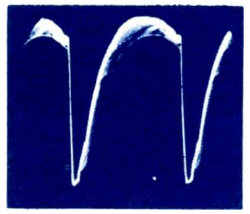
10 40 volts p/p, 60 c.p.s.



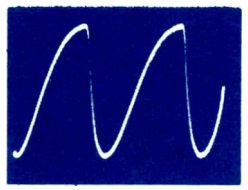
11 1150 volts p/p, 60 c.p.s.



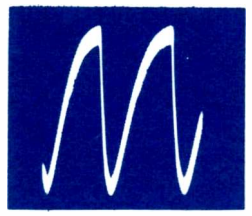
12 60 volts p/p, 60 c.p.s.



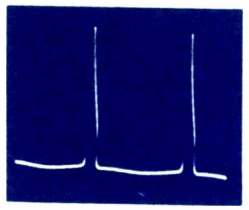
13 8 volts p/p, 15,750 c.p.s.



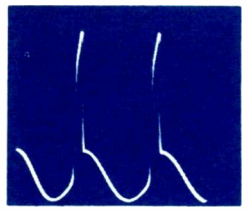
14 12 volts p/p, 15,750 c.p.s.



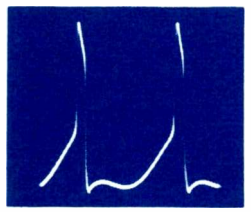
15 15 volts p/p, 15,750 c.p.s.



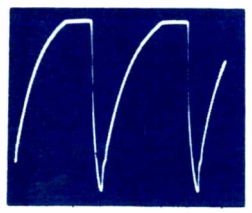
16 8 volts p/p, 15,750 c.p.s.



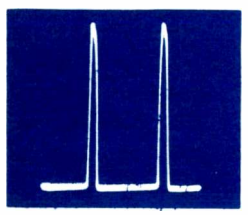
17 30 volts p/p, 15,750 c.p.s.



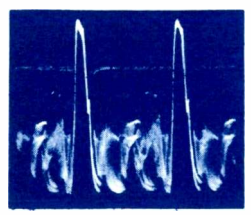
18 25 volts p/p, 15,750 c.p.s.



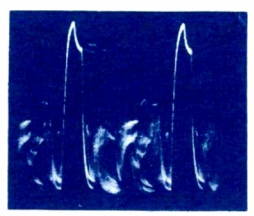
19 90 volts p/p, 15,750 c.p.s.



20 350 volts p/p, 15,750 c.p.s.



21 60 volts p/p, 15,750 c.p.s.



22 16 volts p/p, 15,750 c.p.s.

ELECTRONIC TECHNICIAN TEKFAX

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR FIVE NEW SETS

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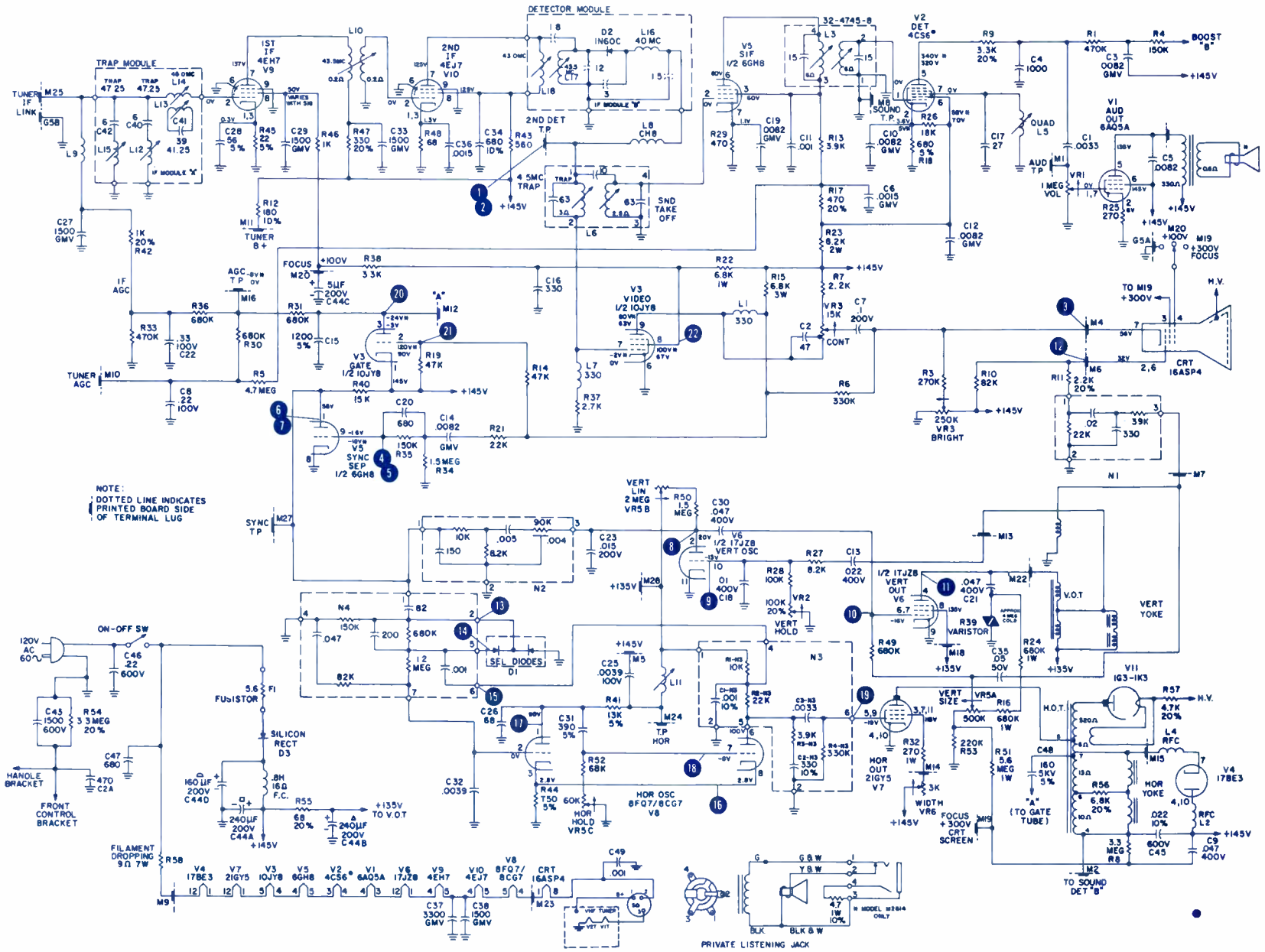
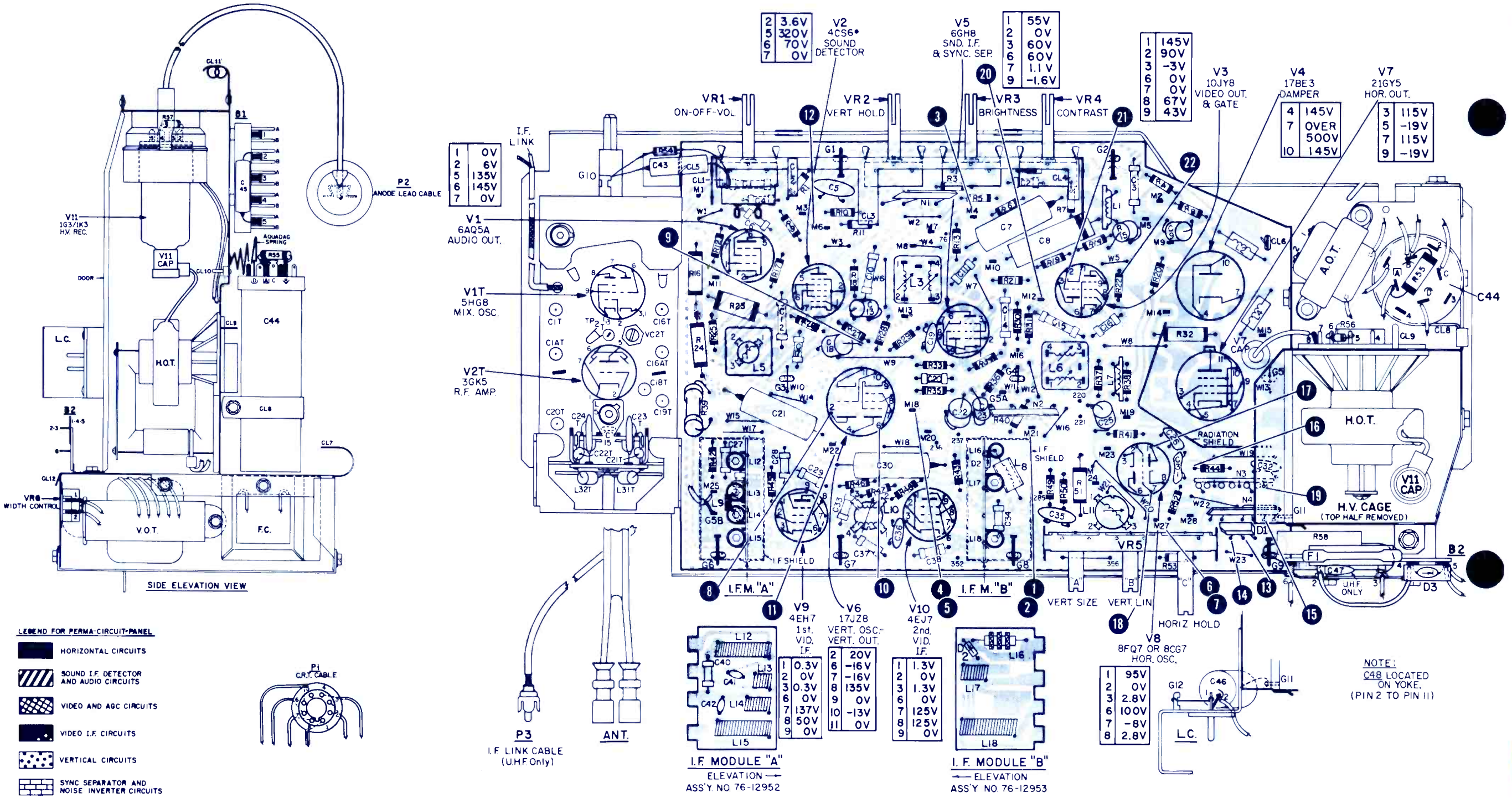
PHILCO
Chassis 14G20

June 1964



NOTES:

1. ALL VOLTAGES TAKEN UNDER NO SIGNAL CONDITIONS. ANTENNA REMOVED AND TUNER OFF CHANNEL.
2. VOLTAGES MEASURED WITH A "PRECISION MODEL 88, V.T.V.M.", FROM POINT INDICATED TO CHASSIS GROUND.
3. VOLTAGES MARKED ✱ WERE TAKEN UNDER AVERAGE SIGNAL CONDITIONS, ANTENNA CONNECTED, TUNER ON AN ACTIVE CHANNEL AND CONTROLS ADJUSTED FOR A NORMAL PICTURE.
4. COIL RESISTANCES READ WITH COIL IN CIRCUIT EXCEPT FOR . A.O.T. SEC. AND SPEAKER V.C. H.O.T. AND HOR. YOKE WHERE THE COMPONENTS WERE DISCONNECTED AND MEASURED INDIVIDUALLY.
5. BALLOONS (1), (2), ETC. SHOWN ON SCHEMATIC, INDICATE WAVEFORM TEST POINTS.
6. CONTROL SETTINGS:
   VOLUME - MINIMUM
   CONTRAST - MID-RANGE
   BRIGHTNESS - MID-RANGE
   ALL OTHER CONTROLS SET FOR NORMAL OPERATION.



1	0V
2	6V
5	135V
6	145V
7	0V

2	3.6V
5	320V
6	70V
7	0V

1	55V
2	0V
3	60V
6	60V
7	1.1V
9	-1.6V

1	145V
2	90V
3	-3V
6	0V
7	0V
8	67V
9	43V

4	145V
7	OVER 500V
10	145V

3	115V
5	-19V
7	115V
9	-19V

1	0.3V
2	0V
3	0.3V
6	0V
7	137V
8	50V
9	0V

2	20V
6	-16V
7	-16V
8	135V
9	0V
10	-13V
11	0V

1	1.3V
2	0V
3	1.3V
6	0V
7	125V
8	125V
9	0V

1	95V
2	0V
3	2.8V
6	100V
7	-8V
8	2.8V

LEGEND FOR PERMA-CIRCUIT-PANEL

- HORIZONTAL CIRCUITS
- SOUND I.F. DETECTOR AND AUDIO CIRCUITS
- VIDEO AND AGC CIRCUITS
- VIDEO I.F. CIRCUITS
- VERTICAL CIRCUITS
- SYNC SEPARATOR AND NOISE INVERTER CIRCUITS

PANEL LUG CONNECTIONS

Lug	Connection
M1	Audio Test Point
M2	White Lead to B1-2
M3	Blue Lead to A. O. T.
M4	Video Output, Yellow/White lead to Pin 7 of C. R. T.
M5	Red/White Lead to B1-5, 145V B-plus
M6	Green/White Lead to Pin 6 of CRT
M7	Orange/White Lead to B1-3, vertical retrace suppression
M8	Sound Det. Test Point, Ground Link
M9	Brown/White Lead to B2-1, start of filament chain
M10	White Lead, Tuner AGC
M11	Yellow Lead, Tuner B-plus
M12	Blue/White Lead to Yoke, AGC Gate Pulse
M13	Red/White Lead of V. O. T., Vertical Feedback
M14	Blue/White Lead to VR6-1, Width Control
M15	Red Lead to H. O. T. Pin 7
M16	AGC Test Point
M18	Orange/White Leads to M28 and to C44B, 135V B-plus
M19	Orange/White Lead to Pin 4 of CRT, 300V, optional focus connection
M20	Green/White Lead to C44C, 100V B-plus, optional focus connection
M21	Video 2nd detector test point
M22	Blue/White Lead of V. O. T., vertical output plate
M23	Brown/White Lead to Pin 1 of CRT, filament
M24	Horizontal Oscillator Test Point
M25	I-F Input, center conductor of shielded tuner I-F link
M27	Sync Test Point
M28	Orange/White Lead to M18, 135V B-plus

RESISTANCE CHART

TUBE	USE	PIN NUMBERS 1	2	3	4	5	6	7	8	9	10	11	12
V1 6AQ5A	Audio Output	60K*	270Ω	17Ω	19Ω	16K	16K	60K*					
V2 4CS6	Sound Det.	6Ω	560Ω	22Ω	19Ω	9 MEG	13K	3.5Ω					
V3 10JY8	Vid. Output AGC Gate	15K	38K	1.7 MEG	24Ω	27Ω	0Ω	3K	23K	13K			
V4 17BE3	Damper	33Ω	33Ω	33Ω	16K	INF.	INF.	8.5 MEG	INF.	INF.	16K	INF.	40Ω
V5 6GH8	Sound I-F Sync Sep.	28K	2.5Ω	16K	24Ω	22Ω	16K	470Ω	0Ω	1.6 MEG			
V6 17JZ8	Vert. Osc. Output	11Ω	2.8 MEG	INF.	16K	INF.	1.5 MEG	1.5 MEG	16K	0Ω	130K	0Ω	17Ω

*VARIES WITH VOLUME CONTROL SETTING

TUBE	USE	PIN NUMBERS 1	2	3	4	5	6	7	8	9	10	11	12
V7 21GY5	Hor. Output	27Ω	INF.	19K	0Ω	330K	19K	19K	19K	330K	0Ω	19K	33Ω
V8 8FQ7 8CG7	Hor. Osc.	24K	1.7 MEG	750Ω	5Ω	8Ω	45K	95K	750Ω	0Ω			
V9 4EH7	1st VIF	22Ω	430K	22Ω	11Ω	10Ω	0Ω	16K	22K	0Ω			
V10 4EJ7	2nd VIF	68Ω	0.1Ω	68Ω	10Ω	8Ω	0Ω	16.5K	16.5K	0Ω			
CRT 16ASP4		5Ω	18K	6M	0Ω 25K** 6 MEG	INF.	18K	165K	3Ω				

**DEPENDS ON FOCUS CONNECTION

PHILCO
Chassis 14G20

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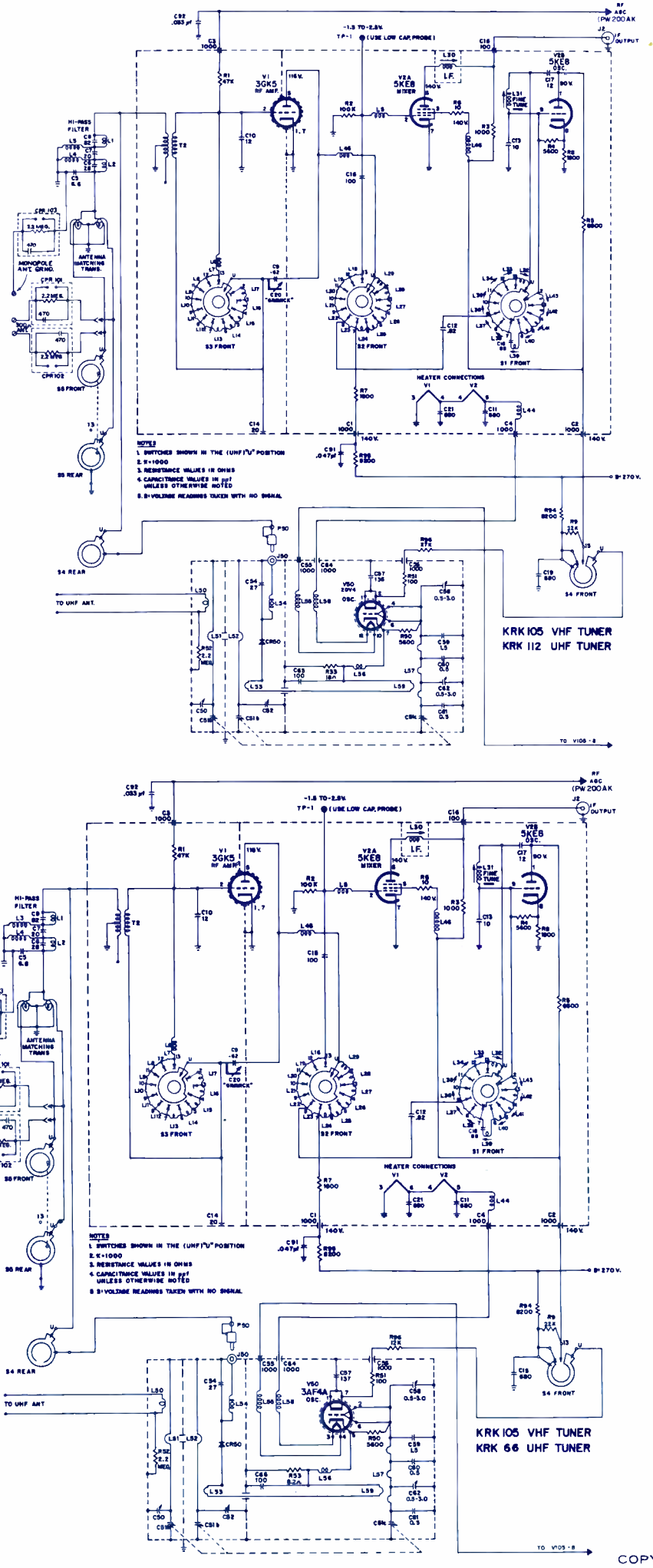
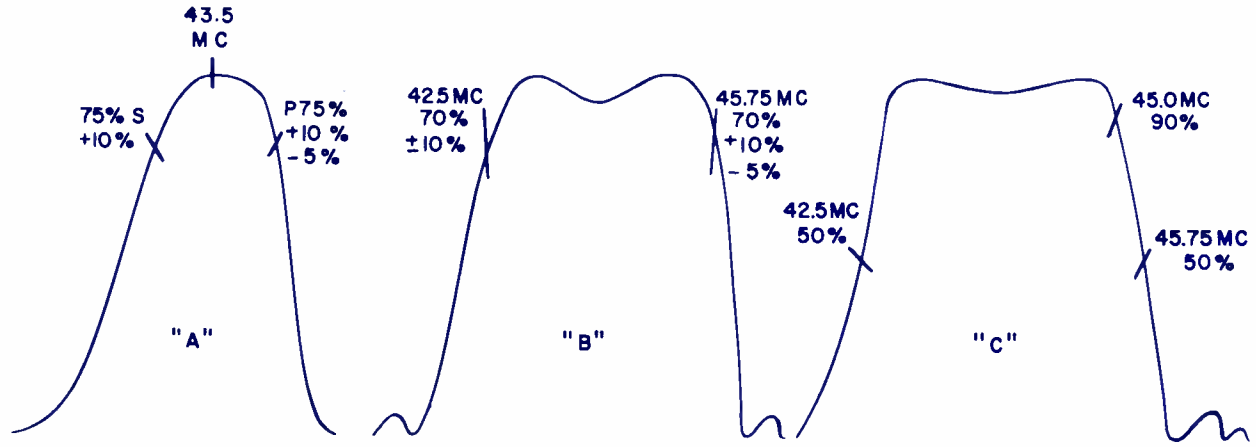
856

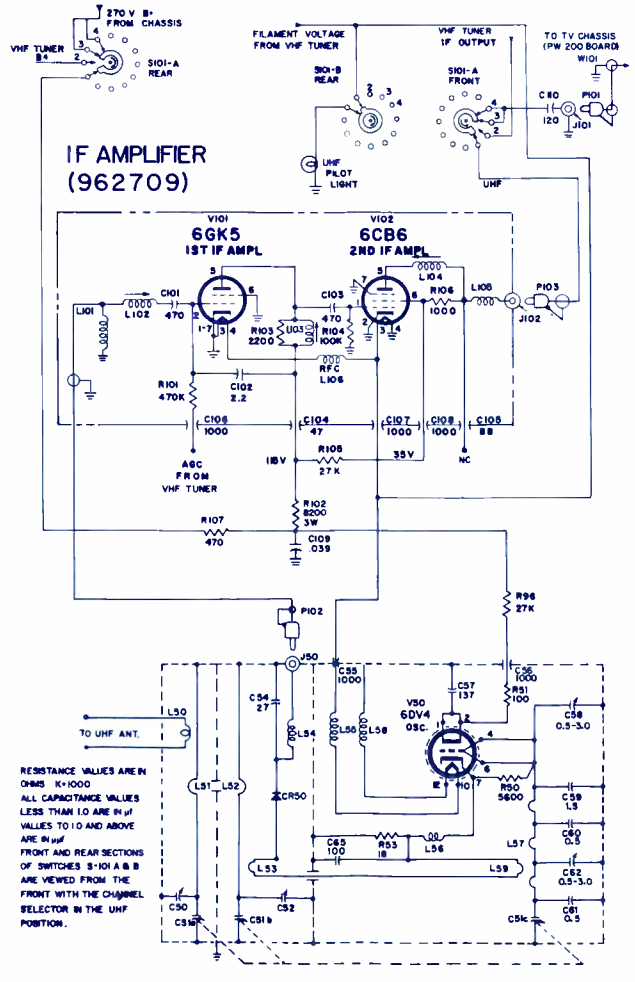
RCA

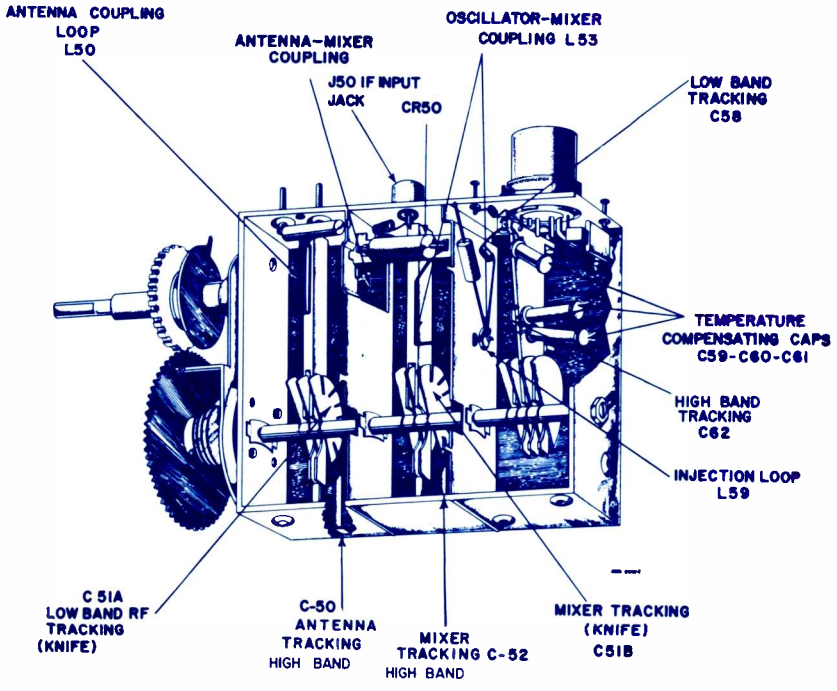
UHF Tuners
KRK105/112,
KRK112 with
962709 IF
Amplifier and
KRK105/KRK66
Series

June 1964









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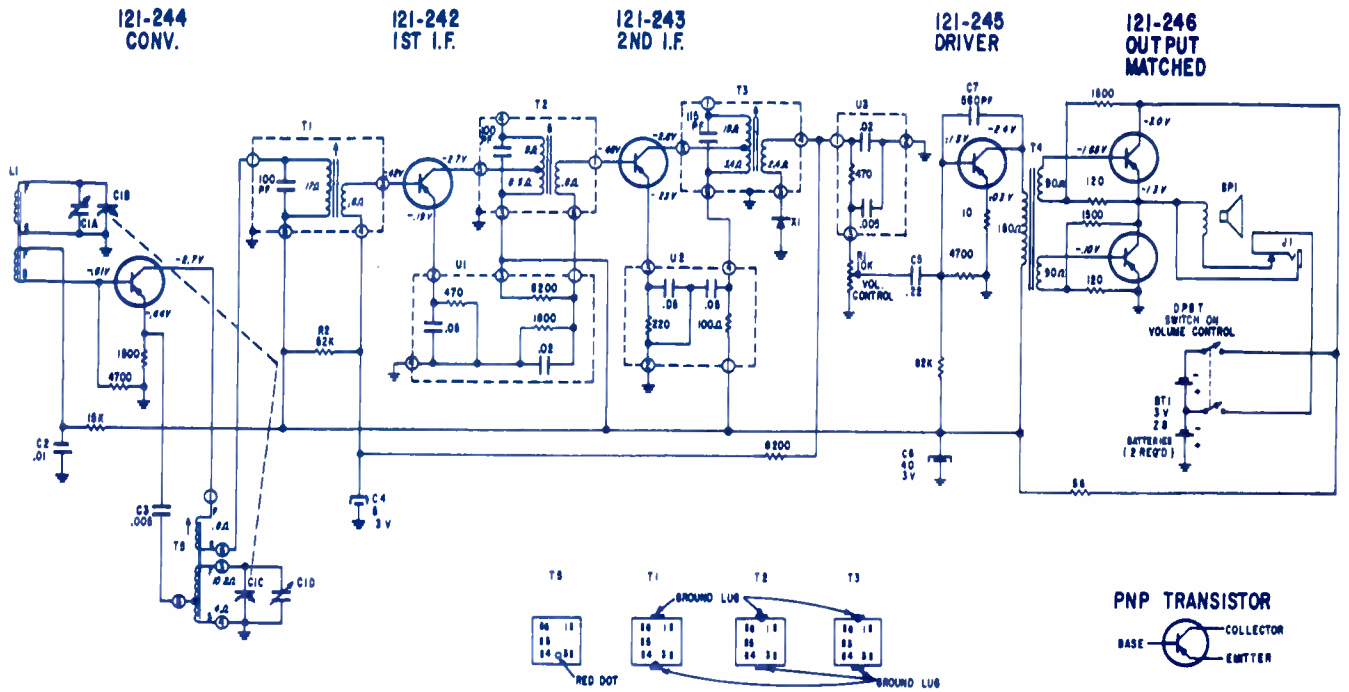
ELECTRONIC TECHNICIAN TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR FIVE NEW SETS

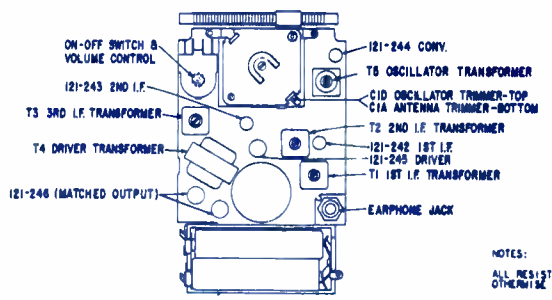
ZENITH
Transistor Radio
Chassis 6KT50Z8
Model 40

June 1964

Chassis	Part No.	Conv.	1st I.F.	2nd I.F.	Crystal Diode Detector	Driver	Output-Output	Supplier
6KT50Z8	Zenith E1A Type	121-244 2N993 PNP	121-242 2N993 PNP	121-243 2N993 PNP	403-1	121-245 C-1438 NPN	121-246 C-1437 Matched Pair NPN NPN	Amperex



Oper.	Input Signal Frequency	Connect Inner Conductor From Oscillator To	Connect Outer Shield Conductor From Oscillator To	Set Dial At	Trimmers	Purpose
1	455 KC	ONE TURN LOOSELY COUPLED TO WAVE-MAGNET	Chassis	600 KC	Adj. T1, T2, T3 for maximum output.	For I.F. Alignment
2	1620 KC		–	Gang wide open.	C1D	Set Oscillator to dial scale
3	600 KC		–	Near 600 KC	Adjust Slug in T5	While rocking gang, adjust T5 for maximum ouptut regardless of dial accuracy.
4	1260 KC		–	1260 KC	C1A	Align Loop ant.
5	REPEAT STEPS 2 & 3		–	–	–	–



LEGEND

B—BASE
C—COLLECTOR
E—EMITTER

NOTES:

ALL RESISTORS ARE CARBON, 1/2 WATT, ±10% TOLERANCE UNLESS OTHERWISE SPECIFIED.

ALL VOLTAGES ARE D.C. UNLESS OTHERWISE SPECIFIED.

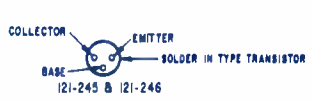
ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

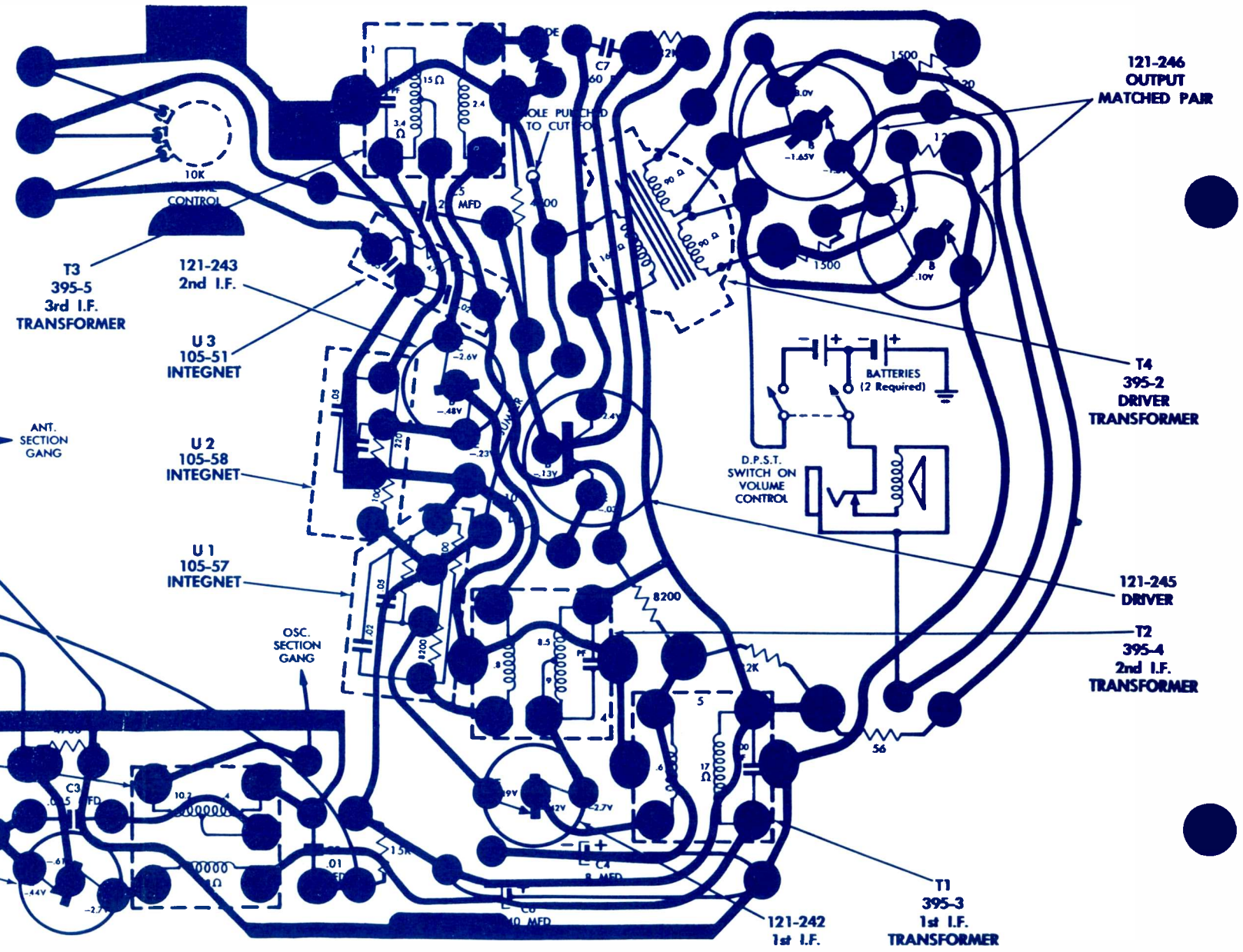
D.C. VOLTAGES SHOWN ARE MEASURED FROM GROUND WITH NO SIGNAL USING A VACUUM TUBE VOLTMETER.

