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highlights of 1963 TV lines

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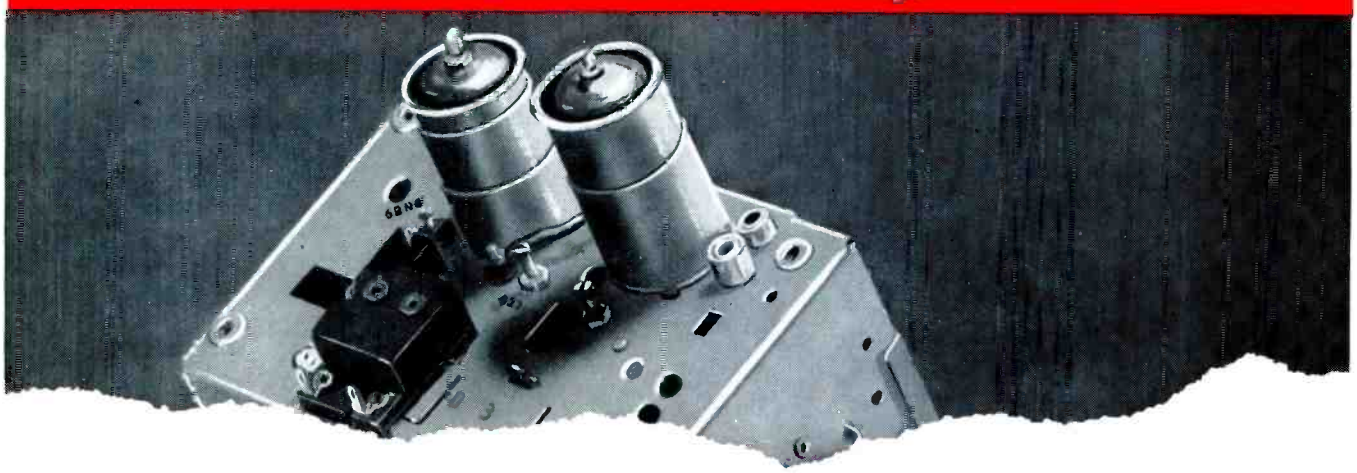

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highlights of 1963 TV lines

What's different about the new TV receivers now appearing on the American scene? You should know about these current trends:

Sales of 19″ sets have climbed sharply. Two distinct types are found in most manufacturers' lines; "portables" tend toward slim briefcase styling and simplified circuitry, while "compacts" have more squarish lines and use circuits like those in big consoles.

The 21″ and 24″ screen sizes have just about disappeared. The 23″ doesn't go unchallenged, however; 10 manufacturers now offer "king-size" sets with 27″ screens. In some of these giants, 110° deflection helps reduce cabinet bulk.

Low-voltage rectifier tubes appear to be on their way out, as more and more manufacturers adopt silicon-rectifier voltage doublers even in transformer-powered sets.

The three-stage IF strip may also be on the wane. Super-high-gain tubes such as the frame-grid 6EH7 and 6EJ7, aided by "hot" RF-amplifier and video-output tubes, are making it possible to omit one IF stage without sacrificing performance. The swing back to DC-coupled video amplifiers is also gathering momentum.

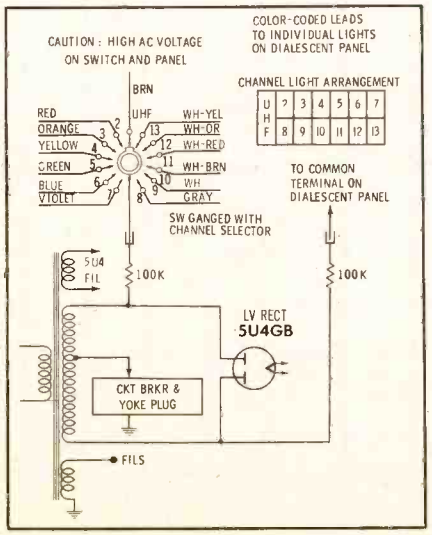
Many wireless remote controls now have transistorized remote-receiver circuitry. For information on troubleshooting this equipment, see the article on page 32 of this issue.

The new color receivers will be described in the November PF REPORTER, which will be an "all-color" special issue again this year. For now, we'll concentrate on presenting thumbnail sketches of all the black-and-white TV lines.

ADMIRAL

Few changes have been made from the '62 lineup. *Thinman* portables now use a 16A3B or -B3B chassis; remote-equipped versions, called *Sportsman* models (pictured here), use the 16C3U or 16D3U. Compact 19″ sets are the manually-tuned *Spectator* (Chassis 16F3B) and remote-controlled *Viceroy* (Chassis 16G3U).

In both classes of 19″ receivers, the models with remote control have a turret tuner; others feature a new wafer-switch tuner with a 2- or 6FS5 *shadow grid* pentode in the RF stage. The latter tuner is also found in the 19E8B group of 23″ sets, but all other 23's have a new *DX-40* turret tuner with a 6DS4 RF amplifier (a remote-cutoff nuvistor). VHF models equipped with the DX-40 can be adapted to UHF by either adding from one to four channel strips, or installing an all-channel UHF tuner available as a conversion kit.



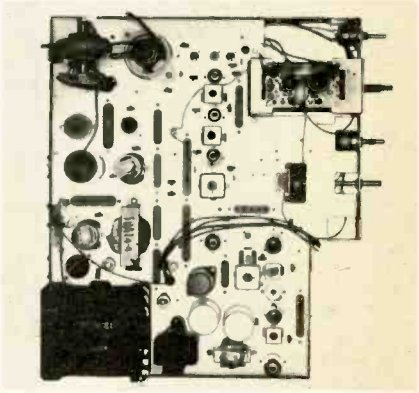
All chassis except the 16F3B and -G3U have a 'BU8 AGC-sync tube in place of the 6K11 compactron featured last year, but the octal damper used in '62 has been superseded by a 6- or 12AX3 compactron. Another new 12-pin type, the 12GE5, serves as a horizontal output tube in portables. In 23″ models, picture-signal gain has been increased by substituting a 6DK6 for the 6CB6A previously used as a third IF tube.

A special feature of the 21N3U chassis is a *Digital Tuning Control Center*, with 13 *Dialescent* (electroluminescent) panels providing illuminated channel numbers. Power is applied to one panel at a time through the switch shown in the schematic, which is ganged with the channel selector. To simplify circuit tracing, the wires to the panel are color-coded in the same color sequence as used on resistors.

Chassis used in combination sets, the 21S3U and -T3U, are like the other new 23″ types except for differences in the audio circuits. The 20T8 in 27″ models (covered in PHOTOFACT Folder 593-1) is similar to last year's 20A8 chassis. Color sets are also offered.

CURTIS MATHES

Two differently-shaped chassis with almost identical circuits are now in production. The 10A is long, narrow, and horizontally mounted, like the Chassis 6D pictured in August, 1962 *Previews of New Sets*. On the other hand, the 9A shown



here is more nearly square in shape, and is mounted vertically on one side of the cabinet.

Several circuit changes have been introduced this season. The two-stage video amplifier (6U8 triode section and 12BY7) of past models has been replaced by a single-stage, high-gain circuit using a pentode section of a 6GN8. In the 9A, this stage drives a 23AWP4 picture tube, a low-Eg2 type which requires less video-signal input than its 23AHP4 predecessor.

Elsewhere in the new sets, an octal 6EM7 vertical output tube takes the place of the former 6DE7 or 6EW7. The combined functions of AGC keying, noise limiting, and sync separation have been taken over by a new 6KA8 triode-pentode. For a description of a similar 6KA8 circuit, turn to the RCA section of this article.

Some of the new Curtis Mathes chassis have a 6BQ5 audio output tube. Others, designed for use in combination models, feed audio through the high-fidelity phono amplifier circuits.

DU MONT

Chassis 120629 through -34, in the new "900" Series of 23″ and 27″ sets,

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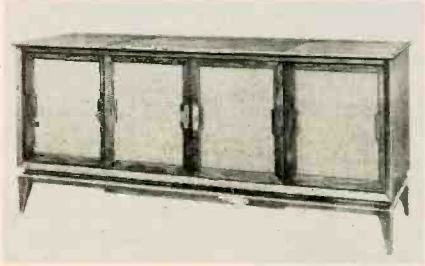
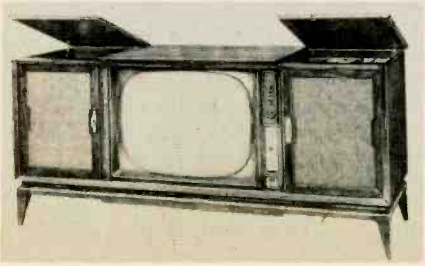
CHASSIS NO.	CRT TYPES	DEG DEF	BOND SHLD	PWR XFR	B+ RECT	TUNER TYPE	DC CPL	NO. IF	HAFC TYPE	KEY AGC	NOI LIM	WIDTH CTRL	PROTECTED CIRCUITS PRI	SEC	SIL	FIL	REM AVL
ADMIRAL																	
16A3B, -B3B, -C3U, -D3U	19XP4	114			Sil dblr	*	✓	2	CC	BU	BU	sleeve			brkr		✓
16F3B, -G3U	19XP4	114		✓	5U4GB	*	✓	2	CC	Tr	Tr	sleeve		brkr		link	✓
19E8B, -F8B, -G8B, -J8B	23BTP4	92	✓	✓	5U4GB	SS	✓	3	CC	BU	BU	sleeve		brkr		link	
21K3U, -L3U, -M3U, -N3U	23BTP4	92	✓	✓	5U4GB	TN	✓	3	CC	BU	BU	sleeve		brkr		link	✓
CURTIS MATHES																	
9A	23AWP4	92		✓	Sil dblr	SS		3	CC	P	*		fuse		fuse	link	
10A	NA	92	NA	✓	Sil dblr	SS		3	CC	P	*		fuse		fuse	link	
DU MONT																	
120591, etc.	17DKP4	110		✓	5U4GB	SG		3	CC	BU	BU	coil		fuse		link	✓
	19AVP4	114															
120629, etc.	23AFP4; 27ACP4	92	✓	✓	3DG4	TG		3	T-D	BU	BU	coil	brkr	*		link	✓
EMERSON																	
120619, etc.	17DKP4	110		✓	5U4GB	*		3	CC	BU	BU	coil		fuse		link	✓
	19AVP4	114															
	23CP4; 27ADP4	110	✓														
GENERAL ELECTRIC																	
QX	16ATP4	114	*		Sil dblr	SS		3	T-D	Tr		coil			brkr		
LX	19CFP4	114		✓	5U4GB	SS		3	T-D			coil	fuse	*		link	
MX	19CKP4; 23DBP4	114		✓	Sil dblr	SG	✓	3	CC	Tr		coil		fuse		link	✓
MAGNAVOX																	
35 Series	23ASP4; 24AUP4; 27XP4	90		✓	Sil dblr	TG		3	S	P		coil	brkr			link	✓
36 Series	23MP4	114		✓	Sil dblr	TG		3	S	P		coil	brkr			link	✓
	24AHP4; 27ZP4	110															
38 Series	19BTP4	114		✓	Sil dblr	TG		3	S	P		coil	brkr			link	✓
MOTOROLA																	
TS-449	19CHP4	114			Sil HW	SG		2H	CA	P	Tr	jumper			brkr		
TS-578	23DAP4	94			Sil HW	SG		2H	CA	P	Tr	coil			brkr		
TS-581	19XP4	114		✓	5U4GB	SG		3	T-T	BU	BU	pot	brkr				✓
	23AHP4	92															
	27YP4	90															
TS-584	19XP4; 23MP4	114		✓	5U4GB	SG		3	T-T	BU	BU	pot	brkr				✓
	27ABP4	110															
	23AHP4	92															
	27YP4	90															
MUNTZ																	
T36 ("19 Met")	19CLP4	92			Sil HW	SS		1	CC						FR		
T37 ("J Series")	23CP4	110			Sil HW	TG		2	T-D						FR		✓
	19XP4; 23MP4	114															
27"	NA	110	NA	✓	5BC3	NA	✓	3	T-D	P	*			brkr		link	
OLYMPIC																	
10119	19XP4	114			Sil dblr	SG		3	T-D						fuse		
MM, MT	19XP4	114			Sil dblr	SG		2	CC						brkr		
MA	23AHP4	92		✓	5U4GB	SS		2	CC					fuse		link	
MB	23AHP4	92		✓	5U4GB	SG		2	CC	BU	BU		brkr				
	27XP4	90															
ME	23AHP4	92		✓	5U4GB	SG		3	CC	BU	BU		brkr				
	27XP4	90															
PACKARD BELL																	
88-14; -15	19YP4; 23BTP4; 23MP4; 24AHP4	*		✓	5U4GB	TG		3	CC	Tr	Tr	coil	brkr				✓
98D16, -C	23CP4	114	✓	✓	3DG4	TG		3	CC	P	Tr	coil	brkr				✓
	23BTP4	92	✓														
PHILCO																	
13J27	19ABP4	114			Sil dblr	SG		2H	CC	Tr	Tr	jumper			FR		
13J28	19ABP4	114			Sil dblr	SG	✓	2H	CC	Tr	Tr	pot			FR		
13J41, -2, -3, -5	19BLP4	114		✓	Sil dblr	SG	✓	2H	CC	P	Tr	*			FR	link	✓
13N50	23BVP4	92	✓	✓	Sil dblr	SG	✓	3	CC	P	Tr	*			FR	link	
13N51, -2, -3	23BNP4	110	✓	✓	Sil dblr	SG	✓	3	CC	P	Tr	*			FR	link	✓
RCA																	
KCS 140	19AYP4	114		✓	Sil dblr	SN	✓	3	*	P	*	coil	fuse		fuse	link	
KCS 141	19AFP4; 19AUP4	114	✓	✓	Sil dblr	SN	✓	3	*	P	*	coil	fuse		fuse	link	✓
KCS 136 Y	23BKP4, 23BLP4	92	✓	✓	Sil dblr	SN	✓	3	*	P	*	coil	fuse		fuse	link	✓

CHASSIS NO.	CRT TYPES	DEG DEF	BOND SHLD	PWR XFR	B+ RECT	TUNER TYPE	DC CPL	NO. IF	HAFC TYPE	KEY AGC	NOI LIM	WIDTH CTRL	PROTECTED CIRCUITS PRI	SEC	SIL	FIL	REM AVL
SETCHELL-CARLSON																	
463	19BRP4	114	✓	✓	Sil dblr	TN		2H	CC	Tr	*		fuse		FR	link	
363	23CP4; 27ABP4	110	✓	✓	Sil dblr	TN		2H	CC	Tr	*		fuse		FR	link	
163	23CP4	110	✓	✓	Sil dblr	TN		2H	CC	Tr	*		fuse		FR	link	
X162	23CP4; 27ABP4	110	✓	✓	Sil dblr	TN		2H	CC	Tr	*		fuse		FR	link	
SILVERTONE																	
.60000	19AYP4; 23BQP4	114			Sil dblr	SG		2	CC			sleeve			brkr		✓
.60100	23BDP4	92	✓		Sil dblr	SG		3	CC	BU	BU	sleeve			brkr		
.61000	19AYP4	114			Sil dblr	SG		3	CC	BU	BU	sleeve			brkr		✓
	23CBP4	114	✓														
SYLVANIA																	
563	19AFP4	114	✓		Sil dblr	SG		3	T-D	Tr	*	pot			brkr		
565	23BGP4; 23BHP4	110	✓	✓	5U4GB	SG		3H	T-D	Tr	*	pot		brkr		link	✓
TRAV-LER																	
1188-12	17CFP4	90			Sil HW	*		2	CC						FR		
1181-42	19XP4	114			Sil dblr	SS		2	S	BU	BU				brkr		
1180-62	19XP4	114			Sil dblr	SS		3	S	BU	BU				brkr		
1179-22	19XP4	114		✓	5U4GB	SS		3	S	BU	BU			fuse		link	
1082-162	23MP4	114		✓	5U4GB	SS		2	S	BU	BU			fuse		link	
1073-152	23MP4	114		✓	5U4GB	*	✓	3	S	BU	BU			fuse		link	
1090-253	27ZP4	110		✓	5U4GB	TG		3	S	BU	BU			fuse		link	
WELLS-GARDNER																	
19S26, -27	19CHP4	114			Sil HW	TS		2H	CA						FR		
19S18	19XP4	114			Sil dblr	TS		2H		BU	BU				FR		
23S330, -350	23AWP4	92			Sil HW	TS		2	CA						FR		
23S29, -31	23AHP4	92			Sil dblr	TS	✓	2H	T-T						FR		
23PS31	23AHP4	92		✓	Sil dblr	TS	✓	2H	T-T						FR	link	
23PN30	23MP4	114		✓	Sil dblr	TN	✓	3	T-T	BU	BU				FR	link	
WESTINGHOUSE																	
V-2438	19CMP4	114			Sil HW	SG		2H	CC	Tr					fuse		
V-2437	19BWP4	114			Sil dblr	SG		3	CC	Te	Tr				fuse		
V-2435	19BWP4; 23CQP4	114			Sil dblr	TG	✓	3	CC	P	Tr	coil			fuse		✓
V-2436	19BWP4; 23CQP4	114		✓	3DG4	TG	✓	3	CC	P	Tr	coil	fuse			link	
ZENITH																	
16K20	19CRP4	92		✓	5BC3	SG		3	CC	BU	BU	sleeve		fuse		link	✓
16K26	19CQP4	114		✓	5BC3	SG		3	CC	BU	BU	sleeve	fuse	fuse		link	
16K27	19CQP4	114		✓	3DG4	TG		3	CC	BU	BU	sleeve	fuse	fuse		link	✓
16K23	23ANP4	92	✓	✓	3DG4	TG		3H	CC	BU	BU	sleeve	fuse	fuse		link	✓
16K22	23BTP4	92	✓	✓	3DG4	TG	✓	3H	CC	BU	BU	sleeve	fuse	fuse		link	✓
16K28QS	23AFP4	92	✓	✓	3DG4	TG	✓	3H	CC	BU	BU	sleeve	fuse	fuse		link	✓

Check mark indicates chassis has feature named; asterisk indicates "see text." Meanings of abbreviations and symbols: **TUNER TYPE** first letter T, turret; S, switch—second letter G, 6GK5 or similar type; N, nuvistor; S, shadow grid (6FS5). **DC CPL** means DC coupling from video amplifier to CRT. **NO. IF** means number of video IF stages; H indicates all IF tubes are high-gain type. **HAFC TYPE**—(selenium diodes) CC common cathode; CA common-anode; S series—(tube) T-T triode section; T-D dual diode section. **KEY AGC** and **NOI LIM** (noise limiter)—P, pentode; Tr, triode; Te, tetrode; BU, combination AGC-sync circuit (6BU8, 'GS8, or 'HS8). **PROTECTED CIRCUITS**—PRI and SEC, primary and secondary circuit of power transformer; SIL, in series with silicon B+ supply; FIL, filament. "FR" means fusible resistor; "link" means short piece of No. 24 to No. 28 wire. **REM AVL**—wireless remote control available.





differ only slightly from the 120612 series introduced last fall. Several new tube types have been adopted: a 3DG4 B+ rectifier, a 3A3 high-voltage rectifier, a 6HS8 sync AGC tube, and the two new CRT's described in the chart. A damper-plate fuse gives additional protection to the flyback circuit besides that afforded by the circuit breaker on the primary side of the power transformer.

A half-dozen stereo combinations are included in the "900" series. One, the *Jameson* (see photo) has sliding doors; the panels are made of grille cloth, so the sound from the twin speaker systems can pass through them when they are pushed back for TV viewing.

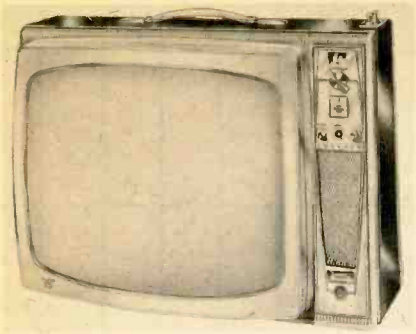
Portable models for '63 are the 17" *Americana* and two 19" types, the *Sportsman and Bon Voyage*. Chassis numbers 120591, -2, -3, -644, -50, and -57 all are variations of the same basic design, a transformer-powered, vertical chassis using mostly printed wiring.

Portables are available with clock timers, and 19", 23", and 27" sets with wireless remote control are offered. The line also incorporates color TV.

EMERSON

All chassis in '63 models are of the same general type, descended from last year's transformer-powered 120587-A and -93-A (covered in July *Previews of New Sets*). New chassis numbers are 120619 through -28, -44, -58, and -59. All of these are equipped with a width coil ('62 sets used a jumper for width adjustment). Some CRT's are new types. The 23" and 27" sets have turret tuners, while portables use switch tuners—but the RF amplifier is a 6GK5 in either case.

The photo depicts a remote-equipped

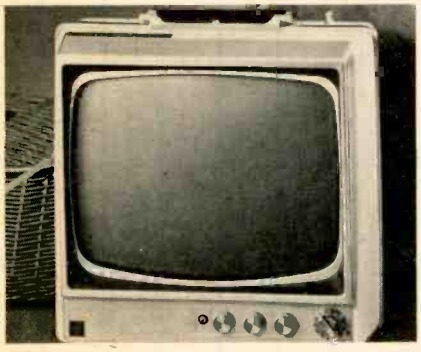


19" *Tru-Slim* portable, which also features an earphone jack. Another portable receiver has a clock timer. Safety windows used in these sets are glass rather than plastic.

At the top end of the Emerson line are several stereo combinations and color TV's.

GENERAL ELECTRIC

Every set in the G-E line (except color) contains from five to seven compactrons in addition to several conventional tubes.



The article, "TV Tube Trends," in the July PF REPORTER gave circuit functions and basing diagrams for all compactrons in the MX chassis (used in 19" compacts and 23" sets) and the LX (used in *Century* 19" portables). Since then, a third chassis (the QX) has been added. Its complement of compactrons is as follows: 11AR11, first and second IF; 15AF11, video output-sound IF-sync separator; 12AL11, audio detector and output; 15FY7, vertical sweep; 8B10, horizontal AFC-oscillator; 17GE5, horizontal output; and 17AX3, damper. The only other tubes outside the tuner are a 6GH8 third video IF-keyed AGC tube and a 1K3 high-voltage rectifier.

The QX chassis is found in the *Escort* (pictured), a 22-lb. portable with a new screen size: 16". The CRT has neither a bonded shield nor a separate safety glass; a thin film of *Lamilite* plastic over the CRT screen gives implosion protection.

Chassis LX, introduced early in the model year, was described in August *Previews of New Sets*. It has one feature which is rare in '63 models—a separate fuse protecting the horizontal sweep section.

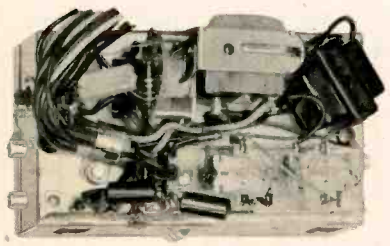
The MX chassis includes several items not found in other recent "M" lines: keyed AGC, a DC-coupled video output stage, and a width coil. Some models are equipped with automatic brightness-contrast control; certain ones also have a wireless remote system. The MX line even boasts a compact *Home Entertainment Center* with 19" TV, stereo phono, and AM-FM-stereo multiplex tuner, in a wood cabinet small enough to sit on a table or hang on the wall.

VHF versions of the QX and LX chassis have a switch-type *shadow grid* tuner, but UHF-VHF sets use a turret tuner with nuvistor RF amplifier.

MAGNAVOX

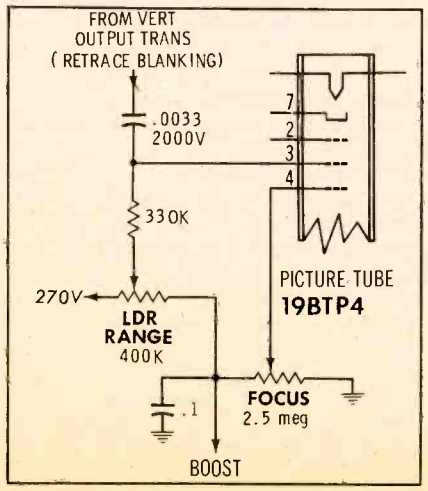
Large sets contain updated versions of the 35- and 36-series chassis—low-slung, U-shaped vertical types with "swing-out" mounting and three printed boards. Powering all 19" sets is a new 38-series chassis, with a more conventional "doughnut-type" vertical chassis pan, but with printed boards almost identical to those in the older series. All boards are marked with wiring paths on the component side, and with component symbols on the wiring side.

A typical model from the 38 series will be described in December *Previews of New Sets*. Circuitwise, it is like the 36 series except that it has a 6GT5 (novar) horizontal output tube. Another new feature, found only in models wih *Magnalux*



automatic brightness-contrast control, is the LDR RANGE adjustment shown in the schematic. This control can be used to set the accelerating-grid voltage of the CRT to any value between boost and B+, to maintain the correct brightness-contrast ratio over the widest possible range of ambient light. In the 35 and 36 chassis, the accelerating grid is simply connected to either boost or B+ by means of a jumper wire.

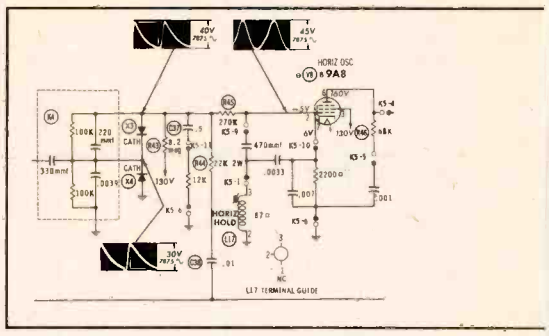
Available with all chassis series is a new version of the *Phantom* wireless remote system, incorporating a 6-transistor receiver section. As shown in the photo, the transistorized circuitry is not visible from the top of the remote-receiver chassis. The transmitter is a "tuned-port" (supersonic whistle) type, operating at the unusual frequencies of 22 and 28 kc.



The 37-series color receivers are still in the Magnavox line, but a new 41 series is scheduled for introduction in the near future.

MOTOROLA

The sets listed in the chart fall into two groups. The TS-449 and -578 are types that were introduced early this year for use in low-priced models, while the TS-581 and -584 series appear in the regular fall line.



Motorola has begun to standardize its chassis designs to the extent of no longer producing separate 400- and 500-series chassis types for 19" and 23" sets. Instead, "universal" chassis will be used (with only slight modifications) in sets ranging from 19" to 27". Chassis numbers have new letter prefixes to indicate CRT size—DTS for 19", ETS for 23", and GTS for 27". Any additional letters placed in front of these prefixes designates a change from the original chassis design.

The TS-449 and -578, almost alike except for sweep-circuit details and picture-tube type, use 300-ma series-string tubes wired in two parallel branches. Only the damper and picture tube are common to both heater strings. The unique horizontal oscillator (see schematic) is a simplified sine-wave circuit controlled directly by a dual selenium AFC phase detector. For further details on the TS-449, refer to February, 1962 *Previews of New Sets*.

All other new sets, in the TS-581 and -4 groups, are electrically almost the same as last year's TS-570 and -579. The main variations among sets within each chassis series involve sweep-circuit modifications to allow for different CRT sizes and deflection angles.

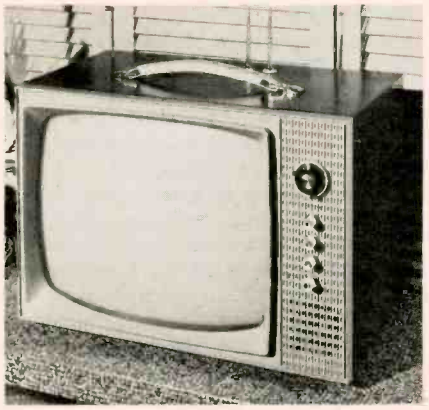
The most noticeable new physical feature is the use of solder-terminal boards mounted flush with the chassis. This type of construction is used throughout the '63 line, although not to as great an extent in the TS-581 as in the other chassis.