BATTERY CURRENT DRAIN: APPROXIMATELY 12 M.A. WITH VOLUME CONTROL AT MINIMUM.

SPEAKER IMPEDANCE: 11 OHMS.

DENOTES GROUND ⏚



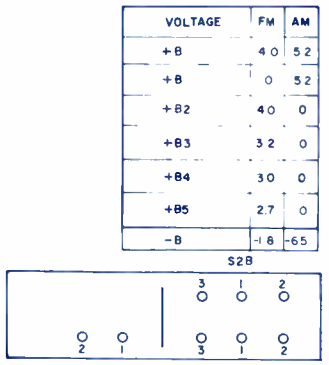


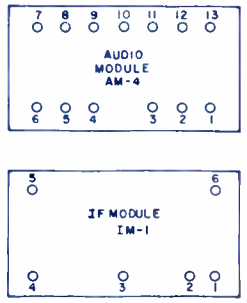
TRANSISTOR	EMITTER		BASE		COLLECT	
	FM	AM	FM	AM	FM	AM
TR1	2.3	0	1.9	0	0	0
TR2	2.2	0	2.0	.6	0	0
TR3	2.2	0	1.9	0	.1	0
TR4	2.0	0	1.7	0	.2	0
TR5	2.15	0	1.8	0	.15	0
TR6	3.0	0	2.7	0	10.5	0

AUDIO MODULE
AM-4

PIN NO	FM VOLTAGE	AM VOLTAGE
1	4.0	5.2
2	3.8	4.8
3	2.5	.35
4	3.9	5.0
5	3.9	5.0
6	1.3	2.5
7	1.1	2.25
8	1.1	2.25
9	-1.8	-.65
10	4.0	5.2
11	0	0
12	4.0	5.2
13	4.0	5.2

VOLTAGE	FM	AM
+B	4.0	5.2
+B	0	5.2
+B2	4.0	0
+B3	3.2	0
+B4	3.0	0
+B5	2.7	0
-B	-1.8	-6.5





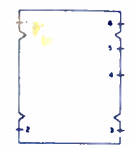
ELECTRONIC TECHNICIAN
TEKFAX

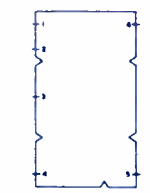
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR FIVE NEW SETS

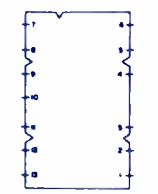
858

GENERAL ELECTRIC
Portable AM-FM Transistor Radio
Models 940 A, B

June 1964


PIN CONNECTIONS FOR CONVERTER MODULE (VIEWED FROM COMPONENT SIDE)


PIN CONNECTIONS FOR IF MODULE (IM-1) (VIEWED FROM COMPONENT SIDE)


PIN CONNECTIONS FOR AUDIO MODULE (AM-4) (VIEWED FROM COMPONENT SIDE)

NOTES

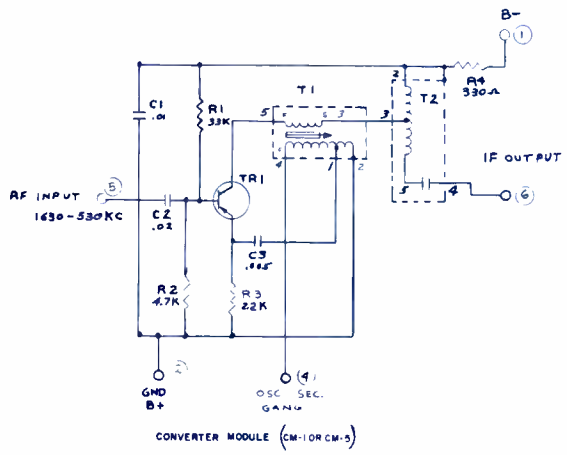
1. UNLESS OTHERWISE NOTED:
   CAPACITORS MORE THAN 1=UUF
   CAPACITORS LESS THAN 1=UF
   RESISTORS= 1/2WATTS, K=1000
2. VOLTAGES ARE POSITIVE WITH RESPECT TO GROUND UNDER NO SIGNAL CONDITIONS & VOLUME CONTROL MINIMUM UNLESS OTHERWISE INDICATED.
3. REPLACE TRANSISTORS AS LISTED IN THE PARTS LIST.
4. CM-1 (CONVERTER MODULE IS TO BE USED IN "A" VERSION, CM-5 IS TO BE USED IN "B" VERSION, L4 (AM ANTENNA) MUST BE MATCHED TO THE CONVERTER MODULE (SEE PARTS LIST)
5. R50 USED IN A VERSION ONLY; C38 BECOMES 15pf L7 USED IN B VERSION ONLY; C38 BECOMES 9pf

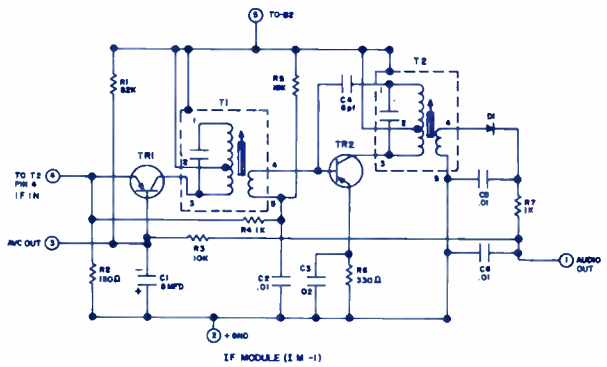
CONVERTER MODULE CM-1 OR CM-5

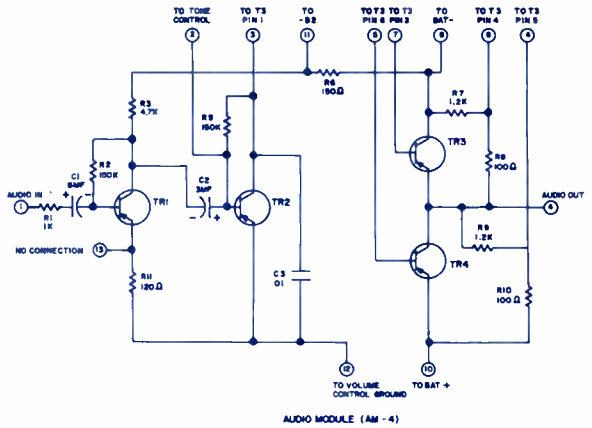
PIN NO	FM VOLTAGE	AM VOLTAGE
1	0	0
2	0	5.2
3	0	5.2
4	0	5.2
5	0	5.2
6	0	5.0

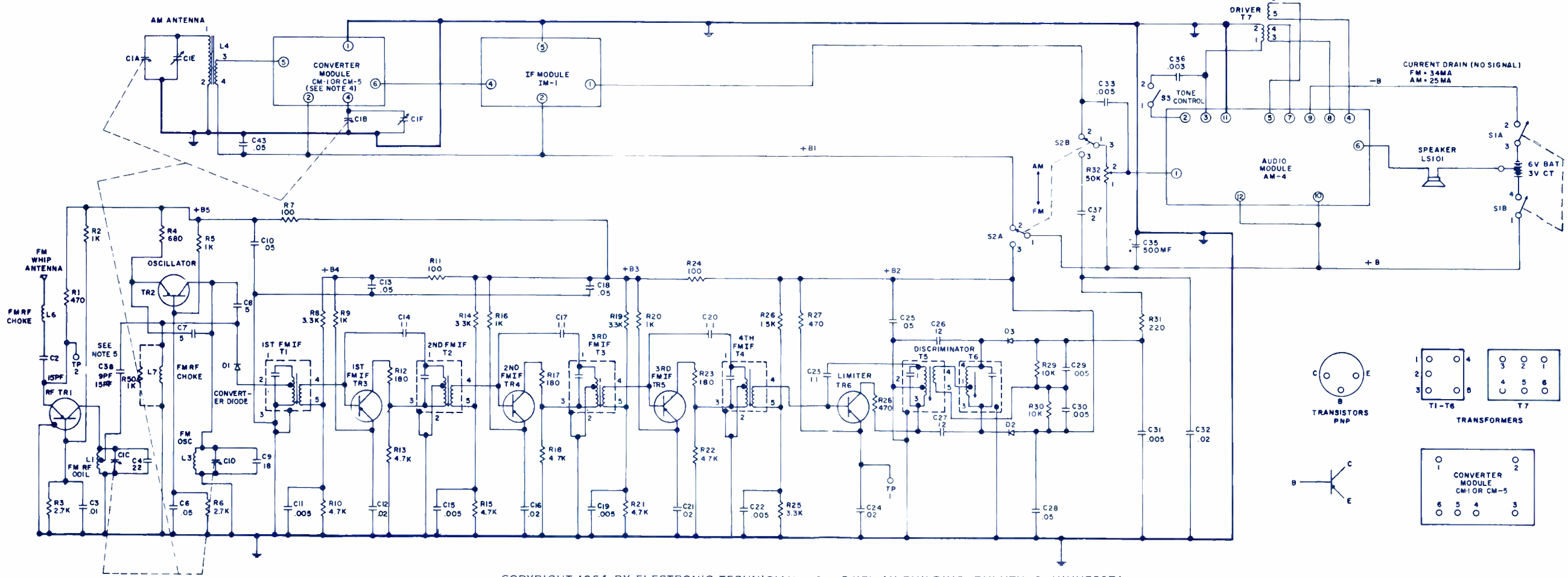
IF MODULE IM-1

PIN NO	FM VOLTAGE	AM VOLTAGE
1	0	5.0
2	0	5.2
3	0	4.8
4	0	5.0
5	0	0
6	0	0









ELECTRONIC TECHNICIAN

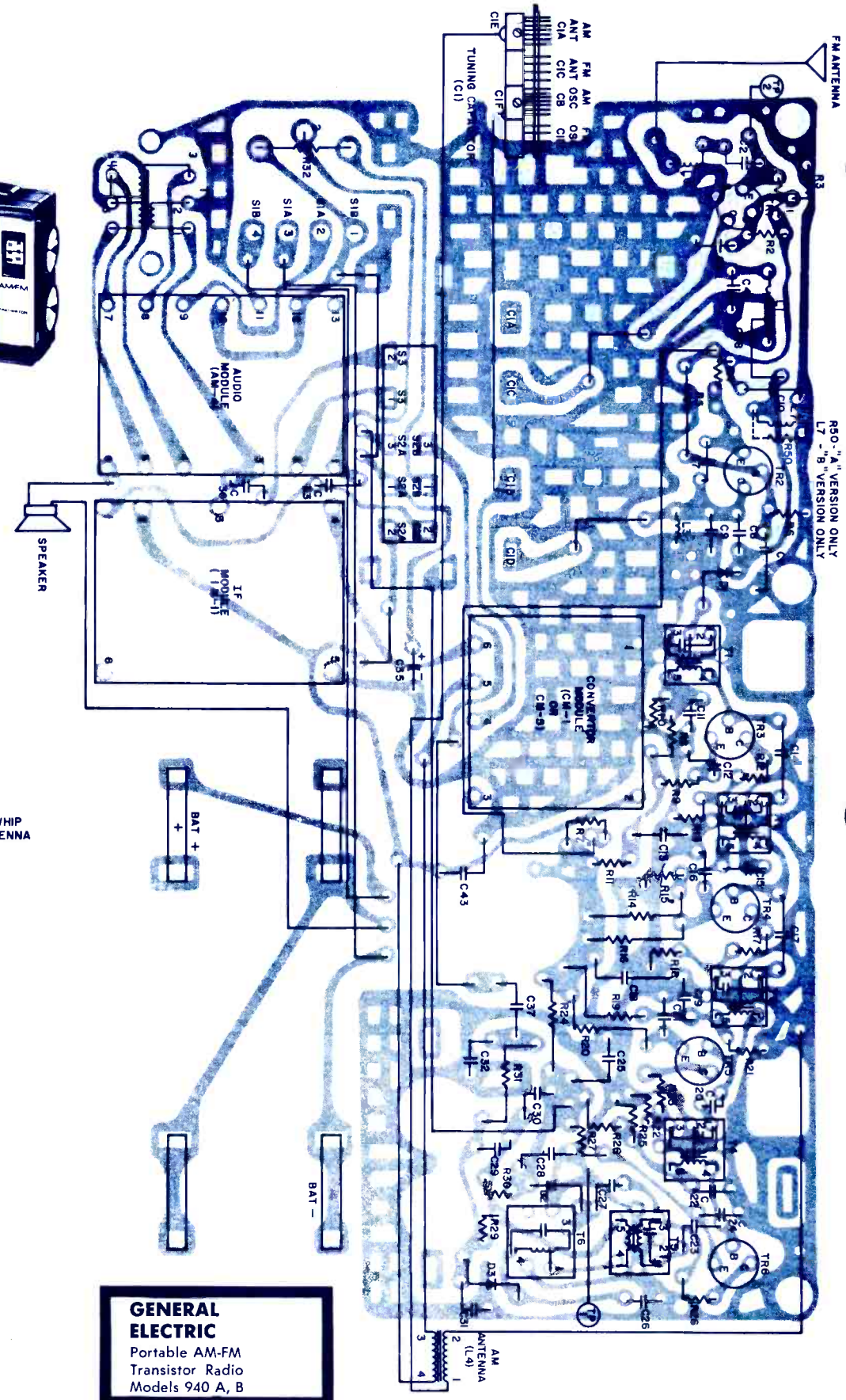
TEKFAX

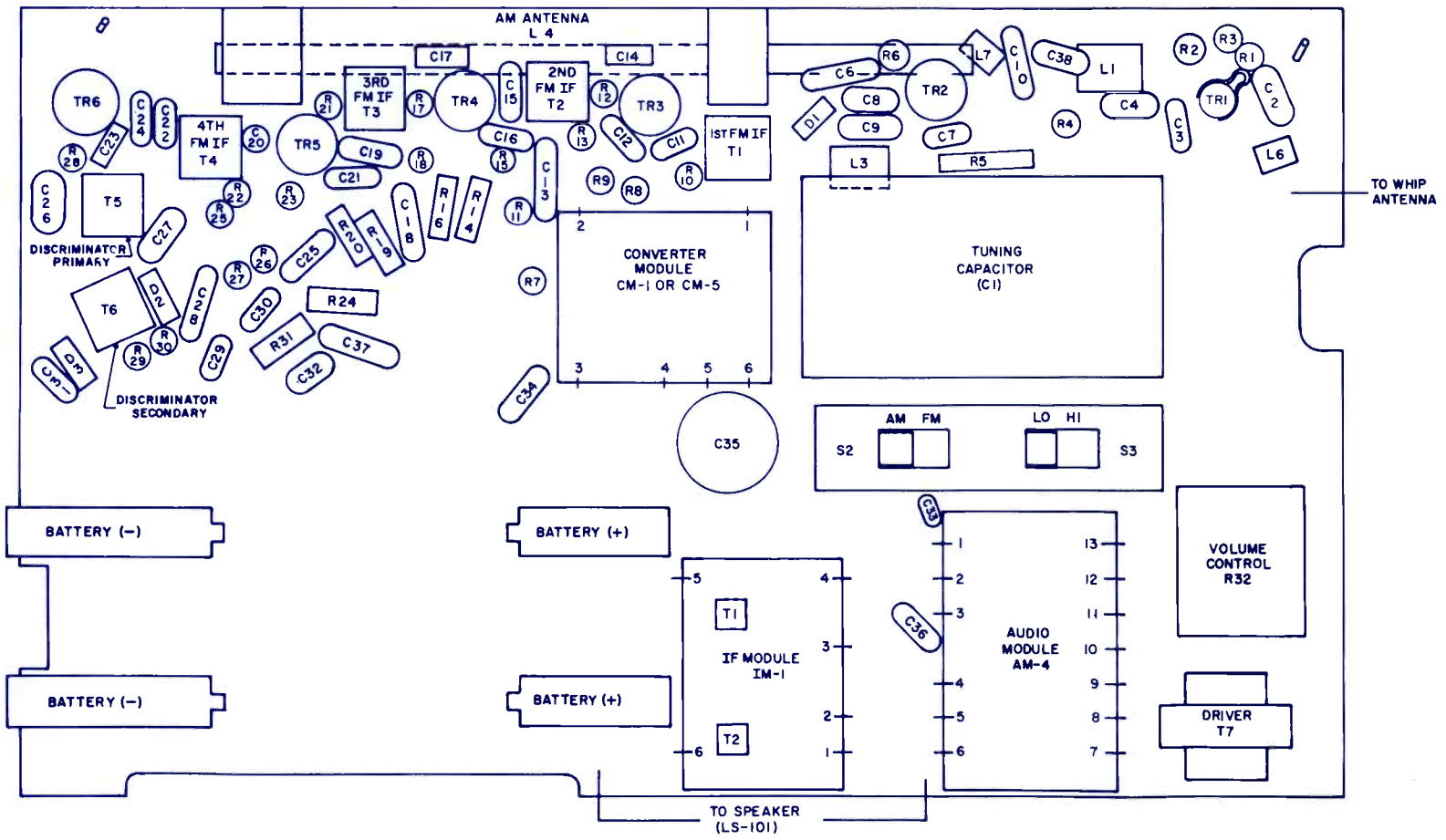
COMPLETE MANUFACTURER S' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR FIVE NEW SETS

GROUP **142**

Schematics No

June 1964





GENERAL ELECTRIC
Portable AM-FM
Transistor Radio
Models 940 A, B

ELECTRONIC TECHNICIAN
TEKFAX
858

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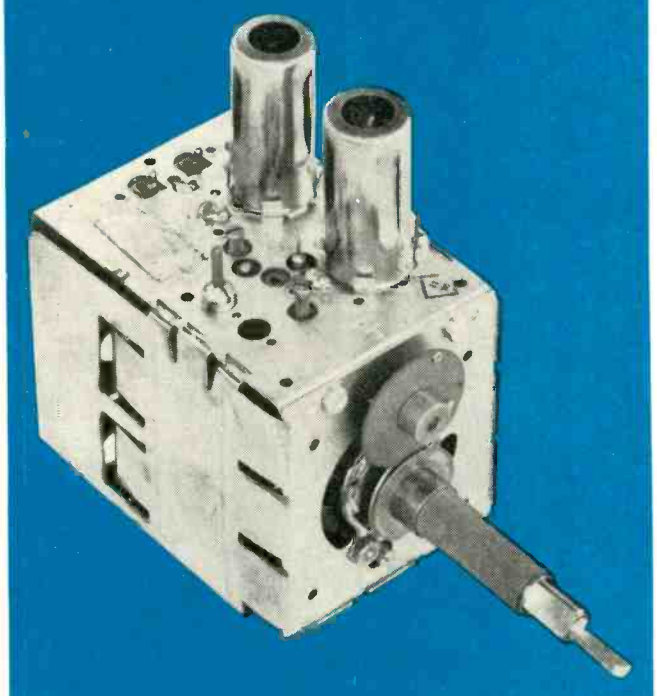

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24-HOUR SERVICE with FULL YEAR WARRANTY

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You get a 12-month guarantee against defective workmanship and parts failure due to normal usuage. Cost to you is only $9.50 and $15 for UV combinations, including all labor and parts except tubes. No additional costs. No hidden charges. All tuners repaired on approved, open accounts. You pay shipping. Replacements on tuners beyond practical repair are available at low cost.

When inquiring about service on other than Tarzian-made tuners, always send TV make, chassis and Model number. Check with your local distributor for Sarkes Tarzian replacement tuners, parts, or repair service. Or, use the address nearest you for fast factory repair service.

SARKES TARZIAN, INC.
TUNER SERVICE DIVISION

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JUNE 1964
VOL. 79 NO. 6

ELECTRONIC TECHNICIAN

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FEATURES

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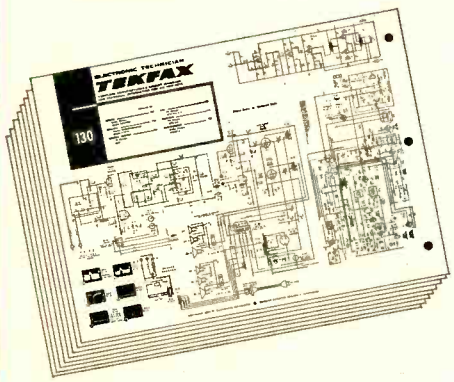
TEKFAX ..... 16 PAGES OF LATEST SCHEMATICS



ELECTROHOME: Chassis SAFARI U

GENERAL ELECTRIC: Portable AM-FM Transistor Radio, Models 940A, B

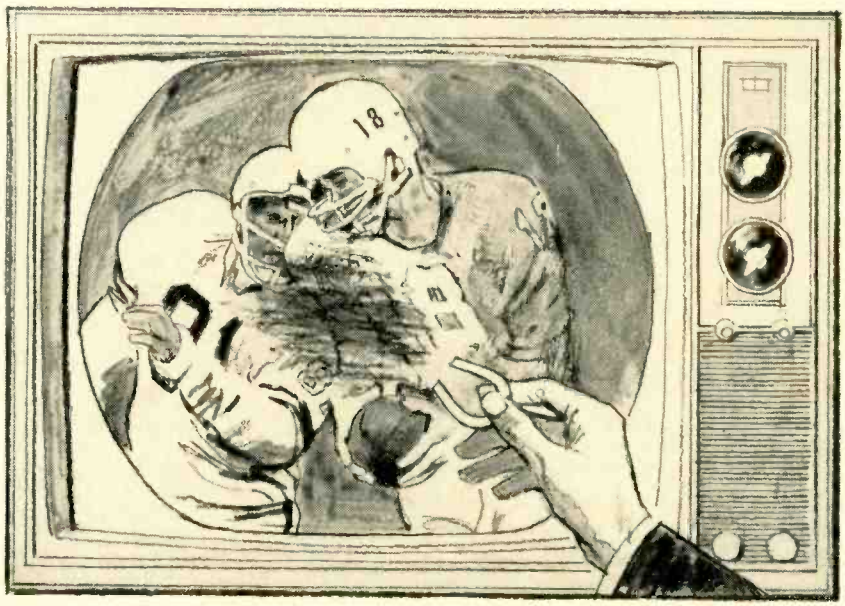
PHILCO: Chassis 14G20

RCA: UHF Tuners, KRK105/112, KRK112 with 952709 IF Amplifier and KRK105/KRK66 Series

ZENITH: Transistor Radio, Chassis 6KT50Z8, Model 40

Exclusive

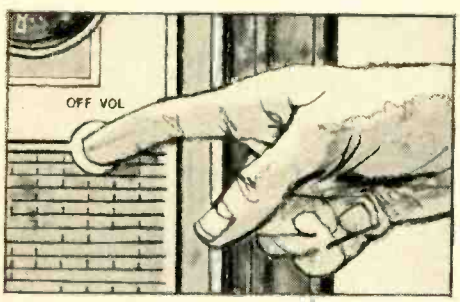
RCA Victor Color TV



Magnetism can cause impurities...

in the color picture—a weak pocket magnet can easily demonstrate this effect. In the home, as you know, magnetic distortions may be caused by moving the set in relation to the earth's magnetic field or they can sometimes be caused by nearby electric appliances.

To "cancel" the magnetism and restore natural color...



simply turn off the set, let it cool 4 or 5 minutes, then turn it back on. That's all—no more need for a separate degaussing coil! The RCA Victor Automatic Color Purifier acts *every time the set is turned on* from a cool start. Color is bright, sharp, true—free of impurities caused by magnetism. The RCA Victor Automatic Color Purifier also removes unwanted color areas from the black and white picture. Here's another major "first" from RCA Victor that can give you a profitable advantage in extra sales . . . and in service savings!

SEE WALT DISNEY'S "WONDERFUL WORLD OF COLOR," SUNDAYS, NBC-TV NETWORK

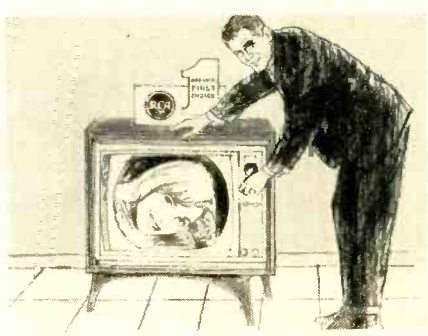
degausses itself!

Gives you 3 big advantages!

1

Floor models always ready for best color picture!

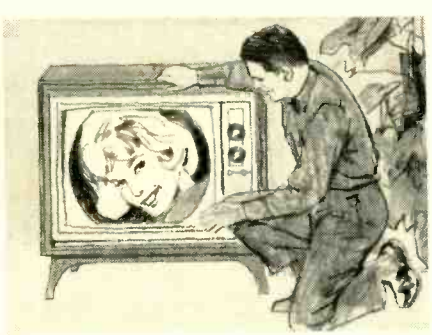
Ever lost a sale because your floor demonstrator needed degaussing? The RCA Victor Automatic Color Purifier cleans up that problem . . . the set always shows unsurpassed natural color. And with a swivel or caster model, you can quickly demonstrate how color TV can now be moved about without worry of magnetic distortion!



2

Faster, easier setup in customer's home!

The RCA Victor Automatic Color Purifier eliminates the need for you to perform time-consuming degaussing when you deliver the new Mark 10 color TV set. This makes setup faster, easier . . . freeing you for more profitable TV servicing. The Automatic Color Purifier is standard on all Mark 10 models except the price leaders.



3

Reduces unprofitable callbacks!

The RCA Victor Automatic Color Purifier will end those degaussing "nuisance" calls that can eat up service time and profits. They're a nuisance to customers, too! Increased customer satisfaction is sure to follow from this new RCA Victor "first"—and remember, a satisfied customer is very often your best salesman.

Make sure you get your share of the big Color TV sales forecast for '65...get with RCA Victor!

RCA The Most Trusted Name in Television

Tmk(s)®

SEE THE RCA COLOR TV CENTER AT THE WORLD'S FAIR

LETTERS TO THE EDITOR

Needs Information

I have a wide band oscilloscope, Model 555, manufactured by the *General Electronics Equipment Company*. I wrote a letter to the company requesting information on the scope, but the letter was returned marked "unclaimed." I would appreciate it if you could help me locate the manufacturer of this scope.

ROSS MENSIK JR.
Chicago, Illinois

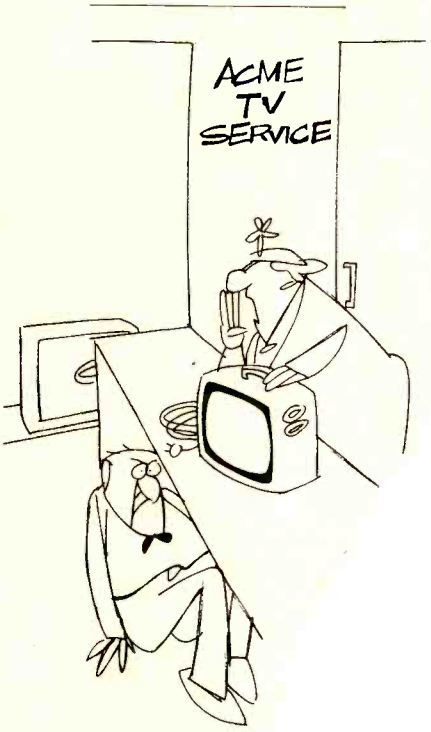
180X Manual

I recently purchased a Hickok Signal Generator Model 180X and would like to get the instruction manual for it. I tried Hickok and was told that the manual was discontinued. Will you please publish my letter, maybe one of your readers can help.

LEONARD BRIENZA
Corona, New York

No Modifications in ET

Have there been any articles in ELECTRONIC TECHNICIAN on converting a tube tester to measure



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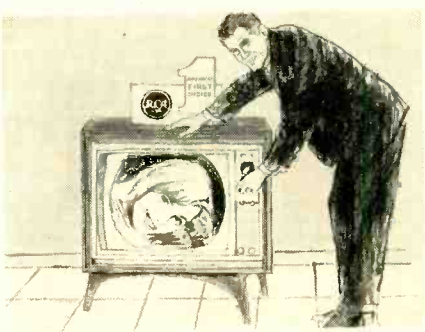

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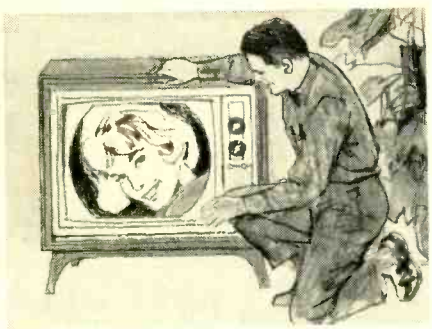

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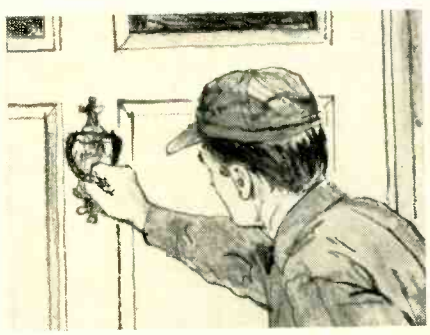

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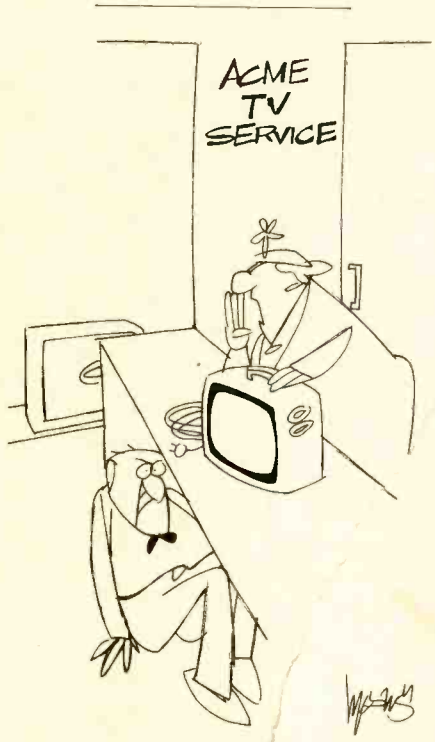

"Yoo Hoo, I'm back again, it still doesn't work right!"

QUESTION: When it comes to electrolytic capacitors, why do more than half of the nation's Radio-TV Service Technicians prefer to do business with Sprague Distributors?

ANSWER: Because they don't want makeshift substitutions or multi-rating "fits-all" capacitors. They insist on exact replacements, which are always available through Sprague Distributors everywhere.

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We don't have to tell you that it's easier to service with *exact* replacements. And we don't have to tell you that it's better, too. When sets are designed, specific capacitance values are used for peak operation, so it takes *exact* replacements to restore original set performance.

And who better than Sprague knows which values and sizes are needed in the replacement market? Sprague, the world's largest component manufacturer, has the most complete specification file on original set requirements. That's why you're always right when you service with Sprague TWIST-LOK *exact* replacements!

GET YOUR COPY of Sprague's comprehensive Electrolytic Capacitor Replacement Manual K-106 from your Sprague Distributor, or write Sprague Products Company, 65 Marshall Street, North Adams, Massachusetts.

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THE MARK OF RELIABILITY

WORLD'S LARGEST MANUFACTURER OF CAPACITORS

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LETTERS TO THE EDITOR

gas in a CRT? I have a combination unit now but it does not check for gas.

M. MELLARD
Niagara Falls, New York

● *We do not publish construction and modification articles where comparable equipment is available on the market. In most cases, it is impractical. We suggest you shop around for a unit that will do a reliable and professional job.—Ed.*

Alarm for Alarm Makers

I would like to know how to get into the burglar alarm systems business. Could you please let me know who I can contact about buying these units and installing them?

I have countless customers who would like to have them installed in their homes and offices.

Any help you can give me on this would be appreciated.

SAUL SCHERR
White Plains, New York

● *We do not have a complete and up-dated list of manufacturers in this field. We will forward information from manufacturers who wish to contact Mr. Scherr, however.—Ed.*

COMING EVENTS

June 8-11: Systems Engineering Conference & Exposition, Coliseum, N.Y.

June 16-18: 40th Annual Convention, EIA, Edgewater Beach Hotel, Chicago, Ill.

June 17-21: 1964 ERA Conference, Concord Hotel, Kiamesha, N.Y.

June 23-25: Int'l Conference on Precision Electromagnetic Measurements, NBS Boulder Labs, Boulder, Colo.

June 24-26: 5th Joint Automatic Control Conference, Stanford University, Stanford, Calif.

July 19-23: Music Industry Trade Show & Convention, Palmer House, Chicago, Ill.

August 17: 6th Annual Pre-Wescon Panel Discussion, Statler Hilton, Los Angeles, Calif.

August 21-23: National Convention, ARRL, Hilton Hotel, N.Y.

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Tips for Technicians

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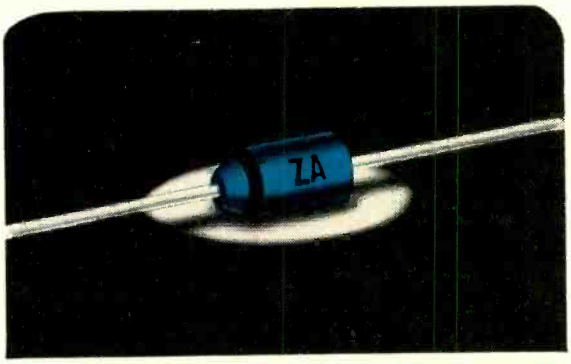
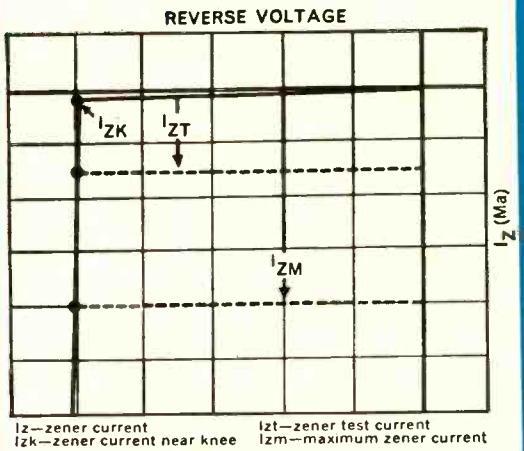
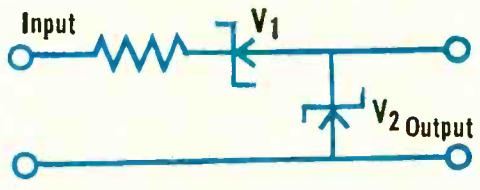
New Kind of Zener Diode







Typical shunt overvoltage protection circuit using zener diodes. Output is controlled between V_1 and V_2.

A zener diode, as you're probably aware, is a special kind of semiconductor which has excellent voltage regulating characteristics. It's the solid-state successor to the gas discharge tube. It acts like a rectifier diode, blocking current in the reverse direction, until the "zener voltage" is reached—then it starts to conduct with a capital C. The zener diode can carry appreciable current continuously. So this makes it a fine regulating device. You can use it in power supplies where you need highly accurate output. Or you can use it in clipper or clamper circuits, by biasing the diode negative.

The big news in zener diodes is that you can now get them from Mallory at a price which makes them practical for service work, experimentation, or commercial circuitry. The news-maker is the new Mallory Type ZA molded-case diode. Its electrical properties and reliability record are comparable to those of military grade units. In fact, we use the same silicon cell in the ZA as in the zener diodes we make for military requirements. But the price is only about *half* that of hermetically sealed diodes.

The ZA is rated 1 watt at 25°C. If you install it in a hot spot, you can use it at ambients up to 100°C, derating linearly to 0.5 watt. Voltage ratings go from 6.8 to 200 volts, in small increments so that you can get exactly the regulating voltage you need. Standard tolerances are 20%, 10% and 5%.

You'll like the cold-case design of the ZA. No need for insulating sleeves when you squeeze it into tight layouts. It's so small—only 3/8" long by 0.220" in diameter—that it fits practically anywhere.

Your Mallory distributor has the Type ZA in a range of ratings. He also stocks Mallory silicon rectifiers . . . including handy packaged doubler, bridge and center-tap circuits. See him soon!

- - - for more details circle 24 on post card

EDITORS' MEMO

Brown Tape

A recent market study made by Electronic Technician editors revealed some startling information—information that indicates some dealers devote little or no study to marketing principles and customer buying habits.

The study, in part, revealed that while 37.6% of ET readers sell tape recorders, only 15.6% of these same dealers sell either blank or prerecorded tape!

Just as everyone who owns a TV set is a potential customer for a new one, so is everyone who owns a tape recorder a potential customer for a new one. Audio fans, people who want to use recorders as study aids, people who want to have some party fun and those who just want to record baby's gurglings are all potential customers.

For the moment, let's concern ourselves with a very large segment of potential customers, those who already have a recorder but are ready to trade it on a new one. Their recorder may be only a few years old or it may be several years old. But one thing they know is that it doesn't sound like it used to and it doesn't sound as good as their neighbor's new one. (Of course, maybe all it needs is a new set of heads.)

During the time that these people have owned a tape recorder they have purchased several reels of tape. Some blank and perhaps some prerecorded.

But one thing is sure—if you don't sell tape—they didn't buy it from you. And if you're not their regular TV man, they may not know that you even sell recorders. Does it still make sense that you should sell tape recorders and not tape?

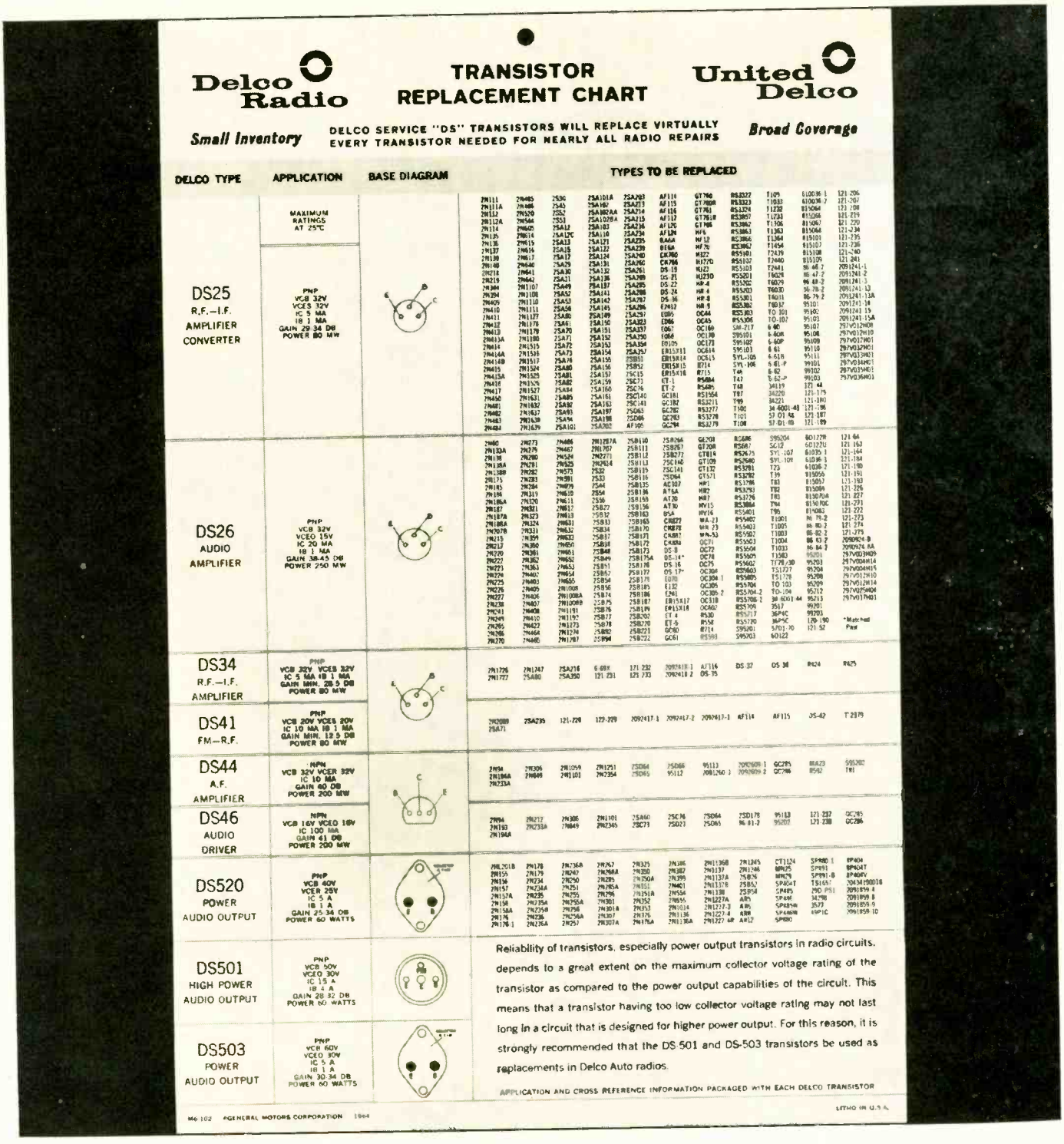
Let's take another viewpoint. Suppose you do have Mr. Prospective Recorder Buyer for a TV customer. But since he already has a tape recorder, and up to now has been satisfied with it, his only interest has been in tape. He knows you don't sell tape so why should he check to see if you sell recorders?

There are a lot of tricks to selling tape recorders—here's a couple to start you thinking:

Scan the newspaper section for new births. Send a mailer which congratulates the new parents along with a certificate for a certain percentage or dollars off on any tape recorder you have to record the new baby's voice for posterity.

Or you may want to include a small reel of tape as a sample (which they may keep and use if they already own a tape recorder or which they may bring in for you to record "baby", and keep as your gift.) Think about it. It's a big market.

Vin Bell



FREE

This is United Delco's new transistor replacement wall chart. □ It lists hundreds of transistors that Delco's compact line will replace (as you can see, that pretty well wraps up the field). It also features specifications for many other applications. It's easy to read (11″ x 17″), and it's yours for the asking. □ Just let us know you want one.

Delco Radio automotive radio service parts are distributed nationally through **United Delco**

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TARZIAN RADIO-TV TIPS

How to calculate required resistance in silicon-for-selenium rectifier replacement

■ Will silicon rectifiers used as replacements for selenium rectifiers fail in predominantly capacitative circuits? Not if you pay strict attention to the peak current limits of the replacement units, as specified by the manufacturer.

Why may silicon replacements fail?

Failure is caused by excessive inrush currents during the first few cycles after turn-on. Silicon rectifiers have extremely low impedence in the conduction region at voltages above 1.5 volts. In addition, the capacitor "looks" like a short circuit until it is charged. This combination allows extremely high currents to flow from low impedence sources such as household mains. Being small, the rectifier has so little thermal mass that failure is instantaneous.

Watch your resistance

Sarkes Tarzian F Series rectifiers are widely used in replacement applications. They carry a surge current rating of 30 amperes. With a 120 volt line, the maximum instantaneous voltage that can be impressed is 1.4 times 120, or 168 volts. You should add to the circuit a minimum surge limiting resistance of $\frac{168}{30}$, or 5.6 ohms. This will apply to doubler or half wave circuits.

For practical purposes, we can ignore the impedence of an F unit with 168 volts impressed during the conduction cycle.

Transformer sets require no additional resistance. Enough impedence is inherent in the secondary to provide limiting action. Figures 1, 2, and 3 show typical circuits and recommendations. Out best advice to you: *depend on Tarzian silicon rectifiers for dependable performance.*

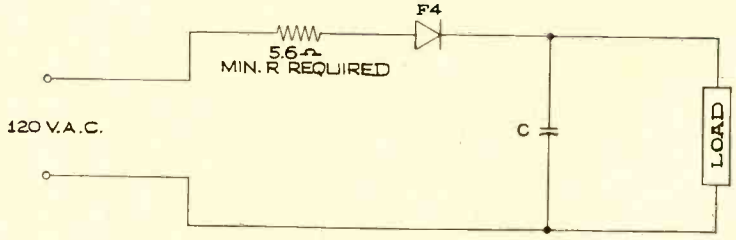

Fig. 1 Rectifier replacement—no transformer

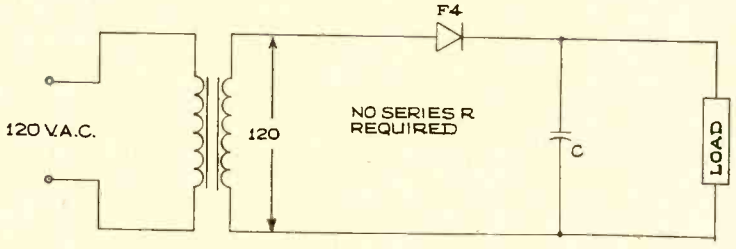

Fig. 2 Rectifier replacement—with transformer

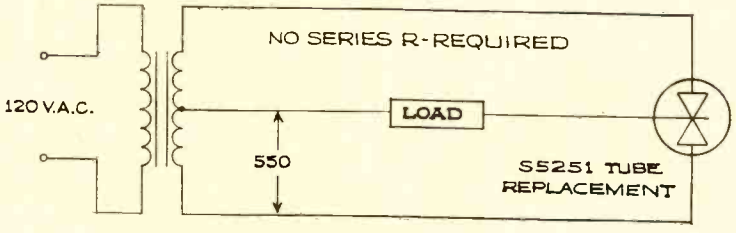

Fig. 3 Tube replacement

The Tarzian Replacement Line includes silicon rectifiers and conversion kits, tube replacement silicon rectifiers, and "condensed stack" selenium rectifiers. Immediately available from distributors throughout the nation, in the quantities and ratings you want most.

FREE...The new 48-page Tarzian Silicon Rectifier Handbook is crammed with interesting technical information and product specifications. For your free copy, ask for Handbook 63-SI-6.

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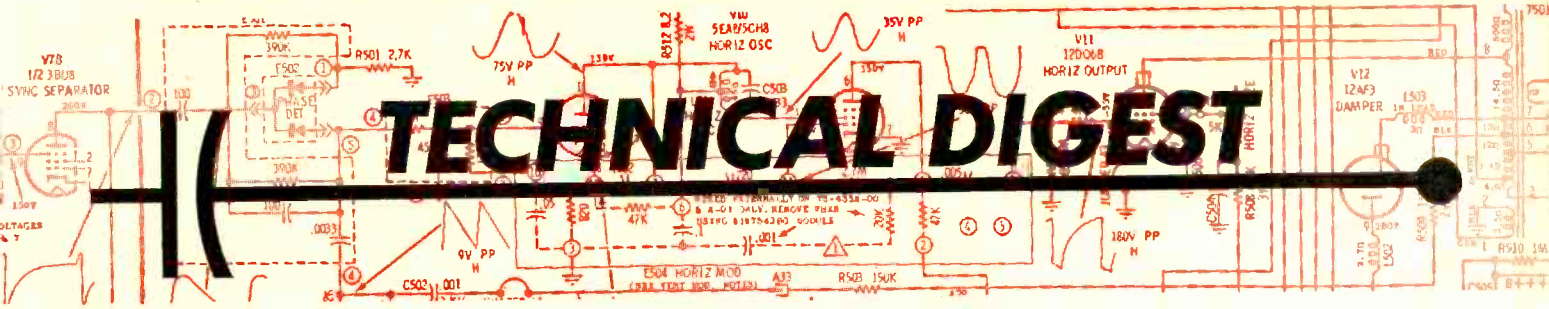


ADMIRAL

TV Chassis Stamped Run 11, C21A1-1A, -1E and C21A10-1C — AGC Control Adjustment

The AGC control is an AGC threshold control which is used solely to adjust the receiver for optimum operation under all signal conditions. Note: This control is set at the factory and will not normally require field readjustment. Improper AGC control adjustment can result in picture bending, tearing (overloading) or buzz in the sound. However, these same conditions can also be caused by other troubles in the set.

If adjustment is required, it should be made exactly as instructed.

1. Turn set on and allow 15 minutes to warm up.
2. Turn channel selector to strongest station in the area.
3. Turn contrast and brightness controls fully to the right.
4. Very slowly turn AGC control to the left, just to the point where picture is weak (loses contrast).
5. Adjust horizontal lock (at rear of set) and vertical hold control (at side of set) for steady picture, without bending of vertical lines at top of picture.
6. Very slowly turn AGC control to the right, until picture just begins to bend, shift, or buzz is heard in sound. Then very slowly turn the AGC control to the left, to the point at which picture bending, tearing, shifting and buzz is removed.
7. Make final adjustment by turning AGC control an approximate additional 10 deg to the left.
8. Recheck at maximum contrast on all channels. Picture should not overload and should reappear immediately after changing channels.

IMPORTANT: AGC adjustment should always be made on the strongest TV station received. If adjustment is made only on a weak station, AGC overload may occur when a strong TV station is tuned in.

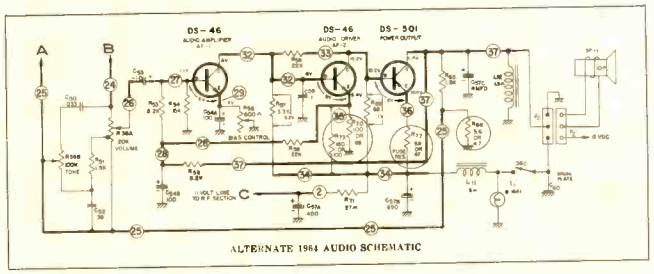
DELCO

Auto Radio, Chevrolet 985876, Buick 980655A, Oldsmobile 982249, Pontiac 984077 — Alternate 1964 Audio Circuit Pushbutton Radios

Some of the 1964 radios, using transistor DS-501 output, will have alternate resistor values in the audio circuit. Four resistors are affected. When replacing any of these parts, such as the fuse resistor, always use the same value that came out of the radio. This will prevent the stability of the direct coupled circuit from being disturbed. The four items are circled in the schematic and listed in the chart.

CHART OF PARTS AFFECTED

ILLUS. NO.	VALUE LISTED ON ORIGINAL SCHEMATIC	ALTERNATE VALUE
R66	5.6 ohms, 1/2 watt	4.7 ohms, 1/2 watt
R70	100 ohms, 1 watt	68 ohms, 1 watt
R72	.68 ohms, fuse resistor	.47 ohms, fuse resistor
R73	180 ohms, 1 watt	100 ohms, 2 watt



ALTERNATE 1964 AUDIO SCHEMATIC

GENERAL ELECTRIC

All TV Sets — Deflection Yoke Tests

When you are faced with a service problem which appears to be caused by a yoke failure, check the yoke before condemning it. A little extra checking will frequently save you the time and expense of replacement. The most obvious test is to check for correct winding resistance. Usually, individual resistances will be shown in the service notes. Any wide deviation from the published values should be investigated, although shorted turns can rarely be determined in this manner. Of course, the most common type of yoke failure is found in the horizontal portion. The symptoms may be loss of brightness, horizontal keystoning, or complete loss of high voltage. In yokes using series connected coils, an open circuit may occur because of wire breakage at any of the terminal lugs. This is easily determined by a resistance check or visual inspection. If the lead is broken short, it should be spliced before attempting to resolder to the lug. You should also check for internal shorts between horizontal and vertical windings, although in some cases the breakdown occurs only under high pulse voltages. Failure of the small capacitor located across one section of the horizontal winding is frequently mistaken for a shorted winding,

TECHNICAL DIGEST

since it also causes loss of brightness and keystoning. In some cases the capacitor will also exhibit a burned spot. Be sure to replace only with the exact part specified in the service manual. These capacitors are critical in value, usually having about a 2KV rating and an N2200 temperature coefficient. Parallel connected windings may become broken at the lugs, thus opening one or both coils. Again, a resistance check will determine this problem and the repair is simple. Vertical windings rarely cause problems. When a vertical problem does exist, the windings should be checked for resistance and damage at the lugs. In saddle wound yokes, resistors of about 1000Ω are located across the coils preventing an open coil from showing as a complete open circuit.

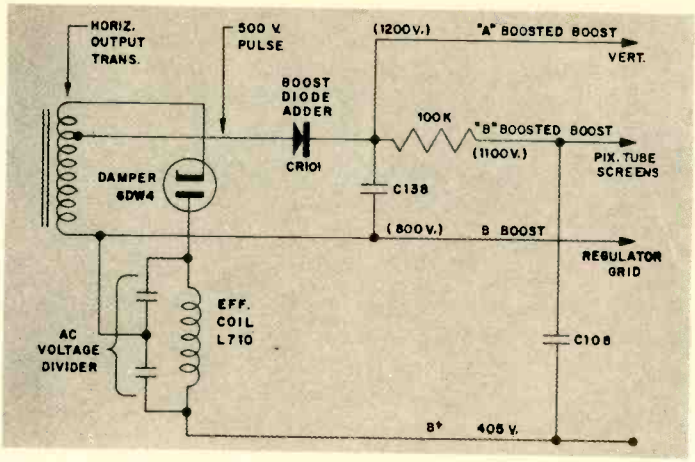
When you are handling or repairing any yoke you should always observe the following precautions:

1. Do not change the dress of windings or permit any leads to cross over others.
2. Handle yokes with care to prevent movement or misplacement of turns when passing over the tube base and neck.
3. Be sure that leads to the yoke are kept away from tubes, hot resistors, or any points likely to induce corona from the yoke leads.

RCA

Color TV Chassis CTC15—'Boosted' Boost

An adder circuit has been incorporated in the CTC15 to supply the higher voltages for the screens of the picture tube. This higher voltage is required to accomplish the smaller spot size feature. The 500 v pulse produced by the collapsing field of the horizontal output transformer during flyback time is applied to CR101, the "boost diode adder," and is effectively added to the normal B-boost of 800 v. The higher "boosted" boost voltage of 1,200 v is utilized as a source voltage for the vertical oscillator. A voltage divider is used to derive the 1,100 v which is applied to the CRT screens.

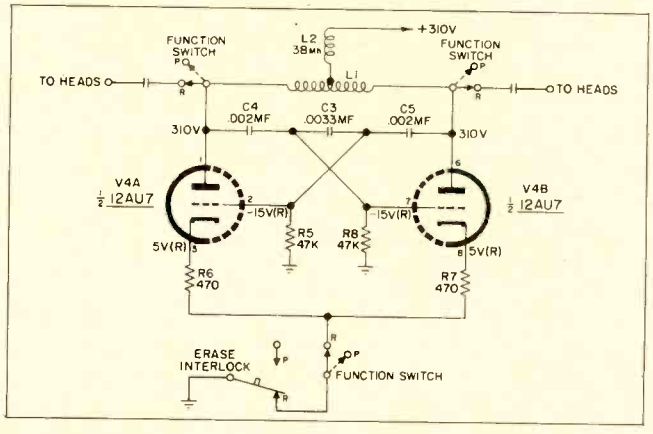


RCA 'boosted' boost circuit.

WESTINGHOUSE

Tape Recorders H22RS, H24RS — Bias-Erase Oscillator

These units use a push-pull balanced, plate-coupled multivibrator with a parallel-resonant output circuit to generate erase- and record-bias voltages.



Westinghouse tape recorder bias-erase oscillator schematic showing erase-interlock and function switch.

As shown in the simplified schematic, the tank circuit is composed of C3, C4, C5 and L1. The frequency is approximately 60 kc. The oscillator's cathode circuit is connected to ground through two switches in series: the RECORD-PLAY function switch and the ERASE-INTERLOCK switch. The ERASE-INTERLOCK switch prevents accidental erasure of tape.

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MIGHTY MITE!

New Burn-out, stick proof meter!

Only 7 Lbs. . . Smaller Than A Portable Typewriter

NEW TC 130

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Checks them all . . . including Novars, Compactrons, Nuvistors, 10 pin tubes — plus Picture Tubes!

NEW

Lower voltage checks for Nuvistors and all new frame grid tubes, as demanded by tube manufacturers, but not found on other tube checkers.

NEW

Speedy indexed set-up cards to reduce "look-up" time. No more cumbersome booklets, or incomplete charts.

NEW

Simplified panel layout reduces set-up time — prevents set-up errors.

NEW

Streamline styling with rounded corners and rubber feet, prevents marring Furniture — presents that "Professional look".

Here's the famous MIGHTY MITE, America's fastest selling tube checker, with an all-new look and many new exclusive features. MIGHTY MITE III brings you even greater portability, versatility and operating simplicity beyond comparison. Controls are set as fast and simply as A-B-C right from the speedy set-up cards in the cover. The new functional cover can be quickly removed and placed in a spot with more light for faster reading of the set-up data or "cradled" in the specially designed handle as a space saver as shown above. New unique design also prevents cover from shutting on fingers or cutting of line cords as in older models.

In a nut shell . . . the MIGHTY MITE III is so very popular because it checks for control grid contamination and gas just like the earlier "eye tube" gas checkers (100 megohm sensitivity) and then with a flick of a switch, checks the tube for inter-element shorts and cathode emission at full operating levels. Sencore calls this *"the stethoscope approach"* . . . as each element is checked individually to be sure that the tube is operating like new. User after user has helped coin the phrase *"this checker won't lie to me"*. Most claim that it will outperform large mutual conductance testers costing hundreds of dollars more and is a real winner in finding those "tough dogs" in critical circuits such as color TV and FM stereo.

See Your Parts Distributor--And See The Mighty Mite III For Yourself!

SENCORE **426 SOUTH WESTGATE DRIVE ADDISON, ILLINOIS**

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MORE CONVENIENT AND
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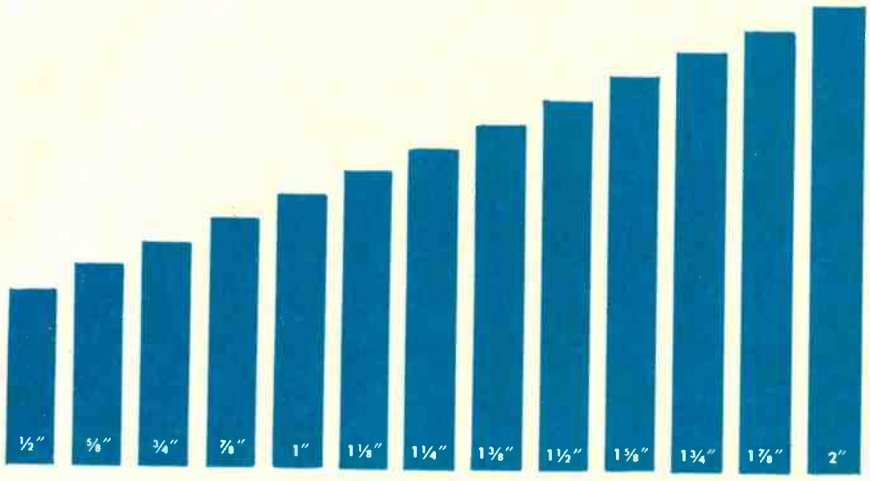

with exact length shafts

Need a control with a flat shaft—or split knurled—or screwdriver slot?

Maybe you need it with—or without—an attached line switch.

But two things are sure: You need a certain *exact* shaft length—and your Centralab distributor can supply it!

Centralab's new exact length solid shafts provide exact replacements for ALL your single control requirements, as well as twins for stereo, triples, and quads.

If you have the FRK-100 Fastatch II Kit, you can add these exact length shafts as you need them; they snap right into place on the Fastatch II front controls. Or, you can always get the exact control you need, instantly, from your Fastatch II distributor.

For a complete catalog on the Fastatch II Control System, write to Centralab or contact your distributor.

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ELECTRONIC TECHNICIAN

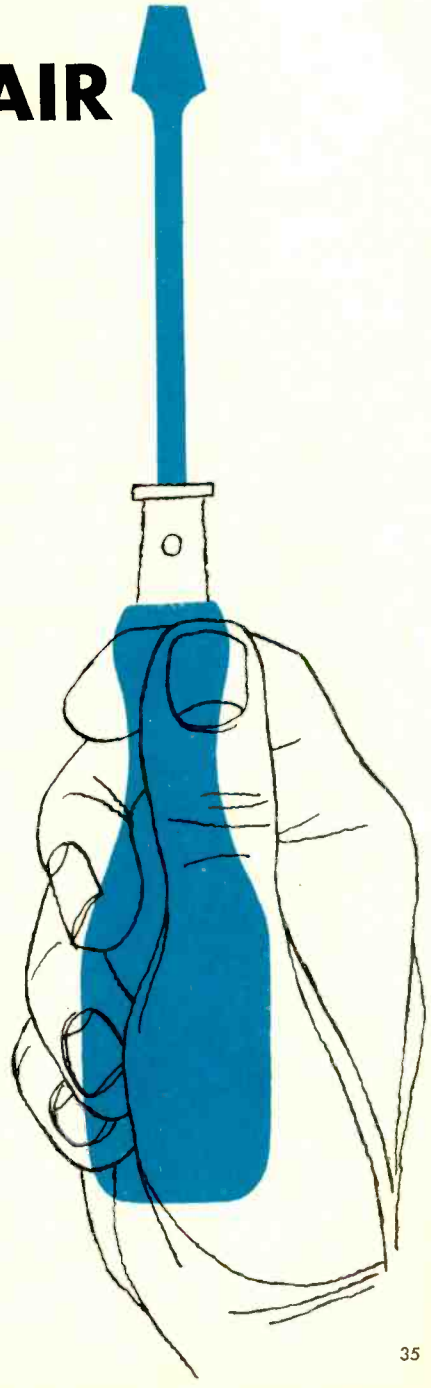
JUNE 1964

TOOLS AND TECHNIQUES FOR AUTO RADIO REPAIR

Get your share of this expanding service and repair business

PART I

by Jack Brayton



■ Hundreds of TV shops are losing business because they aren't tooled up for auto radios and have not taken the trouble to study service techniques involved. Some shops turn away or discourage car radio repairs. Others accept the radios but can't give the fast, efficient service that car radio owners want. Either way, customers are lost. But a little study and investment of a few dollars in the proper tools can prepare any shop for efficient car radio repairs.

The fear of having to remove and reinstall auto radios is, without a doubt, the biggest reason why technicians turn down car radio work. Yet, there is no valid reason for this fear. The job isn't difficult and you don't need to spend a lot of time removing and reinstalling car radios. Only three "ifs" stand in the way of getting the job done quickly:

1. *If* you don't have the proper tools.
2. *If* you have so many tools you can't find the proper one immediately.
3. *If* you have to run back to the shop six or seven times to get more tools.

If you eliminate these three "ifs" you can easily remove and reinstall any car radio—with the exception of a Cadillac—in 20 minutes. Doug Smith, United Radio, Lansing, Michigan, *averages* 6 minutes out, 6 minutes back in, by the clock!

Tools

Tools needed in the car are divided into two groups:

1. For removal and reinstallation
2. For service work

Both groups should be placed in a small tube caddy, or other convenient case, with car radio tubes and fuses. This arrangement will eliminate time lost running back and forth looking for tools.