Included on some models is a fully transistorized remote unit which changes channels, and also operates a stepping relay for the on-off-volume function.

MUNTZ

Accounting for the bulk of present production is the J-shaped T37 chassis, which has been carried over from last year with no significant changes. The '63 models are all 19" or 23" sets with 110° or 114° deflection.

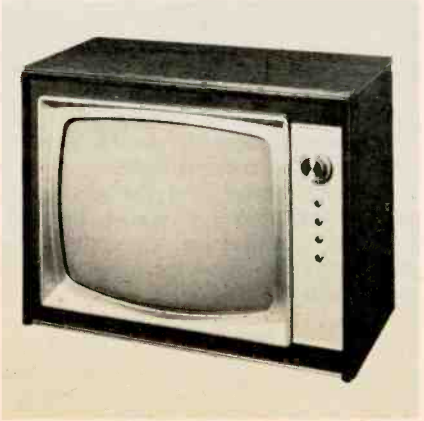
An interesting expansion has taken place at both ends of the Muntz line. A new *Metropolitan* 19" model (see photo) has a simpler chassis than the standard series, using six compactrons plus a 1K3 high-voltage rectifier, two tuner tubes, and a "low-drive" CRT. For compactron types and basing diagrams, refer to "TV Tube Trends" in the July issue. Don't look for boost in this receiver; since voltages above B+ (145 volts) are not needed by any circuits except the CRT anode, the boost source is omitted.



A deluxe transformer-powered chassis has also been designed for use in three new 27" models. The tube complement includes three novar types (6GT5 horizontal output, 6AY3 damper, and 5BC3 low-voltage rectifier); 6DT6 sound detector; 6BQ5 audio output; 6EM7 vertical sweep; and 6BY8 sound IF-AGC clamper. In addition, a 6KA8 is used in a keyed AGC-sync separator-noise inverter circuit similar to the one described in the RCA section of this article.

OLYMPIC

TV-stereo combinations are still a specialty of this manufacturer. All except the lowest-priced models have AM-FM tuners capable of FM stereo reception. The three different transformer-powered chassis used in 23" and 27" combinations, consoles, and table models closely follow previous designs.



Portables and 19" table sets are more prominent in the '63 line than in those of past years. One table model (Chassis 10119) is manufactured for Olympic in Japan; but all *super-slim* portables—and other sets like the one shown—are American made. Four different transformerless chassis—the MM, MT, LT, and LX — are found in recently-introduced models; there is also a transformer-powered portable (Chassis LV).

Rounding out the line are four color TV consoles.

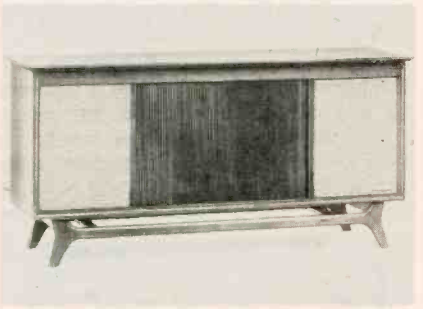
PACKARD BELL

The newest editions of the *Rangefinder* chassis are the 88-14 and -15 (used in 19" *Astronaut* and 23" *Custom* models) and the 98D16 (for *Award* models).

Chassis 88-15 drives a 92° picture tube, the 23BTP4; the three other CRT's listed in the chart with this tube are 114° types used with the 88-14.

A few innovations have been made in the 88-series tube lineup. The damper is a 6BA3 or 6AY3 novar type, a 6CM8 serves as a third IF and noise limiter, and some sets use a 6GW6 horizontal output tube.

The 98D16 chassis is designed to be used with a 114° CRT, except when a "C" suffix is added to the chassis number. In this case, the sweep circuitry has been modified for operation with a 92°, 23BTP4 tube.



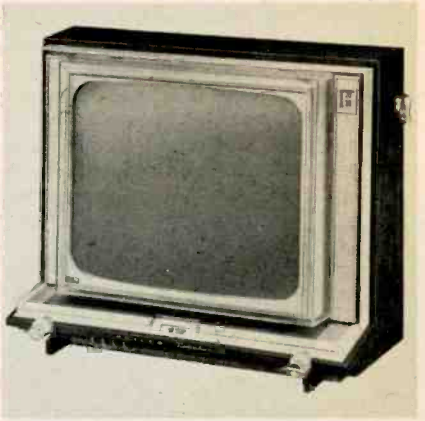
A typical cabinet used with the 98-series chassis is shown on this page. Note the doors—a feature which seems to be gaining in popularity.

One 27" model is offered in the *Award* series, and a half-dozen color models are also available in this year's line. Some *Award* sets have an automatic brightness-control circuit. In addition, a wireless *Roto-Remote* unit is built into certain models (of both series) at the factory, and can be field-installed in other sets.

PHILCO

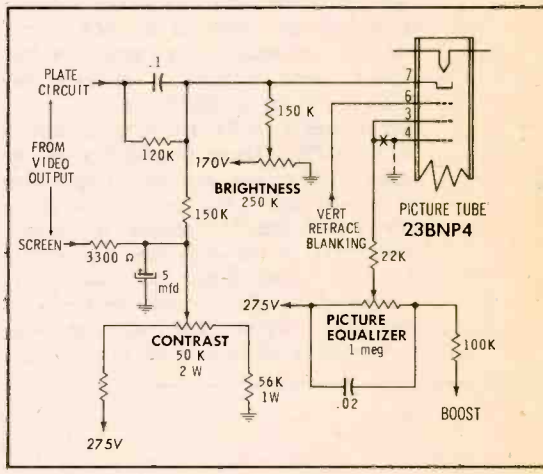
Acquisition of Philco by Ford Motor Company has not resulted in many drastic changes in the '63 TV chassis. For example, the 13J27 *Briefcase* is very similar to last year's 12J27, and the *Town and Country* 13J28 (in a tapered cabinet with rounded top) resembles the 12J28 *Black Beauty* described in July *Previews of New Sets*. However, some interesting changes have been made in the 19" compacts. A new styling idea appears in the *Town House* model (see manufacturer's photo on this page), and a brand-new 13J41-series chassis has been introduced. In circuitry and general layout, it is similar to last year's 12N51 *Cool Chassis*, with one important exception: Using two frame-grid IF's in place of a three-stage IF strip has made it possible to reduce chassis size by consolidating all signal circuits on one large printed board.

The "N" group of chassis, now used only in 23" sets, have been slightly lengthened and rearranged for a more spacious



layout with fewer wire leads. The shield plate covering the underside of the IF printed board is removable, and the cut-outs in the plate underneath the main board have been enlarged.

All 110° *Custom Console* sets use the



13N51 chassis series, which has several features in common with the 12N53 and -4 at the top end of the '62 line—for example, a 6HZ8 *Intensi-Tube* video amplifier, and horizontal retrace blanking.

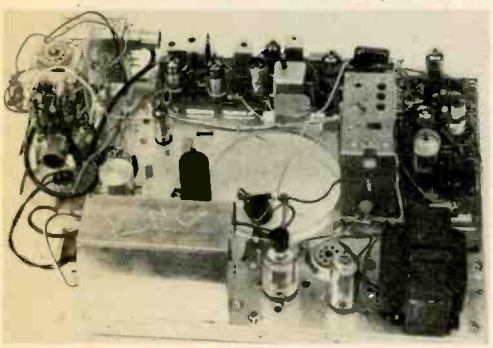
In all 23" sets and compacts, a *varistor* furnishes automatic width control, and a *Picture Equalizer* (G2) potentiometer permits adjusting the accelerating-grid voltage of the CRT to obtain the best possible contrast range. The proper setting is obtained by applying a fixed bias of -1.5 volts to the grid of the video output tube, inserting a DC microammeter in the CRT cathode circuit, and turning the G2 control until the cathode current reads 220 ua (in compacts) or 250 ua (in 23" sets).

Two different types of *Directa* remote controls are available—one with tubes in the receiver, the other with transistors.

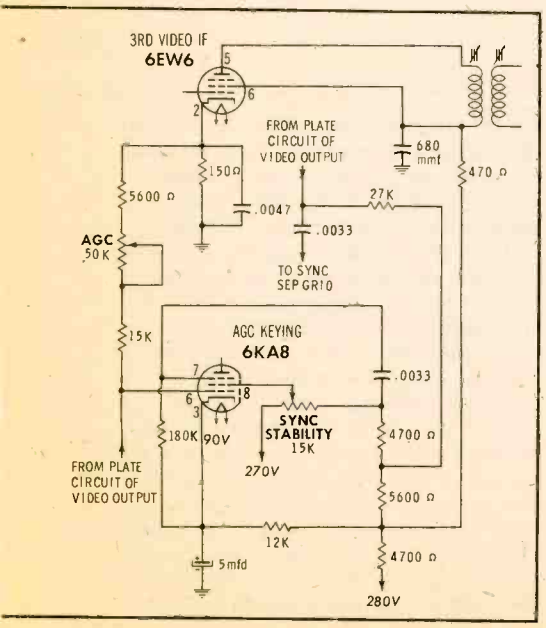
RCA VICTOR

All 23" black-and-white sets contain the KCS136Y chassis, a modification of last year's horizontally-mounted *Magic Monitor*. New features for '63 include silicon B+ rectifiers, a 6AY3 novar damper tube, and changes in the video output circuit to provide greater DC reinsertion. Automatic brightness-contrast control is available in some models.

The KCS130, -7, and -8 chassis have also been revamped for use in some portables; in addition, two new transformer-powered chassis have been introduced. One of these, the KCS140 used in *Stylist* models, was covered last month in *Previews of New Sets*. The other chassis is the KCS141 used in *Debonair* and remote-equipped *Fashionette* sets. A vertically-mounted type with a layout unlike



that of any previous chassis series, it is designed to stand upright without tipping over when removed for servicing. A 6KA8 triode-pentode serves as an AGC keyer and sync separator, in a rather complex circuit which includes a noise-limiting feature. (In the KCS136Y, a similar circuit utilizes a 6GY6 and a triode section of a 6HF8.) Noise interference in the video signal causes negative voltage spikes to be developed in the screen circuit of the keying tube; these are coupled to the suppressor grid of the same tube, and also to the input circuit of the sync separator, to counteract the effect of noise on the AGC and sync outputs. The noise-cancelling action can be varied with the SYNC STABILITY control. Returning the grid of the AGC tube to ground through the cathode circuit of the third IF also contribues to noise cancellation.



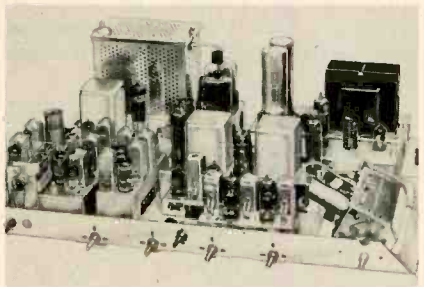
In all the latest chassis, common-cathode selenium diodes develop a DC control voltage for a triode AFC stage, which in turn applies control voltage to a modified *Synchroguide* horizontal oscillator.

A new wireless remote receiver has transistors in all stages except the *Volume Up* and *Volume Down* relay-control circuits; these use sections of a 12BH7A tube.

The '63 color sets have an all-new, horizontally-mounted chassis—the CTC12—which will be covered next month in *Previews of New Sets*.

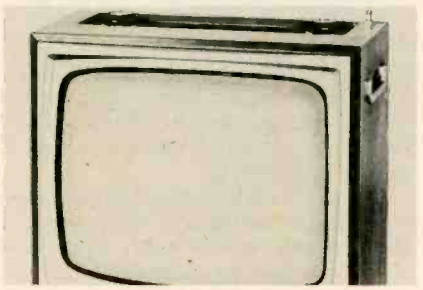
SETCHELL-CARLSON

New circuit features extending throughout the '63 line are a 6DS4 nuvistor RF amplifier, a two-stage video IF strip with 6EH7 and 6EJ7 frame-grid tubes, and two pentode stages in the video-amplifier section. As in previous models, the flyback is a plug-in type, and a 6CS6 operates as a sync separator and noise limiter.



The latest revision of the deluxe *unitized* chassis carries the same number (X162) as last year's version. All circuits except the low-voltage power supply are mounted on six plug-in subchassis units.

A differently-arranged *unit-ized* chassis, the 163, is shown here. Used in combin-

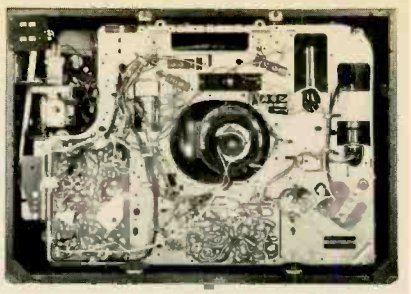


ation sets, it has ten plug-in sections which accommodate all circuits including the B+ supply, twin high-fidelity audio amplifiers, an AM-FM tuner, and FM multiplex stages.

Two smaller chassis, the 363 and 463, use plug-in units only for the tuner, video IF, and 4.5-mc sound circuits. One of the 19" sets equipped with the 463 is a table model in a wood cabinet, with provisions for adding an AM radio tuner.

SILVERTONE

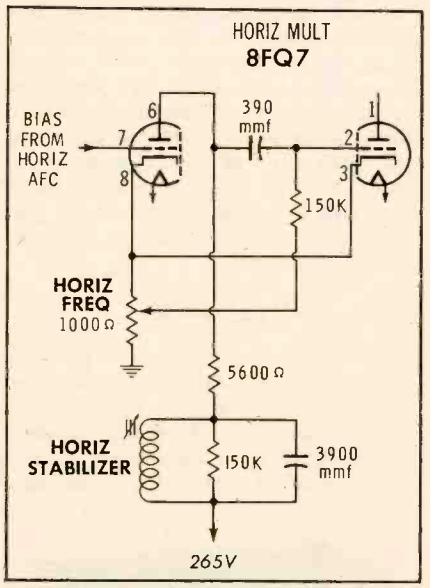
Chassis numbers above .60000 (following the usual 528 or 456 prefix) are applied to '63 sets. The first entry in the chart covers the majority of models. Sets



in this category use the "swing-out" style of vertical chassis shown in the photo, with tubes facing the CRT. The complement of 450-ma series-string tubes is the same as in last year's .51780 chassis, except that the new *shadow grid* tuner (equipped with a 3FS5 and a 6FG7) has been adopted in some models.

The .61000, .61020, and certain other chassis are constructed like the .60000, but have more elaborate circuits. A 4GS8 (an improvement on the 4BU8) is a combined AGC-keying, sync-separator, and noise-limiter tube; the last IF is a new high-gain 5EW6, replacing last year's 4CB6; and a 22BH3 novar damper is introduced in place of a 22DE4.

A small group of models has a different style of vertical chassis, rather high and narrow, with tubes facing toward the rear. Although based on a design that has been in use for several years, this new .60100 chassis has modernized circuitry. Among the 600-ma series-string tubes are a 3GS8 keyed AGC-sync separator, 10EM7 vertical multivibrator-output tube, and 12AX4GTB damper.



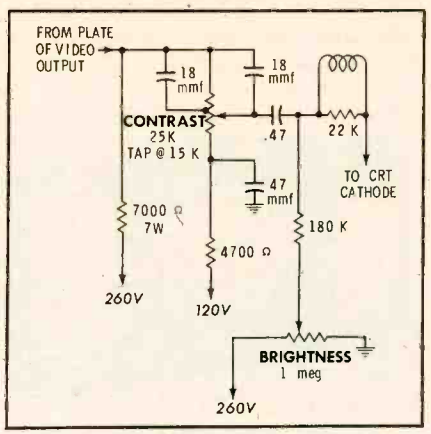
All the new chassis afford a novel and interesting method of varying horizontal-multivibrator frequency. As shown in the schematic, the common cathode resistor is a potentiometer, and the ground return for the second section of the multivibrator is completed through the arm of this control—providing adjustable bias and feedback.

SYLVANIA

The *GT-555* transformer-powered chassis used in 23" sets has been slightly revised for 1963; the newest chassis number

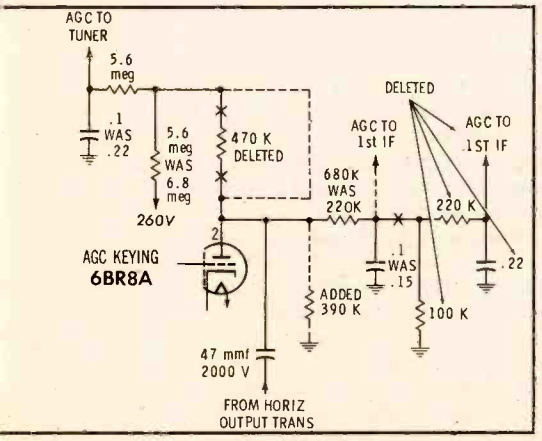
is 565. Three high-gain 6GM6 tubes have been substituted for 6BZ6's in the video IF strip, necessitating an alteration in the keyed AGC circuit (see schematic). The coupling circuit between the video output stage and the CRT has also been changed to the configuration shown.

A few of the more elaborate 19" table models introduced during the past year are



equipped with Chassis 558, which is nearly identical to the 565. (See August *Previews of New Sets.*) Other 19" TV's are transformerless types using Chassis 563, a modified version of the 546 which has been updated to include circuit changes similar to those found in the 565.

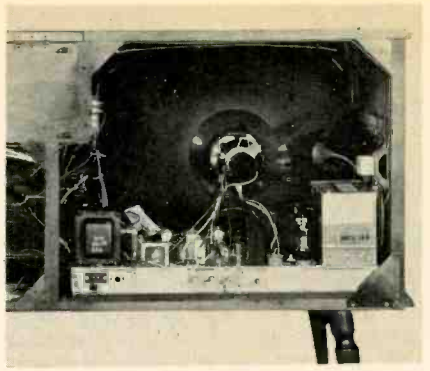
Features carried over from previous lines include a 'CS6 sync separator-noise limiter, an 'ET7 pentode-dual diode used as a video output-horizontal AFC tube, and *Halolight* in 13 console models. One *Home Entertainment Center* combination and three color TV models are also offered this year.



TRAVLER

The entries in the chart are representative samples of the many different chassis employed in *TraVler*-branded and various private-label receivers. Physically, all chassis are grouped into two basic types—the long, narrow horizontal design shown here, and the lightweight double-decker design pictured last month in *Previews of New Sets.*

Circuits have not been appreciably changed during the past year, except that some new tuners have been adopted. Incidentally, the two digits just ahead of the hyphen in the chassis number denote the type of tuner used. For example, an "82"



indicates a TA-82 tuner, one of the latest *shadow grid* types. An "88" signifies a TA-88, the Standard Kollsman *compact* tuner.

The latter is somewhat of a hybrid between switch and turret types. The tuning coils are mounted on discs which are positioned the same as switch wafers, but connections are made through contact buttons like those used in turret tuners. High-channel tuning is by means of incremental coil segments, except in the local oscillator; in that circuit, and everywhere on low-band channels, separate coils are used for each channel.

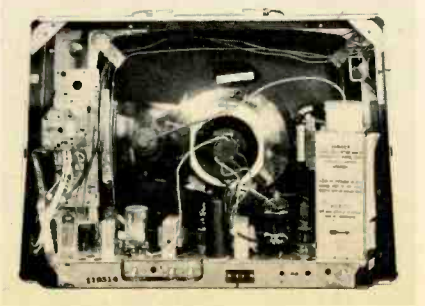
WELLS-GARDNER

The chassis numbers in the chart represent a cross-section of the many types produced under assorted private-label brand names.

All the latest "S"-series chassis have only two video IF stages; however, in all except "economy" models, the IF tubes are both high-gain 3DK6's. Series strings are the rule except in chassis marked "P" used in combination sets; these include a power transformer.

Printed wiring boards have been introduced in several "low-end" models which supersede last year's S15 and similar vertical-type chassis. The new S330 series has one small board containing sync, vertical sweep, and horizontal oscillator components; the remainder of the set is still hand-wired. In the S350 series, there is also a larger PC board containing the video IF, video amplifier, sound, and AGC circuitry.

Other "S" chassis are horizontal, hand-wired units similar to the S14 in the photo (carried over from last year). A 6HS8 takes over the job of a 6BU8 in some new sets, and one of the latest portables has a 13GB5 novar tube in the horizontal output stage. This is the 600-ma counterpart of the 27GB5 described in "TV Tube Trends" (July PF REPORTER).

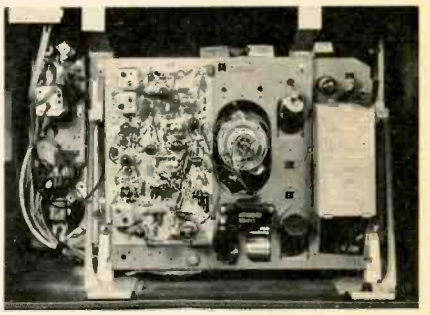


The deluxe "N" series continues to be used in high-end 23" models, retaining such features as a power transformer, 110° picture tube, keyed AGC, and 6DS4 nuvistor RF amplifier.

WESTINGHOUSE

A completely new *Color-Coded* chassis (see photo), with different sections colored bright blue, red, and yellow, is inside 19" *Trendsetter* compacts and most 23" sets. One version (Chassis V-2436) has a power transformer; the other (Chassis V-2435) does not.

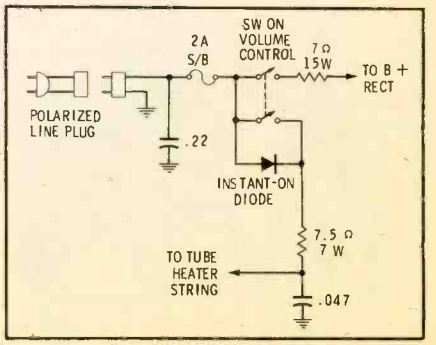
Many transformerless models incorporate the *Instant-On* feature shown in the schematic. When the DPST power switch is in the *off* position, the semiconductor diode applies rectified line voltage to the filament string—thus keeping the set "on standby" and eliminating warmup delays.



The chassis has one large printed board, marked with "road map" lines on the component side, and with *See-Matic* component symbols on the wiring side. In 19" models, the chassis can be pivoted back (after several screws are removed) and operated in a horizontal position.

Like last year's V-2417, the *Color-Coded* chassis have a combined horizontal linearity and width coil. Horizontal retrace blanking is also provided. A few of the tubes are new types—the 6GX6 sound detector, 6- or 10GN8 video output, and 6- or 17GW6 horizontal output.

Slim 19" portables are divided into two groups. *Attache* models (Chassis V-2437) are like the older V-2416, except for three new tubes—a 6GX6, a 10GN8, and a frame-grid 4HM6 third IF—and the addition of keyed AGC. Other portables have an all-new V-2438 chassis with a simplified high-efficiency design. Its 19CMP4 picture tube, a "low-drive" type, accepts a video-signal input of 35 volts peak to peak. The tube complement includes: 4HM6 and 4HT6 frame-grid video-IF pentodes; a 17JZ6 compactron in the vertical sweep circuit; a 12FX5 audio



output; a 10JA8 video output-sync separator; and a 21GY5 compactron in the horizontal output stage. The yoke is a toroid type, and the AGC keying pulse is fed through a series trimmer so that the pulse amplitude can be varied to adjust the AGC bias.

Various models of all types have a *Mobil-Sound* circuit which rebroadcasts the TV sound so that it can be picked up on any nearby AM radio. All transformerless sets have polarized line plugs. An optional wireless remote control, with transistorized receiver circuitry, changes channels and performs a combined on-off-volume function.

For the first time in several years, color sets are available. A wide choice of cabinet styles is offered.

ZENITH

The "K"-series chassis listed in the chart were introduced this fall. Another complete series, bearing "J" numbers, were brought out last spring; they are closely related to the fall-1961 "H" group.

The greatest changes in the Zenith line are noted in 19″ sets. In the 92° version (Chassis 16K20), several new tubes have been introduced—6KD8 horizontal oscillator, 6GE5 compactron horizontal output, 6AY3 novar damper, 6FM7 compactron vertical sweep, and 5BC4 novar B+ rectifier. A similar tube complement is found in the 114° Chassis 16K26, except for a 6GV5 compactron in the horizontal output stage, and a 6DX8 video output-sound IF tube. Incidentally, this chassis has no counterpart in earlier lines. The tube lineup in another 114° chassis, the 16K27, is practically the same as in 23″ sets.

Portables feature tapered cabinet styling, as shown, while *Decorator* compacts have wider, more rectangular cabinet lines.

All 23″ sets now have a *peak picture* control (video bandwidth adjustment) and frame-grid IF tubes. The following special features are found in the 16K22 and 16K28QS chassis: A 6JT8 frame-grid video output tube, *Dynamic Contrast* (DC-coupled video circuitry), a self-adjusting FRINGE LOCK circuit using a voltage-dependent resistor, and new *Super Sunshine* picture tubes. The 16K28QS is the *High Fidelity* chassis employed in the *Edgecombe* (pictured) and two other remote-equipped models in the deluxe *Decorator Group*.

Both versions of the *Space Command* wireless remote control are now fully transistorized.

Color sets have undergone only minor modifications since they were introduced last year; for the full story, see next month's PF REPORTER.

OTHER U. S. BRANDS

Andrea has just introduced two new chassis, the VTT-319 and -23, for 19″ and 23″ sets respectively. Newly-adopted features include a multivibrator-type horizontal oscillator, a quadrature sound detector, a circuit breaker, and silicon B+ rectifiers. Also newly announced are several color models using Chassis VCU-321.

The **Capehart** line includes two 19″ portables, eight 23″ console models (using two different chassis types), and four "Stereo Theaters" with 23″ TV, phono, and AM-FM radio. All sets include a "Shadow Grid" tuner; each console has two speakers.

Sonora has a 17″ portable, various 19″ receivers (with at least three different chassis), and 23″ receivers in a variety of cabinet styles.

Symphonic's 19″ portable, Model H19, is covered in PHOTOFACT Folder 594-2. Also in this season's lineup are three upright consoles and two lowboys (all basically the same, except for cabinets and speakers), and two "Stereo Theater" combinations. All sets have bonded CRT's.

Transvision offers TV chassis in both kit and wired form; cabinets and accessories for custom installation are also available. The "Professional G" chassis, furnished with a 19″, 23″, or 27″ picture tube, is equipped with either a push-pull audio output circuit or a cathode follower for feeding TV sound into a separate high-fidelity system. The "Economy B" chassis is suitable for 19″ and 23″ CRT's. There is a choice of two 21″ color-TV kits—the CK-321 with push-pull audio output, or the CK-3A21 with an audio cathode follower.

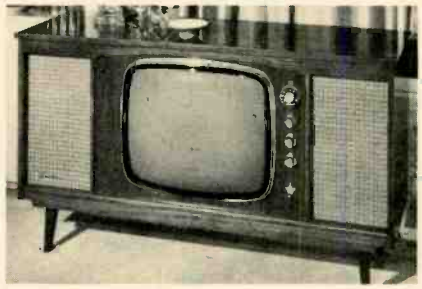
FROM CANADA

Several companies are making their current lines available in the U.S. Although the emphasis is on elaborate 23″ combination sets and TV consoles, smaller models are also offered.

Clairtone has three "stereo theatre" models with TV, phono, and AM-FM-stereo multiplex tuner. The TV audio circuits and speaker are independent of the stereo amplifier, and "silent listening" jacks are provided for stereo earphones. Model names are the "Duchess" (ST 853), "International" (ST 803), and "Viscount" (ST 703).

Electrohome sets use three different hand-wired chassis. The 17-tube "Centurion" appears in one 19″ portable, two 23″ consoles, and three 23″ combinations; the Custom Duramatic, with 18 tubes, is used in another 19″ portable, as well as in three consoles and a combination set of the 23″ line; and the 21-tube Electromatic Imperial is found in five 23″ consoles, All chassis include a "Power Pacer" (thermistor in the primary circuit of the power transformer) to reduce warmup surges.

Sparton's latest introductions are: three



19″ compact sets using Chassis 19M1, -2, -3; five 23″ consoles equipped with Chassis 23M1, -2, -7; and two stereo combinations (including the "Saguenay" model shown) using Chassis 23M4, -6. Another 23″ console series uses Chassis 23L1, -2, -3, and the "Corona" (a 19″ compact) has Chassis 19L1. The "Instant Reflex" chassis used in 23″ sets is a hand-wired horizontal type with a bonded 110° CRT attached.

FROM JAPAN

The **Delmonico** line includes a 17-lb, 8″ personal portable TV (Model 8PV-47U) with 14 tubes, three diodes, a cascode tuner, and a front-mounted speaker; three briefcase-styled portables, Models MTV-1U, -3U, and PTV-19U (for information on the latter, refer to PHOTOFACT Folder 538-1); two TV-AM/FM stereo combinations, Models CTV-237U and -350; and a color TV-stereo combination, Model CC-210.

Panasonic by Matsushita AN-14 is a 14″ portable with 110° CRT. Chassis features include horizontal linearity and width coils, a 6DT6 audio detector, two earphone jacks, a cascode tuner, and an unusual vertical-linearity control (in addition to the usual size and linearity adjustments) which shapes the waveform of the feedback from the vertical output to the vertical multivibrator.

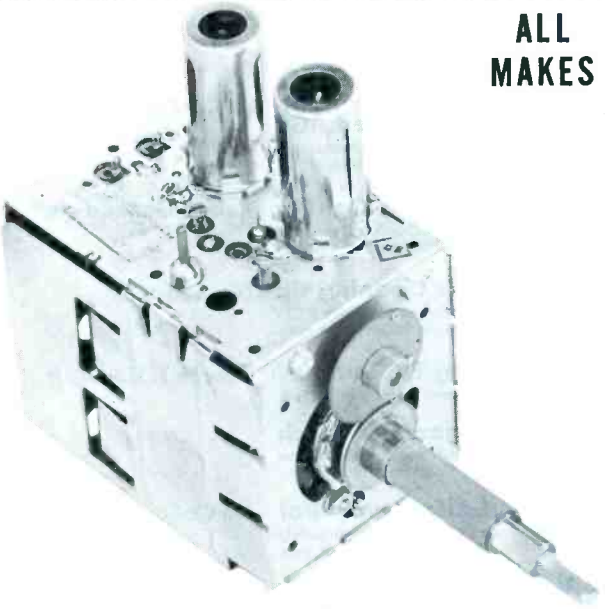
The **Star-Lite,** another 8″ portable with tubes, includes a cascode tuner, three video IF's, and a crystal-diode ratio detector. Another set, expected to be added soon to this line, is a 16″, 110° consolette in a wood cabinet with detachable legs.

Sony is offering a transistorized 8″ personal portable (Model TV8-301W), described in PHOTOFACT Folder 588-2. An even smaller set, the "Micro TV" with square-cornered 5″ CRT, has just been announced. This 8-lb. receiver can be operated from a rechargeable 12-volt battery pack, automobile battery, or AC line. The circuits utilize 24 transistors and 20 diodes.

Tarzian offers

FAST, DEPENDABLE TUNER REPAIR SERVICE

ALL MAKES



ONLY $8.50 INCLUDING

ALL PARTS (EXCEPT TUBES) and LABOR

24-HOUR SERVICE 1-YEAR WARRANTY

It just makes sense that a manufacturer of tuners should be better-qualified, better-equipped to offer the most dependable tuner repair and overhaul service.

Sarkes Tarzian, Inc., pioneer in the tuner business, maintains a complete, well-equipped Factory Service Dept. —assisted by Engineering personnel—and staffed by specialized technicians who handle ONLY tuner repairs . . . on ALL makes and models.

Tarzian-made tuners received one day will be shipped out the next. There is a 12-month guarantee against defective workmanship and parts failure due to normal usage. And compare our cost of $8.50 and $15 for UV combinations. There is absolutely no additional, hidden charge for ANY parts except tubes. Replacements available at low cost on tuners beyond practical repair.

Tarzian-made tuners are identified by this stamping. When inquiring about service on other tuners, always give tube complement . . . shaft length . . . filament . . . voltage . . . series or shunt heater . . . IF frequency . . . chassis identification. All tuners repaired on approved, open accounts. Check with your local distributor for Sarkes Tarzian replacement tuners, replacement parts, or repair service.

Tuners Repaired on Approved, Open Accounts

See your distributor, or use this address for fast, factory repair service

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PF REPORTER

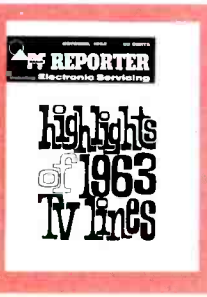
including Electronic Servicing

VOLUME 12, No. 10 OCTOBER, 1962

CONTENTS

ABOUT THE COVER

If you're curious about what's inside the new TV receivers now on display in dealer's showrooms, just turn to page 3 and read our special feature article, "Highlights of '63 TV Lines"—which describes all the latest sets from a serviceman's point of view.



The HIDDEN 500* wrote these 6 SUCCESS STORIES...

Service Technicians supply the happy endings!

Capacitor success stories are no novelty at Sprague. The "Hidden 500", Sprague's behind-the-scenes staff of 500 experienced researchers, have authored scores of them! And customers add new chapters every day. But none has proved more popular than the 6 best sellers shown here. Developed by the largest research organization in the capacitor industry, these 6 assure happy endings to service technicians' problems.

1 DIFILM® BLACK BEAUTY® MOLDED TUBULAR CAPACITORS

The world's most humidity-resistant molded capacitors. Dual dielectric—polyester film and special capacitor tissue—combines best features of both. Exclusive HCX® solid impregnant produces rock-hard section—nothing to leak. Tough case of non-flammable phenolic—cannot be damaged in handling.

2 DIFILM® ORANGE DROP® DIPPED TUBULAR CAPACITORS

Especially made for exact, original replacement of radial-lead tubulars. Dual dielectric combines the best features of both polyester film and special capacitor tissue. Exclusive HCX® solid impregnant—no oil to leak, no wax to drip. Double dipped in bright orange epoxy resin to beat heat and humidity.

3 TWIST-LOK® ELECTROLYTIC CAPACITORS

The most dependable capacitors of their type. Built to "take it" under torrid 185°F (85°C) temperatures—in crowded TV chassis, sizzling auto radios, portable and ac-dc table radios, radio-phono combinations, etc. Hermetically sealed in aluminum cases for exceptionally long life. Withstand high surge voltages. Ideal for high ripple selenium rectifier circuits.

4 ATOM® ELECTROLYTIC CAPACITORS

The smallest dependable electrolytics designed for 85°C operation in voltages to 450 WVDC. Small enough to fit anywhere, work anywhere. Low leakage and long shelf life. Will withstand high temperatures, high ripple currents, high surge voltages. Metal case construction with Kraft insulating sleeve.

5 LITTL-LYTIC® ELECTROLYTIC CAPACITORS

Ultra-tiny size for use in transistorized equipment. High degree of reliability at reasonable price. All-welded construction—no pressure joints to cause "open" circuits. Withstand temperatures to 85°C (185°F). Hermetically sealed. Extremely low leakage current. Designed for long shelf life—particularly important in sets used only part of the year.

6 CERA-MITE® CERAMIC CAPACITORS

Tiny, tough, dependable in practically every application. Low self-inductance of silvered flat-plate design gives improved by-pass action in TV r-f circuits. Higher self-resonant frequency than tubular ceramics or micas. Tough moisture-proof coating. Designed for 85°C operation.

*The "Hidden 500" *are Sprague's 500 experienced researchers who staff the* largest research organization in the electronic component industry *and who back up the efforts of some 7,000 Sprague employees in 16 plants strategically located throughout the United States.*

Handy Hanging Wall Catalog C-457 gives complete service part listings. Ask your Sprague Distributor for a copy, or write Sprague Products Co., 105 Marshall St., North Adams, Mass.

SPRAGUE®
THE MARK OF RELIABILITY

65-347 R1

When is Big too Big?

When you "outgrow" your customers?

When you ration service according to their size?

When you put sales volume ahead of product quality?

When your service loses the *personal* touch?

When you become so self-important that you stop cooperating with the service technicians who helped build your business?

In short, when you forget that your first and biggest job is *satisfying your customers?*

We've seen a lot of companies grow too big for their britches. Not so with Sprague!

In today's complex electronics industry, a company *must* be big! For only bigness—in research, production, and distribution—can bring you the technical services you need. But bigness hasn't gone to our heads. We haven't lost the personal touch that helped us grow. Close attention to your needs is still primary with us.

You can depend on our faithful adherence to this policy—just as you can depend on the unmatched quality and selection of Sprague Capacitors.

SPRAGUE®
THE MARK OF RELIABILITY

WORLD'S LARGEST MANUFACTURER OF CAPACITORS

65-319 R1

now available for custom installation and replacement

RCA VICTOR NEW STUDIOMATIC RECORD CHANGER

stock no. 12 B-100

two-way protection against record wear

1. Protects Against Spindle Wear. Smooth, precise dropping action minimizes wear on the record's center — eliminating a major cause of "wow."

2. Protects Against Groove Wear. Tracking is featherlight . . . true in the groove! Long record life and clean, vibrant sound are assured.

built for endurance and lasting enjoyment

Plays all size records with "Studio-like" precision.

Ultra-sensitive Living Stereo Ceramic Cartridge equipped with synthetic sapphire and diamond styli gives superb stereo separation plus all the brilliance of modern stereo.

'True-Track' Tone Arm is scientifically angled to insure optimum tracking from outer-edge to innermost grooves.

styled for beauty . . . engineered for precision

- Based on years of craftsmanship and millions of performance-proved Instruments.
- A large turntable, almost 12" in diameter is scientifically balanced — cushioned to minimize rumble — supports record across entire playing surface.
- Intermixes 7", 10", 12" records of the same speed.
- Shuts off automatically — also has provision for amplifier shut-off.

available from your local RCA outlet

RCA PARTS & ACCESSORIES, CAMDEN, N. J.

THE MOST TRUSTED NAME IN SOUND

LETTERS TO THE EDITOR

Dear Editor:

I have been in the Navy for almost four years. In eight more months, I'll be on the outside once more.

Before enlisting, I was taking a radio-TV course, and also working part time in a local shop. When I entered service, I went to electronics schools and learned even more about troubleshooting.

Last fall, a friend who was a subscriber to PF REPORTER got me interested in it, and since then, I have regularly received and devoured the issues.

My main object in writing this is to let you know that PF REPORTER is actually a "course" in itself. It has brought much knowledge back to mind and added much, much more. I feel that with my past schooling and experience, and by keeping up to date through reading your magazine, I'll be ready for the outside. Thank you, and keep up the good work.

DUANE P. CULBERTSON, AT2, USN
Coronado, Calif.

What—not shipping over for another hitch? We sure hope the Navy doesn't hold it against us for influencing you in finding a satisfactory role in civilian life.—Ed.

Dear Editor:

We were pleased to note the special emphasis on Antenna Systems in your August issue. However, we were somewhat surprised to note that JFD was not listed in the "Distribution Accessories" category on page 31. As you know, they manufacture a complete line of outdoor and indoor multiset couplers, as well as the TNT105 Transistorized Distribution Amplifier. I trust you will correct this oversight.

JAMES SARAYIOTES
Delphi Advertising,
Agency for JFD Electronics, Inc.

PF REPORTER *has been charged with the "Sin of Omission," and pleads guilty. If you readers filed the list, you may want to add JFD to this category. —Ed.*

Dear Editor:

I must pare down my reading time; so I've decided to sacrifice my magazine subscriptions to the trend of the times . . . Who has time to read, "now-a-daze"?

You people should be first with a far-sighted idea to combat this problem. For instance, why don't you come out with a "Taped Tech Manual" recorded on magnetic tape at 3¾ ips? With each "issue," includes a pamphlet consisting of photos and foldouts with figure numbers. Put in the photos that go with ads, but no printed matter—everything on the tape. Voices on the tape (male and female, and maybe even kids . . .) would give all references to the pamphlet.

I've time to listen, but reading is getting more time-consuming and tedious. Besides, I don't read too fast, but I listen very fast . . .

HENRY G. ZUK
Madison, Ill.

Yes, and our ads could be singing commercials . . . Still like the idea?—Ed.

Dear Editor:

I'm writing this note mainly in explanation of my failure to renew my subscription to your priceless monthly publication.

I have reached the age of 65 and, after many years of servicing radio and television equipment with the accurate guidance of PF REPORTER, I have retired. Although I am keeping my shop open for occasional service jobs, I find I must eliminate even the less expensive items to enjoy my remaining years working in electronics as a hobby.

But I want you to know that without your publication I would have run into a great many headaches, and I will miss the service helps and other information tremendously.

This magazine deserves the highest praise of any, and I strongly advise all servicemen (especially the up-and-coming younger generation) to be faithful to your advice, because it has been invaluable to me in the past.

Now, in my mellowing years, I wish you the best of success and hope your many subscribers will benefit from your information as much as I have.

WILLIAM L. JOYCE
Manager
Franklin Radio & Television Co.
Providence, R.I.

We are deeply and humbly gratified at such praise. If you find you just can't stay away from the ol' bench, Bill, we'll certainly be glad to welcome you back to the fold.—Ed.

Dear Editor:

Concerning the letter from I. & S Electronics published in your August issue, we in Venezuela are confronted with more or less the same problem on certain brands—with the additional aggravation that the parts never were imported.

To avoid embarrassing situations with my customers in connection with the repair of these sets, I very successfully follow the policy of repairing only *American brands.*

RAFAEL FEBRES ORTIN
Febres TV-Radio Servicio
Chacao, Venezuela

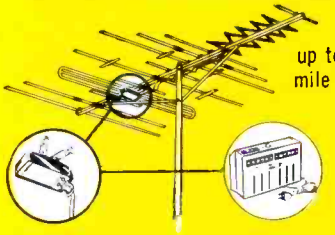
Slogan for today: "Buy Pan-American!" We're glad U.S. manufacturers are standing up to their obligation to make replacement parts available wherever needed.—Ed.

JFD transis-tenna the brand that puts you in command of your market—

brings you the *total* line of TV and FM electronic antennas and antenna amplifiers that is *ahead* in models, *ahead* in features, *ahead* in sell.

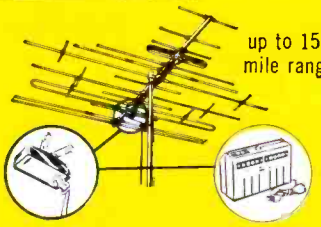
Why settle for less? Rely on JFD, the Antenna America knows best—and profit best!

JFD TRANSIS-TENNA ELECTRONIC TV ANTENNA-AMPLIFIER-DISTRIBUTION SYSTEM



up to 175 mile range

No. TNT1111G-AC $76.95, list



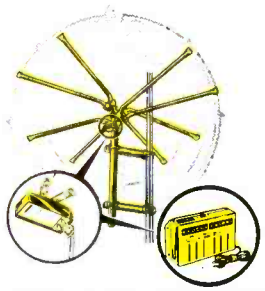
up to 150 mile range

No. TNT520G-AC $66.95, list

ASSURE **MAXIMUM** GAIN AND **HIGHEST** SIGNAL-TO-NOISE RATIO—IN BLACK AND WHITE OR COLOR Super-gain PADT transistor circuit delivers up to 18 db gain on low-band, and 15 db gain on high band . . . exclusive direct-to-terminal mounting—the point of highest S/N ratio . . . a few of many reasons why you get **more clean useable** gain with Transis-tennas. Only JFD provides you with the broadest selection of electronic Transis-tenna systems—**15** models—for **every** location and budget. Priced from $39.95 to $76.95, retail (antenna, amplifier and power supply included). Each antenna gleamingly AAA* gold bond alodized.

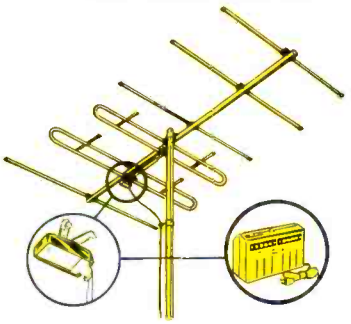
*Attractive, Anti-corrosive, Alodine-treated

100 MILE YAGI-SHARP RECEPTION FROM EVERY DIRECTION— WITHOUT A ROTATOR!



FM Stereo-Cone Transis-tenna
No. TNTFM175G-AC $47.95, list

200 MILE DEEP-FRINGE HIGH FIDELITY RECEPTION



FM Stereo Yagi Transis-tenna
No. TNTFM350G-AC $54.95, list

JFD TRANSIS-TENNA ELECTRONIC FM ANTENNA-AMPLIFIER-DISTRIBUTION SYSTEMS

HIGH FIDELITY FM STEREO RECEPTION STARTS WITH A JFD FM STEREO-ENGINEERED ANTENNA. Whether you select an ultra-powerful JFD FM Stereo transistorized Transis-tenna or one of the 8 other quality-built JFD FM antenna kits, you step up to bright new profit opportunities in the growing FM market. You also get the extra sales boost of knowing that each JFD FM antenna is designed to overcome the power loss and range limitations of multiplexed FM stereo . . . receive distant stations crisply and clearly . . . add high fidelity quality to even budget-priced FM systems. Each antenna in lustrous AAA* gold bond alodized aluminum.

*Attractive, Anti-corrosive, Alodine-treated

No. TNT103 AC-POWERED (shown above) $36.95, list
No. TNT100 BATTERY-POWERED $34.95, list

JFD TRANSIS-TENNA TV/FM AMPLIFIER

THE ONLY "ADD-ON" TV/FM ANTENNA AMPLIFIER THAT MOUNTS ON EVERY TV ANTENNA AT THE RIGHT PLACE—DIRECTLY ON ANTENNA TERMINALS—THE POINT OF HIGHEST SIGNAL-TO-NOISE RATIO.

Only the JFD Transis-tenna mounts **directly** on the terminals of any antenna, regardless of its design—for maximum signal transfer Exclusive PADT transistor circuitry provides superior gain—up to 18 db on low, 15 db on high band. Interference-proof circuit design rejects spurious amateur, CB, aircraft, fire, police and other interfering frequencies. Available with AC powered (TNT103) or battery-powered (TNT100) supply.

No. TNT105
AC-POWERED
$29.95, list

JFD "ALL-IN-ONE" HOME TRANSIS-TENNA TV AMPLIFIER

COMBINES AMPLIFIER AND AC-POWERED SUPPLY IN ONE HANDY UNIT that installs conveniently anywhere in home—yet operates 1, 2, 3 or 4 sets with amplified signal power Average gain: low band, 18 db; high band, 15 db. Adjustable gain control . . . demonstrator shunt switch . . . optional 72 or 300 ohm connectors . . . courtesy AC outlet . . . AC-powered supply . . . 4-set coupler . . . all in one compact housing.

JFD TRANSIS-TENNA FM AMPLIFIER

No. TNT106FM
AC-POWERED
$36.95, list

FOR THE ULTIMATE IN FM STEREO POWER, ADD THE NEW JFD FM TRANSIS-TENNA—THE ONLY FM ANTENNA AMPLIFIER THAT MOUNTS DIRECTLY ON THE TERMINALS OF ANY FM ANTENNA.

The best place for an amplifier is **at** the antenna terminals—and that's **exactly** where the JFD FM Transis-tenna goes . . . regardless of the antenna type. Increases gain of **any** FM antenna by 25 db Complete with AC-powered supply—4 set distribution unit, 300 ohm connectors, and transistorized amplifier

MAKE JFD—THE TOTAL TV/FM ANTENNA LINE—YOUR MAIN LINE TO PROFITS! CALL YOUR JFD DISTRIBUTOR NOW.

JFD

THE BRAND THAT PUTS YOU IN COMMAND OF THE MARKET

JFD ELECTRONICS CORPORATION

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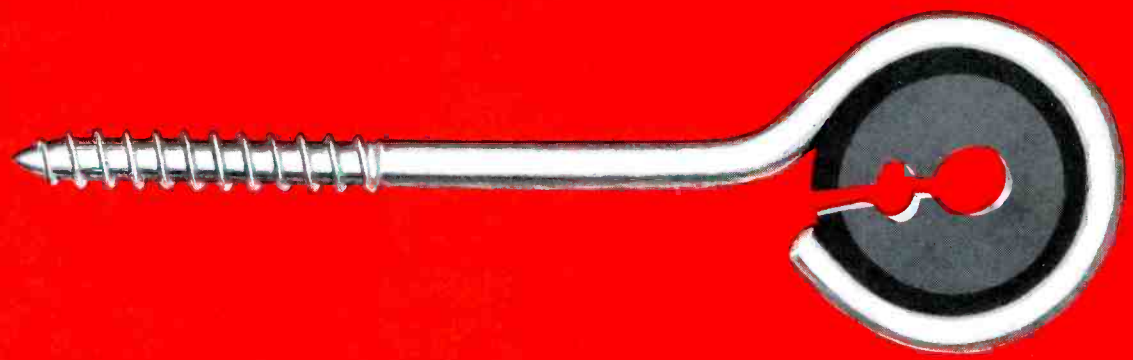
JFD Electronics-Southern, Inc., Oxford, North Carolina
JFD International, 15 Moore Street, New York, N Y
JFD Canada, Ltd. 51 McCormack Street Toronto, Ontario, Canada
557 Richards Street, Vancouver 2, British Columbia

STANDOFF!



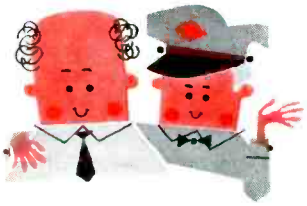
Most people think Standoff means "keep your distance" ■ Any good Service technician knows a Standoff as a gidget to hold the lead-in away from the house ■ So . . . ?

Just this. Philco talks your language, Mr. Serviceman. We practically eat and sleep parts and service day in, day out—just like you! We know your problems intimately. We know that unless you make a profit, this Philco operation can never make a profit, either. Everything we offer must be of value to you.

This Standoff, for instance. It has been tested for heat . . . for cold. It is hot galvanized to be rust resistant, tested for tensile strength, for shear . . . dozens of individual tests and inspections. It's typical of the pains that are taken to insure the quality of every part Philco makes or sells.

Look to Philco for Sales helps, Training aids, Programs, to help keep you the expert in your field. And look to Philco for parts that replace quickly and stay replaced. This means Quality! Your profits will follow as day follows night—and so will ours!

Standoffs, anyone?

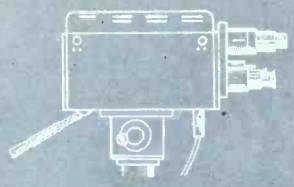


YOUR PHILCO DISTRIBUTOR has a complete selection of Philco tubes, Philco and universal capacitors, batteries, parts and accessories . . . for every service need. See him today!

PARTS & SERVICE OPERATIONS

PHILCO®

A SUBSIDIARY OF Ford Motor Company



The Electronic Scanner

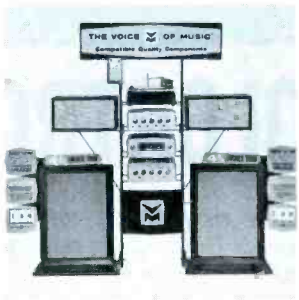
Trading-Stamp Program Continues

Service dealers are now receiving "S & H Green Stamps" from their local distributors with purchases of **Sylvania** tubes. According to E. Bruce McEvoy (right), distributor sales manager for the company's receiving-tube division, "We are highly pleased at the increase in sales of receiving tubes for August. Our tube dealers are exceptionally enthusiastic over this program, since they're able to add the stamps they receive from us to those they obtain through purchases of household goods, food, gasoline, and other products sold by thousands of merchants who give the stamps." Wyot Woods of **Sperry and Hutchinson Co.** is shown with Mr. McEvoy.

Recording-Tape Sales Campaign Initiated

The economical "Tartan" series of "Scotch" brand tapes, for home recordists, are being offered in specially priced three-reel packs by **Minnesota Mining and Manufacturing Co.** as part of their fall-winter sales campaign. Purchasers also will be given a special price on a gold-plated rack which will hold up to 40 boxes of tape.

Component-Display Stand Available



Entering the hi-fi components business is easy with the new metal "demonstration center" stand from the **V-M Corp.** Customers can get a look at the complete line of matching components, which includes the "Stere-O-Matic" record changer, standard and deluxe stereo amplifiers, Stereo/FM/AM tuner, and two sizes of speaker enclosures (with speakers). Also included with the display are a literature dispenser and promotional cards.

6-In-1 Knife-Tool Offered

With every "Universal Pak" of **Anchor** tube brighteners purchased, dealers will receive a knife that contains a cutting blade, screwdriver, bottle opener, Phillips screwdriver, wire scraper, and can opener. Each package contains ten "Briteners" to take care of most TV sets in general use. Dealer net price of the entire package is $11.95.

Come On In, The Water's Wet

Before long, a round-trip nonstop swim of the English Channel (never before accomplished) will be attempted by a lovely young lady of 24 named Mary Margaret Revell. **University** power hailers and loudspeakers will be used to relay information to her from the accompanying launch. These speakers are designed to operate continuously either in the water or out.

"Operation: Service Aids"

Included in **Motorola's** new service-aids promotion are such items as complete service uniforms, tube totes, back-of-set stickers, door-knob hangers, and matchbooks. Servicemen can obtain these service aids as premiums with the purchase of tubes or other replacement parts. Letterhead and billhead stationery, business cards, and "want lists" are also included in the material offered.

NEW FOR COLOR Winegard COLORTRON

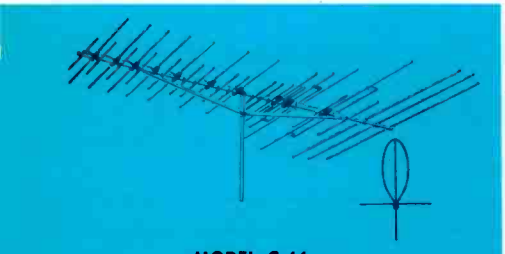
EVOLUTIONARY — The finest TV antenna design ever engineered is the time-proven Electro-Lens all channel Yagi. This patented basic design, with its cross-phased driven elements and intermixed director system, was introduced by Winegard to the industry in 1954 and has never been surpassed. Now, through continuous research and product development, a new, improved Electro-Lens Yagi has evolved—the NEW WINEGARD COLORTRON—bringing this acknowledged design to a new peak of perfection.

4 COLORTRON MODELS $24.95 to $64.95 There are 4 new COLORTRON yagis to cover every reception need, from suburbs to distant fringe areas . . . setting new industry standards for reception results and mechanical construction. They are the only outside antennas that carry a *written factory guarantee of performance* with full factory back-up of consumer satisfaction.

PERFECT COLOR ANTENNA — COLORTRONS have an almost flat frequency response (plus or minus ½ DB across any 6 MC channel), no "suck-outs" or "roll-off" on end of bands . . . accurate 300 ohm impedance match, (VSWR 1.5 to 1 or better) . . . unilobe directivity for maximum ghost and interference rejection. They deliver today's finest TV reception—COLOR or BLACK AND WHITE.