The rear mounting nuts of a car radio are either 7/16 or ⅜ in. Both

TABLE I
Tool Kit Check List

- Open end wrenches sizes 7/16 and 3/8 in.
- 5 Deep sockets sizes 3/4, 11/16, 5/8, 9/16, and 1/2 in.
- 1 Ratchet handle for sockets
- 1 12 in. extension for ratchet handle
- 5 Nut drivers sizes 3/16 (used only on the bench for removing transistors) 1/4, 5/16, 11/32, 3/8 in.
- 1 Large stubby Phillips screwdriver
- 1 Small stubby Phillips screwdriver
- 1 Stubby clutch-head screwdriver
- 1 Stubby flat blade screwdriver
- 2 Stubby nut drivers sizes 5/16 and 3/8 in.
- 1 Set of small hex wrenches
- 1 Pliers
- 1 Soldering gun with extension cord
- 1 Solder
- 1 Plastic tape
- 1 Diagonal cutters
- 1 Long nose pliers
- 2 Clip leads
- 1 Pocket knife or wire strippers
- 1 Flashlight
- 1 Tube puller
- 1 Special tester

TABLE II
Parts For Special Tester

- 1 7 pin tube socket
- 1 9 pin tube socket
- 1 Octal tube socket
- 1 Pilot lamp socket (Any bayonet type)
- 3 Pin jacks (Perferably different colors)
- 1 39Ω, 1 watt resistor
- 1 #47 lamp
- 2 Alligator clips
- 2 Pin plugs
- 1 Pair coiled leads
- 1 Nine volt battery
- 1 Battery clip (type 5D)
- 1 Metal box 4 x 2¼ x 2¼ in.

sizes are on the same wrench so only one open end wrench is needed. Five sizes of front mounting nuts are used. Open end wrenches can't be used on the front because they scratch the dash, are too slow, and often the nuts are counter sunk. Deep sockets with a ratchet handle are used here. The five socket sizes are: ¾, 11/16, ⅝, 9/16 and ½ in.—the latter being rarely used. Also needed is a 12 in. extension for the ratchet. This is used only on the Lincoln. The top nut on the rear of the radio can only be removed after taking the top of the dash (4 screws, all outside) off and using the extension from the top.

A set of nut drivers is needed to remove speaker and panel nuts. A large and a small stubby Phillips, a stubby clutch-head, a stubby flat blade, two stubby 5/16 and ⅜ in. nut drivers, a set of small hex wrenches (to remove knob set screws) and pliers. This completes removal and reinstallation kit tools. A check-list for tools is shown in Table I.

Service tools which should be carried to *every* car radio repair job are soldering gun with extension cord, solder, plastic tape, side-cutters, long nose pliers, at least two clip leads for jumping broken wires, switches, etc., knife or wire stripper, flashlight, and a tube puller.

In addition you will need an instrument to check continuity of leads, switches, filaments and speakers. Also, you must be able to check for voltage. Usually these checks are made with a simple filament checker and a VOM.

Since a VOM can take a beating in this type of work, it may be better to construct the tester shown in Fig. 1. It's rarely necessary to actually measure the 6 or 12-v supply, only a method of indicating the presence or absence of voltage is required. This makes it easy to combine all checking facilities into one compact and inexpensive instrument. It will cost less than $5 if you buy all the parts new but most of the parts can be found around your shop. The wiring is simple and is done according to the schematic shown in Fig. 2. Parts list is shown in Table II.

Using the tester is easy. To check for continuity, plug the leads into the common and continuity jacks. When a short exists between the leads, the lamp will light.

To check a tube filament, simply insert the tube into the proper socket. If the lamp lights, the tube's filament is good. If it doesn't, the filament is open.

To check for voltage, plug the leads into the common and the voltage jack. When 6 v exists across the leads, the light will be dim. The light will be bright when 12 v is present.

Bench Set-Up

The bench set-up must also be correct if the repair time is to be kept to a minimum. A typical bench set-up is shown in Fig. 3. It's compact, efficient, and impresses the customer. This set-up speeds servicing because no time is lost looking for parts, schematics or

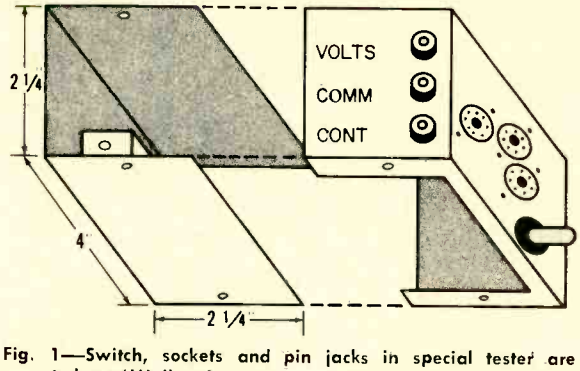


Fig. 1—Switch, sockets and pin jacks in special tester are mounted on 'Minibox.'

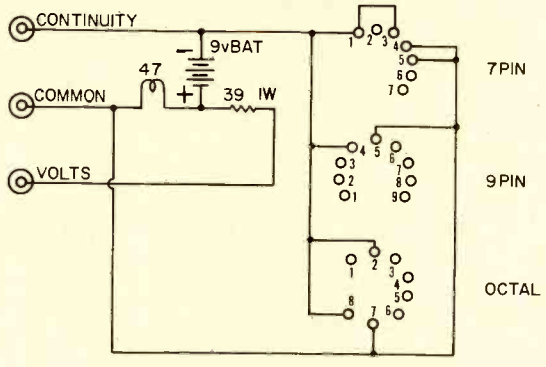


Fig. 2—Wiring schematic for special tester.

test equipment. Everything is within easy reach. Yet it is inexpensive and doesn't require a lot of space.

If you do even a modest amount of car radio work a separate bench will more than pay for itself.

The first requirement of an efficient bench set-up is a 6- and 12-v power supply. This, believe it or not, is where many shops fall down. A battery eliminator does not eliminate the battery. They're OK for checking every circuit *except the automatic tuning*. They do not have sufficient current to pull in the solenoid used on auto radios. *Sometimes* by turning the voltage wide open the solenoid will pull in but then you don't know if it would work properly in the car. Also, if you turn the voltage way up, after the solenoid pulls in the set may be hit with twice it's rated voltage or more!

The only way to get around the problem is to use car batteries. You don't have to run out and buy new ones, just ask your gas station or garage to save the next 6- and 12-v battery he takes out. A battery that won't supply the high current needed to start a car will supply 1 to 10 amp to a car radio. Also you'll be charging the battery most of the time so it doesn't matter how good they are.

If you have a battery eliminator that's designed to run a transistor radio (good filtering) you can use it to charge the batteries. Hook it up as shown in Fig. 4. With this circuit, the battery that's being used is also being charged.

If your battery eliminator doesn't have good filtering and causes hum in the radio then use the circuit shown in Fig. 5. This circuit charges the battery that *isn't* being used. An inexpensive trickle charger could be connected in place of the battery eliminator with this hook-up.

In both circuits the fuse should be a 10 amp slow-blow type and both the volt meter and the ampere meter should be 0-15 amp/v. SW1 should be at least 10 amp. The cheapest switch with this rating is a knife type. Coiled clip leads hung *under* the shelf above your bench is a convenient way to bring the power out, and a central position is usually best.

Since we've taken care of the power supply, the next need is for a test speaker. The speaker can be any 3.2 Ω type. Don't use an old one with a rip in the cone—customers aren't impressed with distorted sound. Mount the speaker in a baffle and hang it *properly* above or below your bench. Don't use up bench space uselessly by laying it on the bench. Also it can get poked full of holes this way. Coiled leads hung *under* the shelf above your bench are also convenient for the speaker.

A standard antenna is needed, not a piece of wire. The antenna can be located anywhere as long as the coax lead and the connector are convenient.

Service manuals, with schematics, are an essential tool for servicing auto radios. These are available from the manufacturer.

Test Equipment

You will need all of the usual test equipment: VTVM, tube tester and a signal generator which is rarely used but badly needed when it is.

There are two pieces of equipment which a lot of shops overlook: a good signal tracer and a scope. Sets that turn out to be "dogs" become routine when a scope and signal tracer is at hand. It's best if you have both, but *one or the other is an absolute must*. The scope does not have to be a wide band, sensitive, high-gain instrument. You need only to see the signal and trace it from stage to stage.

Bench Hand Tools

These are the same as those used in the car. If you do a lot of auto radio repair it pays to have two sets. If you don't, then keep all of the hand tools in the top tray of the auto repair caddy and simply put the tray on the bench when working there and in the caddy before going to the car.

This may sound like a lot of work and expense, but it isn't. Having the right tool for a job pays and keeps on paying long after you've taken it for granted.

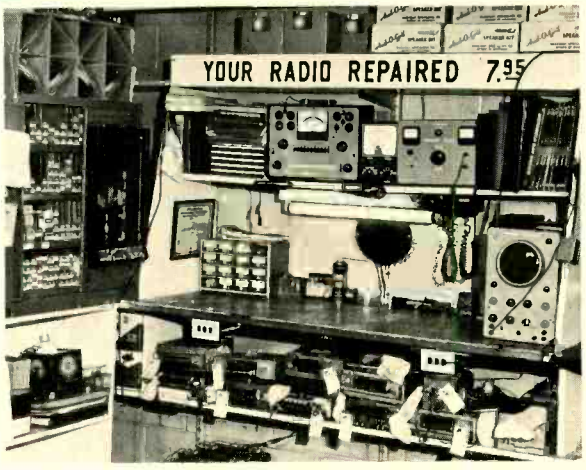


Fig. 3—Test and repair bench for auto radios is organized for maximum efficiency.

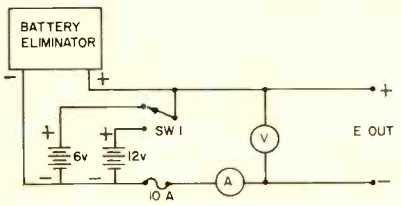


Fig. 4—Hookup of transistor-type battery eliminator used to trickle-charge auto radio batteries at test and repair bench.

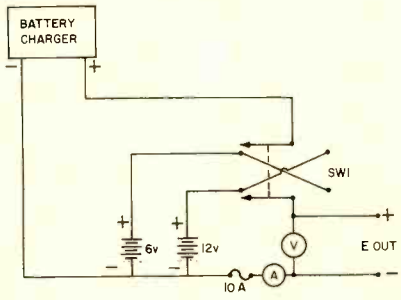


Fig. 5—Hookup for regular battery eliminator supply or trickle charger. The battery not in use is always on charge.

Reach For Your VTVM

Check those leaky and open capacitors fast with an ac meter

by George Phillips and David Van Thinger

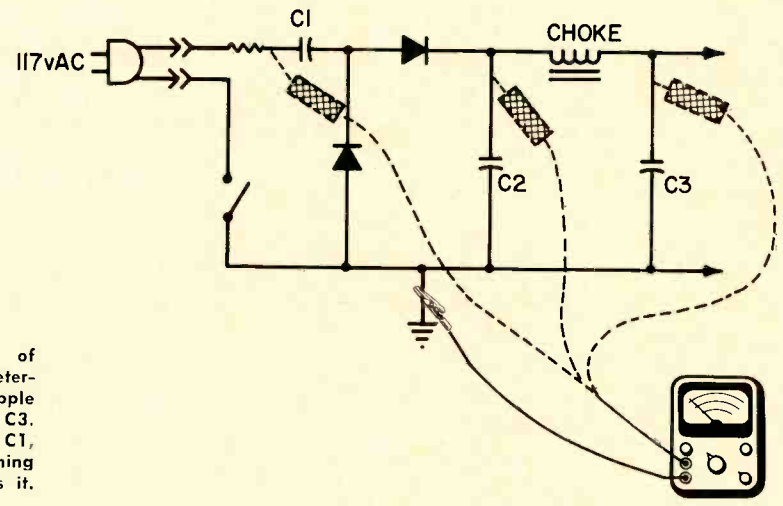


Fig. 1—The condition of filter capacitors is determined by measuring ripple voltage across C2 and C3. The ac line input filter, C1, is checked by determining the voltage drop across it.

■ How many times have you been caught with your oscilloscope down? The answer is probably 'plenty' if you've been a technician for long. But don't give up just because your scope isn't handy. Your VTVM will fill the breach, save the day and cut your capacitor troubleshooting time in half or even less.

To check an open or leaking filter we could use the scope. With the probes attached to the capacitor we could study the waveform on the screen and compare the P-P ripple value with manufacturers specifications—if shown on the schematic. We could also bridge the suspected capacitor with another of the same value and if this shows favorable results, we're OK. But, under the circumstances, let's switch to the VTVM and see if we can't speed things up a bit.

Practical Approach

First, switch your VTVM to the 150 vac range and work down progressively to the 10 vac range, or at least in that general area. The black lead naturally goes to ground or B— and the red ac probe is moved from one positive capacitor terminal to another in succession.

The ac voltage must be low on a normally operated filter. The first filter in a pi network (C2 Fig. 1) will usually show not more than 10 v—ranging from about 3 to 10 v RMS. Ripple across the second filter in the network will usually be less than 1 v RMS—decreasing with the third filter, if one is used. If you find more than 1 v on the second filter and the picture and sound controls are set normal, then the odds are good that you have a defective capacitor.

As in any other measuring technique, practice makes perfect, and with a little training you will find that a voltage fluctuation, or a slight deviation from that normally expected, will lead you quickly to the faulty component. To quickly double-check you can now unsolder, or snip out the suspected capacitor leads, substitute a known-to-be-good unit and check results.

The same procedure can be used

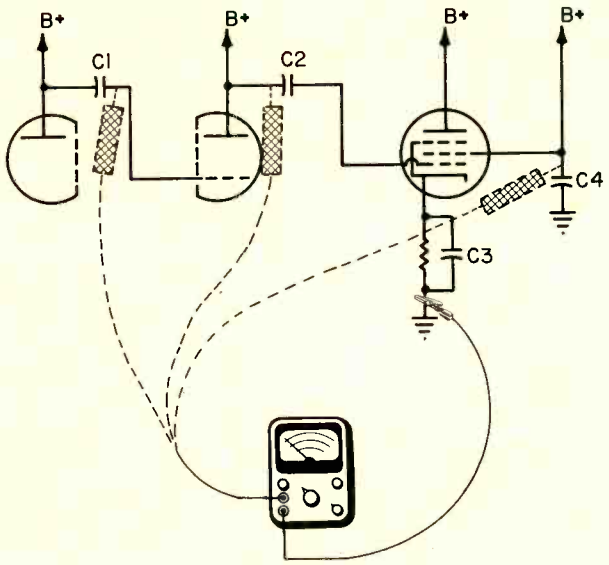


Fig. 2—Coupling and by-pass capacitors are checked with ac VTVM.

to check paper by-pass capacitors. A defective horizontal output tube screen or cathode bypass capacitor, for example, is a common cause of no picture, or narrow picture. A quick check with a VTVM ac probe will show if a capacitor is open (C3, C4 Fig. 2). The same one-volt ac technique applies here. If the voltage exceeds this amount, a new capacitor should be shunted across the suspected unit. Remember, we are talking about ac voltage here. This technique can be employed to check almost all bypass capacitors down to the smallest value—limited only by the frequency response of your VTVM and probe.

Coupling Capacitor Checks

Will this system work for coupling capacitors? It sure will. And let's go back to power supplies where a large value "doubler" or series-coupling electrolytic is used in the ac line input to the power supply (C1, Fig. 1). The negative lead of this capacitor is usually connected to the ac power line and the positive side goes to the silicon or selenium rectifiers. If you have a dead power supply and suspect this capacitor is open, then you can use your VTVM as follows:

Select a high voltage scale between 120 and 200 v RMS. The same amount of voltage should appear on both sides of this capacitor. If there is a voltage drop it should not normally exceed 10 percent. If you find 117 v on one side of the capacitor and very little or none on the other, the capacitor is obviously open.

Your VTVM can be used to check both sides of the coupling capacitor between horizontal and vertical oscillator and output tube circuits (C1, C2 Fig. 2). This check is especially useful in tracing sweep-voltage loss in both horizontal and vertical circuits. It will work on almost all circuits except those using single-tube combined multivibrator/output circuits. It works perfectly in blocking oscillators or other circuits with separate oscillator/amplifier tubes. You simply check the ac voltage on one side of the coupling capacitor connected to the plate circuit of the oscillator tube and the other side of the capacitor which feeds into the grid of the output tube. A voltage difference of 10 percent on either side can indicate a defective capacitor.

AGC Circuits

There are two points in AGC circuits where you can use your VTVM ac scale to advantage. One is on the AGC line itself. If the meter shows excessive fluctuation across the AGC line you may have a defective AGC bypass capacitor. If this capacitor is open or otherwise defective, it usually shows up as picture flash, vibration, bends and sporadic operation of the set in general.

The second point in AGC circuits where you can use your ac meter is to check for loss or insufficient AGC. A high ac voltage (from 150 to 500 v) exists on the plate of keyed or "gated" AGC tubes. The trouble can be traced back to the pulse source—generally originating in the horizontal output or flyback circuit. An open capacitor is frequently found.

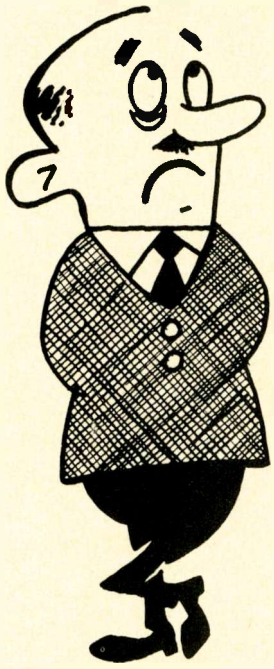
This method can be used to check out a lot of bypass and coupling capacitors in five minutes. And if you are simply trying to locate a single fault, if you know your meter and how to use it and you are thoroughly familiar with the circuit, you can pin-point the fault in less than a minute. ■

Select your customer wisely and increase your annual returns with an effective

PART I

DON'T GO BANKRUPT!

by J. Juola



■ Reams of printed advice have been purveyed to the general public on the subject of selecting a desirable TV-radio, Hi Fi technician. It naturally follows that a close look at the *other side* of the coin reveals the inevitable correlary: the problem of *selecting a desirable customer*. And if you extend credit, your problem is to prevent the wrong kind of customers from pushing you into bankruptcy!

It is well known that short-term and long-term credit has become a way of life. It is now a multi-billion dollar business. When properly handled, one or both methods of selling can increase your sales and your annual income. But this cannot be done successfully unless you establish an effective credit system.

Even before you begin, however, you must decide how much credit you can afford to extend. You will require adequate working capital to obtain maximum benefits from credit sales—especially installment credit sales. Handling your own financing will result in larger returns. But if you don't have sufficient capital you can still sell on installment credit by making arrangements to transfer your credit contracts to banks or to sales finance or finance companies. These companies get the interest on the credit loans but you can still maintain competitive benefits, increased sales and customer good will.

A Credit System

Many factors enter into the establishment of an effective credit

system. A system's "leniency" or "strictness," for example, will be conditioned by these factors. As a broad, general guide, the factors can be placed in two categories 1) those which relate to objective business conditions and 2) those relating to the individual customer.

In the first category, of course, must be placed changing local and national business conditions that may affect your credit policy. Is the Federal Government now encouraging or discouraging spending? Is the local government increasing property taxes? Are local bank rates restraining or relaxing credit conditions? Even more important, has local employment or wages increased—possibly increasing the amount of money in circulation and creating a more liberal public spending mood? Are other local service-dealers extending credit or tightening up on credit sales? Are your distributors more liberal or less liberal in their credit dealings with you? What is the extent and effectiveness of manufacturers' advertising of products you sell? These are only some of the objective factors involved.

Determining Credit Risks

In the second category we are concerned with basic factors that determine the degree of risk involved in an individual contract. The formula varies but the one generally used by merchants in classifying a credit risk includes the buyer's character, income and capital. These three factors are closely interrelated but *character* is rated the prime factor. The second important factor is *income* or ability of the customer to pay. Of least importance is *capital,* the goods and property which an individual possesses in excess of what he owes. Capital assumes increased importance only in the event the customer's income is cut off and when he must fall back on his assets to pay his debts.

The three aforementioned factors must always be considered in relation to each other in determining the degree of risk involved in an individual contract. This is true because *character,* for example, assumes less importance if the factor of *income* is deficient. Hence, willingness to pay a debt without sufficient income does not result in a low credit risk. On the other hand, some individuals with adequate income are slow in paying for various reasons and this also pushes the risk-rate higher. Likewise, if a person's job is not reasonably se-

TABLE I

Date _____

CREDIT APPLICATION QUESTIONNAIRE

1. Name _____ (Last) (First) (Middle)
2. Address _____ (Street) (City) (State)
3. Telephone Number _____ 4. Male _____ Female _____
5. Age _____ 6. Single _____ Married _____ Divorced _____
7. Name (Spouse) _____
8. Number and ages of children _____
9. Employment _____ (Company) (Address) (Position)
10. Employment (Spouse) _____ (Company) (Address) (Position)
11. Total income per month _____
12. Do you own your own home? _____ Do You rent? _____
13. Do you own a car? _____
14. With whom do you bank? _____
15. Have you ever received credit from (this store)? _____
16. List other local merchants with whom you have credit.

Name of Merchant	Address
1.	
2.	
3.	
4.	

17. What is your present debt?

Amount of Debt	Name of Merchant
1.	
2.	
3.	
4.	

I hereby affirm that my answers to the foregoing questions are true and correct and that I have not knowingly withheld any facts or circumstances that would, if disclosed, affect my application unfavorably. I understand that any misrepresentation or concealment of a material fact will be sufficient grounds for disapproval.

_____
Signature of Applicant

cure, the factor of *capital* assumes more-than-normal importance.

Credit System Mechanics

The fi st step in determining a credit risk is to obtain certain information concerning the prospective customer. The Credit Application Questionnaire (Table I) can be used for this purpose and is self-explanatory.

If you are a member of a credit bureau located in your community, you may be able to obtain reliable and helpful information regarding the prospective customer by making a telephone call to the organization.

If a completed questionnaire indicates that you are justified in extending credit to a customer, stipulate the date of payment, or in the case of installment payments, the amount of interest and the dates and amounts of each payment. A sample installment contract is shown in Table II. A written contract is unnecessary in some states, but in other states a written contract is essential to make the sale binding by law. ■

TABLE II

INSTALLMENT CREDIT CONTRACT

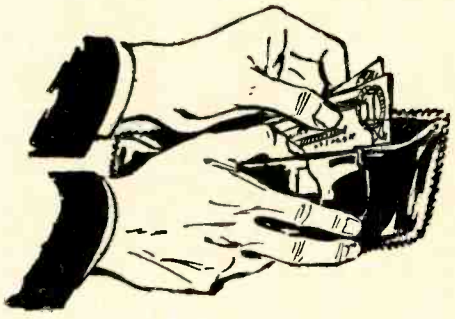
I, _____ (Name), _____ (Address)

hereby promise to make payments to (John's TV Service, 10 Main St., Anycity, Anystate) of the debt created the _____ day of _____, 19__ in the amount of $_____ together with interest thereon at the simple rate of _____% per annum, totaling $_____, beginning the _____ day of _____, 19__ and continuing each _____ day of _____ consecutive months. Each monthly payment will be $_____.

Date _____ Signature _____

Signature _____

John's TV Service
10 Main Street
Anycity, Anystate



Fast Paying Trick on Small Charges

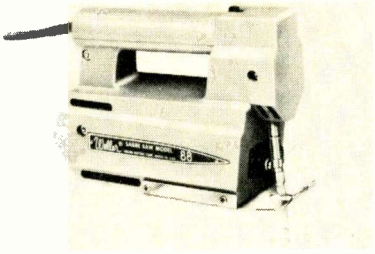
■ Occasionally, a customer you know well needs a fuse or a small tube and comes in without his billfold. If you run a credit system, the small cost of the item is not worth the time consumed in the normal routine of opening a credit account. Also, the time-consuming formal procedure may alienate a good customer.

If you don't run a credit store, again you stand the chance of losing a good customer. Although technically a "charge" transaction, here's a simple way around this dilemma—a method that almost guarantees a fast pay-off and builds a lot of good will. Here's an example.

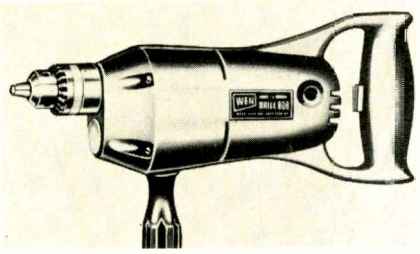
Mr. Good Customer enters your shop to buy a $1.75 tube. When he reaches for his wallet, however, he discovers that he left it at home. He wants to know if you'll trust him til tomorrow. Either explain that your business has no credit system or that the procedure for opening an account is quite involved but that you do have a solution. Pull a couple of dollars out of your own pocket and give it to him as a loan. Mr. Good Customer then pays you for the tube and you give him the change. Explain that he owes you, not the business, and that the accounting system would be fouled up any other way or that your accountant might "kill" you.

Mr. Good Customer will consider your act a great personal favor and will go out of his way to return the money as quickly as he can.

One retailer even gives his employees two or three dollars each to handle such cases in his absence. Try it. It works wonders! ■

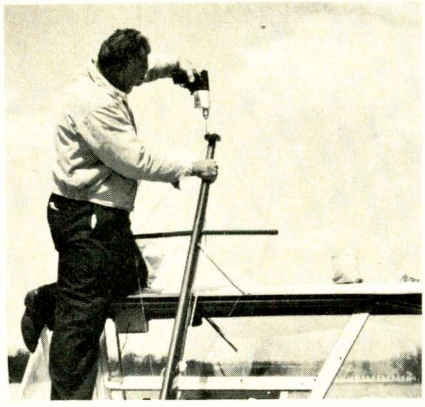


Weller's Sabre Saw.



Regular two-speed drill made by Wen.

SAVE TIME WITH POWER TOOLS



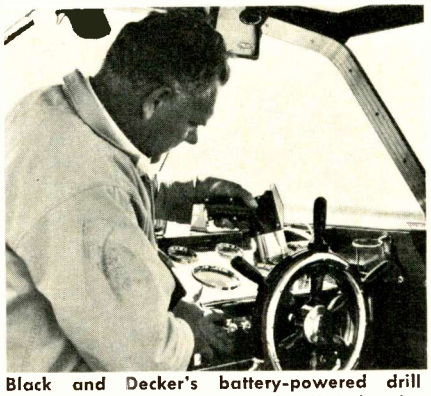
Drilling the mast of a boat for an antenna with a battery-powered drill. It is strongly urged that this type shoe not be worn on boats if you ever want to do more work for the owner.

Battery-powered drill comes in handy for antenna installations.

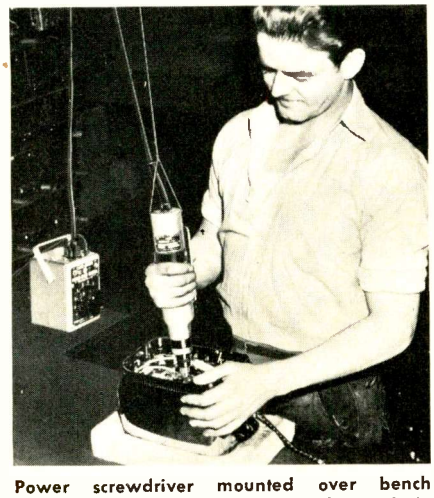
■ New power tools, and some of the old standbys as well, deserve technicians' attention. It is no longer practical for electronic technicians to operate with only nut drivers, a pair of long-nose pliers and a soldering iron or gun.

Most technicians have a standard drill on hand to remove rivets and mount new parts but few have given any thought to owning a power screwdriver for the shop or one of the battery-powered drills for outside work. Not only does battery-operated equipment save time and trouble in hookup, but it has many safety features as well. Indeed, many technicians engaged in marine work will use nothing else. And antenna installers not only find them electrically safer and time saving but particularly easy to climb with on roofs and ladders since there is no cord to trip over or become entangled in their feet.

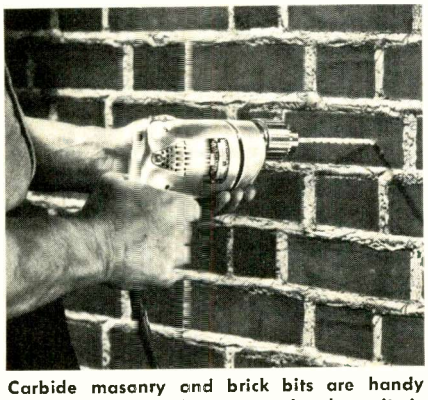
Sound system installers too have found some special tools which are time savers. But rather than list the obvious, let's use the space to show some pictures. You'll probably get some ideas we haven't even thought of yet! ■



Black and Decker's battery-powered drill being used aboard boat to drill holes for new instrument installation.



Power screwdriver mounted over bench speeds assembly and disassembly work in many TV-radio, Hi Fi shops.



Carbide masonry and brick bits are handy for antenna installations and where it is necessary to mount fixtures or outlets on brick or cement surfaces.

Sound system installers find this drill made by Black & Decker particularly valuable where cables must be run through joists.

A story about spooks, snivets and the 'Hausens' — Diode, Spark and Bark

VERTICAL LINES

PART II

Joseph A. Hayes

■ "Darn it Scoot," Bob said to his Saturday helper, "vertical lines are almost always caused by trouble somewhere in the horizontal output circuit so that's the most logical place to begin looking. Vertical lines from the flyback or yoke, 'snivets,' barkhausen oscillations and drive lines are all symptoms of horizontal output or damper stage trouble."

Bob had just finished lecturing Scoot after he had spent most of Saturday looking for vertical line trouble in an oscillator stage. Bob was now reviewing his lecture.

"Remember, snivets are almost always found on the right side of the raster. They are always dark vertical lines—usually a little ragged on the right side. You may see one or a half-dozen. Also, you'll normally find that the snivets are more pronounced with a blank raster than with a picture.

"A new horizontal output tube generally clears up snivets but make sure you try more than one before you give up. A tube that causes snivets in one set may be perfectly normal in another. If a new tube fails to give you better results, try putting an adjustable ion trap around the horizontal output tube. Position the ion trap on the tube for minimum interference and then adjust it like you would on the neck of a CRT. Some manufacturers say the ion trap may shorten the life of the tube though.

"Any questions so far?"

"No. It all sounds so easy when you go over it that I feel like a fool when I'm up against one of these dogs."

Yoke Trouble

"Now," Bob resumed, "vertical lines from the yoke or flyback transformer are not so simple to spot. The best thing to do is classify the problems separately. Let's start with the yoke first. Get that pencil and take this down; it'll help you remember."

Scoot was moody and quiet because of Bob's attitude. Bob was not really angry, though, in fact he actually got a kick out of playacting. And Scoot knew that Bob's inevitable Saturday lectures included not only a lot of fundamental information he already knew, but they were loaded with so much down-to-earth information that wasn't getting into the technical books. So he listened.

"Unlike the snivet lines, the yoke-caused lines are lighter than the raster background. The lines are usually most intense at the left side of the raster and get weaker toward the right side. If you inspect the vertical lines, you'll also find that the raster line is kinked where the raster line and the vertical lines cross.

The focus may be poor near the vertical lines and the lines are usually more intense at the top and bottom of the screen than they are at the center. As another check, you'll find that the lines can be moved around a bit if the ion trap or horizontal drive is changed slightly."

"Bob, I've seen cases where you tried to get rid of the same thing you've just described and even with a new yoke you couldn't clear all of it up."

"That's true in some of the older sets, Scoot. Most of the time, it can still be blamed on the yoke, though. But since no TV set is perfect, we can't be expected to

make them work perfect when they come in for repair. In most cases, all we can do is put them in about the same condition they were in when they came off the assembly line.' OK?"

Bob didn't wait for an answer but went on.

"Sometimes the lines on the left side of the raster appear just after a yoke has been replaced. When this is the case, the cause is usually the matching network in the yoke or an incorrect replacement. Check the replacement yoke to be sure it is correct and check the matching components inside the yoke to be sure they are correct.

"Any changes you make in the yoke network should be done with care. Use only close-tolerance capacitors and be sure they can take about 3 kv—5 kv just to be safe."

"If you aren't sure of what value to use in the anti-ringing network, get that old transmitter air capacitor I keep with the test equipment and hook it across the horizontal yoke winding. Make sure you only touch the knob because you can get quite a jolt from it. Adjust the capacitor for straight raster lines. When the lines are straight, measure the capacitance and put in a good replacement near that value.