RUGGED CONSTRUCTION — SUNFAST GOLD ANODIZED—COLORTRONS are *built to last* . . . made of high tensile aluminum tubing for rigidity and stability. New locking devices keep the elements aligned—straight as a die. This quality of construction will satisfy a perfectionist! Insulators have a triple moisture barrier to insure top performance, rain or shine. Every COLORTRON is GOLD ANODIZED the WINEGARD way for the best looking, most corrosion-proof and permanent Gold finish known for aluminum.

POWERFUL ELECTRONIC ANTENNA — Because the COLORTRON and the NUVISTOR amplifier were designed to match each other perfectly, electronically and mechanically, together they make the most efficient electronic TV antenna yet devised .



MODEL C-44
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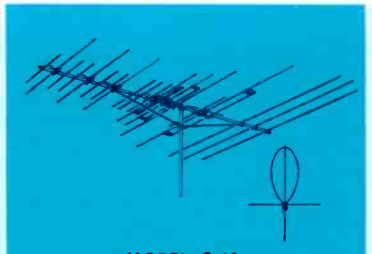

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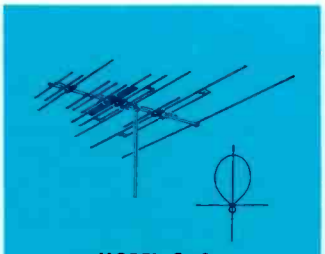

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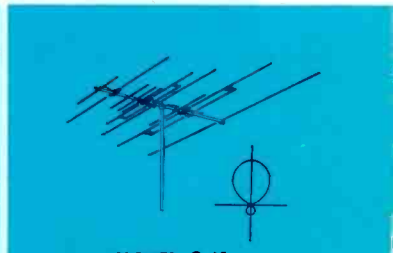

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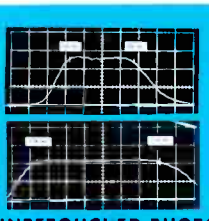

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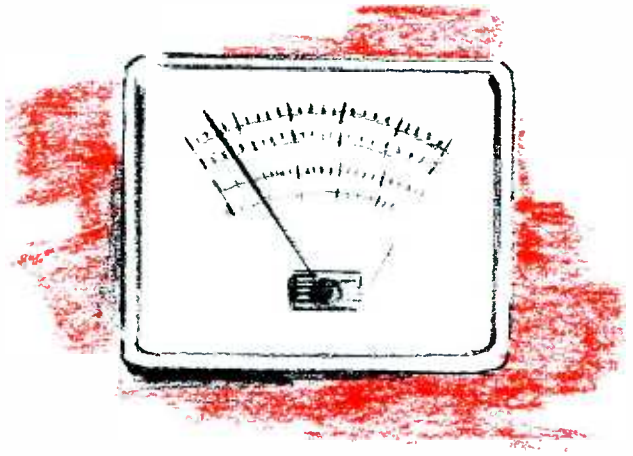

getting more out of RESISTANCE measurements

Visual checks, voltage measurements, and waveform analysis can generally clue the service technician to a troubled stage. After locating the defective circuit, he must find the individual component(s) which are causing the receiver to operate abnormally. His most useful instrument at this time will probably be his ohmmeter; in fact, his skill in using it and interpreting its readings may well determine his profit or loss on the job.

What methods or procedures will help increase the profit? Those mentioned in this article will be beneficial, if you'll start thinking about them and try putting them into practice.

Watch Your Test Points

You'll save yourself a lot of trouble by making resistance measurements as close as possible to the actual component you suspect of being defective. Placing the test probes on remote points, such as tube pins, may allow wiring defects to mislead you into replacing a perfectly good part.

To illustrate the importance of making direct measurements whenever you can, here's a case in which the initial measurements led to wrong conclusions and made some backtracking necessary. In a late-model TV set, intermittent pulling or loss of horizontal sync was the complaint. Rotating the fine-tuning control (to mistune the RF oscillator a small amount) would sometimes cause the set to act up; at other times it wouldn't. A heat lamp was no help. The technician eliminated the AGC circuit (a keyed type) as a trouble spot, and started looking for defects in the noise-limiter and sync circuits (Fig. 1). Note that all connections between these stages are made through a printed-circuit component combination.

The resistance from the grid (pin 2) of the sync separator to chassis seemed normal enough—close to 1.4 meg — but the grid-to-chassis path from pin 9 of the noise limiter measured 22 megs. Connecting the ohmmeter leads between the grids of the two tubes indicated that R1, the 1-meg resistor inside the printed unit, was apparently defective. This could open the grid-return path for the noise limiter, causing intermittent operation.

The type of printed component board used in this receiver, shown in Fig. 2, provides for snap-in replacement of individual components; that is, any part may be replaced by first removing the defective item from the board and then snapping in a new one. Consequently, the technician was able to remove R1 and check it with his meter. To his surprise, it read 1 meg, just as it should. Rather than to put the old part back, he soldered in a new 1-meg resistor from his stock. However, on repeating the resistance check between the noise - limiter and sync - separator grids, he once more found the same

• Please turn to page 98

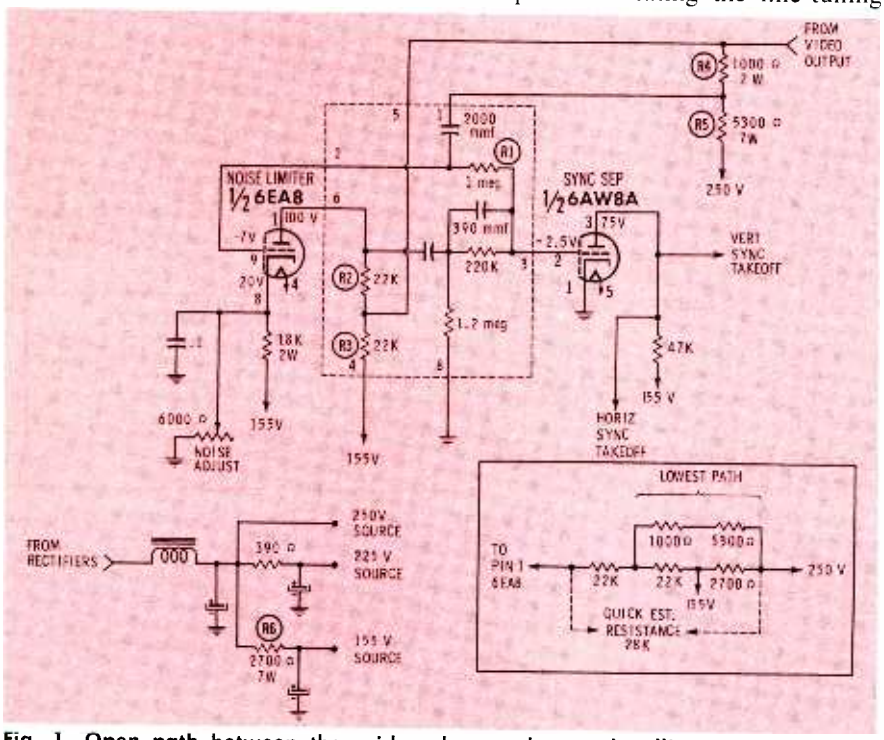

Fig. 1. Open path between the grid and ground caused pulling and poor sync.

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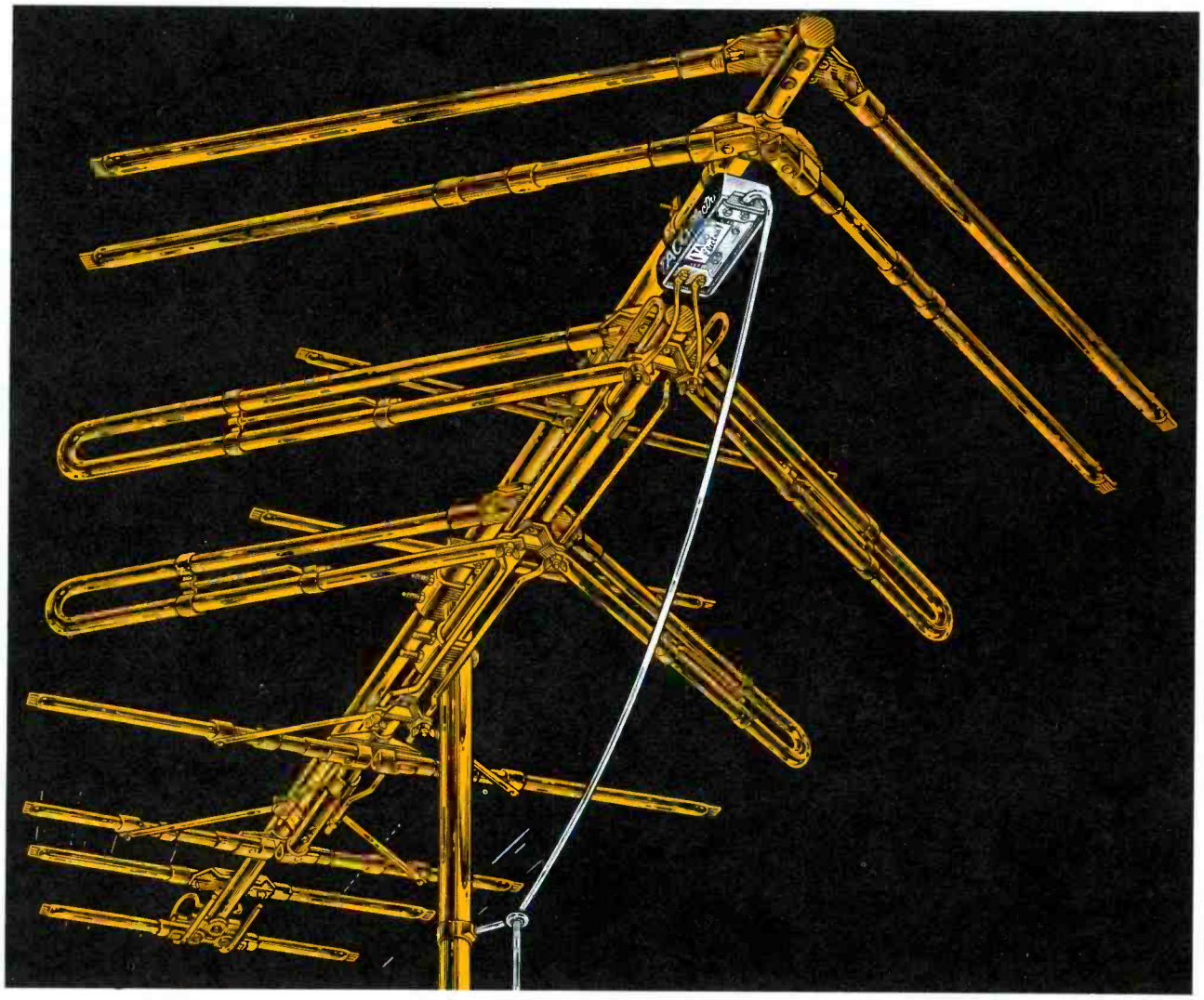

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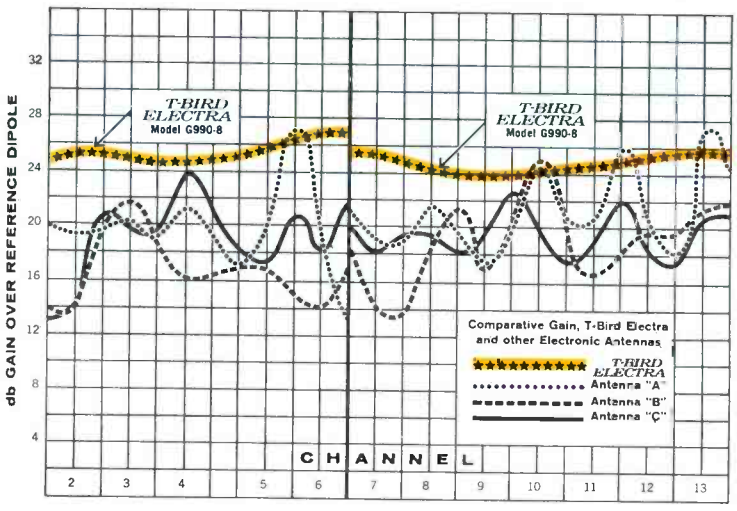

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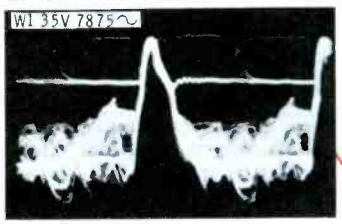
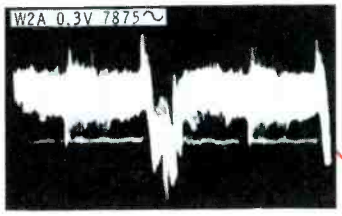
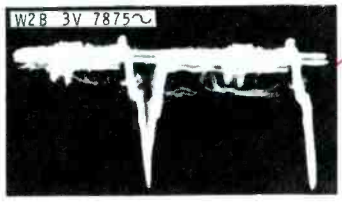
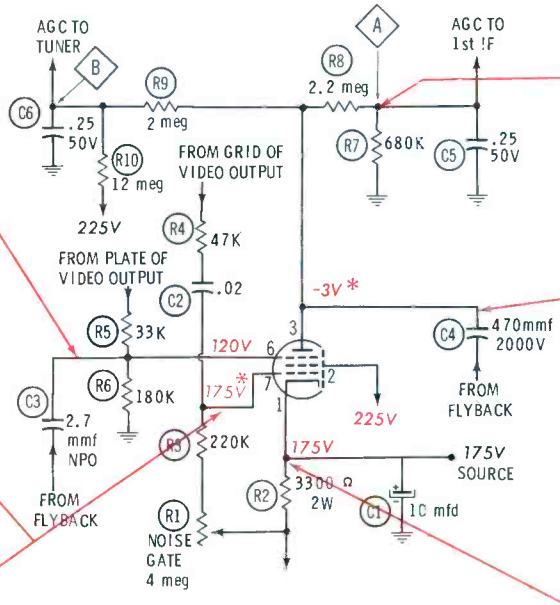
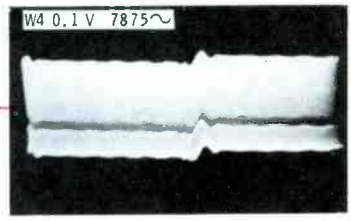
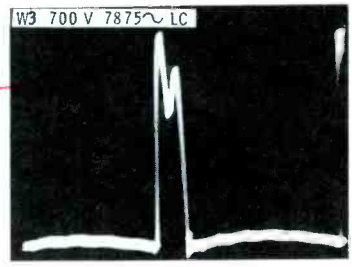


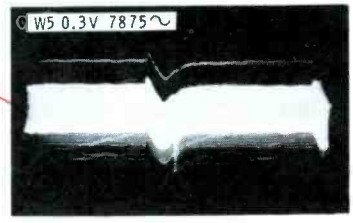












Normal Operation

One of two pentode sections in 'BU8 functions as AGC keying tube. (For description of other pentode section, refer to September, 1962 *Symfact* coverage on 6BU8 sync separator.) AGC portion of tube conducts only when positive keying pulse in W3—a sample of horizontal flyback pulse—is present on plate (pin 3). Strength of plate current is determined by DC voltage level on pin 6 at instant when keying pulse arrives. This element is direct-coupled to plate circuit of video output stage, making pin-6 voltage dependent on two factors: Amplitude of horizontal sync-pulse tips in W1, and DC plate voltage of video output tube. Both of these factors tend to raise voltage at pin 6 when RF input to receiver increases; 'BU8 then conducts harder and builds up additional charge on AGC filter networks in plate circuit. Pin-7 circuit combats noise interference in received signal, which tends to increase 'BU8 conduction and produces too much AGC bias. Sample of video waveform (W2) is fed to pin 7 in such a way that each incoming noise pulse can be made to block 'BU8 for an instant, and thus cancel itself. Unusual feature, small negative flyback pulse fed through C3, neutralizes positive-pulse feedback from pin 3 to 6 within tube.

Operating Variations

PIN 3 Charging of AGC filter generates negative DC voltage proportional to video signal strength — usually −30 to −40 volts on strong stations. W3 overdrives some scopes, unless low-cap probe is used for its AC voltage-dividing action.

PIN 6 Waveform amplitude and DC voltage both change according to contrast setting. DC range, from minimum to maximum contrast, is about 145-70 volts (no signal) or 155-130 (strong signal).

PIN 7 Normally, R1 should be set for zero bias between pin 1 and 7, to swamp out waveform (W2A). Noise-suppression feature is activated by turning R1 so waveshape changes to W2B. Turning control too far disables AGC and sync.

A B

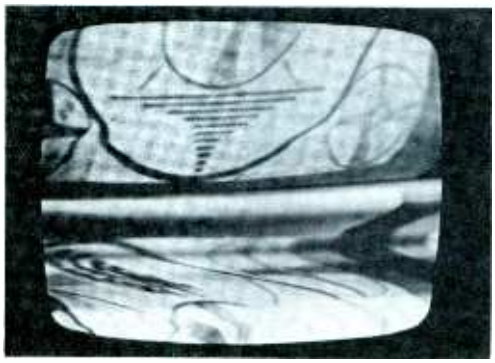
About 1/5 of voltage at pin 3 appears at point A, because of voltage division across R8-R7. At point B, positive voltage fed through R10 opposes AGC bias, until pin-3 voltage reaches about −45 volts. This lets RF amplifier run at full gain under most signal conditions.

SYMPTOM 1

Vertical Roll Horizontal Pulling

Contrast Normal

C5 Open



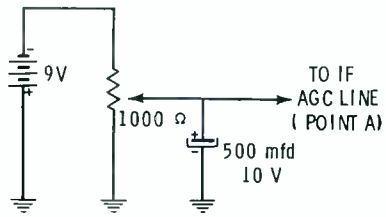
Symptom Analysis

Although complaint is sync trouble, strange white streak through vertical blanking bar points to video-circuit fault. Scope proves video signal is distorted (see below). As part of troubleshooting, fixed bias is substituted for AGC voltage. This removes symptoms, conclusively pinpointing AGC as origin of distortion.

Waveform Analysis

Cause of odd white bar in picture is negative pulse which cancels out most of vertical sync pulse in video signal. This pulse shows up plainly in W1 at scope frequency of 30 cps. Also note that horizontal sync pulses are nearly flattened. Naturally, all waveforms in sync circuits are poor. Tracing AGC circuit reveals ripple in W4 at 7875-cps scope frequency; when scope is switched to 30-cps sweep, negative spike is seen. This pulse, which is mixing with IF signal and causing distortion, should have been suppressed by AGC filter network including R5.

Voltage and Component Analysis



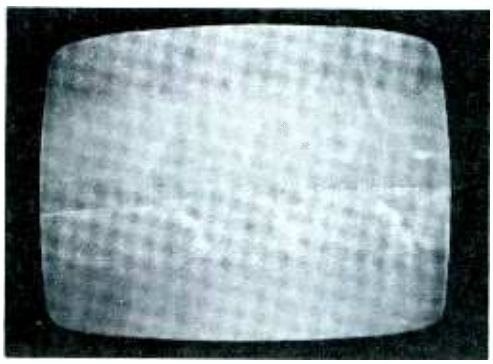
All DC voltages appear normal, whether or not signal is applied. But AGC trouble can be spotted by simple isolation test: *clamping*, or connecting low-impedance source of variable negative voltage to point A. This artificial bias substitutes for missing AGC voltage, or filters out ripple and hum—thus restoring normal video signal and simplifying troubleshooting. Once the isolation test is completed, bias pack may be left connected, to facilitate measurements; in other cases (like this one), AGC line must be unclamped for further attempts at troubleshooting.

SYMPTOM 2

Video Weak or Absent (Except Fringe Reception)

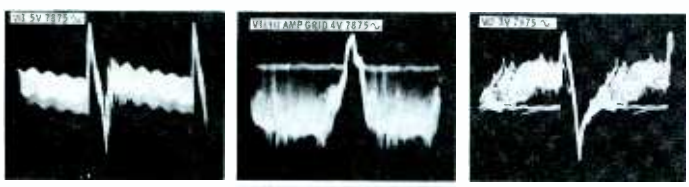
Sound Fairly Normal

R1 Open



Symptom Analysis

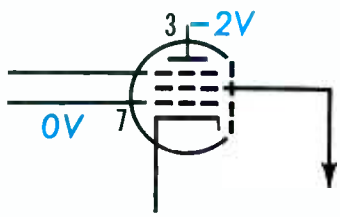
Raster displays normal snow on vacant channels, but is nearly blank when local stations are tuned in. All evidence points to blocking of video output stage by incoming signals—a hint of AGC trouble. Clamping bias applied to point A restores picture, but sync remains critical at all settings of contrast control and R1.



Waveform Analysis

W1 is present, but is misshapen; amplitude is far below normal. Although output signal of video detector is a bit stronger than normal value of 2 to 3 volts p-p, it is inverted; sync pulses in this waveform should be negative. When bias pack is connected, W1 and video waveforms regain proper appearance, but output from sync-separator section of 'BU8 is still almost nonexistent. Scope check at pin 7, in noise-limiter circuit common to both sections of tube, shows unusually large W2A which is unaffected by setting of NOISE GATE control, and is somewhat distorted.

Voltage and Component Analysis



When voltages on 'BU8 are checked, complete loss of DC potential on pin 7 stands out like sore thumb, whether or not AGC line is clamped. Resulting 175-volt bias between pins 1 and 7 keeps both sections of tube solidly cut off. Thus, without clamping, voltage on pin 3 remains close to normal no-signal level of —2 to —3 volts at all times. Since incoming signal overloads video output tube almost to point of cutoff, its plate voltage rises—in turn forcing pin-6 voltage of 'BU8 up to abnormally high level. However, clamping restores correct voltage.

SYMPTOM 3

Excessive Contrast

Horizontal Sync May Be Unstable

R5 Increased in Value

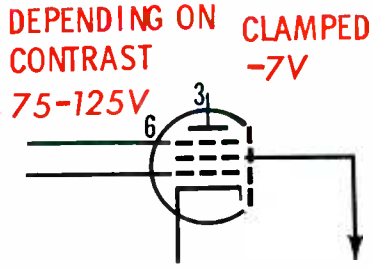
Symptom Analysis

Although slight horizontal pulling and sync buzz are intermittently present, main complaint is "picture too black." Symptoms suggest moderate overdriving of video amplifier by input signal, due to insufficient AGC voltage. Applying variable clamping bias to point A permits adjusting contrast to normal level.

Waveform Analysis

With no artificial bias applied, W1 viewed at either 7875 or 30 cps shows considerable distortion and compression of positive peaks. Output signal of video detector has good waveshape, but amplitude is 9 volts p-p (about three times normal). Clamping restores normal waveforms throughout set. Only scope clue to trouble is furnished by leaving AGC line clamped, setting CRT input at 50 volts p-p, and carefully measuring *amplitude* of W1. The result, 15-20 volts instead of normal 35-40 volts, reveals incorrect division of signal voltage across R5-R6.

Voltage and Component Analysis



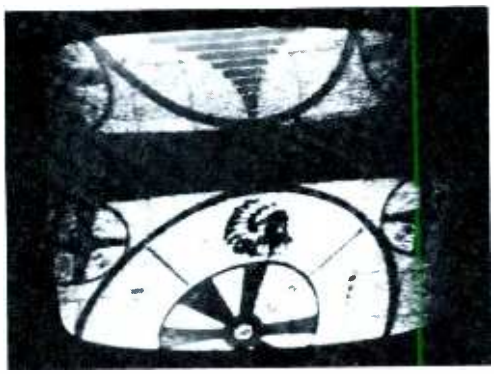
Obtaining usable voltage clues requires extra care in taking readings, plus good understanding of circuit behavior. Here's one pitfall of routine approach to voltage measurement: Although voltage at pin 6 should decrease as result of trouble, this change is likely to be cancelled out by unusually low setting of contrast control, which has effect of *increasing* pin-6 voltage. If R6 instead of R5 had gone up in value, conduction of AGC tube would be above normal, and overproduction of AGC bias would cause weak contrast or even snow in picture on local channels.

SYMPTOM 4

Video Overloading

"Muddy" Picture, Erratic Sync, Noisy Sound

C4 Leaky



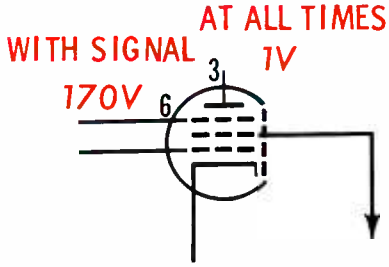
Symptom Analysis

All evidence indicates overdriven video output stage. Touchy sync and flat, dull appearance of picture are signs of clipping or compression in peaks of video waveform. Symptoms are worst on strongest channels—a characteristic indication of AGC trouble. Application of clamping bias to point A restores normal picture.

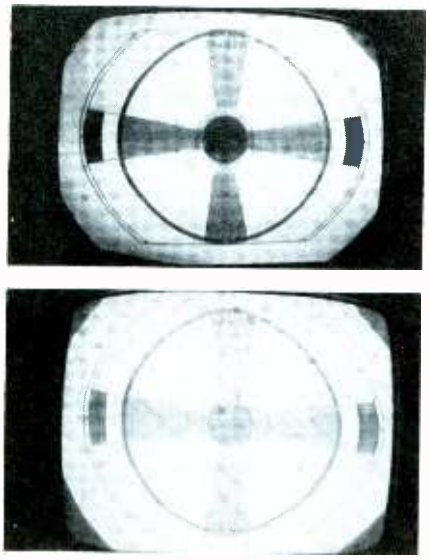
Waveform Analysis

Without clamping, appearance of W1 varies radically according to picture content of video signal. At times, sync pulses are completely flattened. Overall amplitude of waveform averages about 15-20 volts p-p at pin 6 of 'BU8, but may occasionally rise to 50 volts with severely compressed positive peaks. Abnormalities in this and other waveforms are effects rather than causes of trouble. To cite another example, unusual shape of W2A probably has very little influence on symptoms. Incidentally, W3 appears normal in spite of trouble in plate circuit.

Voltage and Component Analysis



Clamping has drawback of restoring all voltages and waveforms to normal. Thus, it's necessary to disconnect bias pack to accomplish troubleshooting. Even then, voltages on AGC tube are no significant help unless signal is applied. Only exception is positive 1 volt on pin 3, which could easily be overlooked. With signal fed in, plate voltage fails to swing in negative direction—an important clue. Voltage at pin 6 is above normal for existing signal conditions, because plate voltage of video output tube is too high as consequence of this stage being overdriven.



WEAK, WASHED-OUT PICTURES

Fig. 1. Loss of contrast detracts greatly from the clarity of the TV picture.

Normal contrast (Fig. 1A) is taken for granted until the TV picture begins to look dull and lifeless. A pale image with no snow (Fig. 1B) makes the set owner begin to worry that his picture tube is going bad. The CRT could possibly be at fault in such cases, but poor contrast with good brightness is much more frequently due to insufficient video-signal input to the cathode or grid of the tube. There's a good chance that replacing the video amplifier (or possibly some other tube in the picture-signal section) will dispose of this problem. If tube changing doesn't help, though, the receiver needs an examination on the bench to find out which circuit is falling down on the job of providing video-signal gain.

In the shop, you may save considerable time by promptly checking the B+ and filament voltages fed to the CRT and picture-signal stages, and correcting any supply deficiencies before further analyzing the signal circuits. If "underpowering" doesn't account for the low video gain, signal tracing is the best way to proceed in isolating the trouble.

Detector Tests

The first circuit to check is the video detector, which joins the video IF strip to the video-amplifier section. The most important test to be made here is a measurement of signal amplitude at the detector output. A voltage-calibrated scope is the best instrument for this purpose, but a VTVM capable of indicating peak-to-peak AC values will also give usable results.