"If you have trouble getting straight raster lines, try different values of series resistors with the capacitors. Wire in both units when you've found the proper values."

"I'll be darned," Scoot beamed, "I've always wondered how you could figure out the proper values for those components. What about the variable capacitor range?"

"The one I use is about 35 to 180 pf—that's normally plenty of range. It's off an old transmitter but you can pick them up at most distributors with the proper value. The only thing you have to be careful of is their voltage breakdown. Of course the dielectric is actually air, so you won't hurt the capacitor but you could damage the flyback."

Flyback Trouble

Bob got his breath and continued with the briefing.

"Some technicians have trouble telling the difference between ringing caused by the flyback and ringing caused by the yoke."

"Well, how *do* you tell the difference?" Scoot asked. "I remember last week you were able to tell the difference just by looking at the raster."

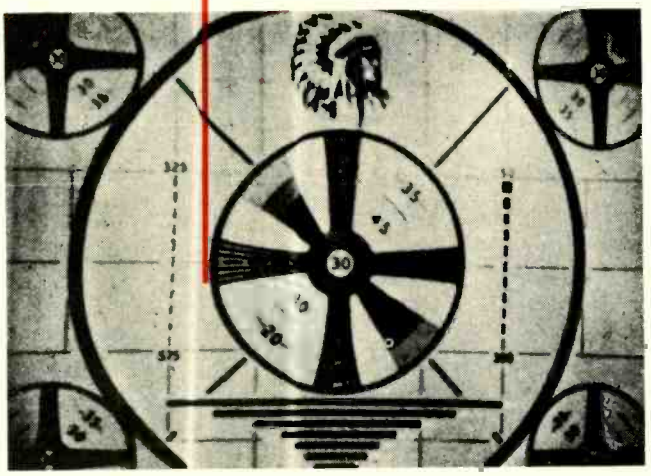
"That's right. You remember when I pointed out some of the details found in yoke-caused vertical lines. I mentioned that the intensity of the lines were usually greater at the top and bottom of the line than they were in the middle. This is the main difference between the two."

"You must also keep in mind when troubleshooting these circuits, either the yoke or the flyback may promote ringing caused by some other element—especially flyback ringing. Any number of things may be at fault, though the most frequent offenders are the width or linearity coil or a capacitor which has been inserted across some of the flyback windings to increase the width. Always check the adjustment on these components before you begin troubleshooting, too. If I know you, you'd be half the day before you decided to adjust the set."

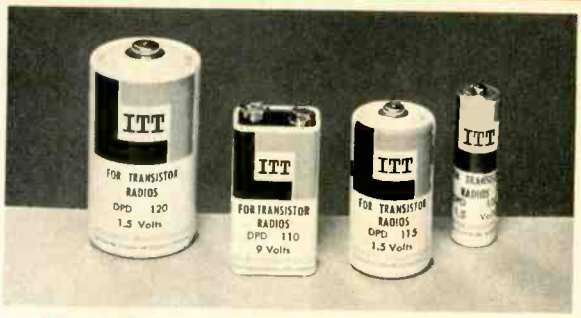
"All right, all right! You don't have to rub it in. Did you ever stop to think that maybe I'm just not a born 'champion' troubleshooter like you? And that reminds me. Do you remember that set you were working on—oh, maybe a month ago? The one that had horizontal linearity trouble? As I recall, you ended up replacing the flyback; but I remember you were measuring the line voltage and all kinds of strange things before you diagnosed it. What about that?"

OK Scoot. I'll explain that later. It's time to close-up shop now,—I'll see you next Saturday bright and early." ■

Lines caused by yoke trouble have a greater intensity at the top and bottom of the picture. Note that the raster lines are bent where white line crosses them. This is peculiar to yoke troubles.



Flyback ringing may be confused with yoke ringing if careful attention is not paid to the intensity and kink in the yoke-caused line. Do not confuse the fold which may take place in the flyback line with the kink in yoke-caused trouble.



Typical batteries used in transistor radios.

This display case includes a battery tester.

Batteries can mean a substantial portion of your profit picture; this low-cost, fast-moving stock takes up little space and builds store traffic

SELLING

■ According to a research report, portable radios were turned on more hours in the U. S. last year than plug-in sets, almost half of all homes had a portable radio and it was operating an average of nine hours per week.

This accounts for the fact that the ten most popular transistor batteries make up 90 percent of today's battery sales.

Few electronics items are as well suited to mass-merchandising as batteries. Batteries are bought on impulse, which means people buy them when they see them displayed and are reminded of their need for them

Virtually every shopper is a potential battery buyer. He buys batteries several times each year. When and where he buys them depends a good deal upon the battery point-of-purchase display he sees; which must (1) catch his eye, (2) stop him, (3) sell him.

Since the electronics industry has a well grounded stake in the battery business, and since the business is booming, dealers will do well to know something about the self-service shopper, and the self-service battery displays available from manufacturers.

Displays

Displays can make as much of an impression as the product itself. Though customers may not buy today, they may remember the display and return to the store when they need batteries.

Because they buy in large quantities, the manufacturer may offer his display free—or at substantially reduced prices.

Some displays can be put near windows so they're seen from the street. Window shoppers may see the display inside the store, be reminded of their battery need and come in to stock up.

In the same manner, window banners attract the casual shopper. Some manufacturers pack window banners along with their battery display packages.

Some battery displays have built in testers. The idea that both old and new batteries can be tested at the point-of-purchase has established some businesses as neighborhood headquarters for all battery supplies.

TV-Radio service dealers should evaluate blister-pack batteries. These appear attractive to the customer, are simple to display, practically eliminate pilferage, and actually help sell the customer. Though all popular types are not available in blister-pack, such packaging does offer distinct advantages.

Blister-pack batteries are also easily and attractively displayed by hanging them on simple pegboard setups.

Good merchandising is simply good showmanship. It's your silent salesman—the one that doesn't cost you anything.

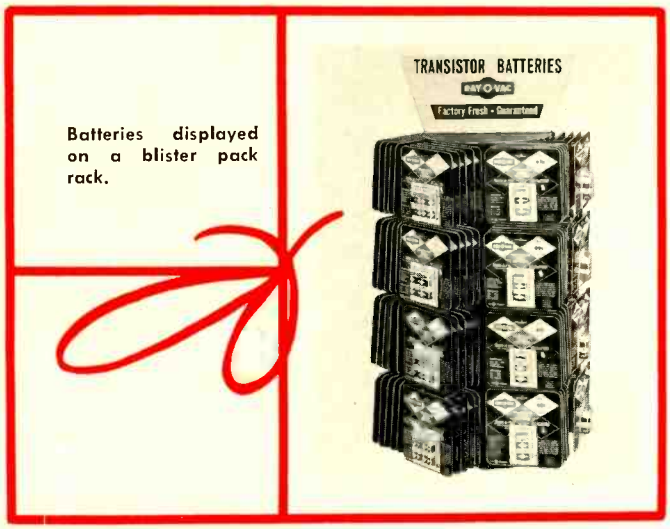
Merchandising History

The history of battery merchandising is the history of batteries. As the demand for them grew, virtually every channel of trade took note—and wanted in on a share of the profit.

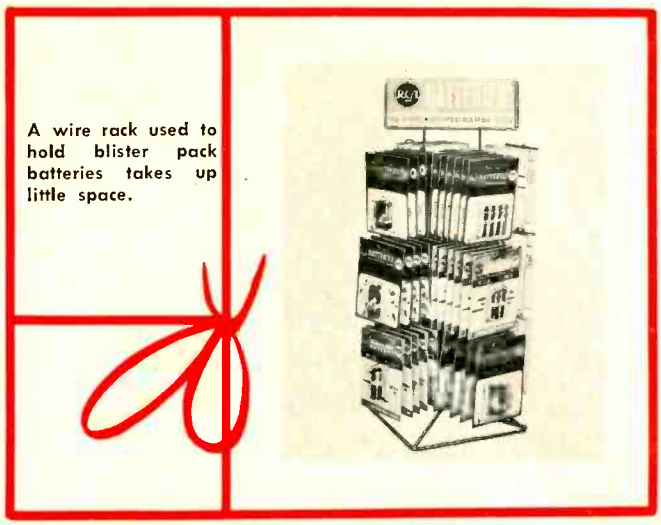
Portable equipment, in the beginning, was powered by standard flashlight batteries. There were several reasons for this: they were a ready source; they were inexpensive; people were familiar with the flashlight loading principal; they were sold in virtually every channel of distribution.

The thing that was unsatisfactory about first merchandising of batteries was that it was too easy for dealers to put them under shelves, or in back rooms, and wait for people to come in and ask for them.

Good advice to the electronic representative interested in increasing his sales of batteries is to familiarize himself with the basic types of dry batteries, their characteristics, and common applications.



Batteries displayed on a blister pack rack.



A wire rack used to hold blister pack batteries takes up little space.

PACKAGED POWER

Battery Types

Carbon-zinc—Best remembered as the common flashlight battery, the carbon-zinc cell is comparatively low priced. It performs with a gradually falling discharge curve. It should be stored in cool locations (even a refrigerator), and used intermittently, as in a flashlight, rather than with a steady drain. Watch the temperature if you display batteries in a window where the sun might damage them.

Alkaline Manganese—These batteries perform well in high and low temperatures. They have a gradually falling discharge curve, good shelf life, and may give up to 100 percent more energy than carbon-zinc batteries. They perform well under heavy duty, high drain conditions, and are commonly sold to power movie cameras, photoflash equipment, emergency lights and appliances requiring high current capacity and continued use. They are more expensive than carbon-zinc batteries, but last longer when current demands are great. Because of their higher cost, they may be less economical than carbon-zinc batteries for use in flashlights, portable radios or similar low drain applications.

Mercury batteries—Mercury batteries have a relatively flat discharge curve and long shelf life. They may be used when high capacity is required from a battery taking up a minimum of space.

They perform well on intermittent or continuous use. They require no recuperation period. Because they are a compact power supply, they are frequently used in transistorized equipment like radios, walkie-talkies and hearing aids.

Silver oxide—These batteries discharge with a flat discharge curve. They perform better than mercury batteries under low temperature conditions. They are used in small hearing aids and watches. They may be button-like cells made to be used with equipment for which they are specifically designed.

Rechargeable batteries—Two types of rechargeable batteries are currently in use—alkaline and nickel-cadmium.

The nickel-cadmium battery performs well under a wide range of conditions. This type of battery may be included as a built-in part of a tool or appliance, or it may be bought as a separate power pack. It is more costly but will withstand more abuse.

Stock

Service dealers should inventory at least some alkaline and mercury types and know when and how to sell them to their customers. This will enable the dealer to earn a higher profit and uphold the reputation for "service." In this direction one manufacturer is helping the dealer get the story over to his customers by making available close to half a million pocket folders which, in layman's terms, explains the difference between basic battery systems.

Although alkaline types are higher priced, they offer another advantage to service dealers. Now with three or four types, he can fill a wide range of battery needs—lighting, photographic, electronic applications, as well as transistor radios; while being assured longer shelf life.

Today's modern TV-Radio service dealer should take advantage of the continued growth of the battery market. With proper store identification, a minimum of modern merchandising, and some sensible inventory investment, he can profitably carry a name-brand line of batteries. On all three counts, his electronic distributor's salesmen can be his first and probably best source of knowledge and assistance. ■

Information and photo credit: Burgess, ITT, Mallory, RCA, Ray-O-Vac, Union Carbide.

Use the proper iron and soldering techniques to eliminate losses from repeat jobs

SOLDERING--PROFIT OR

Last month we discussed solder alloys and fluxes. But the best solder and solder flux made can't guarantee a good connection unless you take additional steps. We can outline these steps as three basic rules of procedure.

CONSIDER THE WORK

Be sure the work is *clean* before attempting to solder. And it isn't necessary to "scrape" the work to clean it. If the surface is covered with wax or grease, clean it with an ordinary cotton swab dipped in an Acetone solution.

If you are connecting a transformer or coil lead that has a varnish insulation on the bare wire, you can remove the varnish with a small ball of cotton dipped in Acetone.

If it is necessary to solder a ground wire to a painted chassis, the paint can be removed with fine steel wool dipped in paint thinner or Acetone. Be careful to wipe the area clean, however, and be sure it is free of tiny steel-wool particles that may cause trouble. Never use dry steel wool or emery cloth to clean a lug or other terminal—there's too much

CONSIDER THE IRON

Be sure to use the proper iron for the work you are doing. To activate the flux, melt the solder and do a good solder job, the soldering iron must provide sufficient heat to raise the temperature of the metals being joined. Soldering irons are available in many types. Straight irons range from the 20-w miniature to the heavy duty 550-w giant.

The weight of a soldering iron is not important—the temperature range of the tip is. When working on delicate, miniature type circuits, many of the lighweight irons are more than adequate to do all the required soldering operations.

When soldering directly to a heavy chassis, it is best to use a larger surfaced tip in a higher temperature range soldering iron. The soldering iron is merely a heat transfer device: to supply the work piece with sufficient heat to melt the solder. Hence, make sure the soldering tip is not too small or too large.

The straight iron—operating directly from an ac line, or through a transformer—is considered best for continuous shop or bench work by some technicians. Soldering guns—available in heat ranges from less than 100 to 325 w—are ideal for outside

CONSIDER SOLDERING TECHNIQUES

Be sure you are using the proper tools and materials correctly. In simple terms, the soldering operation is the application of heat to the surfaces being joined, and the application of solder in its proper alloy and gage. As previously stressed, only 60/40 alloy solder should be used for radio and TV work. The soldering operation is easy when the proper iron is used. Just follow these simple steps:

1. Be sure the work is clean and free of wax or grease.
2. Use the proper size tip for the work you are doing.
3. Apply the tip to the work, leaving sufficient room to apply solder directly to the joint. *Never apply the cored solder wire to the soldering tip—only to the work* (see Fig. 2).

LOSS?

PART II Conclusion

by Melvin Zalkin

Multicore Sales Corp.

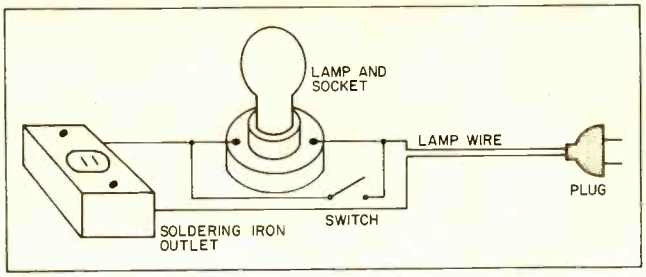


Fig. 1—A 'manual' thermostat can bring your straight bench iron up to working temperature within a few seconds by closing the switch shunting the lamp. Switch is left open when iron is not in use.

danger of trouble being caused by particles dropping into chassis components. Carefully clean away all dirt or film you can see. The rosin flux in modern cored solders will remove and retard the oxide you can't see so the molten solder can flow freely into the joint during the soldering operation. Make certain that the wires or members to be joined remain in tight, stable contact with each other during the soldering process. Movement or vibration of the members will generally result in a poor solder joint.

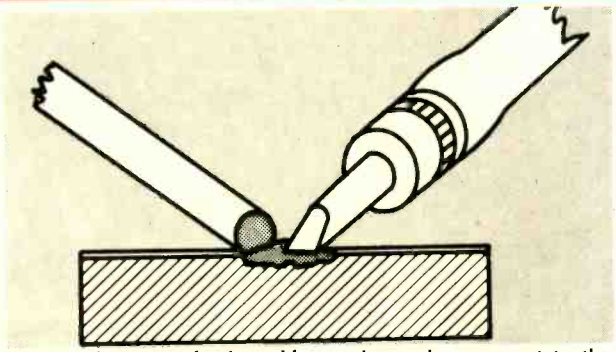


Fig. 2—Always apply the solder to the work area—not to the iron tip.

service or intermittent bench work. The straight iron should be thermostatically controlled to aid in keeping it clean, properly tinned, and maintain the correct temperature.

A low cost shop constructed "manual" thermostat can be easily made with a cleat socket, low wattage lamp, switch, some wire and a plug (see Fig. 1). The lamp socket is wired in series with the soldering iron supply voltage and the switch is wired into the circuit to bypass the lamp when necessary. With the lamp in the circuit, the iron is kept at a proper warming temperature until ready for use. When ready to solder, the switch is closed, cutting the lamp out of the circuit and bringing the iron to its operating temperature in seconds.

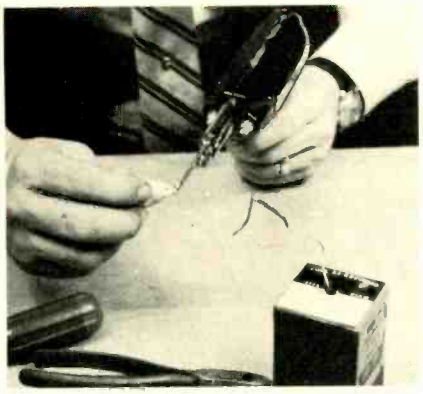


Fig. 3—The iron tip should always be clean and properly tinned so it can transfer the maximum heat to the work. Use a piece of toweling, canvass or other waste cloth to wipe the tip clean before soldering.

4. Never keep an excess amount of solder on the soldering tip—only enough to keep it tinned. Above all—keep the tip clean (see Fig. 3).

5. Pre-tin wires and leads. Stranded leads should be twisted together before tinning.

6. Use a soldering aid instead of your fingers; it avoids accidents and helps you get into tight places (see Fig. 4). ■

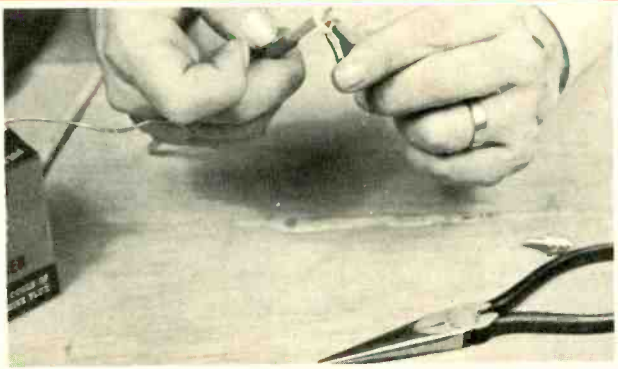


Fig. 4—Soldering aids are useful for many operations. This one is being used to remove insulation from a shielded cable.

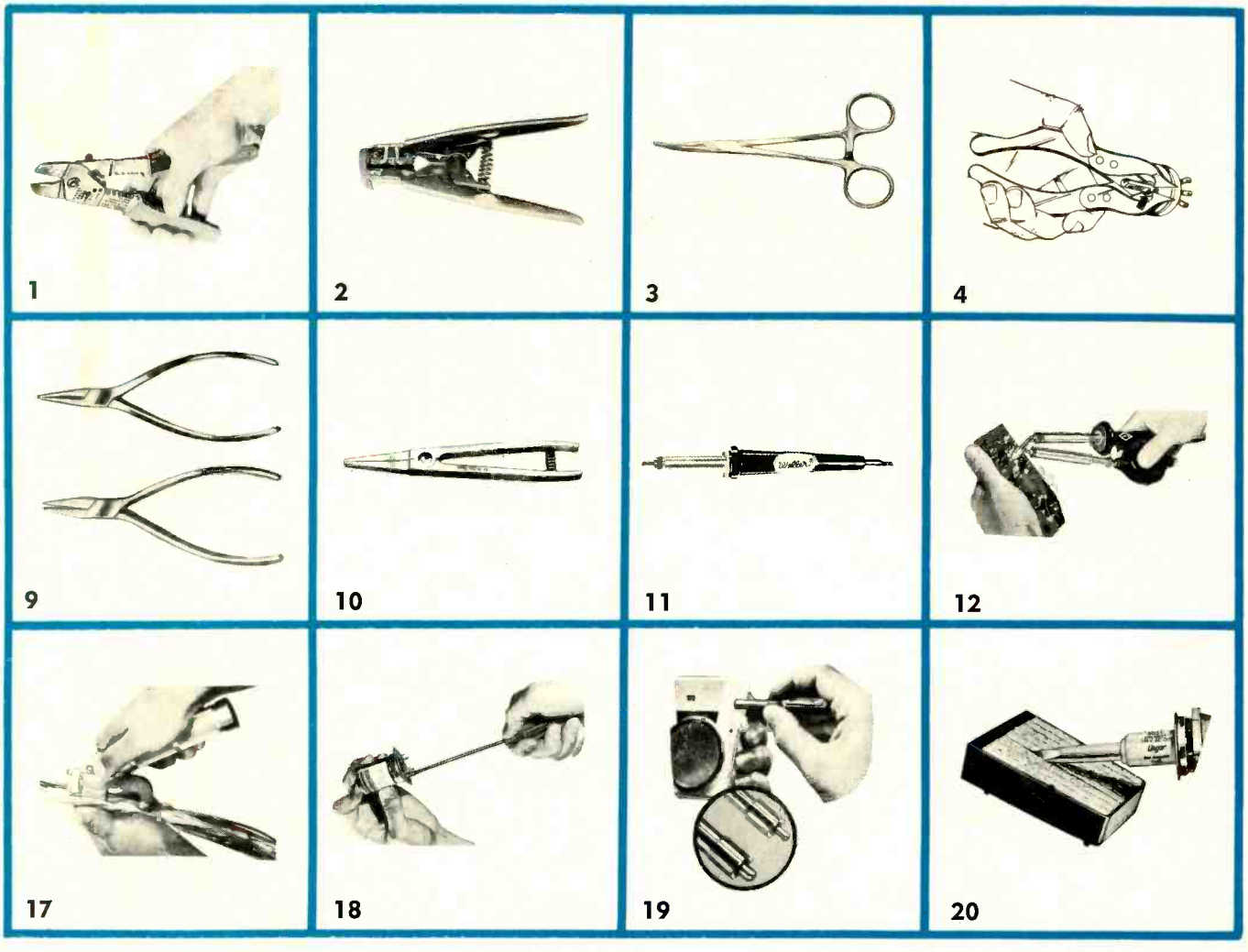
TOOLS FOR

Update your 'bread and butter' equipment and do the job better and faster

■ Man's progress through history is marked by milestones made in the shape of tools. And when the proper tool has been applied to the task for which it was designed, the job has been finished easier, faster and with increased returns in money or time.

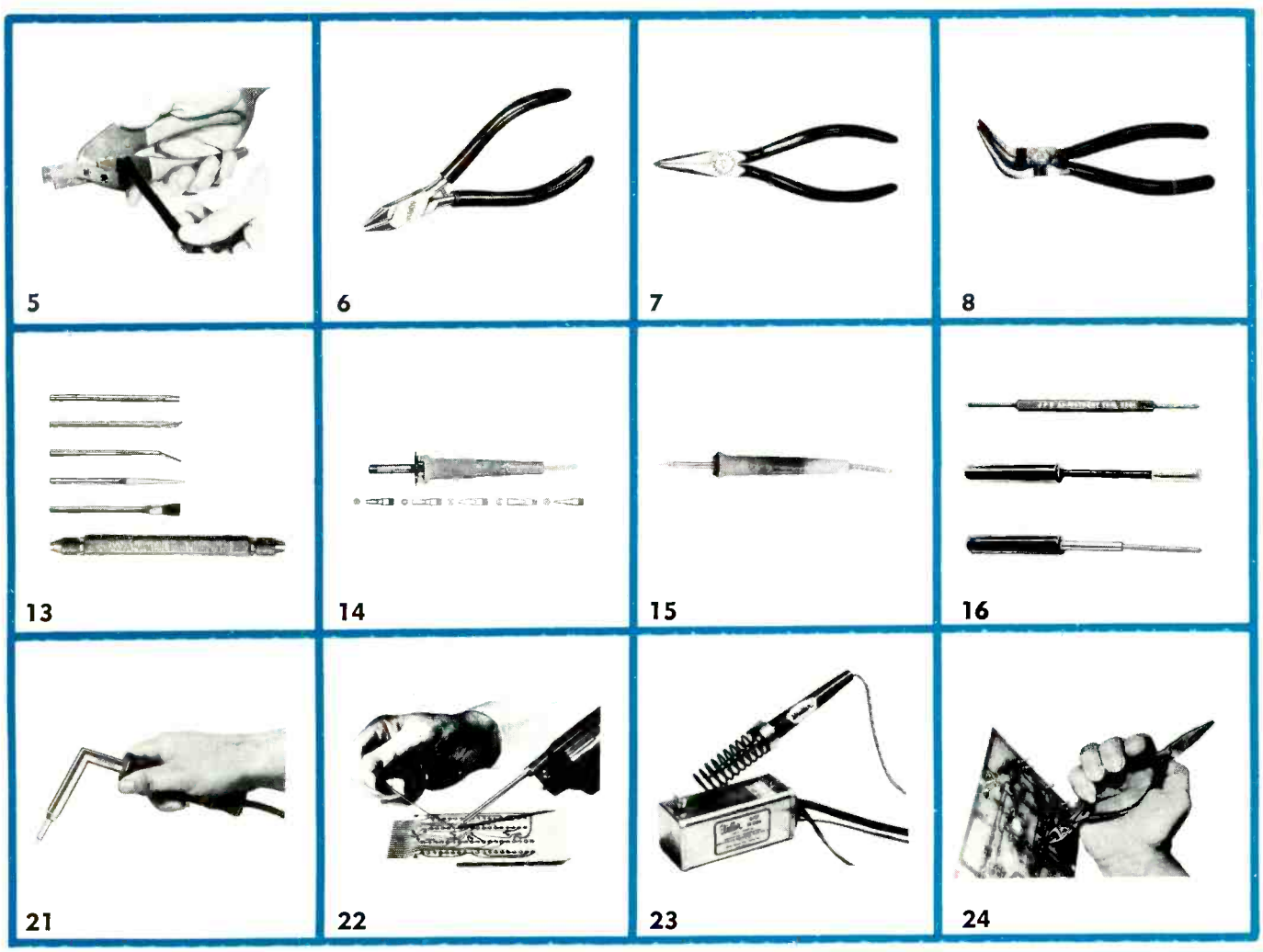
Quick changes are now taking place in electronics technology and servicing techniques. Tomorrow's electronic equipment—probably with microminiaturized circuitry—will call for different service techniques and new tools. Ordinary transistorized circuitry, now being used in more home and industrial electronic equipment, has already created the need for new service tools. "Watchmakers" paraphernalia is now showing up on more TV-radio, Hi Fi work benches. Jeweler's pliers, screwdrivers, magnifying glasses and tweezers have become standard equipment on the transistor-portable repair bench.

It would be impossible to list all the new tools recently designed to speed up and make TV-radio, and Hi Fi technicians' work easier. We have selected and show only a few typical examples here, including some "standard-equipment" items. ■



BUSY TECHNICIANS

1 Vaco's crimping tool and bolt cutter.
2 GC wire stripper.
3 Xcelite bentnose seizer.
4 GC "C" washer and retaining ring tool.
5 GC 300 ohm feedline tool.
6 Techni-Tool's flush-cutting diagonals.
7 Diamond's longnose tip cutter.
8 Diamond's curved needlenose.
9 Oryx miniature pliers.
10 Channellock heat sink.
11 Weller pencil iron.
12 ENDECO printed board desoldering/resoldering iron.
13 Exacto soldering aid chuck with tool tips.
14 Hexacon miniature soldering iron and tips.
15 Ungar 15 w 'Imperial.'
16 JFD adjustment tools.
17 Zippertubing's cable sealing tool for PA installers.
18 General Electric's 'Capacitor Tab Adjuster.'
19 Xcelite transistor radio terminal wrench.
20 Ungar tip cleaner.
21 Hexacon 'hatchet' shaped iron.
22 Wen 'pistol' iron.
23 Weller temperature controlled pencil iron.
24 Hunter dual diagonal/longnose.



Put the damper on howls, squeals, motorboating and microphonics by understanding feedback and spurious-oscillation problems

Stop Unwanted Oscillations

by Eugene Fleming

■ A common sine wave radio frequency oscillator is an amplifier with regenerative feedback. And the fundamental principle is important to the operation of many electronic circuits: local oscillators in superheterodyne receivers, carrier frequency generators in transmitters, etc. But unwanted "feedback" in RF, IF and audio circuits, can create some frustrating problems for technicians.

Today's electronic equipment designers take precautions against unwanted feedback and spurious oscillations. But feedback is an ever-present irritant to TV-radio and Hi Fi technicians in their day-to-day troubleshooting and repair work. It arises for various reasons, including incorrect lead dress, a missing tube or coil shield, a misadjusted neutralizing capacitor, or a defective bypass capacitor—to mention only a few examples. And it frequently reveals itself as howls, squeals, motorboating, microphonics, "squegging," ringing in the TV picture, and in a variety of other symptomatic forms.

Regenerative Feedback

Many technicians have never developed a reliable and systematic approach to solving feedback problems. Resistance and voltage checks seldom yield clues that point to the trouble-source and frustrated technicians waste a lot of time chasing off in all directions trying to locate the trouble in a hit-or-miss fashion.

An efficient approach to the feedback and spurious-oscillation problem cannot be developed without a practical understanding of feedback theory.

Most technicians are aware that an amplifier boosts its input signal. When a portion of the boosted signal is fed back to the input—in phase with the incoming signal—more amplification results. A point is soon reached when the small current variations in the circuit are strongly amplified. If the gain is further increased, the amplifier "takes off" and becomes an oscillator. To sustain oscillation, feedback may be coupled either capacitively, inductively, or mechanically. In any case, when an amplifier "gets its tail in its mouth," it is going to "take-off" and oscillate.

Cases

A few actual cases from the records of TV-radio bench technicians will illustrate better than pages of theory—with no de-emphasis on the importance of fundamental theory intended.

An Emerson 1500 was brought to the shop for service. The original complaint was no sound and a "snowy" picture. Voltages in the IF and video sections checked OK. The technician noted on the record that the set probably required an alignment—considering valid information which indicated the set had been "tinkered with" by a do-it-yourselfer. When the very first adjustment was made on an IF transformer slug the picture "whited-out" on the CRT screen. When the transformer slug was restored to its original position the snow returned. A careful check showed that one other slug produced a similar effect. At this point, the record showed, the bench technician checked his test setup to determine if a fault existed here. Everything in the test setup checked OK.

As every experienced bench technician would know, the normal —0.5 v on the detector plate rose to almost —25 v at the instant of "white out." A similar high negative voltage was found all along the AGC line—which resulted in cutting off the first IF and RF amplifiers. *This is a typical oscillation symptom in high frequency sections of radio receivers.*

Suspecting feedback, the bench technician checked the shielding around components, checked lead dress and "jumped" bypass capacitors, but the fault was not located here. Further checks showed that the grid of the 5AM8 final IF amplifier was "floating." The socket was broken inside—and the grid lead was open—but this did not materially affect the meter reading at the PC board terminal. The small amount of video getting through was coupled capacitively and inductively to the tube's grid. And sufficient coupling was present to cause oscillation.

For variety, let's look at a particular case — a candidate for the easiest troubleshooting job on record. An RCA KCS-98 was giving out with a 400 cycle tone—and 7 horizontal black bars on the CRT screen. When the missing shield of

the tuner's RF amplifier tube was replaced, the problem was eliminated in short order!

Table-top radios, old or new, can develop "oscillatory" problems. A Silvertone model 7040, for example, came to the shop in a "dead" condition—all tubes were dark. When a burned out 12BA6 was replaced, all tube heaters lit up. But when it was tuned near a station it began to "growl" and motorboat. A finger placed on the chassis produced ringing regardless of the tuning dial's position, though it was more pronounced at the low frequency end. Bypass capacitors were "jumpered" without success. Alignment proved impossible—although alignment had cured another radio that displayed symptoms of a "similar" nature. Shields were then placed over the IF amplifier and audio output tubes. This reduced the ringing but did not solve the problem. The new 12BA6 was replaced with another new tube *and the trouble disappeared!* The tube was slightly microphonic. Feedback was taking place at audio frequencies mechanically. The 12BA6 plate voltage was being modulated by vibrations reaching the tube elements. This is a "fluke" situation—but watch for it. If a single burned out tube replacement does not put the set in proper operation, *try one or more similar tubes before you take off in all directions.*

A Buick 981968 had a high pitched whistle all across the dial. All bypass capacitors were shunted but the whistle persisted. A new 350 μf electrolytic in the grid-1 lead

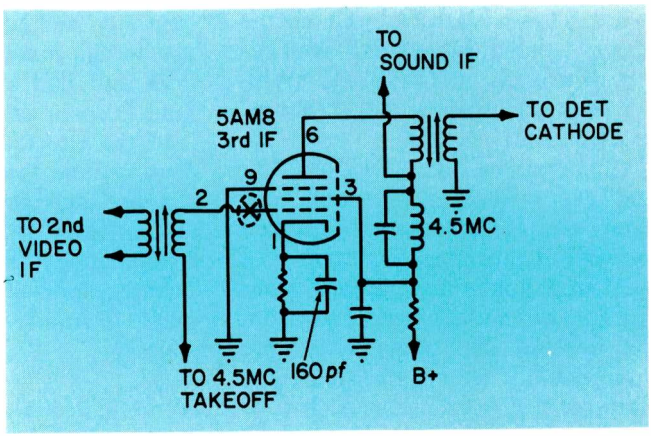


Fig. 1—Broken grid lead in tube socket caused severe oscillation which blanked out the picture in an Emerson 1500 TV set.