No hard-and-fast rule can be laid down regarding what is a "normal" video-detector output. Signal amplitude depends on many factors: the strength of the RF signal picked up by the antenna, the gain available in the front end, the bandwidth utilized in both IF and video-amplifier sections, the design of the AGC circuit, and the tube complement throughout. Although signal values in different sets range all the way from 1 to 10 volts peak to peak, most receivers develop from 1.5 to 3 volts across the detector load.

During the past several years, most TV receivers have been equipped with a high-gain video-amplifier tube in an efficient single-stage circuit having modest input-signal requirements. Detector signals above 5 volts peak to peak, formerly seen in many economy-type sets, are seldom found today. Regardless of the age of a set, by the way, the number of video-amplifier stages it contains has little to do with the signal requirements; in fact, note that the one-stage circuit in Fig. 2 is fed a weaker input than the two-stage circuit in Fig. 3. The extra stage is likely to be included

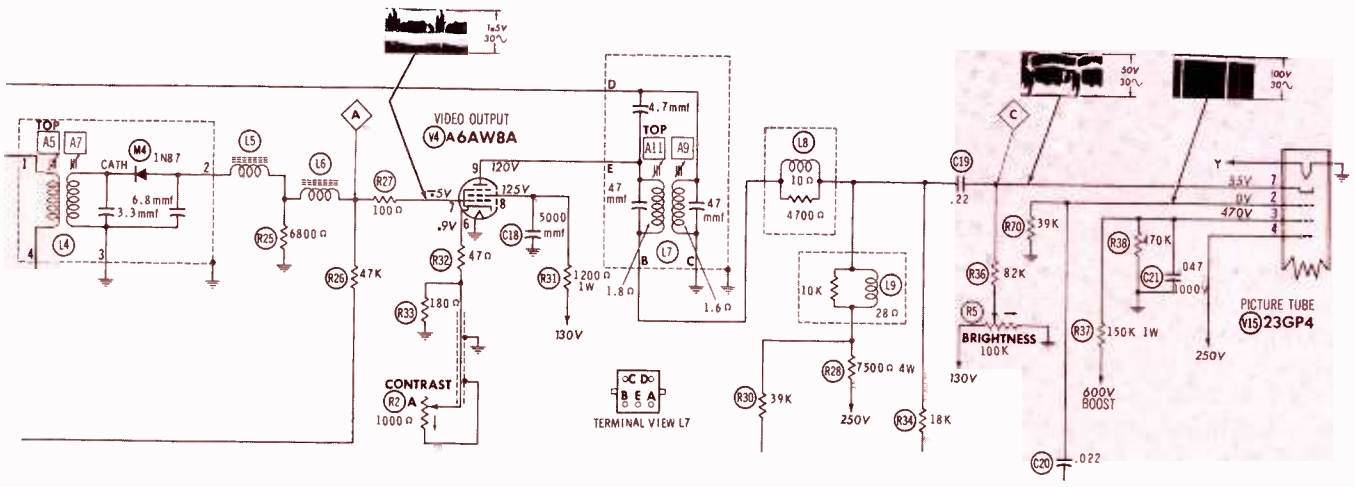


Fig. 2. Most TV receivers obtain adequate picture-signal gain from a one-stage video amplifier.

Remedies for insufficient video drive to the CRT.

by Robert G. Middleton

for reasons other than overall gain —for example, to allow increased video bandwidth, or for improved linearity to give more faithful rendition of gray tones.

The waveform amplitudes given in service data are generally your most reliable guide in evaluating the detector-output signal. If its amplitude definitely seems lower than normal for existing signal conditions, you'll want to investigate further in the IF strip (especially in the later stages) to seek an explanation for the low gain. In recent models, particularly close attention should be given to the last IF amplifier, which often uses a high-Gm tube like the 6EW6 or the frame-grid 6EJ7 to provide extra gain. Checking the effect of tube substitution on detector-waveform amplitude, and measuring voltages and resistances in the IF circuits, are good ways to turn up clues.

Don't forget to check the detector diode itself. Germanium crystal types can be given a rough check of front-to-back resistance with an ohmmeter, but are most satisfactorily checked by substitution.

In receivers with keyed AGC, defects in the keying stage can place too much bias on the controlled amplifiers, resulting in a weak picture. Snow may be present in some cases, but not in others. A simple (unamplified) AGC system cannot "overbias" the RF-IF amplifiers in this manner, unless the circuit contains a LOCAL-DISTANT switch and the adjustment is set to the wrong position.

Sometimes a loss of contrast results from a marginal condition which will leave you wondering whether or not the detector output is adequate. In such cases, you shouldn't spend too much time checking circuits ahead of the detector. You'd be wise to proceed as if the detector signal were normal, and advance to the next key check point —the input to the picture tube from the video amplifier. About 50 volts peak to peak at this point will usually give normal contrast. Some late-model sets with high CRT-anode voltage require slightly more drive; but they generally have plenty of reserve capability, delivering over 100 volts peak to peak at the maximum setting of the contrast control. On the other hand, some of the simpler chassis normally put out less than 50 volts of CRT-drive signal when running "wide open." Receivers in this category cannot tolerate any loss of efficiency in the picture circuits, and a weak picture may even result from nothing more than installation of a new CRT with above-average drive requirements.

Manufacturing tolerances on picture tubes allow for variations in the amount of video signal needed to develop a crisp black-and-white picture, even among tubes of the same type. These differences are recorded in tube manuals — which state, for example, that individual 24AEP4 tubes may require grid-cathode bias values ranging from 35 to 72 volts to extinguish the raster. An "average" tube will do reasonably well with less than 50 volts peak to peak of drive signal, but a "cool" tube of this type could require close to 100 volts (including sync pulses) for really good contrast.

Although it isn't very practical to try several different CRT's in an effort to select a "hot" one, you can often solve a problem of weak pictures in a marginal chassis by taking advantage of this fact: Amplifier tubes are also subject to manufacturing tolerances. A bit of judicious tube selection will often reward you with adequate contrast, without recourse to circuit tests which might not turn up anything helpful. Of course, you'll need to allow for a slight decrease in emission of the new amplifier tube after the initial "cook-in" period.

Video-Amplifier Analysis

If the amplitude of the signal fed to the CRT is much lower than 40 volts peak to peak with the contrast

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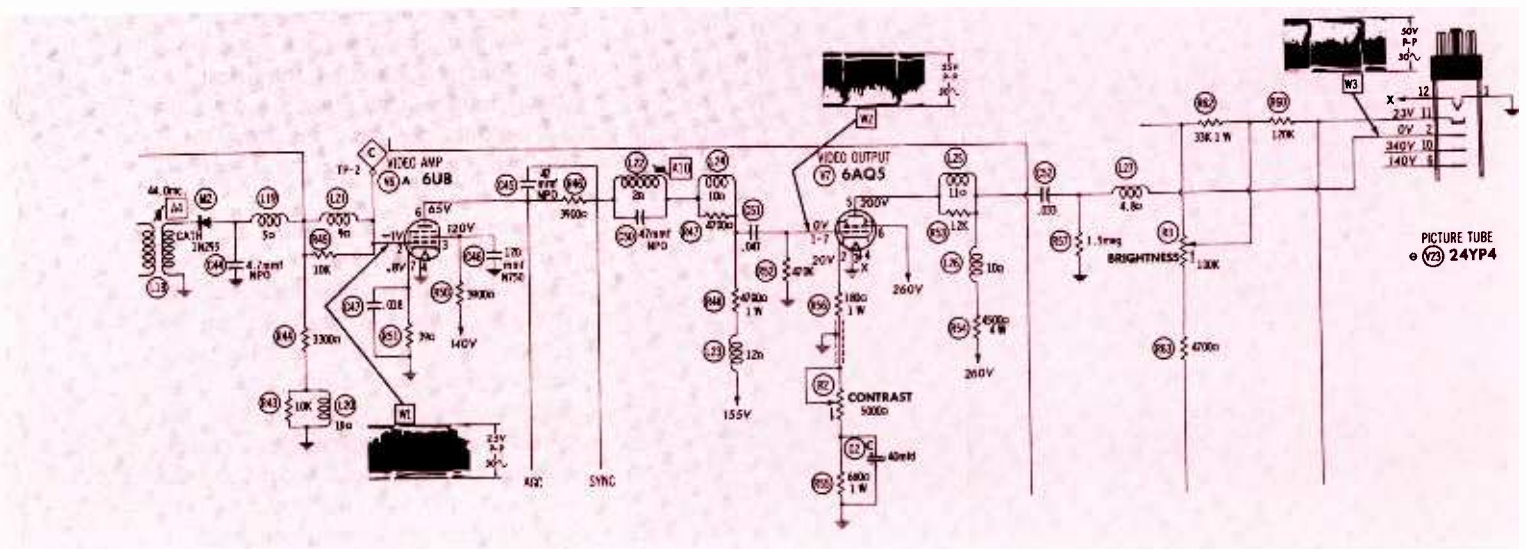

Fig. 3. Two-stage video amplifiers generally provide about as much gain as single-stage type.

closed circuit TV is opening up!

Its growth rate is linked to the caliber of service available. — by Leo G. Sands

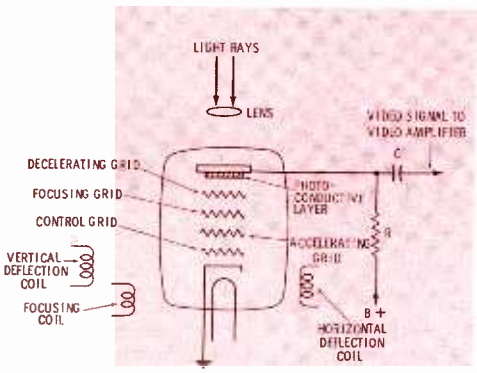

Fig. 1. Vidicon tube is very similar in general construction to ordinary CRT.

Servicing and installing closed-circuit TV systems can be a lucrative full-time or sideline activity for the service technician with TV-servicing experience. Sales of closed-circuit TV (CCTV) systems are rising, and they will be considerably greater when potential buyers are assured of readily available maintenance. The growth of this field, as well as other branches of industrial electronics, is being retarded by the lack of service—when needed—at reasonable cost.

Who Uses Them?

Thousands of CCTV systems, sometimes called industrial television (ITV), are in use. At the world's busiest railroad station—Pennsylvania Station in New York—batteries of CCTV cameras are trained on Pullman-space diagrams. Each ticket window is equipped with a TV monitor on which the passenger may see the location of the Pullman space he is to occupy. At certain busy airports, a TV camera views the departure-arrival board, and the image is reproduced on numerous TV monitors in the airport terminal.

Banks use CCTV for remote viewing of checks and signature cards. In steel mills, machine operators can view and control dangerous operations from a point of complete safety.

A major automobile manufacturer plans to install closed-circuit cameras at infrequently used gates, which would otherwise have to be manned by guards at all times.

A wired - music - service operator plans to install CCTV monitors in bars and restaurants; printed announcements, filmed or taped programs, and special live broadcasts will be transmitted to these units.

All of these existing and planned CCTV installations must be serviced. This maintenance must be performed by employees of the system owners, by the CCTV distributor, or by independent service technicians.

CCTV opportunities will expand even more as soon as slow-scan TV systems become more readily available. Slow-scan systems can be used for transmission of documents, still scenes and (sometimes) slow-moving scenes. Instead of requiring coaxial cable or microwave, slow-scan TV signals can be transmitted over an ordinary voice-grade telephone line.

In one of these systems, the picture to be transmitted is mechanically scanned by a photoelectric cell, and the picture is built up on the screen of a monitor employing a long-persistence picture tube. Another slow-scan system prints the picture on photosensitive paper, leaving a permanent record of the scene. It can even be used to take a picture of a slow-moving train.

The market for CCTV service

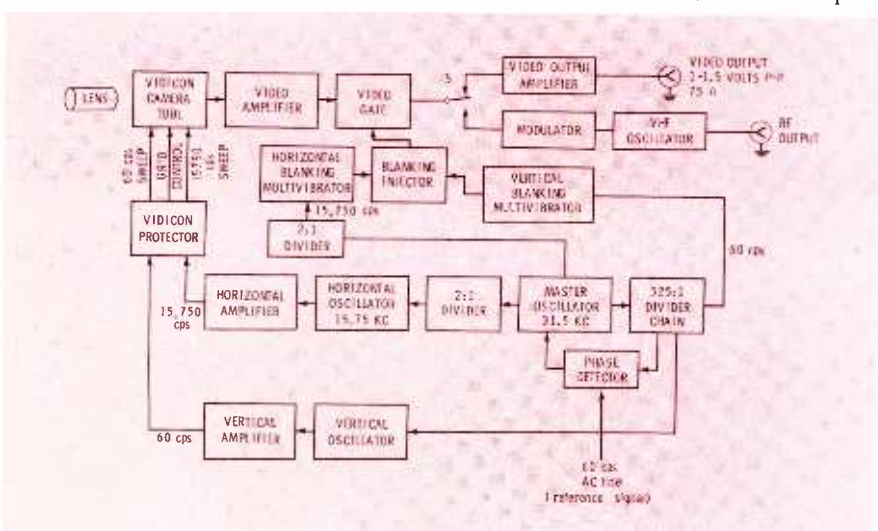

Fig. 2. Block diagram of camera using vidicon tube, showing circuit layout.

will grow quickly when educational institutions start taking advantage of federal ETV grants. Qualified schools will be eligible for matching funds for the purchase of educational TV equipment, including CCTV cameras, monitors, and transmission equipment.

A recent survey reveals that a large number of schools and colleges plan to use CCTV and that most of them will install facilities for transmitting TV programs between campus buildings and to off-campus points. One big-city university plans to transmit TV programs to 30 locations. Another major university plans to transmit TV—via wire lines —from its main campus to locations more than 100 miles away. Servicing these systems would be much less a problem if local maintenance were available for the CCTV equipment at each of the locations served.

The Equipment

A CCTV system may be very simple, consisting of a single camera and monitor, or it can be as complex as a network-TV facility. The basic equipment, however, is no more complex than an ordinary TV receiver. Some CCTV cameras deliver only a video signal and require the use of a special monitor or modified TV receiver. Others contain an RF signal generator, the output of which is modulated by the video signal; the modulated signal is then fed through coax or twin-lead —or sometimes an antenna distribution system— to the antenna terminals of regular home-type TV receiving sets.

To transmit TV programs from one building to another, coaxial cable or a microwave link is generally utilized. If the buildings are on the same parcel of property, and it is not necessary to cross public thoroughfares, a coaxial-cable system may be installed. But, if the buildings are separated by public thoroughfares, it is usually necessary that TV transmission lines be leased from the local telephone company.

Typically, the cost of leasing a CCTV transmission circuit runs around $20 per quarter-mile per month for local service. For long runs, the rate may drop as low as $45 per mile per month. In addition to rental charges, installation costs must be paid and a five- or ten-year contract is generally demanded. There is also a charge for rental of the equipment which connects the CCTV equipment to the facilities of the phone company. When a long, privately-owned coaxial cable is used, it may be necessary to install line amplifiers to make up for transmission losses, and equalizers to adapt the signal to cable characteristics.

Partial List of CCTV Equipment Manufacturers

Adler Electronics, Inc.
1 Le Fevre, New Rochelle, N.Y.

Avco Corp., Crosley Div.
1329 Arlington, Cincinnati, Ohio

Bendix Aviation, Friez Instrument Div.
1400 Taylor, Baltimore, Md.

Blonder-Tongue Labs
9 Alling St., Newark 2, N.J.

Dage TV Division
W. 10th St., Michigan City, Ind.

DuMont Labs
750 Bloomfield Ave., Clifton, N.J.

Fairchild Camera & Instrument Corp.
Robbins Lane, Syosset, N.Y.

General Precision, GPL Div.
63 Bedford Rd., Pleasantville N.Y.

General Electric, Comm. Products Div.
Lynchburg, Va.

Lear-Siegler, Inc.,
Hallamore Electronics Div.
714 N. Brookhurst, Anaheim, Cal.

ITT Federal Div.
100 Kingsland Rd., Clifton, N.J.

Jerrold Electronics
15th & Lehigh, Philadelphia, Pa.

Kay Electric Co.
14 Maple Ave., Pinebrook, N.J.

Miratel, Inc.
1st St. S.E. & Richardson,
New Brighton 12, Minn.

Motorola Comm. & Electronics, Inc.
4501 W. Augusta Blvd.,
Chicago 5, Ill.

Packard Bell Electronics Corp.
12333 W. Olympic,
Los Angeles 64, Calif.

Radio Corporation of America
Camden 2, N.J.

Setchell-Carlson, Inc.
New Brighton 12, Minn.

Sylvania Electric Products, Inc.
1100 Main St., Buffalo, N.Y.

Thompson Ramo Wooldridge
23555 Euclid Ave., Cleveland, Ohio

Vicon Corporation
1369 Industrial, San Carlos, Calif.

How It All Works

CCTV systems employ cameras which utilize a vidicon tube for picking up images. A vidicon tube is small and costs only a fraction as much as the image orthicon used in most commercial TV broadcasting.

In a vidicon TV camera, the image is focused by a lens on a photoconductive layer which is the anode signal element, and which is held at a positive potential (see Fig. 1). A beam of electrons emitted from the cathode passes through four grids on its way to the photoconductive signal anode. The beam is electromagnetically swept 15,750 times horizontally and 60 times vertically per second by deflection coils arranged around the neck.

Video and Sweep Signals

As the beam scans the photoconductive layer, anode current rises whenever the beam passes a point illuminated by the image. This causes current through load resistor R to vary, resulting in a video-signal voltage which is fed through the coupling capacitor to the video amplifier.

As illustrated in the block diagram (Fig. 2), this amplified video signal is fed to a video-gate or mixer stage, where blanking pulses are added. The composite signal is fed to a video output stage and thence to a TV monitor — sometimes directly or through a switching ar-

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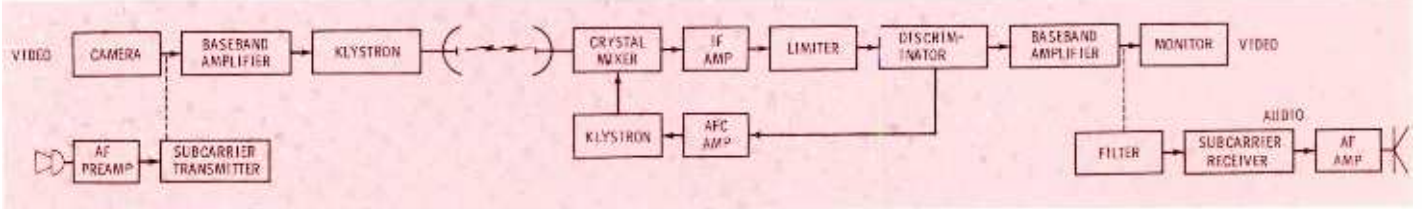

Fig. 3. Unidirectional microwave link which also includes a sound channel.

They're Transistorizing TV Remotes

New receiver units draw only a trickle of standby current . . . by George F. Corne Jr.

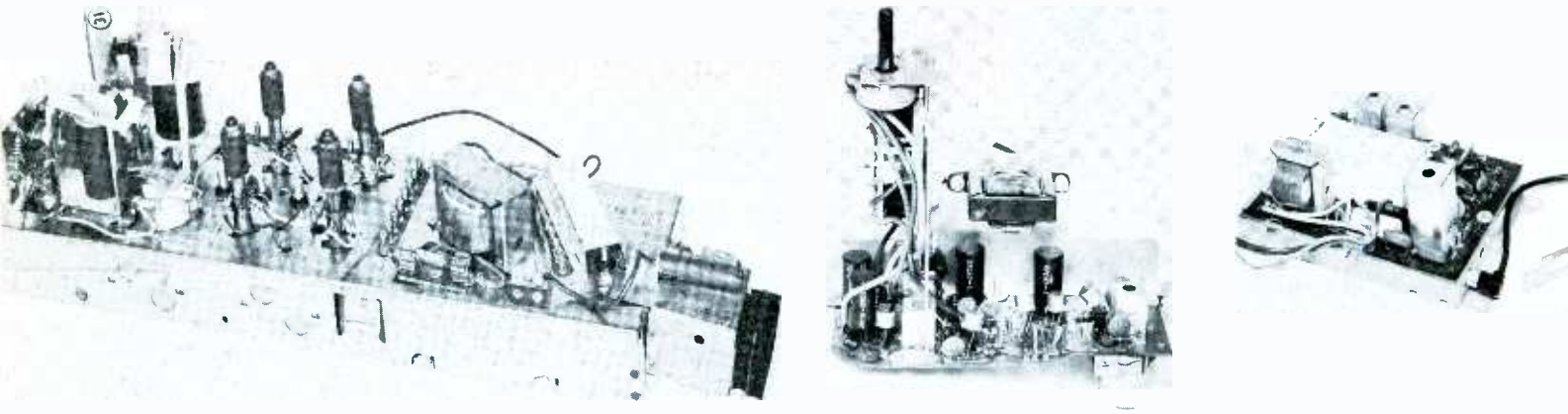

Fig. 1. Transistorized TV remote receivers of different shapes and sizes.

The majority of the remote control receivers in the latest TV models contain all-transistor circuitry. PNP transistors are the kind you'll find in most sets—generally from 6 to 8, depending on the number of remote operations the set is required to perform. Ordinarily, four transistors function as RF amplifiers in the 40-kc frequency region, and the remaining ones serve as driver or relay-control stages. As in tube-type remotes, various relays are energized by incoming signals to complete the electrical path for motors, volume switches, and similar components.

The design of remote transmitters has not changed appreciably; the familiar transistor - oscillator types and mechanical tone generators are both still used. For this reason, we won't concern ourselves with transmitters in this article, but will direct our full attention to transistor receivers.

Fig. 1 shows some of the physical

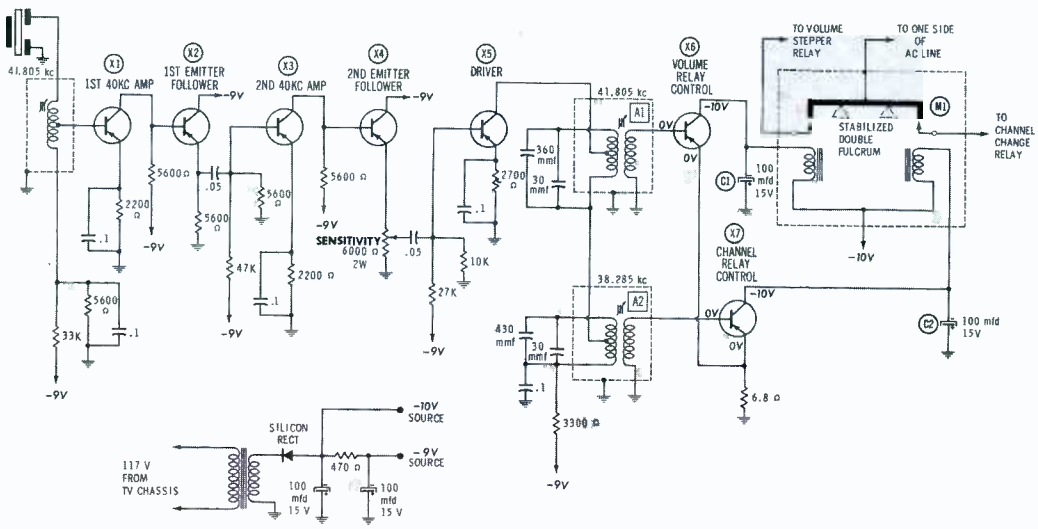

Fig. 2. Received signal is amplified to high enough level to drive relay-control transistors into conduction.

shapes and sizes of the transistorized remotes you'll be seeing in new TV sets.

Stage Functions

The actual circuits, as well as the functions, are basically no different from one transistorized remote to another. The unit shown schematically in Fig. 2 is representative of those being used at the present time. We'll first review some pertinent facts about circuit functions, and then suggest a few procedures to help you isolate a defective stage in any transistor remote.

Power for the remote receiver is normally obtained from the AC input circuit of the TV set, via a step-down transformer and half-wave silicon rectifier. These transistorized devices have low current requirements—an important advantage in a unit which is customarily left operating even when the rest of the TV set is turned off.

Methods used to couple the incoming signal to the base of the first amplifier vary in different models, but capacitive or direct coupling to a tuned input coil is found in the majority of sets. Some have an untuned input; in this case, a tuned circuit is located in one of the later amplifier stages.

In some receivers, certain RF stages are emitter followers. No gain is realized from these stages (X2 and X4 in Fig. 2), but this type of circuit results in good impedance matching between amplifiers.

Driver stage X5 has two tuned transformers in its collector load circuit—one tuned to 41.805 kc and the other to 38.285 kc. Through these, the incoming signal is coupled to relay-control transistors X6 and X7, which are biased at cutoff under no-signal conditions. The negative portion of the incoming signal causes one of these PNP transistors to conduct. Collector current then energizes one side of relay M1, completing the path for one of the remote-controlled functions. (Fig. 3 is a close-up photo of this bistable relay.)

Capacitors C1 and C2, wired in the collector circuits of the control transistors, smooth out the current through the relay to keep it from chattering. They also filter out noise pulses, which might otherwise cause erroneous relay operation. Remember these components if you have a set which changes channels, or performs some other remote function, without a signal from the transmitter. Also, when a set is troubled by this *noise keying* effect, check to see if it includes a sensitivity control which can be used to vary the operational gain of the receiver. If such a control is used in the remote you're called on to service, adjust it for the least gain needed to obtain adequate remote operation. Seldom will it need to be set above the halfway point in its rotation; too high a setting could defeat its purpose.

Remote Control for Rotators

Circuits similar to those just described are also found in a transistorized remote control recently introduced for use with antenna rotator systems. In addition, the electromechanical sequence of relay operation in this unit is practically the same as in TV remotes. Much of the following description of rotator-control circuitry therefore applies equally well to TV-control functions such as remote adjustment of volume.

The "rotator remote" merely duplicates the electrical function of a three-position push-button switch located on the main rotator-control box. Spring loaded to the *off* position, this switch is used to start the rotor turning either clockwise or counterclockwise. Rotation will continue as long as this button is held down.

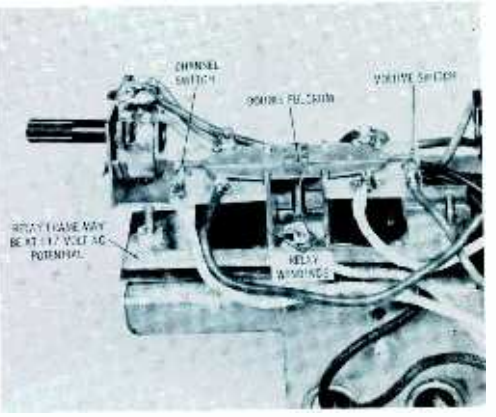

Fig. 3. Transistor collector current energizes one side of relay at a time.

In remote operation, a 46-kc pulse is transmitted by pressing a button on a hand-held *actuator* unit (a mechanical tone generator of the type used with TV's). Picked up by a transistorized receiver, this signal is first amplified and then used to energize relay M1 (Fig. 4) for the duration of the pulse. M1 closes switch S1, completing a current path for stepper relay M2. As M2 operates, the three cams on the actuating arm of this relay (see Fig. 5) cause the individual sections of S2 (A, B and C) to operate in the sequence shown in the chart in Fig. 4.

The A section is connected, via a plug and socket, in series with the motor-transformer in the rotator-control primary circuit. Sections B and C are likewise in series with the secondary of this transformer. The B section completes the circuit for

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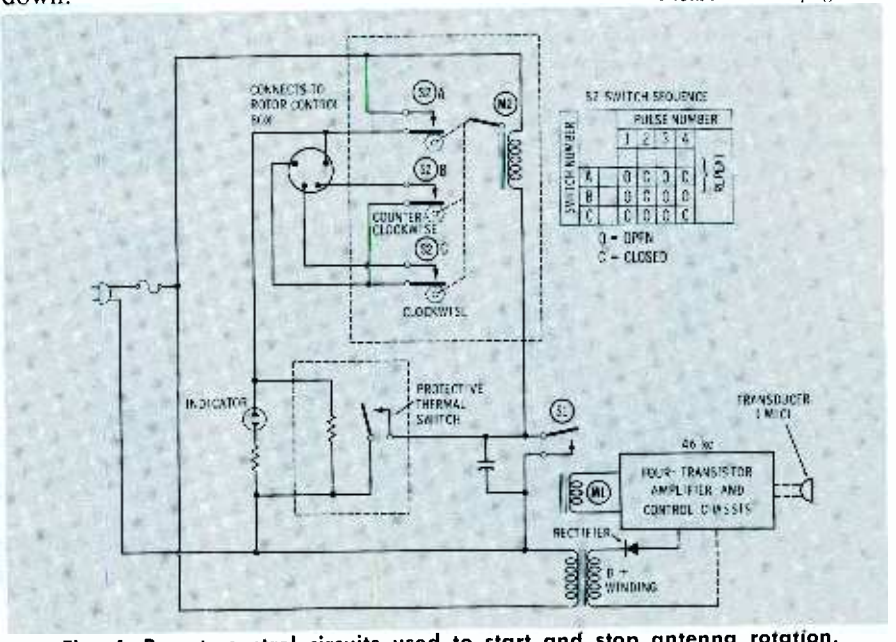
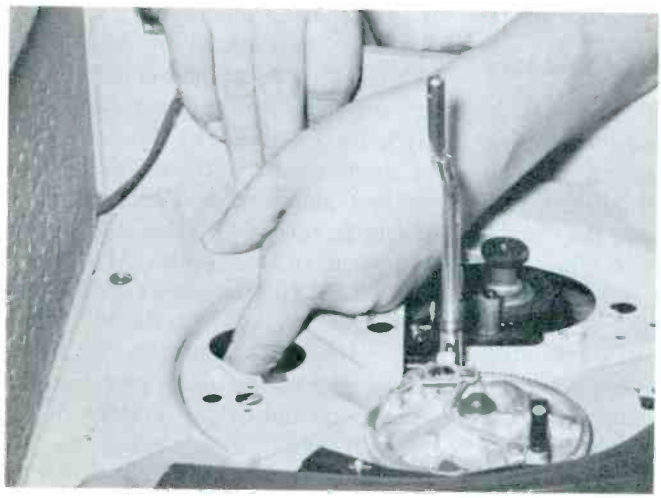


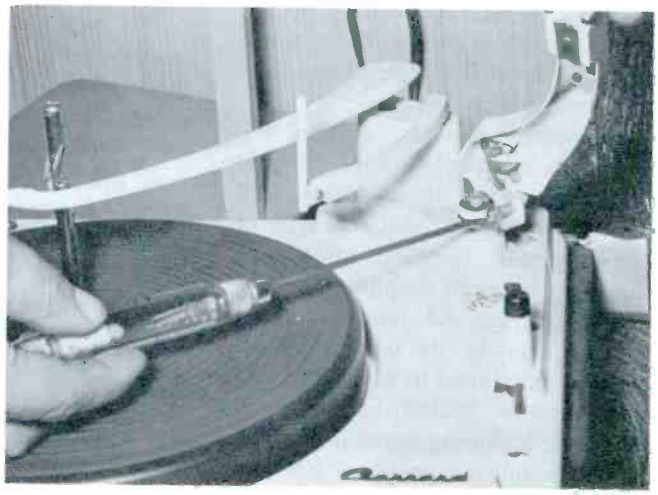
Fig. 4. Remote-control circuits used to start and stop antenna rotation.

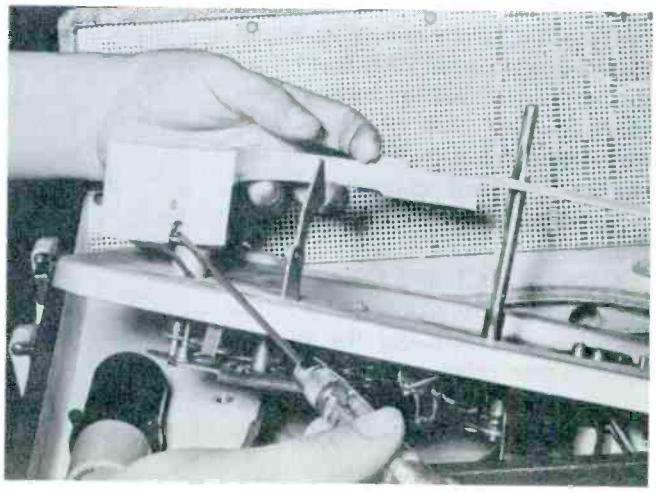
fixing Record Changers *is a cinch!*



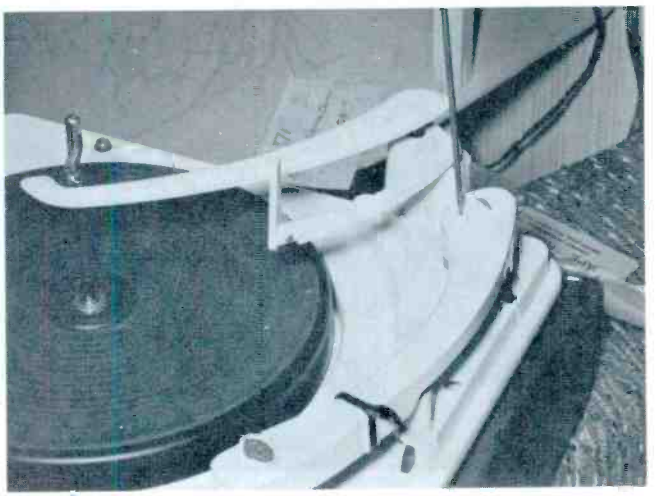
To the uninitiated, getting the changer mechanism out of the cabinet for servicing occasionally presents something of a problem. The unit shown here is typical of changers with "hidden" hold-down clips. After first removing the turntable, you can release one clip by reaching through the access hole; one side of the changer platform can then be lifted and the unit slid sideways out of the mounting board. If you plan to take the mechanism completely out of the cabinet, be sure to disconnect the motor-power and cartridge cables.

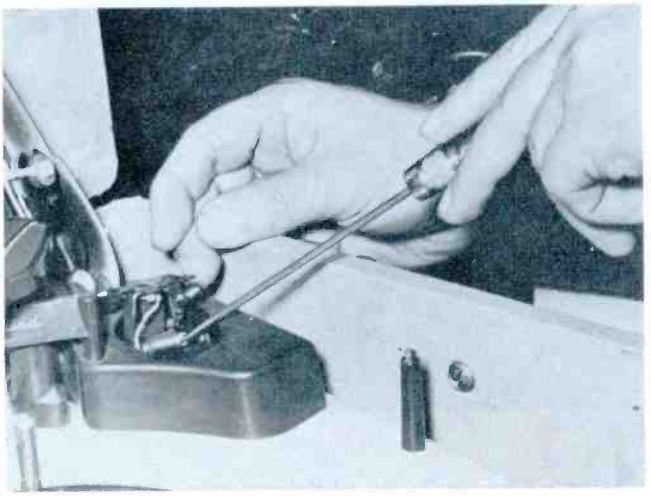
One of the most common complaints with changers is improper set-down or landing of the tone arm; the needle either misses the record or lands past the beginning of the music grooves. Almost invariably, this adjustment is controlled by a spring-loaded screw at the base of the tone arm. Two typical screwdriver adjustments are shown here; not shown is a third type which can be reached from above, after lifting the tone arm to expose the adjusting screw. The small 45-rpm changer shown in the photo below is adjusted by loosening the tone-arm set screw, and placing the arm at its proper location on the spindle. Any inability to control the landing adjustment of a changer can be traced from the adjustment, back through the spindle, to the timing wheel or cam (or the slide) in the mechanism below, until the fault is found.





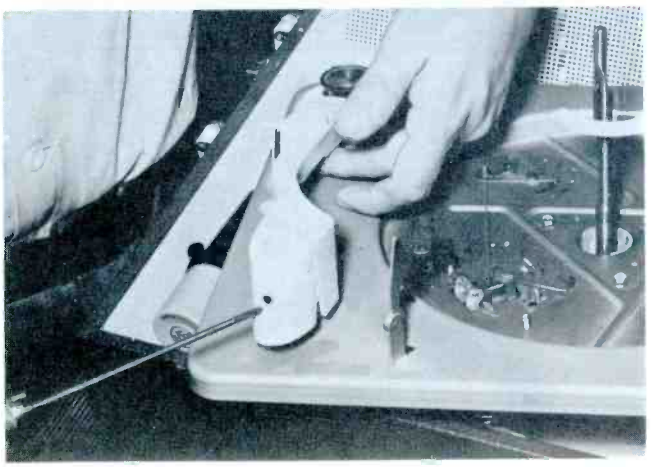
Any record-changing mechanism, although seemingly complex, actually goes through a "simple" series of interrelated actions. Various mechanical adjustments control these actions, setting the starting and finishing points of the different movements of certain slides, wheels, and/or cams. If you can understand the adjustments, and their locations, you will have little problem applying this knowledge to trace a changer-mechanism fault to its source. The photos show the various adjustment points, and the captions indicate how to apply this system of reasoning to changer troubleshooting.

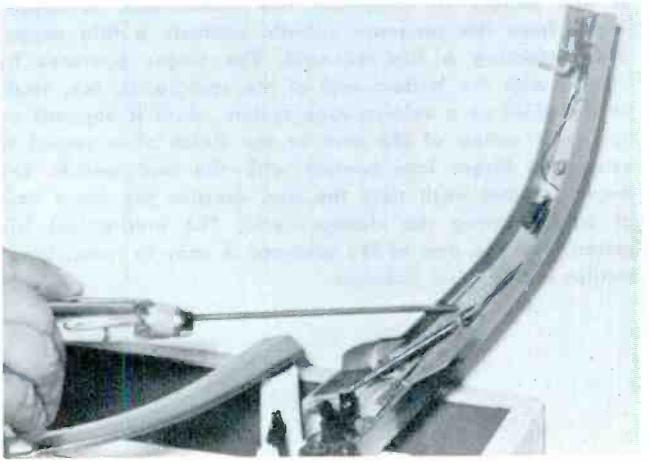


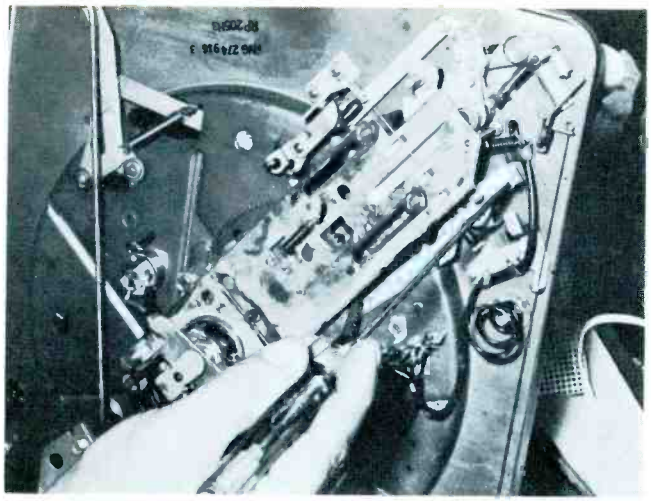


Needle-tracking pressure is important to modern changers. This is usually controlled by an adjustment at or near the base of the tone arm, as shown in the two photos. Some changers use a screwdriver adjustment to set the balance of the arm, while others use a simple spring arrangement (as shown in the photo to the right). Still other, more elaborate units have counterbalance weights somewhere on the base end of the tone arm. In any case, this is probably the simplest of the various adjustments. Since very little can go wrong with this portion of the mechanism, any fault involving needle pressure or tracking will be easy to trace. If a gram gauge indicates correct pressure at the needle end of the arm, any tracking fault (such as skipping) is probably caused by the needle or cartridge being improperly mounted.

During the change cycle, the arm may sometimes fail to clear a large stack of records. The arm height is controlled by an adjustment, usually in conjunction with a lift rod in the spindle. The adjustment, as indicated in the photos, may be reached from the top of the tone arm, from its underside, or at the base. The photo on the left shows a spring-and-drum arrangement, which can be adjusted with any small-diameter pointed instrument by merely inserting the point and revolving the drum. Faulty arm-height action can usually be traced through the lift rod (in the spindle) to the timing wheel or slide below. On the timing device—or associated with it—you will find some form of inclined plane which raises and lowers the tone arm as the changer goes through its cycle. Check these parts in the event of arm-height trouble.

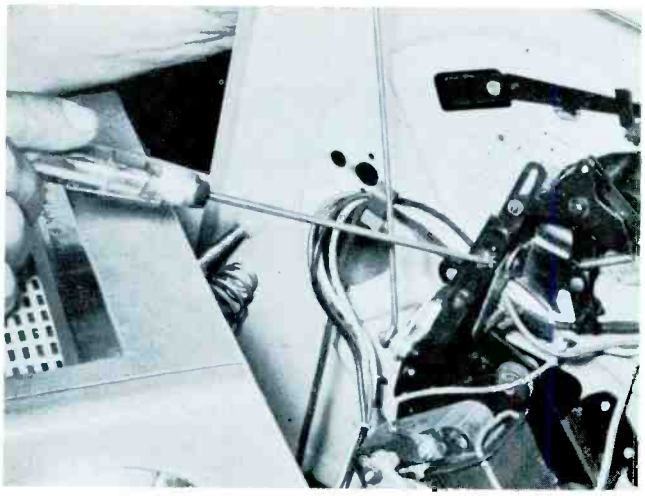


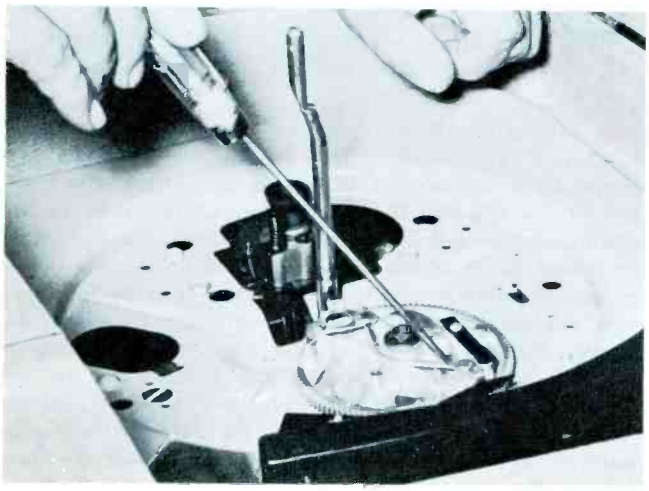




When a changer trips before completing a record, or fails to initiate the change cycle after the record is finished, the fault lies in the trip-mechanism adjustment (or its associated actions). The greatest differences you will find in record changer adjustments are in these mechanisms. In this photo, one of the more common trip mechanisms is depicted. The trip lever is adjusted to actuate the mechanism at just the proper tone-arm position by bending the tab indicated by the screwdriver. This tab is contacted by a finger from the tone arm, and is set to trip the mechanism when the needle reaches the inner groove of the recording.

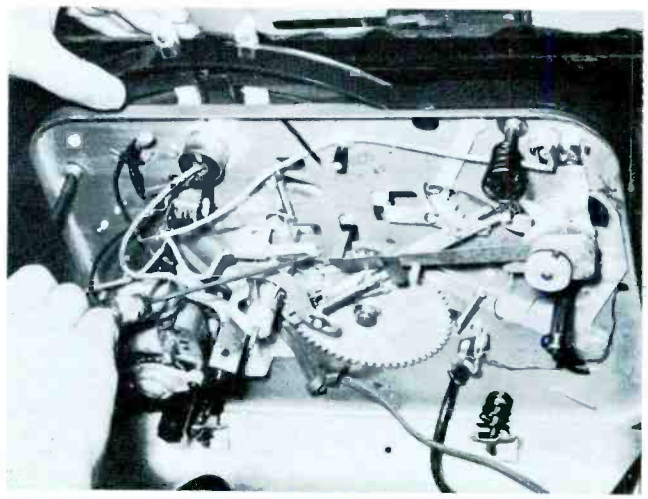
There are a large number of variations in trip mechanisms, as well as in the method of adjusting the various linkages. This photo shows a changer whose trip lever has an action similar to the one described above, but the length of this lever can be adjusted by means of a set screw. This lever, too, is actuated by a finger from the tone-arm spindle. Both trip levers described actuate a mechanism which initiates the change cycle; therefore, any failure of the changer to properly begin or end a change cycle can be traced from the tone-arm finger, through the trip lever and its linkages, to the actual cycling mechanism (and its drive arrangement).





The mechanism in this photo represents a typical velocity-type trip arrangement. It depends on the quick movement of the tone arm as the needle enters the eccentric lead-out groove in the center of the recording. This system requires that each of the parts in the "chain" of action have absolute freedom of movement. They must, consequently, be kept very clean, and free from oil and dirt. (Alcohol is an excellent cleaning agent for these parts.) When a system of this type gets out of adjustment, it is usually very difficult to realign. Often, replacement of the entire assembly is more expedient, and less expensive, since the cost of parts is usually rather minimal.

A somewhat different type of trip device is shown in this picture—an electrical trip mechanism. A copper finger from the tone-arm spindle contacts a thin copper leaf, actuating a trip solenoid. The finger operates by friction with the bottom end of the spindle. It, too, could be classified as a velocity-type system, since it depends on the quick action of the arm at the finish of a record to bring the finger into contact with the leaf switch. The finger is reset each time the arm reaches the outer limit of travel during the change cycle. The mechanical trip action from the arm of the solenoid is easy to trace, being similar to other trip linkages.



are you replacing top quality tubes with identical top quality tubes?

You can, now! You can carry the identical tubes that you find in most of the quality TV sets you're servicing. Chances are, you were not aware that these sets were designed around special Frame Grid tubes originated by Amperex.

For some time now designers have been using many Amperex Frame Grid tubes in their quality TV receivers and we can tell you now that even more Amperex tubes are being designed into the sets you'll be handling in the future.

Compare, if you will, the performance of Amperex Frame Grid tubes with conventional IF tubes: they provide 55% higher gain-bandwidth, increase TV set reliability by simplifying circuits and they make your servicing easier, faster and more profitable because their extraordinary uniformity virtually eliminates time-consuming realignment when you replace tubes. Technicians are finding Amperex THE line to carry.

Tubes introduced by Amperex and currently being used by major TV set makers include:

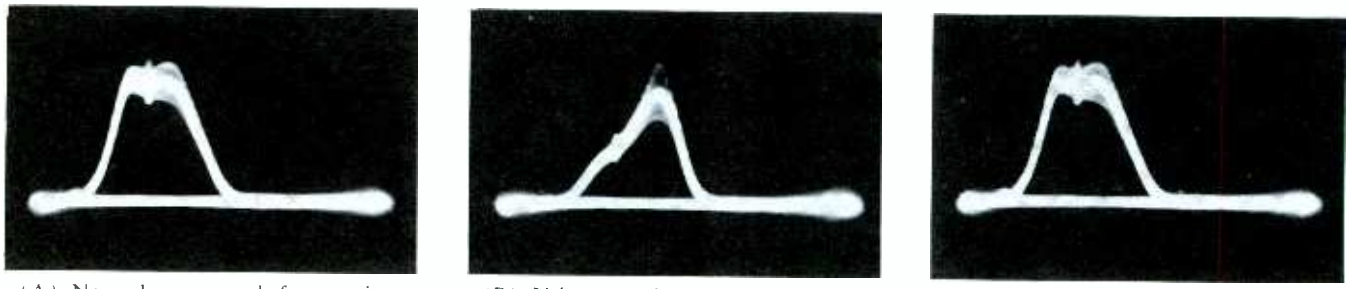
Frame Grid				*Others*	
2GK5	4GK5	6GK5	6EH7	6AL3	9A8
2ER5	4EH7	6ES8	6EJ7	6BL8	15CW5
3GK5	4EJ7	6ER5	6HG8	6BQ5	16AQ3
3EH7	4ES8	6FY5	7HG8	12AX7	27GB5

For optimum customer satisfaction and maximum profit operation for yourself, make room in your caddy right now for the identical, matchless-quality tubes designed into the original sets. Next time you visit your distributor look for the green-and-yellow box and ask about Frame Grid tubes for TV and other entertainment replacement applications. Amperex Electronic Corporation, 230 Duffy Ave., Hicksville, L. I., N. Y.

In Canada: Philips Electron Devices Ltd., 116 Vanderhoof Ave., Toronto 17.

Finding the Right Alignment Tool

Be ready to align any equipment that comes to your shop . . . by Jim Galloway



(A) Normal response before tuning. (B) Using metal screwdriver blade. (C) Using plastic alignment tool.

Fig. 1. Effect on IF response when tip of tool is inserted in transformer.

Fig. 1 shows graphically how important it is to use proper alignment tools when you are adjusting tuned transformers. The waveform in part A is that of a normal IF response curve. Part B shows what happens to this curve while a steel-bladed screwdriver is being used to tune the transformer slug; Fig. 1C shows the same waveform when a non-magnetic alignment tool is used. You can see from these pictures that it's next to impossible to properly tune a transformer with a tool that distorts the frequency response.

Granted, you can get by with using an ordinary screwdriver, if you turn the slug only slightly, and then withdraw the screwdriver blade to observe the change in tuning. After repeating this procedure several times, you might find the correct setting; however, this inefficient process wastes much time. Such makeshift techniques are seldom needed by the technician who makes a point of accumulating a good selection of alignment tools.

Literally dozens of special tool types are used in day-to-day servicing. Although the great majority of coil cores commonly found in home entertainment equipment can be adjusted with only a few basic tools, many modifications of these general types have been made available for increased convenience in servicing. Tools with standard tip shapes are supplied in many different lengths, ranging from a little more than one inch to slightly over a foot and a half. They are also manufactured of several different materials, and to add further variety, there are many double-ended tools with different combinations of tips.

The roster of alignment tools also contains a number of special-purpose items with unusual tip styles. Almost every major innovation in electronics brings with it some new alignment-tool requirement. For example, the IF transformers in some portable transistor radios have square holes in the slugs, instead of the usual hexagonal or slotted arrangement.

Color TV has been another influence on the expansion of alignment-tool types. Most color sets have one or more concentric potentiometers; often two different sizes are found in the same set. Efficient adjustment of these controls requires the use of a special tool that allows simultaneous adjustment of inner and outer shafts. Many of these tools have facilities for adjusting both sides of concentric controls commonly encountered.

The assortment of tools shown in Fig. 2 gives some idea of how many

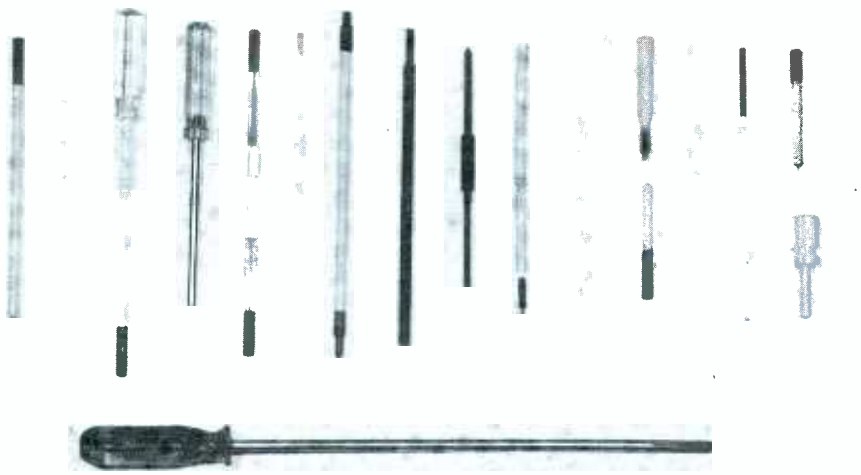


Fig. 2. Radio-TV service shops have uses for all these alignment tools.

What Does F.C.C. Mean To You?

What is the F. C. C.?

F. C. C. stands for Federal Communications Commission. This is an agency of the Federal Government, created by Congress to regulate all wire and radio communication and radio and television broadcasting in the United States.

What is an F. C. C. Operator License?

The F. C. C. requires that only qualified persons be allowed to install, maintain, and operate electronic communications equipment, including radio and television broadcast transmitters. To determine who is qualified to take on such responsibility, the F. C. C. gives technical examinations. Operator licenses are awarded to those who pass these examinations. There are different types and classes of operator licenses, based on the type and difficulty of the examination passed.

What are the Different Types of Operator Licenses?

The F. C. C. grants three different types (or groups) of operator licenses—commercial radiotelePHONE, commercial radioteleGRAPH, and amateur.

COMMERCIAL RADIOTELE*PHONE* operator licenses are those required of technicians and engineers responsible for the proper operation of electronic equipment involved in the transmission of voice, music, or pictures. For example, a person who installs or maintains two-way mobile radio systems or radio and television broadcast equipment must hold a radiotelePHONE license. (A knowledge of Morse code is NOT required to obtain such a license.)

COMMERCIAL RADIOTELE*GRAPH* operator licenses are those required of the operators and maintenance men working with communications equipment which involves the use of Morse code. For example, a radio operator on board a merchant ship must hold a radioteleGRAPH license. (The ability to send and receive Morse is required to obtain such a license.)

AMATEUR operator licenses are those required of radio "hams"—people who are radio hobbyists and experimenters. (A knowledge of Morse code is necessary to be a "ham".)

What are the Different Classes of RadiotelePHONE licenses?

Each type (or group) of license is divided into different *classes*. There are *three* classes of radiotelephone licenses, as follows:

(1) Third Class Radiotelephone License. No previous license or on-the-job experience is required to qualify for the examination for this license. The examination consists of F.C.C. Elements I and II covering radio laws, F.C.C. regulations, and basic operating practices.

(2) Second Class Radiotelephone License. No on-the-job experience is required for this examination. However, the applicant must have already passed examination Elements I and II. The *second class* radiotelephone examination consists of F. C. C. Element III. It is mostly technical and covers basic radiotelephone theory (including electrical calculations), vacuum tubes, transistors, amplifiers, oscillators, power supplies, amplitude modulation, frequency modulation, measuring instruments, transmitters, receivers, antennas and transmission lines, etc.

(3) First Class Radiotelephone License. No on-the-job experience is required to qualify for this examination. However, the applicant must have already passed examination Elements I, II, and III. (If the applicant wishes, he may take all four elements at the same sitting, but this is not the general practice.) The *first class* radiotelephone examination consists of F. C. C. Element IV. It is mostly technical covering advanced radiotelephone theory and basic television theory. This examination covers generally the same subject matter as the second class examination, but the questions are more difficult and involve more mathematics.

Which License Qualifies for Which Jobs?

The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain, and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radiotelephone license qualifies you to install, maintain, and operate every type of radiotelephone equipment (except amateur, of course) including all radio and television stations in the United States, and in its Territories and Possessions. This is the highest class of radiotelephone license available.

How Long Does it Take to Prepare for F. C. C. Exams?

The time required to prepare for FCC examinations naturally varies with the individual, depending on his background and aptitude. Grantham training prepares the student to pass FCC exams in a minimum of time.

In the Grantham *correspondence course*, the average beginner should prepare for his *second class* radiotelephone license after from 300 to 350 hours of study. This same student should then prepare for his *first class* license in approximately 75 additional hours of study.

In the Grantham *resident course*, the time normally required to complete the course and get your license is as follows:

In the M thru F DAY course, you should get your first class radiotelephone license at the end of the 12th week of classes.

In the M-W-F EVENING course, you should get your first class radiotelephone license at the end of the 20th week of classes.

In the Tu-Th EVENING course, you should get your first class radiotelephone license at the end of the 30th week of classes.