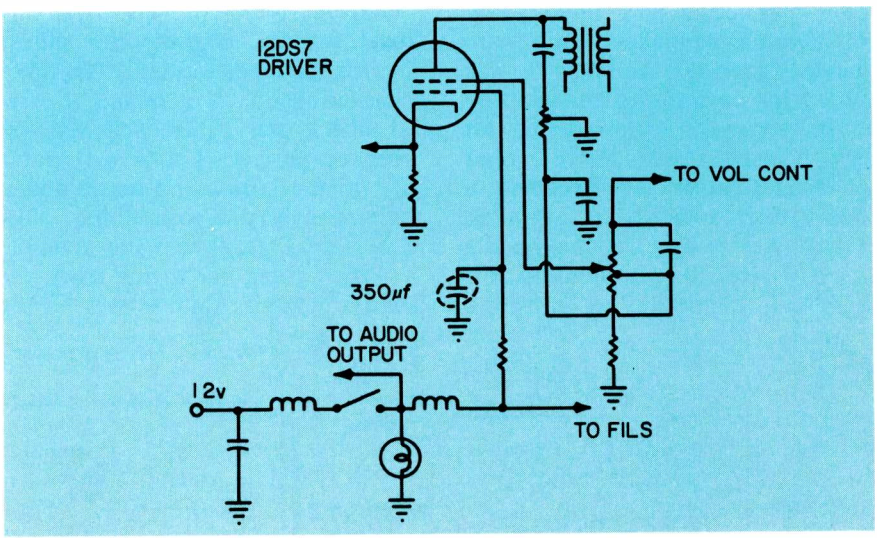


Fig. 2—A 350 μf electrolytic, which checked good on a capacitor tester, caused a high pitched whistle all across the dial in a Buick auto radio.

of the 12DS7 stopped the howl. The original unit checked OK in a reliable capacitor tester.

A Systematic Approach

With so many symptoms and causes to contend with, can a systematic troubleshooting approach be applied to feedback cases?

Experienced technicians already know that the first thing to check

Continued on page 77

TOUGH DOG CORNER

Difficult Service Jobs Described by Readers

Shorted Turn

An eleven in. portable Admiral TV, chassis C21A1Y, was brought onto my bench with no high voltage. The appropriate tubes were changed without favorable result. Waveform and drive at the horizontal output tube grid were OK as well as the screen voltage, but no RF was being developed at the plate. With the high voltage rectifier removed there was still no RF.

Capacitors C435, C433, C432 and every likely (and some unlikely!) components were checked but still the trouble persisted.

Then I noted that various other circuits in the set were fed from the boosted B+ and these were disconnected to ensure that they were not over-loading the high voltage circuit. Still no luck.

The high voltage transformer and yoke were tested and found good, but in order to make certain were changed anyway. By now I was not leaving anything to chance. The results were the same—a big fat zero. I began to wonder if I could get a nice quiet job sweeping a factory floor somewhere!

As I was poking around on the underside of the printed board chassis I happened to move a shielded cable and at once the set sprang to life! Once this happened the explanation was simple. The keyed AGC pulse was fed from the transformer partly through this shielded cable. In making the original connections, the heat had apparently melted the insulation between the inner and outer conductors and had shorted after the set had been in use for a while. This had the effect of placing a shorted turn around the high voltage transformer making it completely inoperative.

Somebody else can sweep the factory floor—for a while anyway! *Reg. Bartlett, Windsor, Ontario, Canada.*

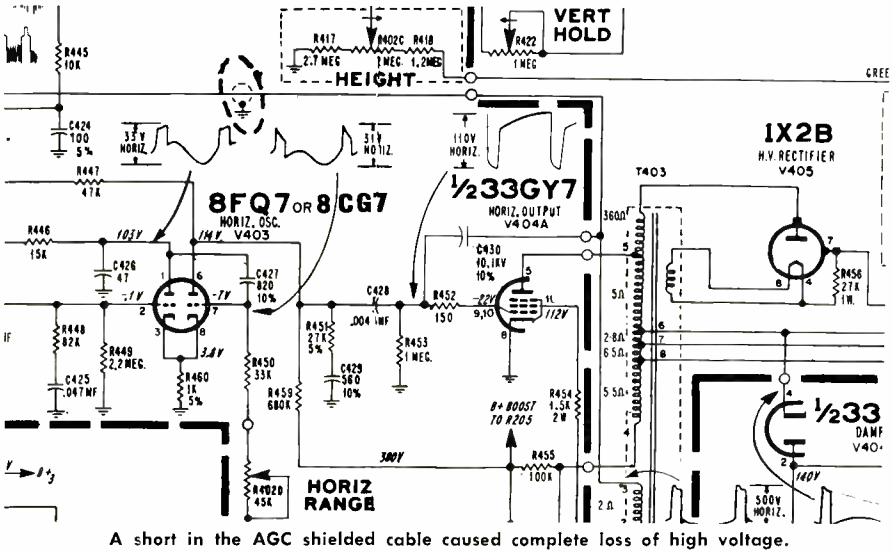
Lead-In Trouble

A call was received with the complaint that only one UHF station could be received. This was the local station. Making the call, I figured the tuner was bad. The tubes checked good so I pulled the set to check the tuner, but the set checked perfect. I took a portable TV to the customer's home and it only received one channel too. Now I began to feel it was the antenna.

When going out to my truck the man downstairs said he was having trouble and the people next door asked for service a moment later. I tried to figure what would block out all of these sets. We have a TV cable system in town, and I thought that possibly, in some remote way it could be the cause. I contacted the cable people and they sent out an engineer and one of their service technicians. They thought at first I was crazy but on examination became as baffled as I. We then took an antenna and field strength meter to check for oscillations but picked up nothing. The cable signal was even killed, but the sets were still operable on only one channel.

We figured that all the sets in this one block could not go bad at the same time or that all of them could not be struck by lightning at the same time, so we took a signal strength meter and climbed the antenna tower. At the antenna we had a 140 μv signal and at the sets nothing. Then we knew it was the twin lead. Changing the wire solved the problem. But how could all of the wire go bad at about the same time? There was a substance on the outside of the wire which had a high resistance on every piece we checked. I'm enclosing a piece of wire. *Jack Fennasi, Oylesly, Illinois.*

● *The piece of wire we received looked as if it were from an ocean-front installation. It was a good quality wire and had none of the characteristics commonly found in "weathered" wire.—Ed.*



A short in the AGC shielded cable caused complete loss of high voltage.

TOUGH DOGS WANTED

$10.00 paid for acceptable items. Use drawings to illustrate whenever necessary. A rough sketch will do. Photographs are desirable. Unacceptable items will be returned if accompanied by a stamped envelope. Send your entries to "Tough Dog" Editor, ELECTRONIC TECHNICIAN, 1 East First St., Duluth, Minnesota 55802.

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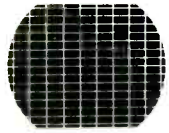

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SHOP HINTS

TIPS FOR HOME AND BENCH SERVICE

Template Tip

When installing antennas for car radios, and cutting a hole in the fender, cut a template and wet it. Place it and press it down on fender, then drill the hole. This eliminates taping the template and possible paint burns from hot cuttings. *Ed Mayover, Sarasota, Fla.*

Transformer Check

Unless the output transformer has an open primary or one of the coils is shorted to the core, this is a fast way to check them: Operate your soldering gun very close to the output transformer. If the transformer is ok, the gun will induce a voltage in the transformer which causes hum from the speaker. *S. Clark, East Bradenton, Florida.*

Aerosol Compressor

"Empty" tuner spray cans have enough gas left to be used as an air compressor. They are ideal to blow dirt from the rotor plates of noisy gang capacitors, etc., that cannot be reached otherwise. *Thomas Casey, New York, N. Y.*

Nut Driver Tip

When using a hollow shaft nut driver and the hex bolt is too short to start in the chassis, I take another bolt and insert it in the driver upside down. This extends the short one so it can be started. *Don Studt, La Barge, Wyoming.*

Easy Etching

Steel tools and equipment can be permanently etched with your name or other identification with paraffin and iodine. First clean the surface of the tool and coat it with melted paraffin. Scratch through to the metal with a sharp scriber and apply iodine to the lettering. After a few minutes, wash with water; scrape off the paraffin and wipe with an oiled cloth. Marked tools make ownership easy to prove and are often returned faster when they are borrowed. *H. Josephs, Gardenville, Penna.*

Capacitor Replacement Tip

From time to time you may be called on to service one of the older type radios. After laying idle over a period of years in a hot, dusty attic, the electrolytic capacitors will generally need replacement. Usually there are no identifying marks on these filter capacitors. In this case, the following information will serve as a guide for ordering a replacement:

Input filter capacitor—Use a 10 μf to 20 μf at 200 vdc.

Output filter capacitor—Use an 8 μf to 16 μf at 200 vdc.

Speaker field coil filter capacitor —Use a 4 μf to 8 μf at 200 vdc.

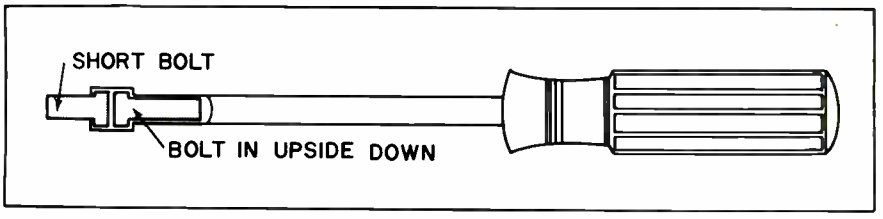
Audio output tube cathode filter capacitor—Use a 5 μf to 10 μf at 25 vdc.

Detector cathode filter capacjtor —Use a 5 μf to 10 μf at 25 vdc.

Higher voltage ratings may be used in all the above applications, of course. *Noble C. Travis, Sheridan, Kentucky.*

TV Shock

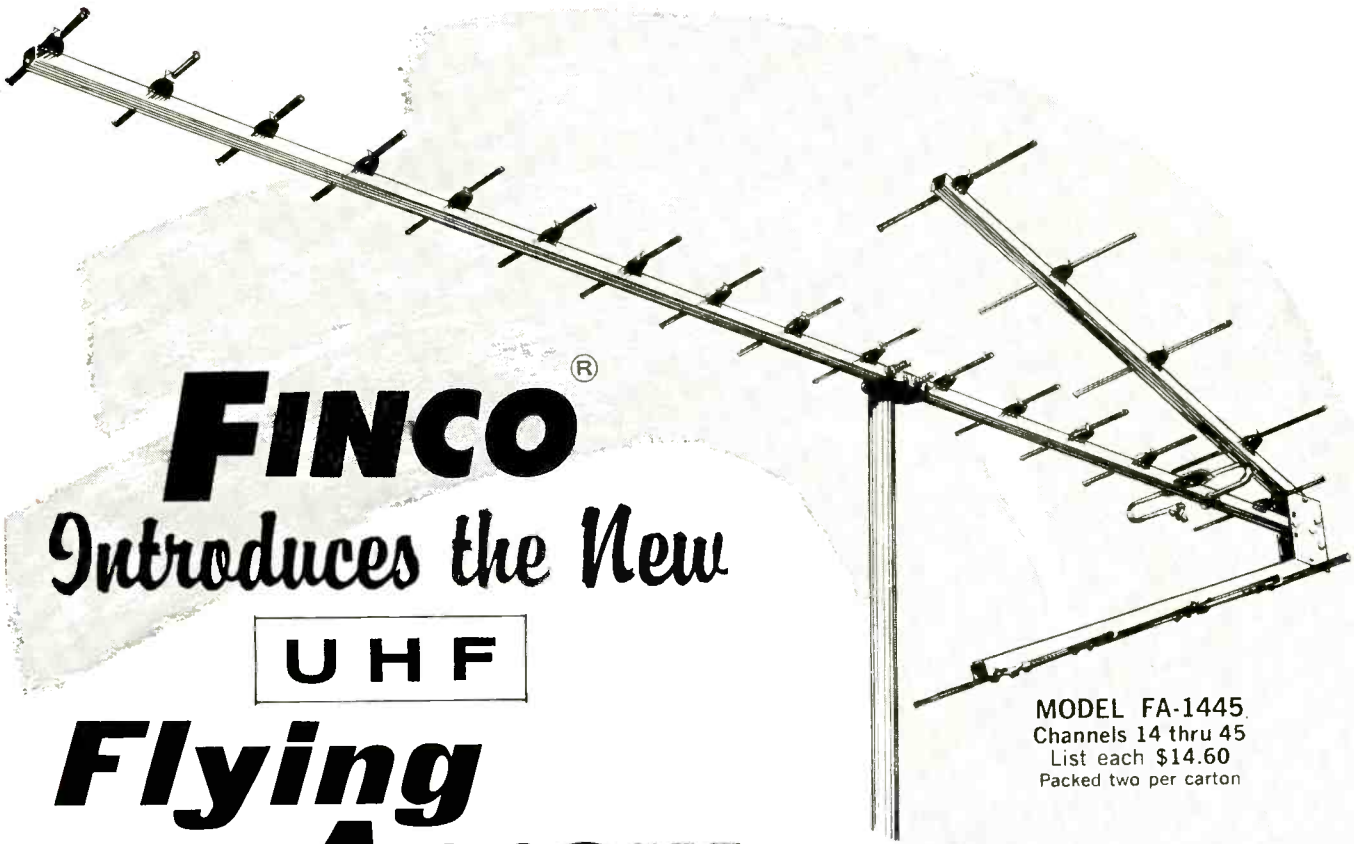
Over a period of time various complaints of shock from Admiral portable TV sets have been investigated. The shock takes place at the instant a set is turned on or off. Checks showed that all sets were of the type having a paint finish around the front mask. Careful observation indicated that the shock originated from a static charge from the CRT which charges this coating and when touched by a customer would discharge with an unpleasant shock. Further investigation showed that the problem can be solved easily by dismantling the TV and removing the CRT from the front mask. A paint "leg" will exist from the front mask finish to the metal reinforcement strip which in turn is grounded to the chassis. Using gold metal paint, repaint the strip or apply a new leg from mask finish to the metal grounding strip. It is recommended that two or more coats of paint be used. This simple reapplication cures this type of trouble. But make sure to test-run the set to guarantee fail-safe results. *J. Wildon, Central Islip, N.Y.*



A screw inserted backwards in a nut driver makes it easier to start short screws in out-of-the-way places.

SHOP HINTS WANTED

$3 to $10 for acceptable items. Use drawings to illustrate whenever necessary. A rough sketch will do. Unacceptable items will be returned if accompanied by a stamped envelope. Send your entries to Shop Hints Editor, ELECTRONIC TECHNICIAN, Ojibway Building, Duluth, Minn. 55802. The hints published in this column have not necessarily been tried by ELECTRONIC TECHNICIAN editors and are the ideas of the individual writers.



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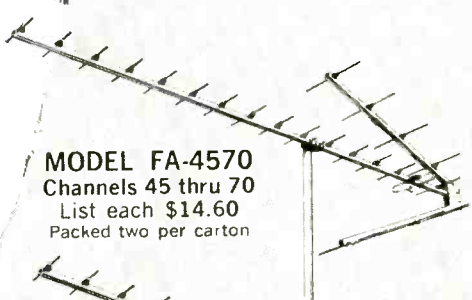

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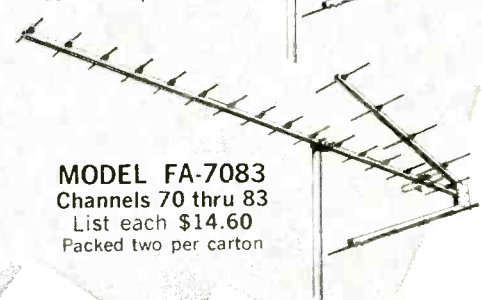

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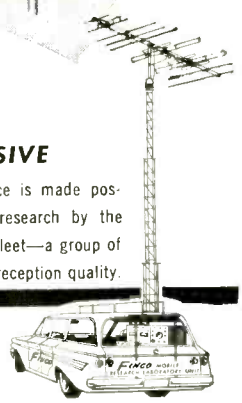

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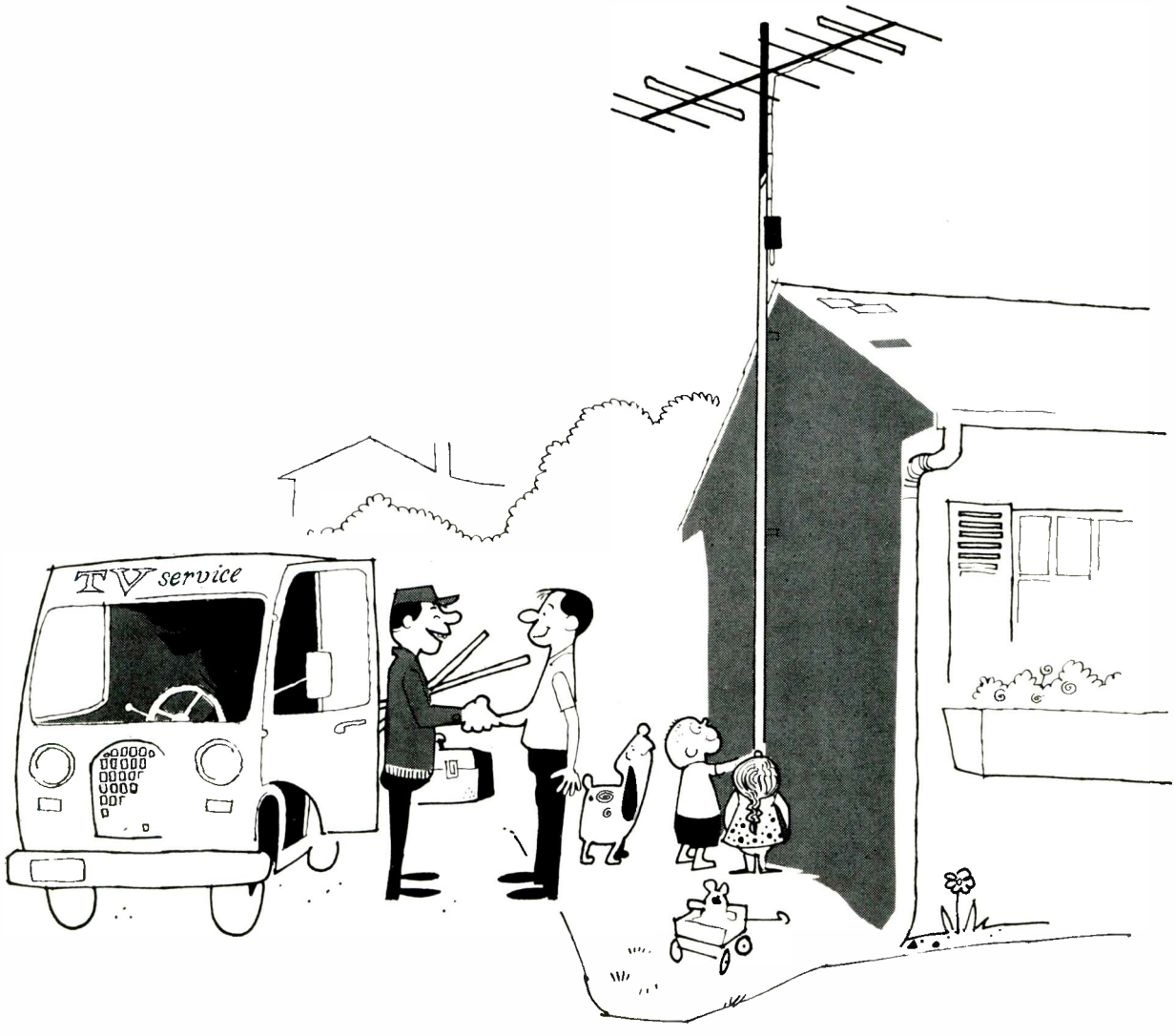

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INDUSTRIAL ELECTRONIC SECTION

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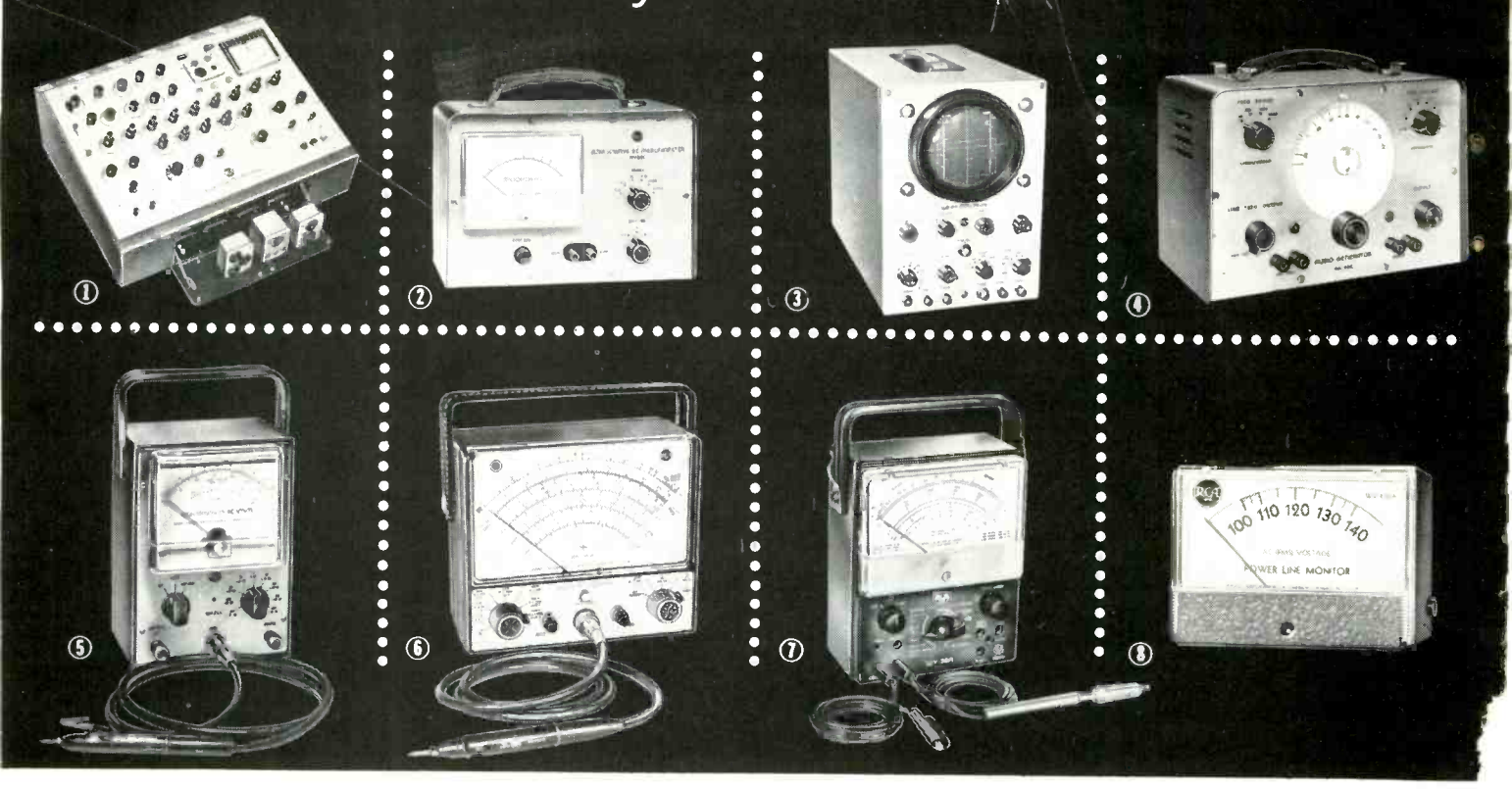
For production-line testing... Equipment maintenance...Product quality checks... Laboratory measurements...



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POCKET PAGERS

■ Ever try to keep track of 11 fork lifts and platform trucks operating indoors and outdoors over a 50-acre area? Peter Maguire has—and it isn't easy!

Maguire is Receiving and Materials Handling Supervisor for the Curtiss-Wright Corporation Wright Aeronautical Division in Wood-Ridge, New Jersey. The plant occupies over 3 million sq ft of floor space. Because of the huge size of the facility, keeping raw materials moving properly in smooth coordination with production lines represents a considerable task.

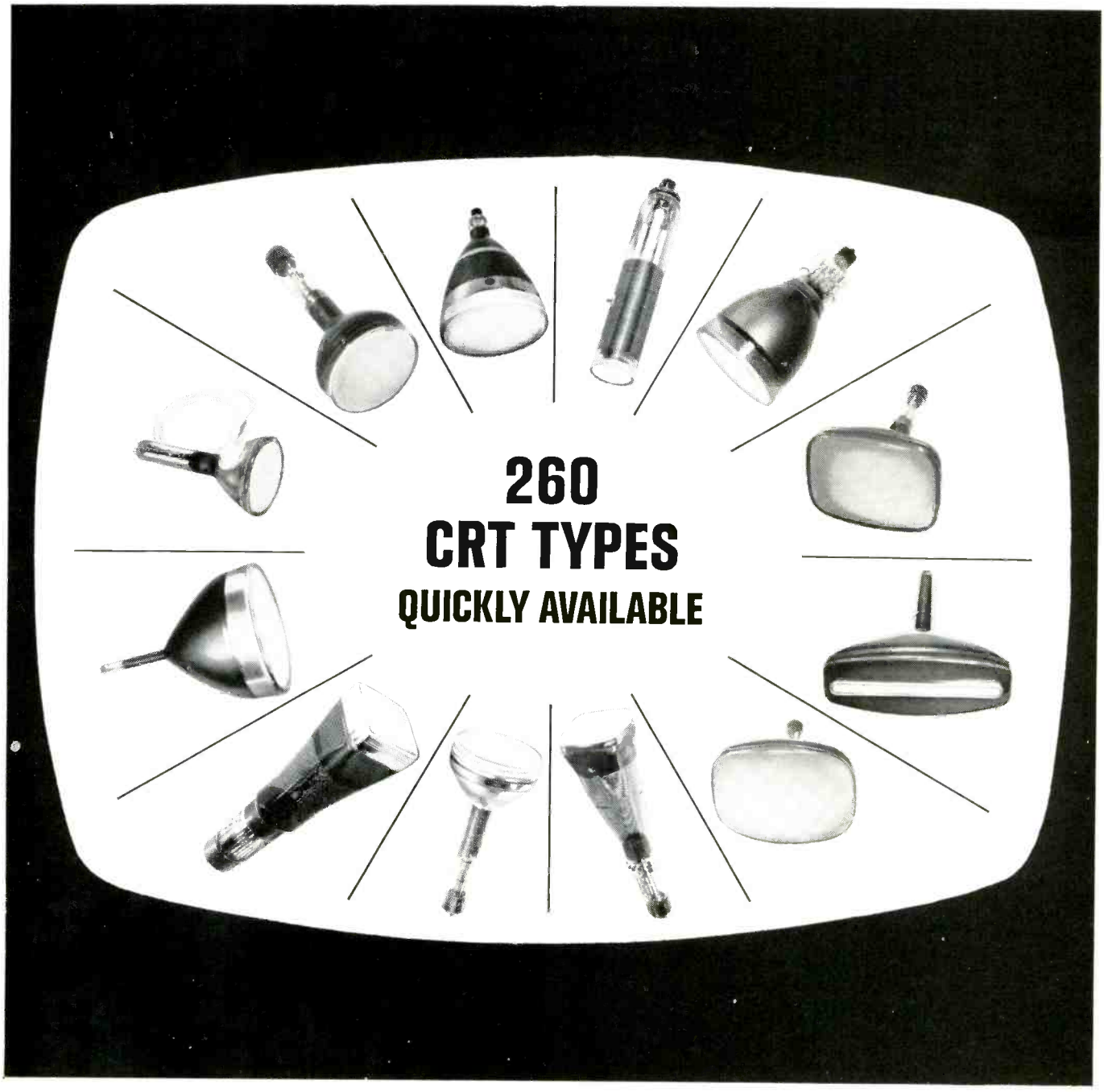
In the division's traffic department, five fork and platform lifts are used on fixed routes to transport goods throughout the plant. Two other trucks are assigned in the yard, and four over-the-road trucks are used on interplant movements.

Says Maguire: "Great quantities of goods must be moved from one point to another with a minimum time loss. Dispatching the goods, of course, is an important aspect of this operation. It must be done quickly and efficiently with minimum labor and time loss."

To integrate the operation, the firm uses 15 pocket VHF/FM radio communications receivers which link key office personnel with the vehicles and with each other.

Before the radio system was installed, the company used bicycles to contact yard and interplant trucks, and it sometimes took 12 minutes or more to deliver messages.

With the pocket paging system,



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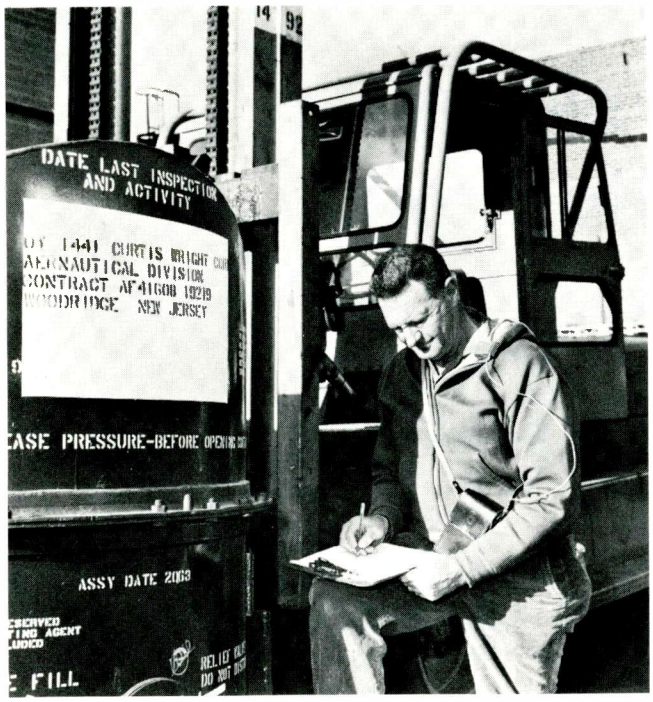

A lapel speaker brings audio message to ear of forklift operator. Previously out of contact with the office, forklifts can now respond immediately to fast calls for vital materials.

however, there is instant contact. Messages are dispatched as soon as they are received.

Units worn by forklift drivers are "receiver only." They get their calls from a 300 w, high-band base station transmitter on a shelf in the traffic office. In conjunction with the transmitter, a 100-tone generator on Maguire's desk keys calls to individual drivers.

For inside drivers, the radio system provides a private alerting system that eliminates dependence on the public address system. Drivers previously were able to hear the PA only on very limited occasions, and much of the time, lift operators could not hear the PA because of equipment noise. Naturally, public address messages were missed frequently.

"Our productive output requires instant filling of supply orders," Maguire points out. "We couldn't hold up production waiting on a driver in the plant who missed a call. With the new paging system, though, the call goes where he goes. This means a considerable speedup in our materials handling operation. Our forklifts now work more productively because they need not stand idle while waiting for new instructions. Because in-plant shipping time is reduced, production costs are lowered."

Small enough to fit in a shirt pocket, the units also are worn in leather carrying cases on a belt by some of the radio-equipped personnel, while others wear them camera-style, on a strap slung over the shoulder. Although this system relies on 7 v mercury batteries, the equipment also is designed to use nickel-cadmium rechargeable batteries.