The Grantham course is designed specifically to prepare you to pass FCC examinations. All the instruction is presented with the FCC examinations in mind. In every lesson test and preexamination you are given constant practice in answering FCC-type questions.

Why Choose Grantham Training?

The Grantham Communications Electronics Course is planned primarily to lead to an F.C.C. license, but it does this by TEACHING electronics. This course can prepare you *quickly* to pass F. C. C. examinations because it presents the necessary principles of electronics in a simple "easy to grasp" manner. Each new idea is tied in with familiar ideas. Each new principle is presented first in simple, everyday language. Then after you understand the "what and why" of a certain principle, you are taught the technical language associated with that principle. You learn more electronics in less time, because we make the subject easy and interesting.

Is the Grantham Course a "Memory Course"?

No doubt you've heard rumors about "memory courses" or "cram courses" offering "all the exact FCC questions". Ask anyone who has an FCC license if the necessary material can be memorized. Even if you had the exact exam questions and answers, it would be much more difficult to memorize this "meaningless" material than to learn to understand the subject. Choose the school that teaches you to thoroughly understand—choose Grantham School of Electronics.

Is the Grantham Course Merely a "Coaching Service"?

Some schools and individuals offer a "coaching service" in FCC license preparation. The weakness of the "coaching service" method is that it presumes the student already has a knowledge of technical radio and approaches the subject on a "question and answer" basis. On the other hand, the Grantham course "begins at the beginning" and progresses in logical order from one point to another. Every subject is covered simply and in detail. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC-type test so you can discover daily just which points you do not understand and clear them up as you go along.

Advanced Resident Training

The Grantham F.C.C. License Course is Section I of our Electronics Series. Successful completion of this course is a prerequisite for enrollment in Section II which deals with more advanced material. However, it is not necessary for the student to take Section II unless he wishes to advance beyond the level of a first class F.C.C. License.

Accredited by the National Home Study Council

What NHSC Membership Means:

Over the years, people have come to respect membership in the National Home Study Council as a hallmark of quality. No school can be a member of the Council unless it has met the rigid standards set up by the Council's Accrediting Commission. This means that all schools, such as Grantham Schools, Inc., which display the seal of the National Home Study Council have demonstrated their integrity and adherence to high ethical standards. It means that they offer quality instruction at reasonable tuition rates. It means that these schools believe in, and are specialists in, the home study method of instruction.

For further details concerning F.C.C. licenses and our training, send for our FREE booklet, "Grantham Training". Clip the coupon below and mail it to the School nearest you.

Get your First Class Commercial F.C.C. License Quickly by training at

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Los Angeles 27, Calif.	Seattle 4, Wash.	Kansas City 9, Mo.	Washington 6, D.C.
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NATIONAL HEADQUARTERS OFFICE
1505 N. Western Ave., Hollywood 27, Calif.

Gentlemen:

Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call. **29-R**

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City _____ State _____

I am interested in: ☐ Home Study, ☐ Resident Classes

types are available to the modern serviceman. With this wide selection at hand, he can be reasonably sure of finding the right tool to do any job he might encounter.

It doesn't take a serviceman very long to assemble this large a complement of tools, even if he simply buys new types one by one as the occasion demands. However, waiting for the actual need to arise is likely to cause some headaches. If a serviceman doesn't have the correct tool for a particular job, he probably won't go out and buy it without first trying to make some other tool do the work. In too many cases, he finally has to make a trip to the distributor, after all—buying not only the alignment tool but perhaps also a new slug (or even a complete new transformer) to replace one damaged by use of the wrong tool.

A more systematic way for a serviceman to accumulate these tools is to anticipate his needs and buy an assortment of the more commonly-used ones. The chart included in this article will be of help in choosing the most useful types.

Actually, assortments well suited to the average serviceman's needs have already been planned by radio-TV accessory manufacturers, who offer several different kits of alignment tools. A well equipped service shop might have one kit containing tools for radio jobs, and another for TV alignment. There are different-sized kits available in several price ranges; thus, a serviceman's preparations for alignment work may be either as simple or as elaborate as necessary.

Unusual Alignment Tools

Certain items are of particular interest because they offer unique ac-

• *Please turn to page 46*

Fig. 3. Some tools have scale to count number of turns a slug is moved.

SENCORE
SIMPLIFIES COLOR SERVICING

NEW! CA122
COLOR CIRCUIT ANALYZER

A simple approach to a complex problem

Here is an instrument that is designed to eliminate the guesswork in color TV servicing. A complete analyzer that provides all required test patterns and signals for testing from the tuner to the tri-color tube. Additional analyzing signals for injection at each stage including audio, video and sync, brings to life a truly portable and practical TV analyzer for on the spot service; virtually obsoleting other analyzers with the advent of color. Sencore's simplified approach requires no knowledge of I, Q, R-Y, B-Y, G-Y or other hard to remember formulas. The CA122 generates every signal normally received from the TV station plus convergence and color test patterns.

The CA122 offers more for less money:

TEN STANDARD COLOR BARS: The type and phase that is fast becoming the standard of the industry. Crystal controlled keyed bars, (RCA type) as explained in most service literature, offer a complete gamut of colors for every color circuit test.

WHITE DOTS: New stabilized dots, a must for convergence, are created by new Sencore counting circuits.

CROSS HATCH PATTERN: A basic requirement for fast CRT convergence.

VERTICAL AND HORIZONTAL BARS: An added feature to speed up convergence, not found on many other color generators.

SHADING BARS: Determines the ability of the video amplifier to produce shades (Y Signal) and to make color temperature adjustments. An important feature missing on other generators.

COLOR GUN INTERRUPTOR: For fast purity and convergence checks without upsetting color controls. Insures proper operation of tri-color guns, preventing wasted time in trouble shooting circuits when CRT is at fault.

A must for color . . .

a money maker for black and white TV servicing

ANALYZING SIGNALS: RF and IF signals modulated with any of the above patterns for injection into grid circuits from antenna to detector. IF attenuator is pre-set for minimum signal for each IF stage to produce pattern on CRT thus providing a check on individual stage gain. Sync and video, plus or minus from 0 to 30 volts peak to peak, have separate peak to peak calibrated controls for quick checks on all video and sync circuits. Crystal controlled 4.5 mc and 900 cycles audio simplify trouble shooting of audio circuits.

NEW ILLUMINATED PATTERN INDICATOR: A Sencore first, offering a rotating color film that exhibits the actual color patterns as they appear on color TV receivers. Locks in with pattern selector control.

You'll pay more for other color generators only.

Dealer Net 187.50

NEW! PS120 PROFESSIONAL WIDE BAND OSCILLOSCOPE

A portable wide band 3 inch oscilloscope for fast, on-the-spot testing. An all new simplified design brings new meaning to the word portability...it's as easy to operate and carry as a VTVM. Though compact in size, the PS120 is powerful in performance: Vertical amplifier frequency response of 4 MC flat, only 3 DB down at 7.5 MC and usable to 12 MC, equips the technician for every color servicing job and the engineer with a scope for field and production line testing. AC coupled, with a low frequency response of 20 cycles insure accurate low frequency measurements without vertical bounce. Sensitive single band vertical amplifier; sensitivity of .035 volts RMS for one inch deflection saves band switching and guessing. Horizontal sweep frequency range of 15 cycles to 150 KC and sync range from 15 cycles to 8 MC (usable to 12 MC) results in positive "locking" on all signals. New exclusive Sencore features are direct reading peak-to-peak volts —no interpretation; dual controls to simplify tuning; lead compartment to conceal test leads, jacks and seldom used switches. Rear tilt adjustment angles scope "just right" for easy viewing on bench or production line.

Size: 7"w x 9"h x 11¼"d. Weight: 12 lbs.

Dealer Net 124.50
(with low cap. probe)

Kit 74.50

A must for servicing color TV in the home . . . lowest priced broad band scope. All hand wired — all American made

SENCORE

SIMPLIFIES SWEEP CIRCUIT TROUBLE SHOOTING

SS117
SWEEP CIRCUIT ANALYZER

For Color and Monochome Testing

A professional trouble shooter that helps you methodically walk the trouble out of "tough-dog" sweep circuits in monochrome and color receivers. The SS117 provides a positive but simple push button test on all circuits indicated in the block diagrams. These time-consuming circuits are checked step-by-step with tried and proven signal injection and substitution methods. All checks can be made from the top of the chassis or from under the chassis when it is removed from the cabinet.

TV horizontal oscillator check is made by substituting a universal oscillator known to be good. Horizontal output check consists of a cathode current and screen voltage test. The TV horizontal yoke is checked by substituting a universal yoke from the SS117 and viewing brightness or restoration of 2nd anode voltage. Horizontal flyback is checked dynamically in circuit by measuring the power transfer to the yoke when TV is turned on. TV horizontal sync can be used to control the SS117 horizontal oscillator, providing a positive check on sync from the video amplifier to the TV oscillator. Vertical circuits are tested by simple signal injection from vertical yoke to oscillator for full height on CRT. The SS117 with the CA122 Color Analyzer provides a complete TV analyzer for virtually every stage in monochrome or color receivers.

External checks for AC, DC, peak to peak voltage readings and DC current in the upper right hand corner save using a separate VTVM. Accurate 2nd anode measurements up to 30,000 volts are made with a sensitive 300 microamp meter and the attached high voltage probe. AC outlets, all steel construction and mirror in the cover makes every servicing job easier.

Size: 10¼" x 9¼" x 3½". Wt. 10 lbs.

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The SS117 checks them all

FREE—A 33 RPM half hour permanent record packed with every unit explains each test.

FOR FASTER MORE ACCURATE TUBE TESTING

TC114 MIGHTY MITE
TUBE CHECKER

This is the famous Mighty Mite, acclaimed by over 25,000 servicemen, maintenance men and engineers as "the best they've ever used." A complete tube tester that is smaller than a portable typewriter yet finds tubes that testers costing hundreds of dollars miss, thus selling more tubes and reducing call backs. A real money maker for the serviceman and a trusty companion for engineers, maintenance men and experimenters. The Mighty Mite has been acclaimed from coast to coast as the real answer for the man on the go. Even though the Mighty Mite weighs less than 8 pounds, new circuitry by Sencore enables you to use a meter to check grid leakage as high as 100 megohms and gas conditions that cause as little as one half microamp of grid current to flow. Thus, too, it checks for cathode current at operating levels and shorts or leakage up to 120,000 ohms between all elements. And it does all this by merely setting four controls labeled A, B, C, & D with new type easy grip knobs. Check these plus Sencore features... Meter glows in dark for easy reading behind TV set... The new Mighty Mite has large size Speedy-Setup Tube Chart inside of cover—cuts setup time for even faster servicing. New stick proof D' Arsonval meter will not burn out even with shorted tube... Rugged, all steel carrying case and easy grip handle.

The improved Mighty Mite will test virtually every radio and TV tube that you encounter, nearly 2000 in all, including foreign, five star, auto radio tubes plus the new Compactrons, Novars, Nuvistors and 10 pin tubes. Has larger, easy-to-read type set-up booklet for faster testing.

Size: 10¼" x 9¼" x 3½". Weight: 8 lbs.

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Fast, Accurate . . . never lets you down

A must for color

TM116 TUBE TESTER MODERNIZING PANEL

New tube adapter for testing Compactrons, Novars, Nuvistors and 10 pin tubes in any tube tester except cardomatic types. Plugs into octal socket of your tube tester enabling you to test these new tubes in the same manner that your tester checks conventional tubes. Tube set-up chart included with each adapter.

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SENCORE

TRANSISTOR CIRCUIT TESTING MADE EASY & PROFITABLE

TR110 TRANSI-MASTER

A new transistor tester that will analyze the entire transistor circuit in minutes. Transistors can be checked in-circuit or out-of-circuit. Here is how it works:
First, check the batteries or power supply with the 0 to 12 volt voltmeter. Next, check the current drain with the 0 to 50 milliamp meter. A special probe is provided so that you do not need to break the circuit. Intermittents caused by cracked boards can be localized by the current check.
If trouble is not located by now, isolate the trouble to a specific stage by touching the output of the harmonic generator to the base of each transistor and note spot where sound from speaker (or scope where no speaker is used) stops or becomes weak. The generator becomes a sine wave generator for audio stages to help find distortion.
If trouble points to a transistor, check it in a jiffy with the exclusive in-circuit power oscillator check provided by the TR110. A special probe is also provided for this.
If the transistor checks bad in-circuit, remove it and give it an out-of-circuit check with the oscillator check or the more accurate DC check.
The DC check is provided for comparison reasons, experimental or engineering work and to match transistors in audio output stages. Beta (current gain) is read direct or on a good-bad scale for service work.

Dealer Net **59.50**

- **COMPLETE IN OR OUT-OF-CIRCUIT TRANSISTOR TESTER**
- **SIGNAL TRACER • VOLTMETER**
- **BATTERY TESTER • MILLIAMMETER**

TR115 TRANSISTOR DIODE-CHECKER

Tests transistors for leakage, gain, opens and shorts. Reads gain as good or bad or directly in Beta. Checks diodes for forward to reverse ratios. Tests them all from the smallest transistors used in hearing aids to the power types used in auto radios. Also lists Japanese equivalents. This simple to operate, time tested checker can be used with or without set-up chart for both servicing, experimenting and lab work. The industry's most popular transistor tester, used by Bell Telephone, Sears Roebuck, Edison and many others.

Dealer Net **24.95**
Kit **15.95**

NEW! BE124 BATTERY ELIMINATOR

An easy to use power supply that replaces batteries during repair time of transistor radios. Tapped voltages at 1.5 volt DC intervals from 0 to 12 volts are on front panel for easy connection and to insure center tap and bias voltages when required. Function switch converts meter to a trouble shooting 0 to 50 Ma current reading device to monitor the current drain of the transistor radio. Improved regulation and voltage calibrate pot. guarantee accurate well filtered output. Also for charging nickel cadmium batteries.

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HG104 HARMONIC GENERATOR

Finds Defective Stage in a Minute . . . a real time saver. Just touch the output leads of the HG104 to inputs and outputs of transistors and a clear 1000 cycle note from speakers will tell you whether or not the stage is defective. It works every time from speaker to antenna. Two leads and calibrated output (not found on pencils) are a must for speaker connection, grounding to prevent RF spray and front end checks. With batteries.

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A NEW VERSATILE APPROACH TO CIRCUIT TESTING

SM112 SERVICE MASTER

A combination VTVM and VOM in one compact unit to simplify every testing need. The SM112 offers a conventional VTVM, operating from 115 volts AC for accurate bench or lab work . . . flip the function switch to VOM and two standard flashlight batteries power the unit as it is connected to a 5,000 ohms per volt meter. This Sencore first enables you to make voltage, resistance and current measures anywhere anytime. And to top this, indicating arrows located along the left side of the meter flash on and off as the controls are rotated to indicate the exact scale to read on any VTVM position or range. Hard to remember technical data is listed in the removable cover. One permanent probe is used for every test on VTVM or VOM. High voltage probe fits on end of permanent probe for measurements up to 30,000 volts DC. Standard specifications of 11 megohm input impedance on VTVM, 6 AC and DC voltage ranges from 0 to 1000 volts on both VTVM and VOM, 6 resistance ranges from 0 to 1000 megohms on VTVM, 2 ranges on VOM, and a 2 percent six inch meter provide all requirements for fast accurate measurements. Zero center scale and peak-to-peak measurements as added features create a truly great Sencore value.

Dealer Net ..... **only 79.95**

SENCORE COMPONENT CHECKING MADE EASY BY SENCORE PARTS SUBSTITUTION

RC121 COMPONENT SUBSTITUTOR

A complete range of carbon resistors, capacitors, electrolytics and universal selenium and silicon rectifiers at your finger tips for on-the-spot substitution. Say goodbye to messy crumpled parts, unnecessary soldering and unsoldering when substituting components for test purposes only. Each section operates independently with a value close enough for every substitution need. Components in each section are isolated from chassis and from other sections. New electrolytic substitution section provides dual electrolytics as well as 25 single electrolytics. Exclusive surge protector prevents arcing, sparking or healing of single or dual capacitors being bridged. Electrolytics are automatically discharged when surge protector is released. Here are the values provided ...81 in all.

1. **CARBON RESISTORS**...12 resistors, 1 watt from 10 ohms to 5600 ohms. 12 resistors, ½ watt from 10 K to 5.6 megohms.
2. **POWER RESISTORS**...20 wire wound, 20 watts from 2.5 to 15,000 ohms.
3. **CAPACITORS**...10 capacitors at 600 volts from 100 MMFD to .5 MFD.
4. **RECTIFIERS**...Universal Selenium; .5 amps, 800 PIV. Universal Silicon; 5 amps, 800 PIV.

All your favorite Sencore Substitution time-savers in one compact unit.

5. **ELECTROLYTICS**...10 dual electrolytics from 2 MFD to 250 MFD at 450 V DC can be used as singles or tie them together and double capacity to form up to 25 separate single values. Both sections protected by surge protector.

All hand wired, complete with four test leads.

RC121.....Dealer Net..... **39.95**
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H36 "HANDY 36"

Provides the 36 most often needed resistors and capacitors for experimenting, substituting and testing. 24 Resistors from 10 ohms to 5.6 megohms, 10 Capacitors from 100 mfd to .5 mfd, 2 Electrolytics 10 mfd and 40 mfd at 450 volts.

Dealer Net..... **12.75**

RS106 RECTIFIER TROUBLE SHOOTER

Substitutes for single and dual Selenium and silicon rectifiers, single and dual diodes. Gives you a positive check every time. A must for servicing voltage doubler circuits. Protected by a ½ amp. Slow Blow Fuse.

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ES102 "ELECTRO-SUB"

Complete safe substitution for Electrolytic Capacitors from small transistor radio types to the largest used in Hi-Fi amplifiers. Contain 10 electrolytics from 4 to 350 mfd. Completely safe, has automatic discharge, surge protector circuit. Usable from 2 to 450 volts, DC.

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PR111 "BIG 20" SUBSTITUTOR

For power resistor substitution from 2.5 to 15,000 ohms. Withstands up to 20 watts for normal testing time.

Dealer Net..... **12.75**

Time Saving Service Aids

BE113 DUAL TV BIAS SUPPLY

A single 0 to 20 volts DC bias supply or two separate 0 to 20 volts DC bias supplies—without interaction. Save time in AGC trouble shooting and aligning TV sets. Provides all TV biases recommended in photofact schematics and by all TV manufacturers. Well filtered—provides virtually pure DC with less than one tenth of one percent ripple. Calibration accuracy better than equivalent battery tolerance.

Dealer Net..... **12.75**

VB2 VIBRA-DAPTER

Checks 3 and 4 prong Vibrators faster and easier. Plugs into any tube checker; ideal for use with LC3 or the Mighty Mite. To check 6v. vibrators, set for 6AX4 or 6SN7; for 12v. vibrators, set for 12AX4 or 12SN7. Two No. 51 lamps indicate whether vibrator needs replacing.

Dealer Net..... **2.75**

FC123 FILAMENT CHECKER

Newly designed filament checker for continuity speed testing of all tube filaments including the new compactrons, novars, nuvistors and 10 pin tubes as used in new series TV receivers. Test leads are provided for CRT filament testing, continuity tests are AC or DC neon indicator voltage tests. TV cheater cord is used to power unit as a check on the cord to insure 115 volts AC on TV.

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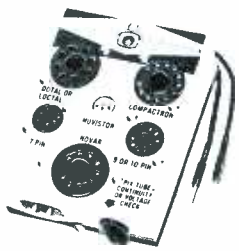


HM119 "HANDYMAN"

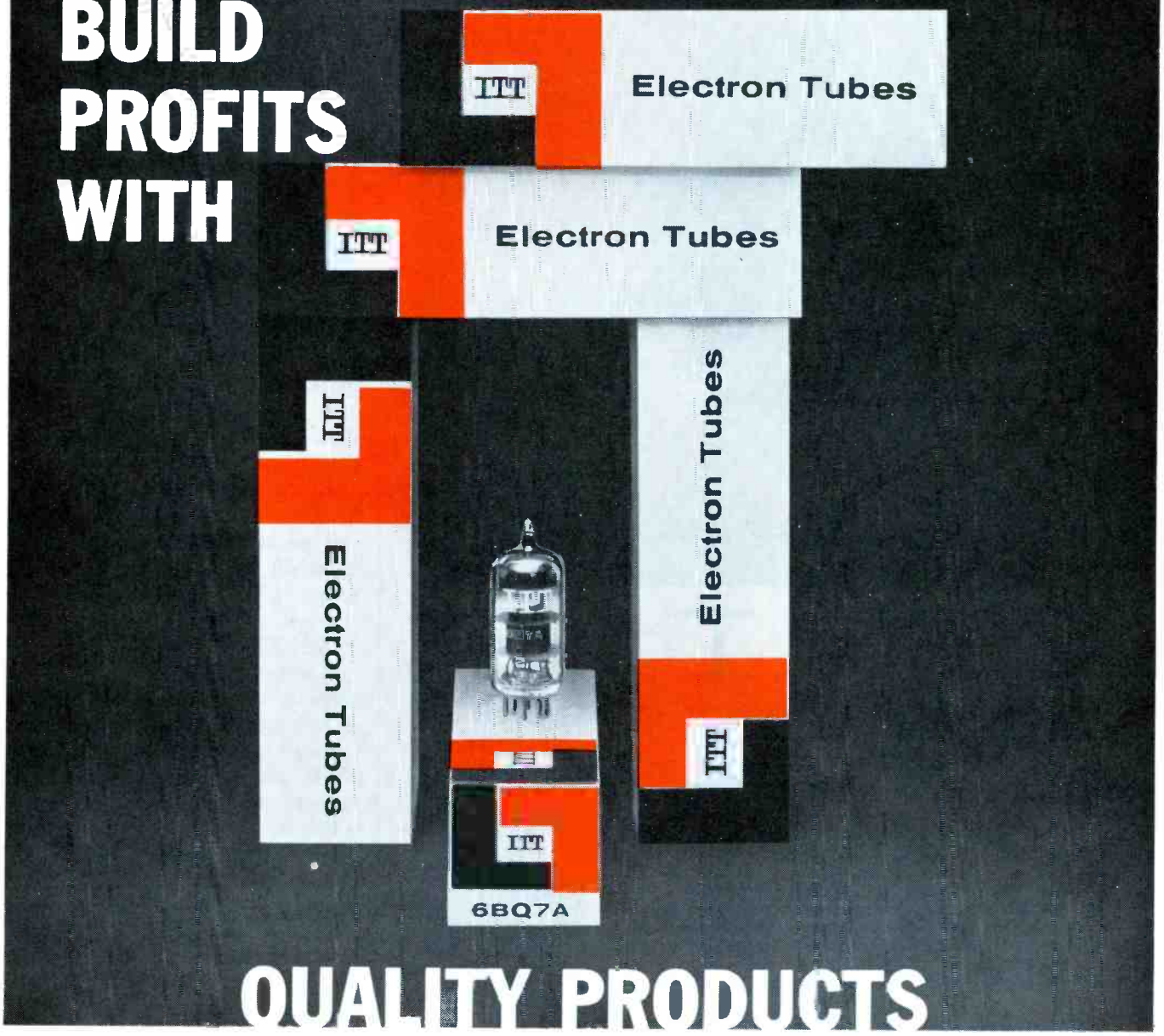
A Sencore time-saver to eliminate wasted time behind TV sets. Imagine, a cheater cord with on-off switch, dual extension cord, up to date filament checker, universal fuse checker, handy trouble light, neon voltage and continuity checker, pin straighteners and cord wrapper all in one complete unit.

Dealer Net..... **9.95**

ALL AMERICAN MADE ALL HAND WIRED SENCORE ADDISON, ILLINOIS

FROM THE LEADING NAME IN WORLD-WIDE COMMUNICATIONS

BUILD PROFITS WITH



QUALITY PRODUCTS

Let's face it — you're the professional. Your customers rely on your judgement — if they don't, you're just working, not **building.** When your customers see you use the familiar and accepted ITT-labeled tube, they know you're a friend. **You** know it's a profitable friendship, and that's the kind that lasts. For over 25 years ITT has been advancing the state of the art in tube design and manufacture. This traditional quality is the stuff your reputation is made of . . . use it well. We can help you with a confidence-builder, **"the ITT TUBE STORY"**, pamphlet. Give one to your customers — they may give one to you (a customer, that is).

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INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

Alignment Tools

(Continued from page 40)

Fig. 4. Retrieving tool has pivoting blade section which grips slug tightly.

cessory features or are made of special materials. Some alignment tools are fitted with the device shown in Fig. 3, which enables the serviceman to count the number of turns (to the nearest quarter-turn) he has moved the slug from its original position. These tools come in especially handy for returning a slug to its original setting after you have checked to see if the coil is tuned to the right peak.

Another special device helps the serviceman overcome a problem sometimes encountered in aligning certain models of turret tuners. These are sometimes troublesome because they contain air-core coils which have a slug threaded directly into the coil wire. The coils are doped after the slug has been adjusted, and freeing the slug is likely to require more than normal pressure. If a slug is pushed too hard, it can slip out of contact with the windings. The special tool used to alleviate this problem has concentric shafts, as shown in Fig. 4. The center one, when turned, applies pressure against the sides of the slot, and allows the slug to be pulled as well as turned. In this way, its threads can be brought back into contact with the coil wires.

Although most modern alignment tools are made of some type of plastic, there are some special types made of other materials. For example, screwdrivers constructed of beryllium or some other nonmagnetic metal are useful when considerable torque is needed for loosening frozen slugs. Some older TV's also required this type of screwdriver for adjusting focus. Other ma-

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Tips for Technicians

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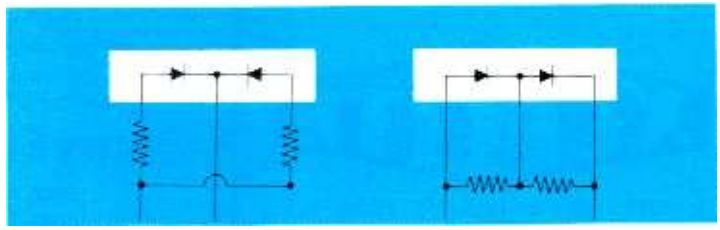

terials that are occasionally used for making alignment tools are fiberglass and bone fiber. Tools made of these two materials have the advantage that they can be easily repointed on a bench grinder.

One highly useful tool, unlike the others mentioned above, is not intended for turning slugs. This device, the tuning wand, simply provides a convenient way to check a coil for proper alignment. It consists of a plastic rod with a powdered-iron tip on one end and a brass tip on the other. Inserting the powdered-iron core into a coil form raises the inductance of the coil, while inserting the brass core lowers the inductance.

Other Service Aids

A number of additional items, which are not alignment tools in the strict sense of the word, are nevertheless classified in the same general category. They are similar in construction to the special screwdrivers and wrenches used in alignment, and are equally handy to have in the shop.

Several interesting devices of this nature are shown in Fig. 5. At the left is a screw-holding screwdriver —a useful device indeed. Many minutes can be wasted trying to start a screw in a hard-to-get-at location. Few of us have the patience necessary to survive dropping a small screw in an inaccessible spot several times. With a captive screwdriver it is usually a simple matter to start the threads. The unit in the photo functions in the same manner as the slug-retrieving tool shown in Fig. 4—a rotating blade section, operated by an inner shaft, grips the screw by pressing against the slot.