According to Maguire, units using mercury cells go two weeks before new batteries are required, despite the fact that they are in use eight hours a day. Although the 15 receivers have had a combined total service of more than 100 months, breakdowns have been "virtually nonexistent."

"We have come to depend on this equipment," Maguire said, "in effecting the coordination our production requires. It helps us manage our operations more efficiently, saving valuable time and preventing costly delays." ■

Two-Way Radio Speeds Plant Operations

■ An industrial communications system that includes 119 transistorized vehicular and portable two-way radios and six base stations has been placed in operation by General Dynamics' Fort Worth plant.

The system includes 94 mobile radio units and 25 hand-carried units. Four base stations and two table-model stations are used.

Transistorized sets have been installed in maintenance, traffic and nuclear departments for safety and security work. Among vehicles equipped with the new units are 35 forklifts engaged in materials handling.

In addition to in-plant communications, the mobile system is designed to include vehicles operating out of the plant in the Dallas area. A repeater station on Chalk Hill in Dallas facilitates calls.

It was reported that the new equipment was installed to replace older sets which did not meet FCC requirements. ■

G-E hand-carried two-way radio is used in General Dynamic's Fort Worth, Texas, plant.

TUNNEL DIODES as Industrial Circuit Elements

This ultra high-speed semiconductor can simplify many industrial switching and control circuits

by Allen Lytel

■ The tunnel, or Esaki, diode is a voltage-stable semiconductor that exhibits a negative conductance over a section of its forward characteristic. In the typical characteristic curve the diode has an extremely low impedance in the reversed-biased state and has a normal diode characteristic at "high" forward voltages. The device has wide industrial potential as an amplifier, switch or an oscillator.

Characteristics

The operation of ordinary transistors, or even electron tubes, depends on a charge carrier being influenced by the electric field between the emitter and collector electrodes. The upper operating frequency limit for these devices, therefore, is a function of the time required for the charge carrier to travel through this region. Tunnel diodes operate on a different mechanism, however, and have a theoretical frequency limit of 107 Mc, which is higher than other semiconductor devices.

The tunnel diode is named after the "tunnel effect," a process that obeys the laws of the quantum theory. Particles disappear from one side of a potential barrier and appear almost instantaneously on the other side—although the particles do not have sufficient energy to surmount the barrier. In effect, the particles "tunnel" under the barrier.

Because tunneling action is an effect of majority current carriers the device's frequency response can be considered equal to that of current flow in a normal conductor. There is no apparent limit to its speed; units have operated over 5 Gc. The two major areas of application are in switching circuits, where the diode is switched from a low-voltage positive resistance state to a high-voltage positive resistance state, and in linear amplifiers and oscillator circuits where the tunnel diode is biased in the negative resistance region.

As voltage increases from zero the diode's current increases to a sharp peak (B, Fig. 1); it then dips into a valley (C) after which the current rises again.

For bistable operation, positive-resistance sections of the characteristic curve are used. The portions of the curve from A to B and from C to D are positive resistance because current increases as voltage increases. But from B to C is negative resistance because current decreases while voltage increases.

Points E and G, both positive-resistance points, can be connected to produce a load line for bistable operation. E is a high-voltage, low-current point while G is a low-voltage, high-current point. Each point represents a stable state for the tunnel diode, and when operating along this load line, the diode acts as a switch.

Tunnel Diode Bistable Circuit

Tunnel diodes can act as fast and effective switches, as in the simple bistable circuit, or flip-flop, shown in Fig. 2. Here the tunnel diode is biased in the low-voltage state by a current which is slightly less than the peak current. Since the transistor is in the off condition, the collector voltage is at the supply level. If sufficient positive trigger pulse is supplied at the input to increase the tunnel diode current above the peak current, the diode switches to the high-voltage state. The diode will remain in the high-voltage state with a major portion of the bias current being diverted into the base of the transistor. A negative trigger returns the diode to its original state.

Current less than peak is supplied through the 6.8K resistance. The 47Ω resistance biases the diode above the valley point in its off state.

Light-Readout Circuits

Tunnel diodes can be teamed with photocells for a number of interesting circuits.

A simple light-activated oscillator is shown in Fig. 3. When light falls on the photocell, a voltage is generated; the capacitor charges then discharges through the tunnel diode and coil when the resistance of the diode decreases. Thus the LC values cause oscillation at about 20 Mc with an output of 0.5 v. This circuit can be used for remote light sensing where the 20-Mc signal is transmitted to a nearby receiver. Every time light hits the photodiode, the circuit thus produces an RF output.

Various types of light modulation techniques have been developed for short- and long-range communications. A method for using a photoelectric device for light modulation is shown in Fig. 4. The tunnel

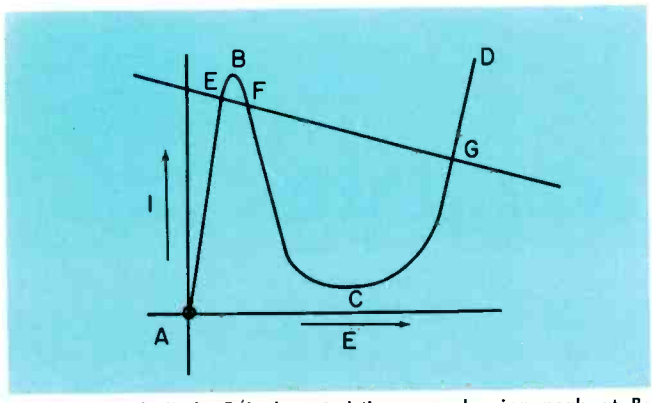

Fig. 1—Tunnel diode E/I characteristic curve showing peak at B, valley point at C, and further current rise to D as voltage increases.

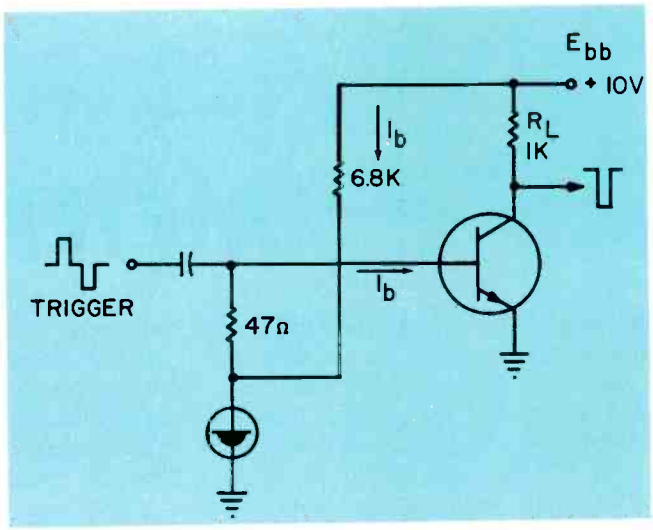

Fig. 2—Tunnel diode and NPN transistor in bistable circuit.

diode audio oscillator is activated by light falling on the cell. This audio modulates the RF produced by the backward diode RF oscillator; output is from the transistor.

Because of their speed, tunnel diodes are also used in special test equipment where different pulse trains of various characteristics are available for television circuit testing, telemetering, and control circuits such as the shift register.

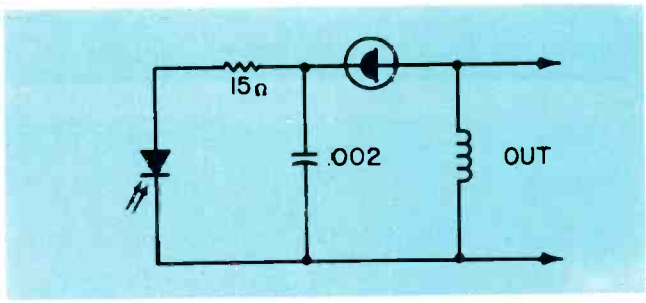

Fig. 3—Tunnel diode oscillator activated by photoelectric cell.

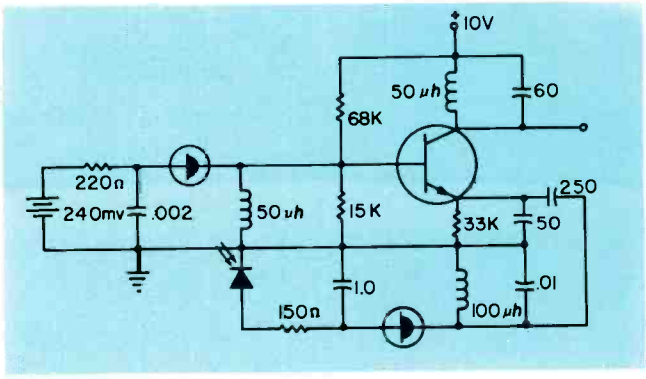

Fig. 4—Light operated modulator circuit is RF oscillator and audio oscillator.

Tunnel Diode Shift Register

A series of monostable tunnel diode circuits makes up the shift register as illustrated in Fig. 5.

Assuming that the first stage, TD1, is in the high-voltage state, diode D1 becomes forward-biased in the application of a negative-going pulse, and this pulse is therefore passed, via capacitor C1, to

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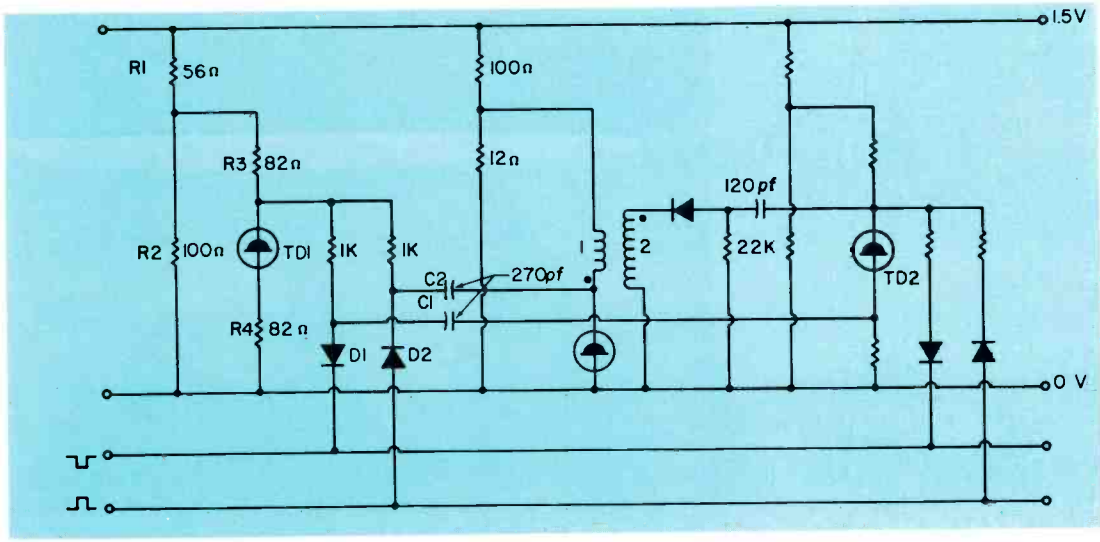

Fig. 5—Shift register circuit using tunnel diodes and backward diodes.

A Look at

METER RELAYS

■ When the salient features of meters and relays are combined they result in an instrument that can do all the things that meters and relays can do separately plus some that neither can do alone.

A meter relay is essentially a meter with one or two adjustable contacts attached. It can be read just like any other meter, yet the contacts can be set so the meter movement will open or close them at a particular reading. The composite instrument thus combines the meter's measurement and indicating functions with the relay's switching function. Because it can operate on low-level (microampere or milliampere) signals, amplifying devices are not necessary for relay operation. As an additional advantage, the opening or closing points of the relay are as accurate as the meter —commonly 2 percent dc and 3 percent ac—and repeat accuracy is within 0.5 percent.

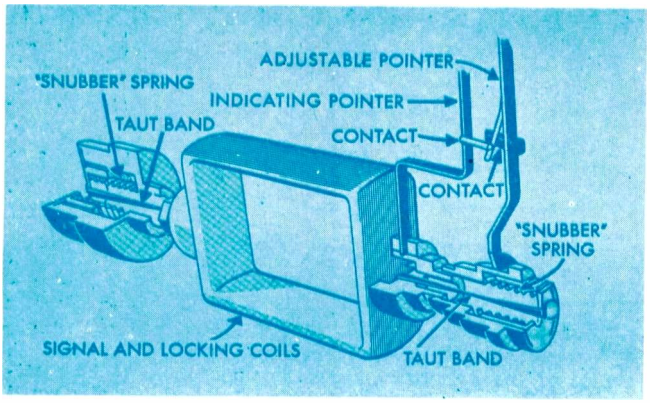

Fig. 1—Construction of a typical meter relay.

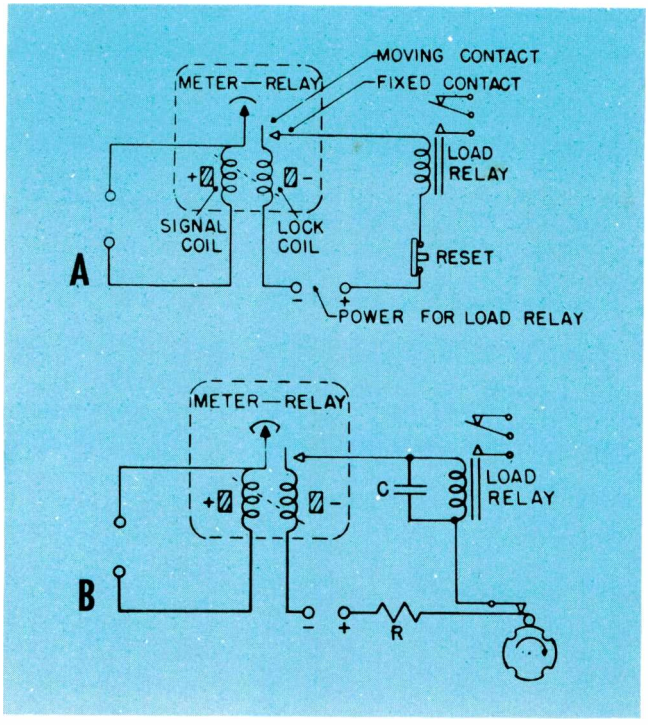

Fig. 2(A) — Basic meter relay circuit with manual reset.

(B)—Automatic reset by cam.

Operation

One contact of the meter relay is adjustable, and the other is carried by the "pointer." This is clearly shown in Fig. 1. The indicating part of the meter is conventional, but because the moving coil has low torque it cannot reliably actuate the relay. Therefore, when the contacts touch, current through a locking coil wound with the indicator coil holds the contacts together when they touch. Currents that can be handled commonly range between 0 to 5 ma and 0 to 50 amp, and voltage ratings range between 0 to 5 mv and 0 to 500 v.

A simple meter relay is shown in Fig. 2A. When the signal current is applied to the input, the signal coil moves the pointer until the moving contact touches the fixed contact. Current from the load-relay power source then flows through the circuit, locking the meter relay in position and energizing the load relay.

Because of this locking feature the meter relay remains closed after the signal current is removed. A

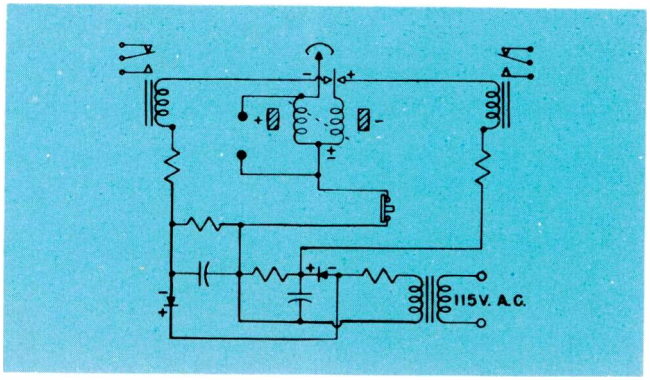

Fig. 3—A double contact circuit with manual reset.

reset button, in this case manually operated, breaks the lock-coil circuit when it is pushed. If the signal current has fallen below the lock-in level, the relay will stay open; otherwise, the relay will remain locked.

Since meter relays do not "drop out" as conventional relays do when current through the signal coil is reduced. To get "on & off" action, a sampling circuit with an automatic interrupter is generally used, so that the meter contacts are unlocked periodically to sample the signal current. If the signal is still up to the control point, the meter contacts remain locked; however, if the signal has dropped, the meter contacts separate and the load relay releases.

Automatic Reset

An automatic reset where the rotation of a cam periodically resets the meter relay is shown in Fig. 2B. The capacitor keeps the load relay closed while the cam tests the signal current, and R limits the peak charging current.

There are cases where both upper and lower limits are required such as heater current for a tube. A meter relay for this purpose is shown in Fig. 3. Note that the voltage for the lower limit is opposite in polarity to the voltage for the upper limit. A manual reset is shown here with a dc power supply for the load relays. The upper and lower limits are shown each with a single load relay for alarm signals.

Several meter relays can be operated from a single power supply. Each may operate into its own load relay or several may work into the same load relay. A single interrupter may be used for all, or some relays in the group may be operated manual reset while the others are automatic. Both single- and double-contact meter relays, as well as either high- or low-limit types, may be used.

If the high contact on one meter relay and the low contact on another are apt to be "made" at the same time, it is necessary to break the separate locking circuits through each meter relay, because breaking just the common leg will not release the contacts.

One of the simplest automatic interrupters is shown in Fig. 4. Since the load relay does the interrupting, the load circuit also will be interrupted periodically. For alarms and some types of control this is usually satisfactory. In some automatic controls the load relay holds steady unless the current in the signal coil drops.

In this circuit, capacitor C2 holds the load relay energized for a specific period while the load relay contacts are open. This type of circuit may be used for short interruption periods, from several times per second up to once in 4 or 5 sec. The frequency of the interrupter is determined by C2, R2 and the characteristics of the relay load. Using a 5 ma, 12kΩ coil relay with 200μf at C2 and 3300Ω at R2, the interrupter will be open about 1 sec and closed about 4 sec. A smaller capacitance at C2 will speed it up—a larger capacitance will slow it down. To lengthen or shorten the time it is open, the value of R2 may be changed. Resistor R2 should not be less than 3000Ω—R2 limits the peak charging current to C2 and protects the meter contacts.

For interruption periods of five sec or longer the motor-driven interrupter is normally used.

The three-position interlocking arrangement (Fig. 5) is a control circuit which corrects the signal to a specific point within a preset

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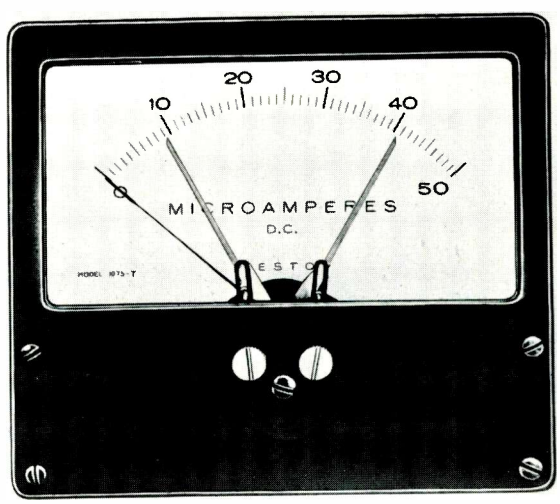


Photo of a typical meter relay.

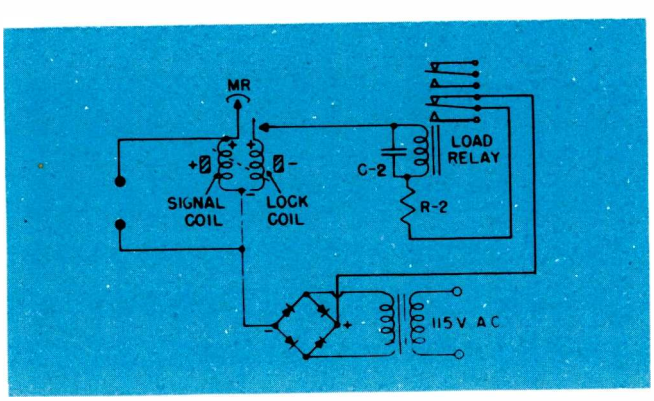


Fig. 4—Single contact self-releasing meter relay circuit.

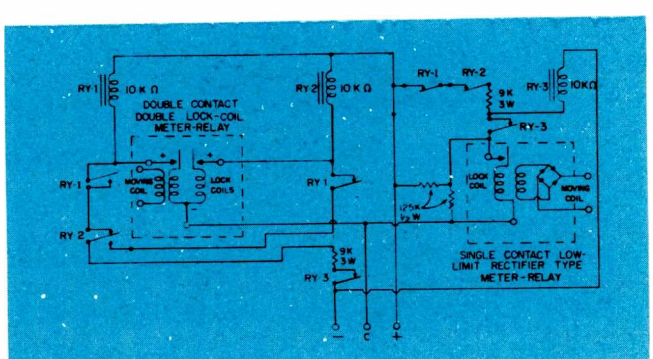


Fig. 5—Three position interlocking circuit corrects signal within a preset range.

NEW PRODUCTS

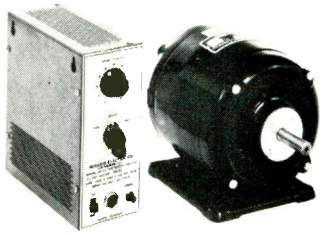
VOLTAGE REFERENCE 400

A voltage reference source providing voltages for a wide variety of applications in modern electronic

and research laboratories, is announced. Voltages produced by this instrument may be used for calibration of laboratory instruments or for accurate measurement of unknown voltages, it was said. Output voltage is variable from 0 to 100 v dc with readout made on three calibrated dials, COURSE VOLTAGE, FINE VOLTAGE and RANGE. Accuracy is within 1% or 1 mv, whichever is larger. Price $65, factory assembled. Heath.

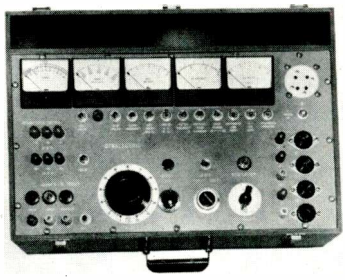
SPEED CONTROLLER 401

A feedback type motor speed controller has a 20:1 speed range which may be precisely selected with fingertip control its maker announces. It was said that solid state silicon controlled rectifier circuitry assures dependable performance and long life on the most rugged applications. Specifications indicate the unit is equipped with an automatic circuit breaker for overload protection, a manual reset button, and is engineered for 115 v, 60 cps ac input for 115 vdc shunt wound 1/15th and 1/8th hp shunt wound Bodine motors. Minarik.



THYRATRON TESTER 402

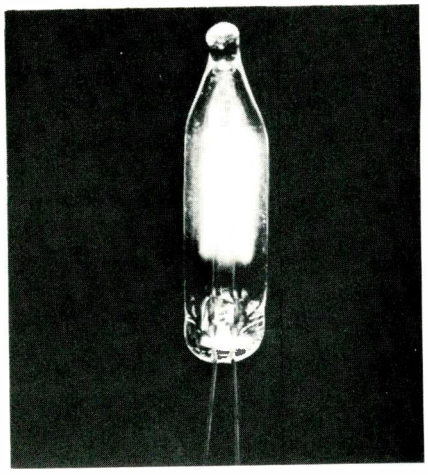
An industrial quality thyratron tube and semiconductor tester is announced. It is said the unit per-



mits quick comparisons with tube chart, gives automatic indication of critical grid volts (trigger points), automatic indication of critical grid current on thyratron tubes and operational test of semiconductors. Accommodates all common industrial tubes from 0.1 through 16 amp, the maker said. Price $1,285 net. Alectric.

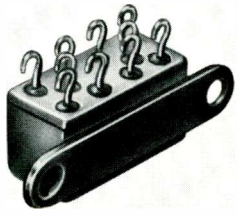
NEON LAMP 403

A close-tolerance neon glow lamp for use in electronic devices using solid state photo-conductive cells, is announced. The Type A074 has been specially designed for use with Cadmium Sulfide and Cadmium Selenide photocells. Typical applications may include photo-choppers, modulators, low noise switching devices, overload protectors to prevent damage to other circuit components, power supply regulators, and others, the announcement said. Signalite.



LATCHING RELAYS 404

A half crystal-can size magnetic latching relay, type LS, which needs only a short duration, low power



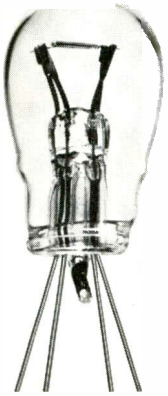
pulse to shift its bistable contacts, is announced. The contacts will maintain either of their two positions without consuming power, and will operate satisfactorily under severe environmental conditions, the announcement said. It has 2 Form C DPDT contacts rated at 2 amp, 28 vdc resistive load. Contact resistance is 0.05Ω maximum, or 0.100Ω after 100,000 operations, operating time is 3 ms at nominal voltage at +25°C, specifications indicated. Branson.

NEW PRODUCTS

FOR MORE INFORMATION CIRCLE PRODUCT NUMBERS ON POSTCARD FOLLOWING PAGE 82.

PROTECTIVE BARRETTERS 200

Three circuit components called barretters which protect power transistors from damaging current



surges or overloads is announced. The circuit elements are made with tungsten filaments carefully chosen for their positive temperature coefficient of resistivity. Located in series with a transistor emitter, the barretters act like variable resistors, offsetting any increase in transistor collector current by a corresponding increase in the resistance of their filaments, the maker said. Color coded leads already processed for soldering are brought out through the bottom of the envelope permitting each barretter to be wired directly into transistor circuits. Tung-Sol.

COLOR YOKE 201

Replacement deflection yokes for color TV receivers are reported to incorporate an adjustable damping network to duplicate the deflection

yoke in nearly every color TV receiver in use. Yokes are stocked by distributors throughout the U. S. Included with each yoke is an instruction sheet containing schematic, technical and installation data. Triad.

TWO-SET COUPLERS 202

A two-set coupler which may be used with TV sets and FM receivers is reportedly available. The unit is enclosed in molded plastic cases and is skin-packed or boxed. Models FM 300, boxed or SP 300, skin-packed, can be mounted on or near the TV set and is said to be engi-

neered especially for fringe or trouble areas. $1.59 I. E. H. Manufacturing.

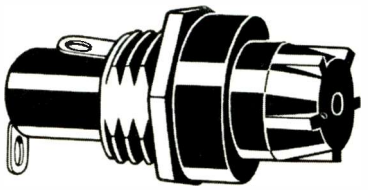
STEREO TUNER/AMPLIFIER 203

A 64-w FM stereo tuner/amplifier is announced. The model 345 is a low-cost, compact unit that is said to combine the features, power, and performance of more expensive separate components. Incorporated into the unit are three new circuits: (1) Low-impedance symmetrical drive, for more power down to the important low frequencies, lower distortion, cooler operation, and complete stability with any speaker load. (2) Series-Gate Time-Switching multiplex for ultimate stereo suppression-limiting for effectively suppressing impulses from such separation and presence. (3) Pulse-sources as automobile ignitions, apartment house elevators, and re-

frigerators. Price under $3.50. H. H. Scott.

FUSEHOLDER 204

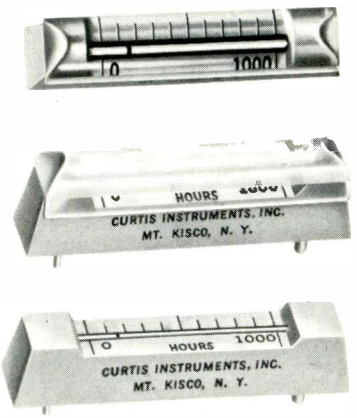
A miniaturized panel mounted fuseholder is only 1⅝ in. long, and extends just 29/32 in. behind panel

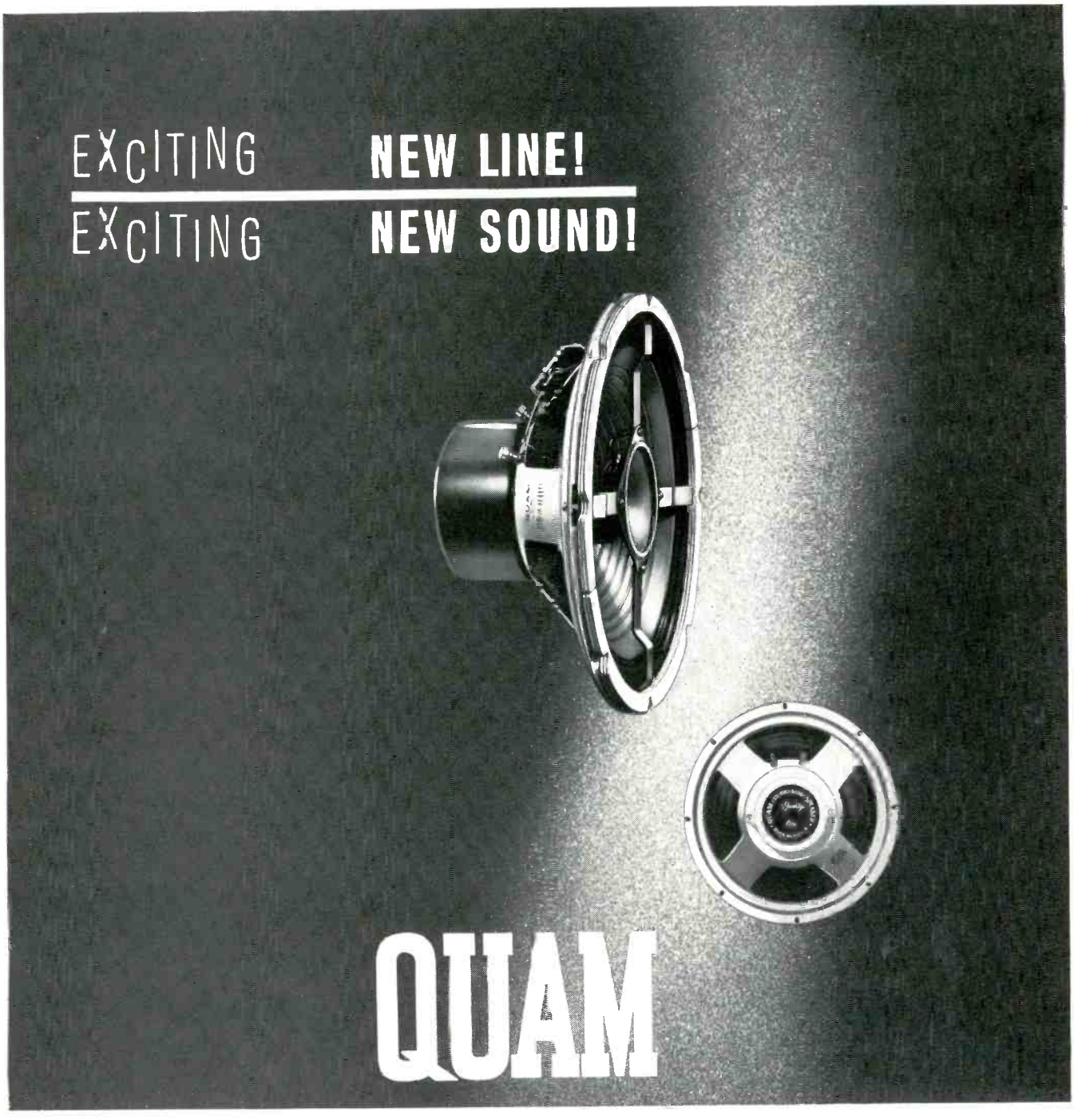


front. It takes ¼ x 1¼ in. fuses and can easily be converted to take 9/32 x 1¼ in. fuses simply by changing the screw type knob, the maker announced. Bussmann.

MAGNIFYING LENS 205

A snap-on magnifying lens for use with the Indachron miniature elapsed-time meter is now being offered. It is claimed that this lens provides approximately 3x indicator and scale magnification and is fabricated of scratch resistant lucite. Curtis Instruments.





FULL FIDELITY HI-FI SPEAKERS

Slim-line styling! Ceramic magnets! Superb reproduction over the full audio spectrum! Complete choice: coaxials, extended range, tweeters, woofers! The new Quam hi-fi line is as modern as tomorrow—and it's designed to offer the *serviceman* a top-quality product at a *list* price that's lower than others' "audiophile net." (Quam never advertises net prices—to protect your mark-up!)

Use Quam Hi-Fi Speakers in new systems, as extension speakers in existing hi-fi systems, and as replacement improvements in stereo consoles. They'll open your way to exciting new sales!

Write for your free copy of the new Quam Hi-Fi Catalog HF-64.

QUAM-NICHOLS COMPANY • 234 East Marquette Road • Chicago, Illinois 60637

- - - for more details circle 27 on post card

NEW PRODUCTS

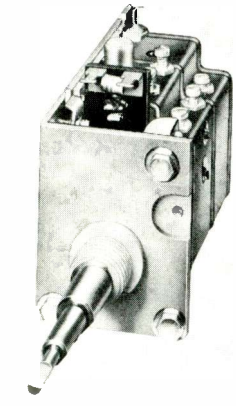
PA SYSTEM 206

Introduced is a portable PA music system said to be no larger than an over-the-shoulder pocket

book. The Model MVS-5 is capable of amplifying both voice or music to a full eight watt sound output which gives it an effective range of approximately 600 yards, the announcement said. The system is fully transistorized and comes complete with a high quality dynamic microphone and coil cord. Separate inputs for microphone or music sources are included. Weighing less than ten pounds and measuring 11 x 8 x 4 in. the system makes a very handy companion for lectures, guided tours, square dances and general outdoor social and civic functions, the maker said. Price $112.50, complete with microphone and carrying strap. FANON-MASCO.

UHF TUNER 207

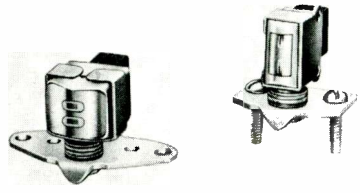
Introduced is a UHF tuner with an automatic frequency control.



The tuner is a detenting (indexing) type which snaps in each of the 70 channels on the UHF band, the same as VHF tuners. The detented feature contrasts with continuous tuning. Oak Mfg.

REPLACEMENT TAPE HEADS 208

Tape head replacement units for Sony models 101, 262-D and 262-SL decks and recorders are an-



nounced. These American-made heads are available in all track styles. Head kit contains the laminated head, mounting hardware, replacement pressure pad material detailed easy-to-follow illustrated instructions and everything else needed to make the installation, it was said. Nortronics.

MOBILE TRANSCEIVER 209

A compact 15 w two-way mobile radio unit for use in the 148-174 Mc band is announced. Specifically

produced for "business radio" users, the ten-in. two-way unit has been designated as the SPOKESMAN, Type M-810. It is said the unit features interference-free communication, reduction of harmonic radiations, hand-wired chassis, gold alloy antenna relay contacts with dust-tight enclosure, and moisture-fungus proofing. Price $369. Du-Mont Laboratories.

CONTACT CLEANER 210

An aerosol spray, CO contact cleaner, is said to instantly clean electrical and electronic equipment. It provides an easy and economical

method of removing dirt, dust, grease and other foreign material to give like-new performance to high-precision electronic instruments and components, according to the report. Available in handy 4-oz cans equipped with 6-in. plastic tubes. Corrosion Reaction Consultants.

PORTABLE TV 211

A 19-in. portable TV receiver complete with OFF/ON TV sleep timer and earphone attachment with 15 ft cord, is announced. The CRT is aluminized with built in optic filter. Other features are front-mounted channel indicator, tone control, fine tuning control, dipole antenna and all-frame grid VHF turret tuner. Also available as the UP9640 series with two-speed transistorized UHF continuous tuner. Offered in a choice of black or white finishes with silver-golden trim. Admiral.

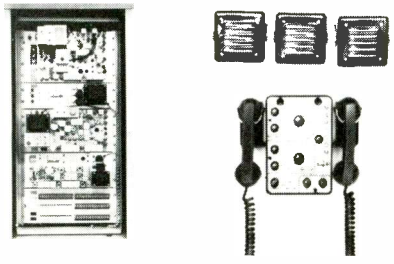
ANTENNA 212

A fiberglass encased antenna, weighing eight pounds, is developed for two-way radio base stations operating in the 25 to 50 Mc range. It is said the antenna was designed to improve message reception and transmission by minimizing static noise interference generated by charged dust and rain particles. Capable of handling as much as 500 w RF power, the antenna provides a vertically polarized, omni-directional pattern. The antenna without whip stands 136 in. high. Price $86.75. Motorola.

NEW PRODUCTS

RADIOTELEPHONE 213

A marine radiotelephone for large pleasure craft and commercial vessels has been introduced. The



system, known as MARICOM, provides all of the communications requirements of most vessels. It consists of radio transmitters and receivers inside a weatherproof equipment cabinet designed for bulkhead mounting and a remote control unit. A system can be equipped to provide any or all of various available services, the report said. A single sideband/compatible-AM transmitter-receiver for operation on up to six channels in the marine bands in the 1.6-30 Mc range is installed in the cabinet. For communicating with ships and shore stations equipped with conventional AM radio equipment, the unit is operated in the compatible-AM mode. Communications Co.

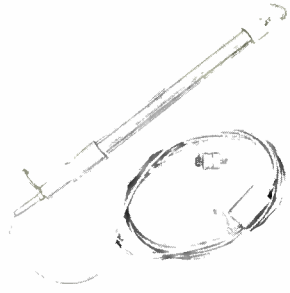
CB TRANSCEIVER 214

A CB transceiver is added to this line of transceivers and testers. Known as 1250, the hand-wired chassis is modular constructed. It is said that sensitivity is better than 0.3 μv for 10 db S+N/N ratio, and adjacent channel rejection 30 db. A silicon rectifier full wave

bridge provides power. Power requirement 115 vac or 12 vdc. Audio output 3 w; RF power output 3.2 w or better. Size 4 x 6¼ x 10 in. Weight, 11 lb. Hallmark.

FLUORESCENT HAND LAMP 215

A compact, heavy duty, trouble light, said to give maximum light, at minimum cost, is announced.



Company engineers state that the "SAFETY YELLOW" Fluorescent hand lamp delivers from 80% to 140% more lumens than other comparably-sized hand lamps. The lamp is offered in either 14 or 15 w size, and with 25, 35 or 50 ft cord. Daniel Woodhead.

BATTERY DISPLAY 216

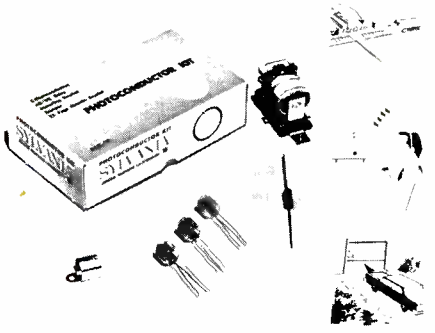
A hardwood transistor battery counter display that shows the six most popular transistor radio bat-

teries and the radios they power, is announced. The display, which measures 12¼ x 15 x 13½ in., goes to the dealer free with the purchase of the batteries. The dispenser tray keeps batteries neat and orderly and simplifies stock control, the report said. Ray-O-Vac.

POWER CONTROL 217

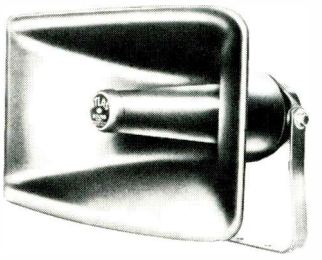
A solid state source of continuously variable ac power is announced. The unit operates directly from the 115v 60 cps line and controls as much as 500 to 1000 w from zero power to 100% rated power by rotation of a calibrated single turn dial, the report indicated. Control Research.

PHOTOCONDUCTOR KIT 218



A basic photoconductor kit, ideal for electronic hobbyists and experimenters, is announced. The kit includes three photoconductors with moisture detecting blue dots that turn pink if hermetic seal is broken, a Sigma ac/dc relay, a 22KΩ 1 w resistor, mounting bracket, and a 52-page circuits booklet describing a variety of practical applications. Price $9.95. Sylvania.

PROJECTOR SPEAKER 219



Announced is an all purpose wide angle projector, CJ - 44, complete with super power driver with a continuous power rating of 40 w. The horn

NEW PRODUCTS

is of all weather fibre glass construction. Impedance 16 Ω, response 115-12,000 cps. Dispersion 120 x 60 deg, bell opening 23 x 13 in., overall length 19 in. Atlas Sound.

TWIN STEREO MIKES 220

Two matched cardioid dynamic microphones, model 500, are announced. The package was specifically designed for sale to owners of high quality tape recorders and as an add-on item for the audio dealer to suggest when making the

initial recorder sale, the maker said. The microphones come complete with plugs to match most stereo recorder inputs, so that the dealer can sell the package "as is" to his customer without fussing with connectors. Set $99.50. Turner.

CAPACITORS 221

A special capacitor service deal, the No. 150 V-V, is announced. It consists of 150 dipped mylar-

paper capacitors, 600 wvdc, in thirty 5-pak transparent bags. Dealer net price of $24.95 reflects a discount of more than 50% from the list price of the capacitors and includes a Vacu-Vise free—listing at $6.95, according to the maker. Arco.

NEW LITERATURE

HAND TOOLS 300

This 16-page catalog lists and describes a full line of tools—cutters, pliers and wrenches—for electronic technician and general use. Diamond.

ALL-PURPOSE TRUCK 301

A 16-page, full-color catalogue details a compact, all-purpose motor truck. Six cab and body styles plus four types of seat arrangements are shown, including optional equipment items and attachments. International Harvester.

WIRE & CABLE 302

A 52-page catalog details more than 7,000 items available from stock including two pages of coaxial cable manufactured to military specifications. Also illustrated are many wire cable items, including control and instrumentation cable, flat ribbon cable, unshielded control cable, and U.L. hook-up wire. Alpha Wire.

TWO-WAY PRICE SCHEDULE 303

This list briefly describes a line of CB equipment and accessories, including user net prices. Antennas, test equipment, mounting brackets and rechargeable batteries are also included. Pace Communications Corp.

TRANSISTORIZED INVERTER 304

Specification sheet describes a 40-w continuous duty inverter for operating 115 vac record players, dictating machines, radios, tape recorders, electric razors, etc. in auto, boat or camp from 12.6 v storage battery. Merit.

STEREO TAPE RECORDER 305

A 4-page brochure describes and gives complete specifications on a joy-stick controlled stereophonic tape recorder which has three separate heads, digit counter and automatic shutoff. Newcomb.

CERAMIC CARTRIDGES 306

A 4-page brochure lists and describes three stereo ceramic cartridges which are said to offer new safety features to protect records and needles. Sonotone.

. . . UNWANTED OSCILLATIONS

Continued from page 53

is bypass and decoupling capacitors when confronted with unwanted oscillations. Missing tube shields can cause no end of trouble. Careless handling of lead dress, especially in high frequency circuits, is a good way to breed "dogs." High resistance RF ground connections on shields and printed boards cause trouble, too. A quick but *precise* check of these items will quickly locate about 90 percent of the troubles caused by feedback. So there you have it. What approach could be simpler?

But what about the other 10 percent—the one case out of ten? You follow fundamental troubleshooting precedure—isolate the fault—locate the feedback loop first. The loop will usually consist of two or four tubes and associated circuitry. It is usually easy to determine the part of the circuit picking up the signal returned from later stages. This area can be located easily in parallel heater circuits by beginning at the input and pulling tubes stage by stage until the symptoms disappear.

After the pick-up stage has been located, the input (grid of the tube or base of a transistor) can be bypassed to ground through a 0.5 μf capacitor to determine if it is picking up the feedback. If the symptom disappears, chances are good that it is. Sometimes a cathode or plate lead will be the offender. To locate the pick-up stage in a series string heater circuit, connect the capacitor to the input of each stage—beginning near the input stage—until the feedback symptom disappears.

Once the pick-up stage is located, the "antenna" for the loop can be eliminated. Simple repositioning of grid leads may do the trick. Replacing them with shielded wire is occasionally necessary. In pentodes a poorly grounded suppressor grid can cause some weird symptoms. Remember also that an open screen bypass can cause regeneration, but an open cathode bypass causes degeneration.

The source of feedback is usually inductive, but may very well be capacitive or mechanical. Mechanical coupling creates only audio symptoms. If the audio detector is inside the loop, monitoring the voltage at its output can offer clues. Starting at the input following the detector stage, ground successive points along the signal path. As long as the point is within the loop, the voltage at the detector will drop sharply. The first point that does not cause a voltage change at the detector is probably just outside the loop.

Once the point of radiation has been pinpointed, leads can be rerouted or shielded. If the loop is entirely audio, a scope connected near the pick-up point can be used to indicate the end of the loop in much the same manner as measuring detector voltage. RF loops can usually be treated in a similar manner by using a detector probe. When a scope is used here, the wave-shape or voltage is not important. The thing to watch for is a change or lack of change in the amplitude. When points inside the loop are grounded through a capacitor, the amplitude will decrease markedly. Points outside the loop have little effect on the amplitude.

The application of circuit theory and well-known troubleshooting techniques can help control those "dogs" caused by unwanted oscillations. ■

SYNC ON BUSINESS

Inverters are in season now and every TV shop should stock a few. Not only campers and sportsmen but businessmen as well can find use for 115 vac in their car. Carry some literature and at least one unit with you on house calls.

Skilled TV-radio technicians earned from $100 to $115 a week in 1962, according to limited information obtained by the U. S. Department of Labor. Some technicians earned as much as $150 a week, however. Starting pay was about $65 to $75 a week the report said.

No bites, no fish, may be one of the complaints you'll be getting soon. The latest gadget to help catch fish uses a transistor transmitter unit which is kept in the boat and is connected to a submerged transducer that lights up and emits low-frequency sounds which bring fish to the vicinity. The unit is called TR-Sonic Fish Call.

Test equipment can be purchased anytime but you may find it more profitable to buy *now*. Many distributors who are preparing to stock equipment manufacturers' new lines are now in a mood to offer regular customers more liberal discounts on last year's items.

Poison Ivy can be almost crippling, as anyone who has had it can tell you. And servicing TV sets might be almost impossible with it. Although the highest incidence of poison appears in the spring, it can be contracted at anytime. Just because you've never had it does not mean you won't get it. If you're planning an outdoor vacation or a jaunt in the woods, you may find "Poison Ivy, Poison Oak and Poison Sumac," a 15¢ booklet issued by the Superintendent of Documents, Washington, 25, D. C., a good investment. And while you're at it, "Camping," a 20¢ booklet from the same source, describes some of the outstanding attractions which can be seen and enjoyed on national forests and grasslands.

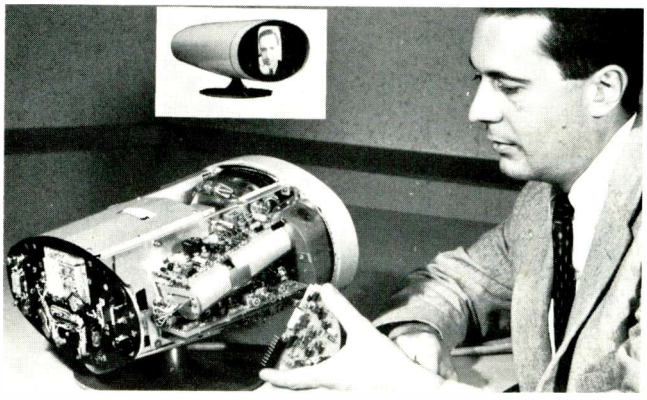
CBS color programing will be heavier this fall according to a network official. Although not planning a regular color schedule, it is understood the network will offer more specials than in the past. Here's another opportunity to cash in on color set sales. Many consumers are only waiting for more programing to buy color TV sets.

Ultrasonic cleaners are becoming more practical for TV shops as prices decrease and small-unit capabilities increase. Fighting the dust and dirt in a tuner or PC board may soon be a thing of the past when technicians just drop entire units—maybe even whole TV sets—into an ultrasonic cleaning tank.

Traffic accidents in the U. S. took a record 42,700 lives in 1963 as motorists raced helter-skelter down the nation's highways. More than 3,460,000 were injured. The death toll topped the nearly 40,000 persons killed in 1941—a record high which stood for twenty years—and even surpassed the new record of 40,500 deaths established in 1962. Men and women under age 25 had the worst record of any age group. Of the 42,700 persons who lost their lives, 34,700 died in accidents caused by driver error and traffic law violations.

Retractable phono cartridges are being added to manufacturers' lines this summer and fall. In most cases a few basic types can be installed in almost any tone arm in a few minutes. This should be an easy item to push on service calls since it is an almost guaranteed record saver.

See-as-you talk telephone service was recently demonstrated by the Bell Telephone Laboratories. A circuit is set up between the New York World's Fair



and Disneyland in Anaheim, California. To make a Picturephone call, the caller sits about three feet from the set's screen.

. . . TUNNEL DIODES

Continued from page 65

the cathode of TD2 in the next stage to switch it to the high-voltage state.

If the first stage is in the low-voltage state, a positive-going pulse is allowed to pass via the backward diode, D2, and capacitor C2 to the monostable circuit. This positive pulse triggers the tunnel diode to the high-voltage state. The resulting positive voltage pulse is amplified and inverted by the transformer and passed to the anode of TD2 in the next stage to switch it to the low-voltage state.

If the required triggering voltages are to be small, it is desirable to have R3 and R4 as small as possible. With the 1.5-v supply used, a potential divider circuit, R1 and R2, must be used. By making R2 variable a convenient method of adjusting the bias points of the tunnel diode is obtained. ■

. . . METER RELAYS

Continued from page 67

range. It provides faster control action than is possible with automatic interrupters because it eliminates the delay inherent with periodic locking and unlocking of a meter relay while a signal is sampled. Its corrective action is steady instead of pulsing.

The circuit includes two meter-relays—one a double contact model, adjusted for both high and low error, the other a single-contact model on which a control point can be preset anywhere between the high and low limits of the other meter relay.

In operation, when a signal rises or drops to either of the limits on the double-contact meter, a relay is tripped and action is initiated to return the signal to the point desired. When this point (set on the single contact meter) is reached, another relay is tripped, causing the first relay to unlock and stop the original corrective action.

The single-contact model can be adjusted to "coast" the signal back to the control point. This feature tends to prevent overshoot while the signal is being corrected.

A single load relay can be used for both high and low limits on a double-contact meter relay, and it can be made self-releasing. ■

broadcast equipment to provide on-the-spot coverage of outdoor news and sports events. The camera is made by Cohu Electronics, Inc., Kin Tel Division.

Zenith Earnings Up

Profits of Zenith Radio Corporation for three months ended March 31, 1964 amounted to $5,845,000, or 63¢ per share after estimated provision for Federal income taxes of $6,078,000. This represented a 15% increase over the record first quarter earnings reported in 1963 of $5,063,000, or 56¢ per share on the shares then outstanding. Sales of $102,663,000, an all-time high for any quarter, were 11% above the previous record of $92,267,000 set in the first quarter of 1963, and marked the first time in the Company's history that quarterly sales had exceeded one hundred million dollars. Color television contributed significantly to Zenith's record first quarter sales volume. Distributor sales to dealers of Zenith color television receivers during the first quarter were approximately double the year earlier.

'Rubber Necking' Automated

Greyhound At The World's Fair, Inc., has selected United Data Control to supply their "Travel-Talk" automatic announcing equipment for use in the public transportation vehicles at the New York World's Fair, according to Sam Gilman, President of UDC. United Data Control supplies recording and reproducing equipment to the airlines, and has installed automatic announcing systems in some of the major airport ter-

NEWS OF THE INDUSTRY

Channel Master Motion Overruled

On April 9, 1964, Judge Frank A. Hooper overruled a Motion of Channel Master Corporation to strike the demand of Kay-Townes Antenna Company for a Jury Trial with respect to the allegations of Kay-Townes' Counterclaim in patent litigation between Channel Master Corporation and Kay-Townes Antenna Company.

CATV Survey

A survey of the National Community Television Association indicates that 93 CATV systems located in 32 states receive the signals of 33 educational television stations located in 24 states and the District of Columbia; serve 156,172 students in 418 elementary, junior and senior high schools and 17 institutions of higher learning located in 170 separate communities. The 33 ETV stations received by CATV systems represent 76% of the ETV stations which operate in areas where CATV systems are located, the report said.

'Tote' Camera

A 3-in. diameter portable television camera weighing just 4½ lb, has been adapted for use with standard

partments ready for cooking. The control unit at the heart of AMFare System is known as ORBIS—"Ordering and Billing System"—an electronic console ordering device which prints a check at the order assembly area, computes totals and sales taxes, delivers the check for each order to the assembly point, and activates the menu producing machines.

Electronics Merit Badge

Robert W. Sarnoff, chairman of the board of the National Broadcasting Company, honored 32 Boy Scouts of New Jersey and New York who are the first to qualify for the new Boy Scout merit badge in Electronics. One of the first to qualify is Kipp Heacock, of 38 Wittmer Court, Princeton, New Jersey.

Rectangular Color CRT

The Radio Corporation of America Television Picture Tube Division is demonstrating its new 25-in., 90-deg rectangular color TV tube to set manufacturers.

Sylvania Sales Up

Sylvania Electric Products Inc. announced that its television factory sales for the first quarter were 20 percent ahead of the same period of 1963 and was its best first quarter for TV sales since 1959. Sylvania is a subsidiary of General Telephone & Electronics Corporation. Robert J. Theis, President, Sylvania Home & Commercial Electronics Corp., a marketing subsidiary of the company, attributed the sales increase to continued improvement in Sylvania's distribution pattern.

...New Developments in Electrical Protection

minals. All transportation at the Fair will be provided by Greyhound At The World's Fair, and the "Travel-Talk" equipment will be aboard their specially-constructed grand sight-seeing tour busses and glide-a-ride segment tours. The "Travel-Talk" announcing system is operated by the driver from a remote control unit in the cab and is completely automatic in operation, requiring only push-button action to play the selected announcement.

Automated Kitchen

A system for automating the ordering, billing and preparing of food in "limited menu" restaurants was disclosed today by American Machine & Foundry Company. According to Carter L. Burgess, AMF chairman, the new automation development known as the AMFare System will fill needs in the growing roadside "drive-in" restaurant industry for methods to guarantee (1) food preparation of high quality and uniformity, (2) food savings, (3) inventory and dollar control. He said that the system should also accelerate the industry's expansion at a rate now restricted by shortage and retention of qualified labor. Capable of preparing and serving a complete meal in four minutes, the AMFare System has been designed initially to make and dispense the six principal groups of food and drink items of the "limited menu" industry including: (1). Hamburgers. (2). Fried entrees (chicken, shrimp, fish). (3). French-fried potatoes. (4) Hot dogs. (5). Milk shakes. (6). Mixed carbonated drinks. Fresh foods and meat are dispensed from refrigerated com-

ADVERTISERS INDEX

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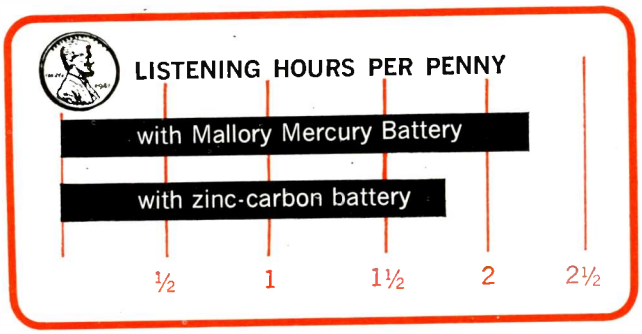
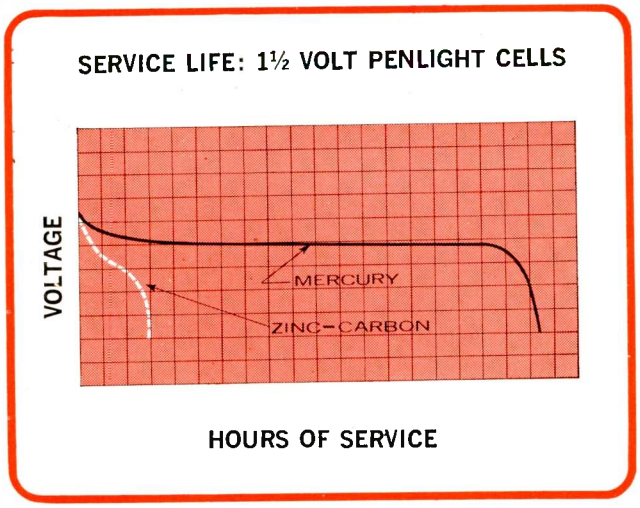
MALLORY

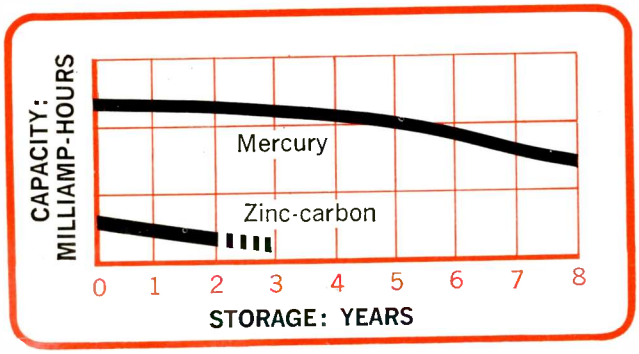
Tips for Technicians

Mallory Distributor Products Company
P.O. Box 1558, Indianapolis 6, Indiana
a division of P. R. Mallory & Co. Inc.

Why Mallory Mercury Batteries work better in transistor radios







There are a lot of good reasons why more and more people are using mercury batteries in their transistor radios. And the reasons boil down to this—they're a better value, and they give better performance.

To get a comparison between mercury batteries and ordinary zinc-carbon batteries, let's look at a typical transistor radio. This radio uses size "AA" penlight batteries and has a current drain of 15 milliamperes. The Mallory Mercury Battery is the ZM9 and the zinc-carbon type would be the NEDA type 815. The ZM9 retails for 75¢ versus 20¢ for the 815. Got the picture?

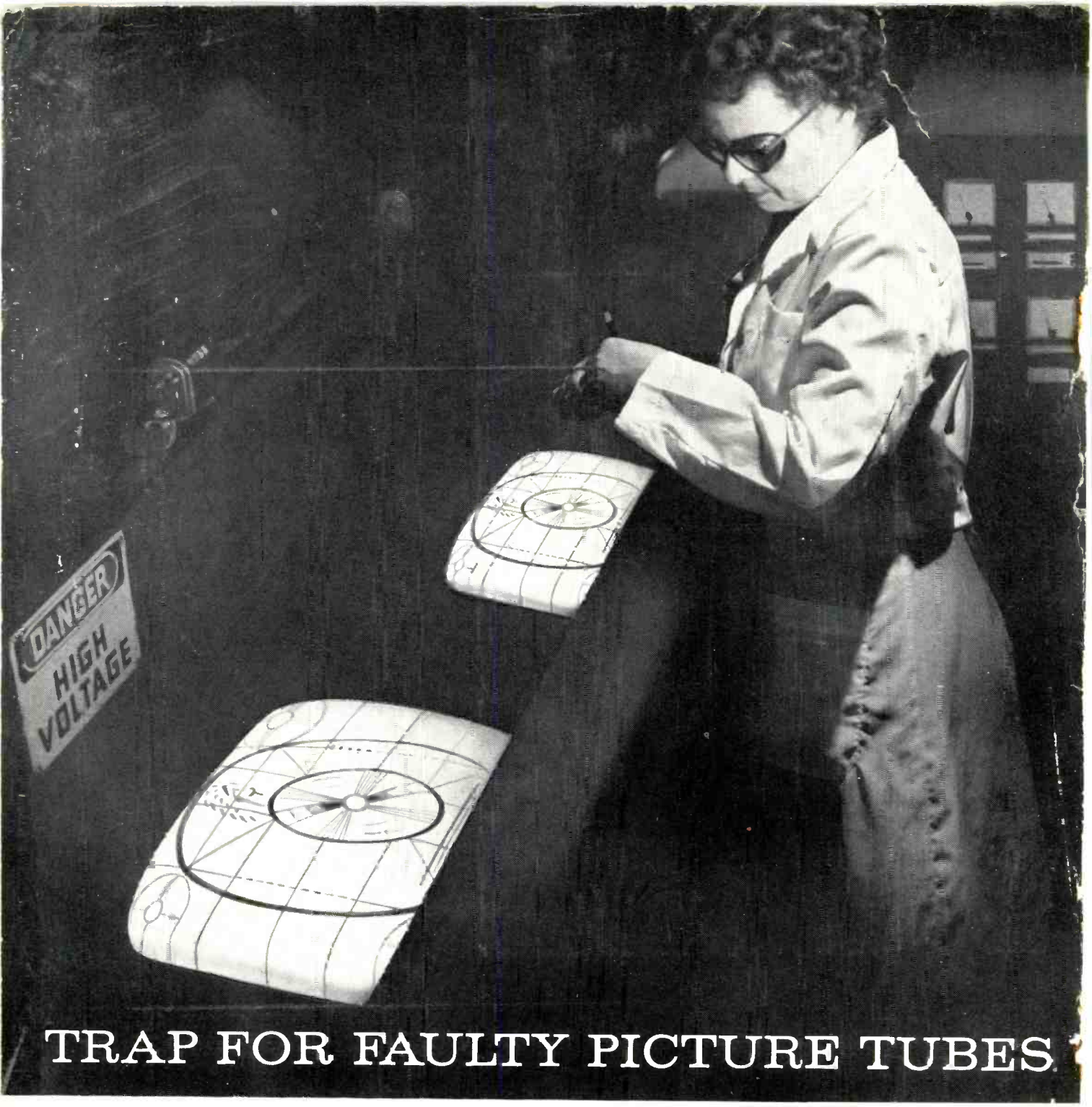
Here's where the fun begins. The ZM9 will operate the radio for 165 hours versus only 35 hours for the zinc-carbon battery. This means that for one penny you'll get 2.2 hours of listening pleasure using the ZM9 versus 1.75 hours for the zinc-carbon battery. In other words, it costs you 0.57 cents per hour to use the zinc-carbon compared to only 0.45 cents for the mercury battery.

We're not through yet. Let's get back to *listening pleasure*. The mercury battery has essentially a flat discharge curve. This means that it presents a more constant voltage to the transistors. Result: you don't have to keep turning the volume control up while you're listening AND the radio *sounds* better because there's far less distortion.

Had enough? There's one more important point. Suppose you put the batteries in the radio and use it only slightly. Those 20¢ zinc-carbon batteries go "dead" in a few months whether you use them or not. But the mercury batteries can be stored 2 to 3 *years* and still deliver dependable power. Plus the fact that Mallory Mercury Batteries are guaranteed* against leakage in your transistor radio.

We've used this "Tip" to illustrate the superiority of Mallory Mercury Batteries in transistor radios. But this superiority extends to *thousands* of other applications. So whether you're building test equipment, heart-pacers, or satellites, see your Mallory Distributor. He has a Mallory Mercury Battery that will do exactly the job you want done.

**We guarantee to repair the radio and replace the batteries, free of charge, if Mallory Mercury Batteries should ever leak and damage a radio set. Send radio with batteries to Mallory Battery Company, Tarrytown, New York.*



TRAP FOR FAULTY PICTURE TUBES

RCA Guards Against Callbacks 26 Ways

Under the watchful eyes of trained inspectors, RCA Silverama® Picture Tubes are carefully scrutinized for screen quality and focus.

All Silverama replacement picture tubes as well as those destined for original equipment undergo a battery of 26 automated tests. These include: warm-up, emission, gas, leakage, electron-gun performance, and other critical factors that can spell the difference between long-term performance or costly callback. Tubes failing a single test are automatically tagged and rejected. In addition to automatic testing, every tube lot leaving the RCA plant has been sampled by Quality Control.

Nothing is left to chance; part by part, inside and out, from base to faceplate the quality of each tube has been carefully controlled and assured prior to assembly. Even the Silverama envelope is carefully inspected prior to re-use, and is internally scrubbed, buffed, and restored to the peak of its optical capabilities. Result: a superior picture tube, an RCA Silverama. Make it your next installation choice.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N. J.

The Most Trusted Name in Electronics

CARRY EACH SILVERAMA FACTORY-FRESH INTO YOUR CUSTOMER'S HOME. New Foam-Lined RCA Picture Tube Tote Bag makes scratched, marked, or scuffed faceplates a thing of the past. Makes carrying both easier and safer. Two sizes: one for 16" to 19" tubes, one for 20" to 24" tubes.

SEE YOUR AUTHORIZED RCA PICTURE TUBE DISTRIBUTOR FOR DETAILS