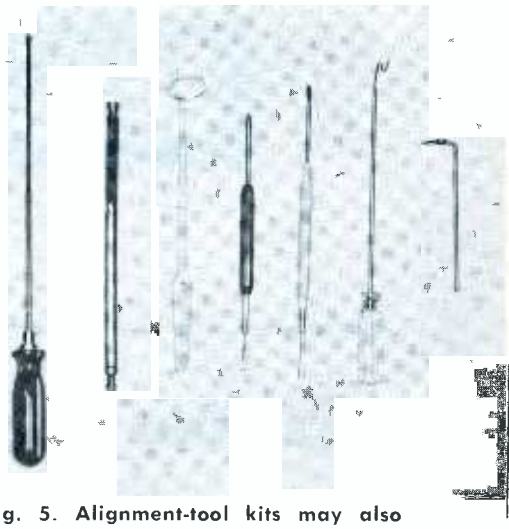

Fig. 5. Alignment-tool kits may also contain service aids, such as these.

A nut-starting tool (second from left) has coiled steel tips which fit over the heads of hex nuts and hold them steady to facilitate installing them in awkward spots.

Next in line is an inspection mirror, which comes in handy for jobs such as replacing a miniature tube located in a spot where the socket is difficult to see. These mirrors can also be used to examine resistors and other components hidden behind a transformer or electrolytic. Many different types are available, including nonmetallic and illuminated models.

To the right of the mirror are two different types of soldering aids. Both tools have a wire brush at one end for removing solder from connections, but the remaining tips have different purposes. One, a slotted probe, is useful for prying wires off terminals; the other, a sharp blade, can cut through foil conductors or pierce silicone-resin insulation on printed wiring boards.

The hooked probe, next in line, removes much of the exasperation

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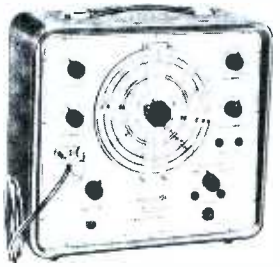
STEP TWO. VISUAL ALIGNMENT AND WAVEFORM ANALYSIS.

ES-150 Wide Band Oscilloscope with DC to 5 mc Response. VERTICAL CHANNEL: 3-stage push-pull, balanced DC amplifier. **Sensitivity:** DC: 70 mv/in.; AC: 25 mv RMS/in. **Frequency Response:** DC: within 3 db to 4.5 mc, within 5 db at 5 mc; AC: within 3 db from 1 cps to 4.5 mc, within 5 db at 5 mc. **Rise Time:** better than .08 μs. **Input Impedance:** 1.5 megohms shunted by 23 mmfd. **4-Step Frequency-Compensated Vertical Input Attenuator:** Frequency compensated. **Vertical Polarity Reversal Switch:** Simplifies pattern reversal. HORIZONTAL CHANNEL: Push-pull output amplifier; sensitivity: 0.6 v RMS/in. **Frequency Response:** Within 3 db from 1 cps to 400 kc. **Input Impedance:** 5 megohms shunted by 23 mmfd. **Cathode-Follower Horizontal Input Circuit:** Linear time base 10 cps. to 100 kc. Provisions for external capacitor sweep to 1 cps. **Net Price:** $149.95. Also available in kit form as PACO S-55: $95.95.

STEP THREE. VISUAL SWEEP RESPONSE WITH ES-150.

E-410 Sweep Generator And Marker Adder. **Frequency Coverage:** 3 mc to 1080 mc in 6 bands (to 216 mc on fundamental). **Continuously Variable Sweep Width:** 0-3 mc on Band A to 0-30 mc on Band D. Band E varies from 0-16 mc. **Output Impedance:** 50 ohms terminated. **Internal Blanking:** Eliminates return trace. **Automatic Gain Control:** Regulates voltage amplitude on any band. **Marker Adder:** Superimposes marker "pips" on response curve; variable in size and width. **Internal Phasing Control:** Corrects phase shift between RF and horizontal scope outputs. **Fixed Frequency Markers:** Crystal circuit for accurate marking (one 4.5 mc crystal supplied). **External Marker Input Connector:** Permits use of external marker such as E-200C to provide variable marker "pips." **Separate Line Filter:** Minimum line cord radiation. **Continuously Variable Attenuators:** Control sweep width and vertical scope pattern. **Net Price:** $159.95. Also available in kit form as PACO G-32: $85.95.



STEP FOUR. ALIGNMENT AND VARIABLE MARKER.

E-200C Multi-Band RF Signal and Marking Generator. **Frequency Range:** 88 kc to 440 mc (to 110 mc on fundamental). Direct reading in 10 bands up to 440 mc; within 1% accuracy on all bands. **0-1000 Point Vernier Dial:** Ideal for hand calibration and frequency spotting. **Dual-Shielded RF Attenuators.** Smooth, stepless RF control. **Four Types of Signals:** Unmodulated RF; modulated RF (400 cps); externally modulated RF; 400 cps output. **Direct Reading Variable Modulation Control 0-100%:** Triples signal utility as against obsolete fixed or stepped modulation of only 30% or 40%. **Built-In AVC-AGC Bias Substitution:** Overcomes alignment troubles arising from varying receiver AVG and AGC. **Net Price:** $109.95.

Alignment-Tool Requirements For Radio-TV Shops

Basic Tool Complement

1. Medium-length metal-tipped screwdriver
2. Medium-length plastic-tipped screwdriver
3. 2½" recessed-tip screwdriver
4. Flexible tuning wand
5. .100"-diameter hexagonal tool used on Zenith TV's
6. .075"-diameter hexagonal tool
7. "K-Tran" IF-transformer tool with torque handle
8. 12" plastic screwdriver

Expanded Assortment

9. Short metal-tipped screwdriver
10. ⅛"-square socket driver
11. ⅛"-blade small-diameter screwdriver
12. Stud-core tool used on Stewart-Warner, Belmont, Motorola TV's
13. 2½" recessed-tip tool used on Westinghouse and RCA TV's
14. Oscillator and IF-transformer tool used on RCA, G-E, Philco, and Admiral TV's
15. 9" tool with ⅛"-diameter shaft for "cup cores" (nested iron cores)
16. Recessed-tip screwdriver used on Zenith TV's
17. 7" metal-tipped screwdriver with torque handle
18. 10" beryllium screwdriver
19. Transistor-IF core-alignment tool
20. Concentric-shaft potentiometer tool used on color TV's.

Service Aids

21. Inspection mirror
22. Contact-adusting tool
23. Dial-cord stringing tool
24. Soldering aids
25. Screw-holding screwdriver
26. Nut-starting tool

from another tedious service job—the manipulation of dial cords and springs. Another hook (at far right) has slotted tips and is intended for straightening contacts on relays and switches.

Still another service aid, sometimes called "mechanical fingers" (not pictured), is designed to reach into small corners and other inaccessible places to retrieve small screws, nuts, and components. Several "fingers" are spring loaded in a housing; when the inner shaft is pushed from one end, these fingers extend from the housing and surround the object to be retrieved. When the inner shaft is released, the fingers clamp tightly around the object and allow it to be withdrawn.

Shop Hints

Here are some tips in connection with the use of alignment tools that might save some time on future jobs:

1. When working on older radios or TV sets, you might encounter a slug that is frozen in position, perhaps because it has never been adjusted during the life of the set. To loosen it, try a steady pressure first in one direction, then in the other. If the slug doesn't come free, don't force it; apply a couple of drops of alcohol directly to the slug. Other agents will also work, but be careful not to use anything that might dissolve the varnish which coats the turns of the coil.
2. If you should happen to strip the slot or hexagonal hole in the end of the slug, check the bottom side of the chassis; many slugs have adjustment slots on both ends.
3. Always examine a slug carefully before attempting to insert a tool. Many of the different recesses look similar, but unless the proper tool is used, the slug could be irreparably damaged.

Conclusion

A radio-TV technician needs many different alignment tools and related accessories in the course of his daily work, but since most of these are very reasonable in price, even the most elaborate collection of them will seldom cost him over $25.00. This modest investment will spare him the great inconvenience and unnecessary damage to components that would result from using inadequate tools. ▲

STOCK GUIDE FOR TV TUBES . . .

This list omits over 50 of the rarest TV tube types, which many shops do not find it practical to keep in stock. To simplify the chart as much as possible, common radio and hi-fi tube types used in TV combinations are omitted; so are UHF types. Tubes marked* are primarily used in color sets.

The figures on a gray background suggest a stock of 350 tubes which should account for over 90% of your replacement needs, and should minimize your risk of being "caught short" even if you travel all day without refilling your tube caddy. However, if you prefer a more limited caddy stock, the other set of figures (on white background) will help you decide which types to cull out. These figures indicate the number of tubes of each type you could expect to find in a random sample of 1000 tubes taken from all TV sets now in service. Where the usage is well below 1 per 1000, a dash is shown. To scale down your stock, you can omit many "dashed" types, and also reduce quantities of other types. In so doing, keep in mind three other factors besides usage rates which influence the demand for various tubes:

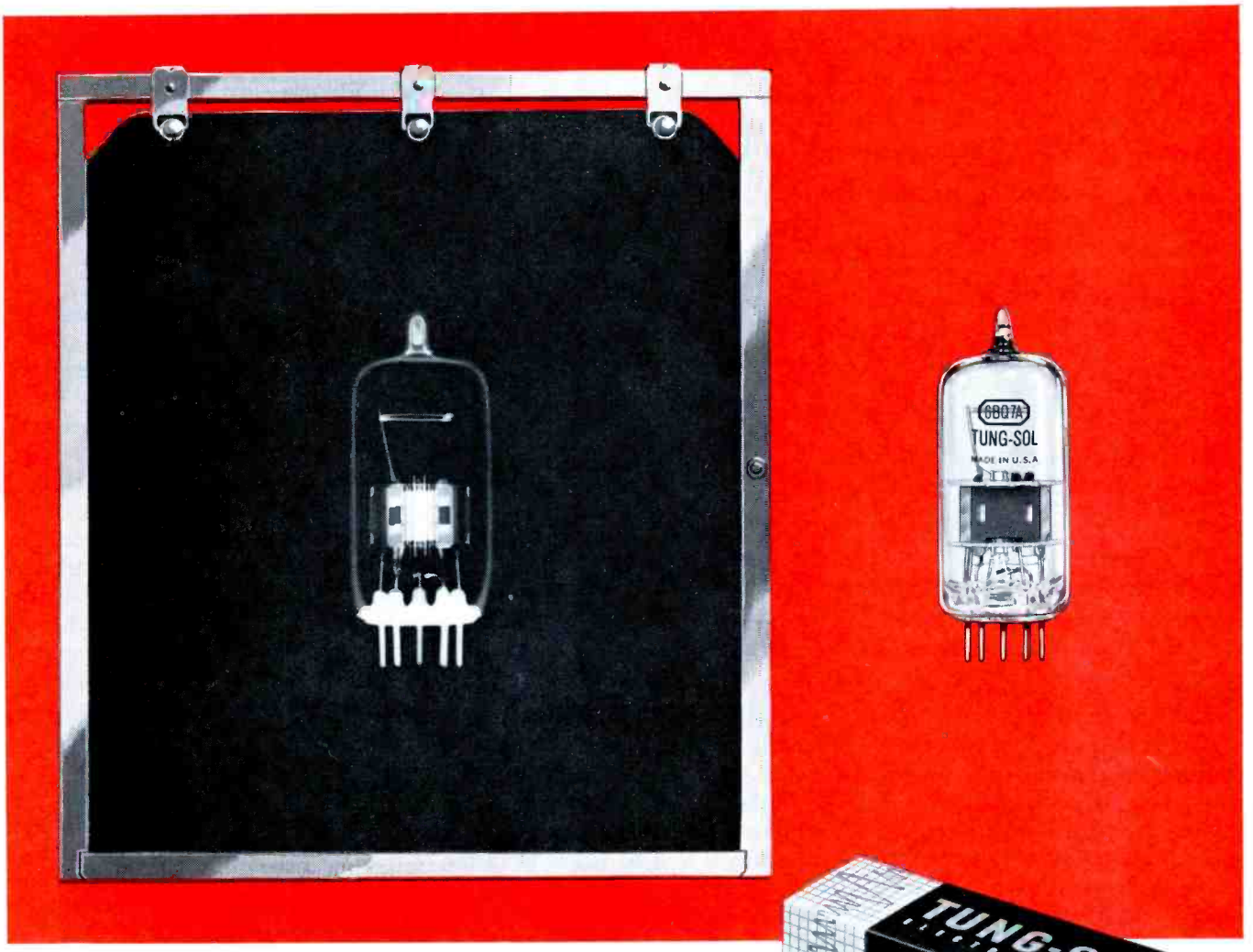
1. Relatively high failure rate of power output and similar types.
2. Your specialization in certain makes of sets.
3. Average age of sets containing a particular tube type.

Temporary substitution of available types for rare types, as outlined in the Howard W. Sams book, **Tube Substitution Handbook, Vol. 5**, can also help you reduce stock requirements.

Another way to ease tube-stock headaches is to use only the latest –A or –B versions of various tubes. Types in common use are listed in the chart.

PER 1000	CADDY STOCK	TUBE TYPE	PER 1000	CADDY STOCK	TUBE TYPE	PER 1000	CADDY STOCK	TUBE TYPE	PER 1000	CADDY STOCK	TUBE TYPE	PER 1000	CADDY STOCK	TUBE TYPE	PER 1000	CADDY STOCK	TUBE TYPE
25	3	1B3GT	—	1	5AS4	14	3	6AW8A	1	1	6CS7	—	1	6FW5	—	1	10EM7
13	2	1G3GT	—	1	5AS8	—	1	6AX3	3	1	6CU5	1	1	6FY5	—	1	10HF8
5	1	1J3	1	1	5AT8	23	3	6AX4GTB	1	1	6CU8	—	1	6GC5	1	1	12AF3
4	1	1K3	—	1	5AV8	3	1	6BA6	1	1	6CW4	—	1	6GE5	4	2	12AT7
1	1	1S2A	—	1	5AU4	1	1	6BA8A	—	1	6CW5	4	1	6GH8	16	3	12AU7
—	1	1V2*	1	1	5B8	3	2	6BC5	2	1	6CX8	1	1	6GK5	1	1	12AV5GA
6	2	1X2B	—	1	5BE8	2	1	6BC8	2	1	6CY5	2	1	6GK6	1	1	12AV7
2	1	2BN4	1	1	5BK7A	2	1	6BE6	1	1	6CY7	2	1	6GM6	7	2	12AX4GTB
—	1	2CW4	1	1	5BR8	—	1	6BF6	1	1	6CZ5	3	1	6GN8	4	2	12AX7
3	1	2CY5	—	1	5BW8	2	2	6BG6GA	2	1	6DA4	1	1	6GW6	2	1	12AZ7A*
—	1	2FH5	4	2	5CG8	2	1	6BH8	—	1	6DB5	1	1	6GX6	1	1	12B4A
—	1	2FS5	2	1	5CL8A	—	1	6BJ8	7	2	6DE4	1	1	6GY6	6	2	12BH7A
—	1	2GK5	1	1	5EA8	—	1	6BK4*	4	2	6DE6	—	1	6HF8	1	1	12BQ6GTB
4	1	3A3	—	1	5EW6	1	1	6BK5	1	1	6DE7	—	1	6HJ8	—	1	12BR7
1	1	3AL5	—	1	5GH8	5	2	6BK7B	1	1	6DG6GT	2	1	6HS8	—	1	12BV7
3	1	3AU6	—	1	5GM6	3	2	6BL7GT	5	2	6DK6	1	1	6J5	9	2	12BY7A
1	1	3BC5	—	1	5J6	2	1	6BL8	2	1	6DN7	10	3	6J6	3	1	12C/-CU5
3	2	3BN6	1	1	5T8	2	1	6BN4	—	1	6DQ5*	3	2	6K6GT	1	1	12CA5
3	2	3BU8	33	3	5U4GB	8	2	6BN6	20	2	6DQ6B	—	1	6K11	2	1	12D4
18	2	3BZ6	5	2	5U8	3	1	6BN8	2	1	6DR7	1	1	6S4A	1	1	12DB5
8	2	3CB6	2	1	5V3	6	2	6BQ5	—	1	6DS5	1	1	6SL7GT	8	2	12DQ6B
2	2	3CS6	1	1	5X8	10	3	6BQ6GTB	—	1	6DT5	31	3	6SN7GTB	—	1	12DQ7
1	1	3CY5	2	2	5Y3GT	9	2	6BQ7A	11	2	6DT6	1	1	6SQ7	—	1	12DT5
2	1	3DG4	1	1	6AB4	1	1	6BR8A	1	1	6EA7	8	2	6T8	—	1	12ED5
2	2	3DK6	2	1	6AC7	—	1	6BS8	9	2	6EA8	11	3	6U8A	—	1	12GC6
7	2	3DT6	1	1	6AF3	6	2	6BU8	5	1	6EB8	1	1	6V3A	2	1	12L6GT
—	1	3EA5	2	2	6AG5	—	1	6BW8	1	1	6EH7	8	2	6V6GT	1	1	12SN7GTA
—	1	3GK5	1	1	6AG7	1	1	6BX7GT	1	1	6EJ7	5	2	6W6GT	1	1	12W6GT
—	1	4AU6	1	1	6AH4GT	2	2	6BY6	1	1	6EM5	5	2	6X8A	1	1	13DE7
—	1	4AV6	3	2	6AH6	2	1	6BY8	5	2	6EM7	2	1	7AU7	—	1	13DR7
1	1	4BC8	1	1	6AK5	34	3	6BZ6	2	1	6ER5	—	1	7EY6	1	1	13EM7
—	1	4BN6	1	1	6AL3	2	1	6BZ7	2	1	6ES8	1	1	8AW8A	—	1	13FD7
1	1	4BQ7A	31	2	6AL5	3	2	6C4	—	1	6ET7	—	1	8BA8A	1	1	17AX4GT
—	1	4BU8	4	1	6AM8A	65	3	6CB6A	—	1	6EU8	2	2	8BQ5	1	1	17D4A
3	2	4BZ6	3	2	6AN8A	1	1	6CD6GA	5	1	6EW6	1	1	8CG7	—	1	17DE4
1	1	4CB6	20	3	6AQ5A	2	1	6CF6	—	1	6EZ5	—	1	8CX8	—	1	17DM4
1	1	4CS6	2	1	6AS5	33	3	6CG7	—	1	6FD7	—	1	8EB8	2	1	17DQ6B
—	1	4DE6	1	1	6AS8	11	2	6CG8A	2	1	6FH5	—	1	8EM5	—	1	17GW6
1	1	4DT6	1	1	6AT6	1	1	6CL6	—	1	6FG7	—	1	8ET7	2	1	19AU4GTA
—	1	4EH7	1	1	6AT8A	1	1	6CL8A	—	1	6FM8	—	1	8FQ7	—	1	22DE4
—	1	4EJ7	5	2	6AU4GTA	—	1	6CM6	—	1	6FQ5	1	1	8GN8	1	1	25AX4GT
—	1	4ES8	56	2	6AU6A	5	2	6CM7	1	1	6FQ7	1	1	9AU7	—	1	25BQ6GTB
2	1	5AM8	2	1	6AU8A	2	1	6CN7	—	1	6FS5	—	1	9BR7	1	1	25CD6GB
1	1	5AN8	1	1	6AV5GTA	2	1	6CQ8	—	1	6FV6	2	2	10DE7	1	1	25DN6
5	2	5AQ5	9	2	6AV6	4	2	6CS6	—	1	6FV8	—	1	10EG7	2	1	25L6GT

HIGH GAIN AND LOW CAPACITANCE OF FRONT END TRIODES EXPLAIN ABSENCE OF SNOW ON PICTURE TUBES



SNOWY or hazy pictures are symptomatic of tv front ends that transmit input noise infections to the video stages. The wideband RF amplifier triodes manufactured by Tung-Sol for tv tuner service are immunized against this disease by abnormally close spacing of grids and cathodes, boosting power gain and allowing transconductance to increase faster than input capacitance. Isolation of tube elements is maintained by three-part formula: clear mica spacers and rigidized construction to prevent thermal warping and microphonics; high-purity materials prevent gas generation and the formation of leakage paths; extreme cleanliness during every step of manufacture avoids contaminants. Shot noise caused by uneven cathode emission is prevented by using finely dispersed cathode materials.

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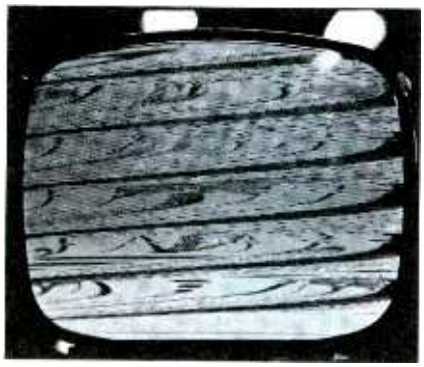
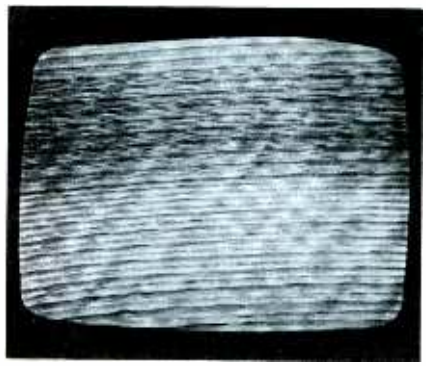
SYNCHROGUIDE

From Squegs to Squeals

What to do when a horizontal blocking oscillator strays off frequency . . . by Thomas A. Lesh



(A) Few cycles off frequency.



(B) Greater frequency error.

Fig. 1. Oscillator running too slow—mild case at left, severe case at right.

In many cases of horizontal-sync trouble, the sync pulses are perfectly normal, but the horizontal AFC circuit isn't responding to them by making the necessary corrections in horizontal-oscillator frequency.

The direction of the frequency error makes quite a difference in the trouble diagnosis, as we saw in "Horizontal Oscillator Running Wild" (August PF REPORTER). If the oscillator is running just slightly slow, the picture will appear as in Fig. 1A, with diagonal bars slanting downward to the left. In worse cases (Fig. 1B), the bars will increase in number until they can no longer be distinctly seen; also, a loud squeal will be heard from the flyback. As a secondary effect, the boost voltage will usually decrease; this may cause a loss of height in sets which use boost as a source voltage for the vertical oscillator or output stages.

On the other hand, too high an oscillator frequency will produce bars slanting downward to the right. If the frequency change is great enough, the horizontal drive signal will be weakened, causing a decrease in width and high voltage.

Another symptom of operation above normal frequency is peculiar to the blocking-oscillator and triode-AFC *(Synchroguide)* circuit, shown in Fig. 2. The frequency change causes distortion of the combined sine-sawtooth waveform developed in the oscillator plate circuit, producing the unstable form of oscillation called "squegging" or "Christmas-tree effect" (Fig. 3).

Several different faults in the oscillator or AFC stage can cause "above-frequency" operation. In addition, certain other troubles (especially in the AFC stage) can lower the oscillator frequency, while misadjustment of the tuned coils may create a frequency error in either direction.

Just as in a multivibrator, various conditions which cause a slight frequency shift are usually covered up by the action of the AFC circuit or by adjusting variable components. The front-panel horizontal hold control of a *Synchroguide*-equipped set usually has less range than in a set using a multivibrator, but the internal horizontal-frequency slug adjustment can be used to tune the oscillator over several thousand cycles of range. If this slug is periodically reset, a gradually worsening trouble will not be evident until the end of the slug's range is reached without locking in the picture. When the

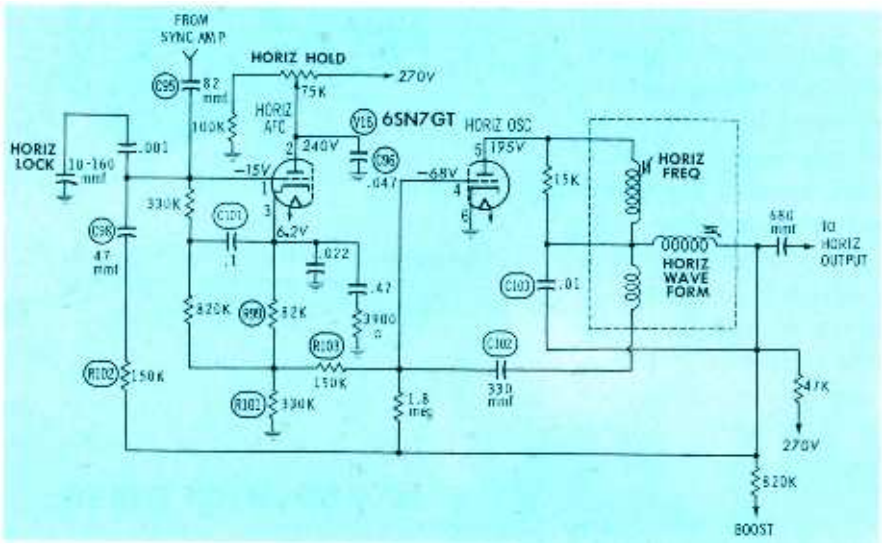


Fig. 2. *Synchroguide* circuit—blocking oscillator controlled by triode AFC.

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Model 1076 Television Analyst

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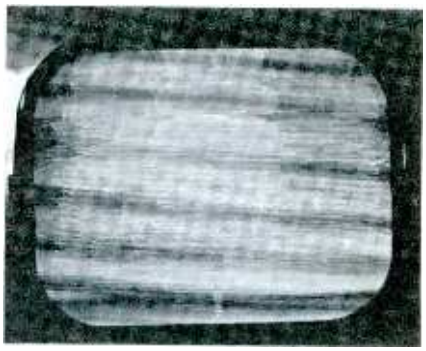

Fig. 3. "Christmas-tree effect" is a characterisistic Synchroguide symptom.

offending component is finally replaced, the out-of-sync condition may be as extreme as depicted in Fig. 1B, until the frequency slug is returned to a more normal setting.

Mild cases of frequency error may simply mean that a readjustment of the circuit is in order. But if the frequency slug has to be turned very far from the middle of its range to sync the picture, look out for incipient trouble which may become worse later, resulting in a callback.

When a raster full of coarse horizontal lines (and a piercing squeal from the flyback) tells you that the *Synchroguide* oscillator is running far below its normal frequency, you can usually assume that the trouble is in the AFC stage. You'll probably find that the cathode voltage of the AFC triode is more negative than normal; this usually indicates that its conduction is abnormally weak. With this stage failing to conduct properly, too much negative bias voltage is allowed to build up on the grid of the oscillator and each cycle of oscillation is lengthened—so the frequency is lowered.

Just by measuring the DC voltages on the AFC stage, you'll be able to tell that something's wrong, because malfunctions cause wild fluctuations in voltage on the elements in this tube. For instance, take note of what happened in one Philco that developed a shorted plate-bypass capacitor (equivalent to C96 in Fig. 2). Of course, the plate voltage dropped to virtually zero, effectively pinpointing the trouble spot; in addition, the grid voltage of the AFC triode dropped from the normal −10 volts to −42 volts, and the cathode voltage fell from +8 to −35 volts. The oscil-

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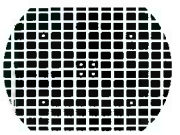

Enables you to troubleshoot and signal trace color circuits in color TV sets, or facilitate installation.

Generates white dot, crosshatch and color bar patterns on the TV screen for color TV convergence adjustments.

Generates full color rainbow display and color bar pattern to test color sync circuits, check range of hue control, align color demodulators. Demonstrates to customers correct color values.

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Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

lator grid voltage changed from –95 to –110 volts, causing about a 20% decrease in oscillator frequency.

Another possible reason for oscillator slowdown is a loss of one or both input signals to the grid of the AFC stage. In Fig. 2, an open C95 would remove the sync-pulse input, and an open C98 or R102 would eliminate the sawtooth signal which is supposed to be fed back from the oscillator plate circuit. In either case, the AFC tube would conduct less, and the reduced voltage drop across R99 would make the cathode voltage of the AFC stage more negative than usual. The low-capacitance probe of your scope, touched to the AFC grid, will tell you if either component of the grid signal is missing. You're likely to have difficulty analyzing a grid-circuit defect in terms of DC voltages measured with a VTVM, since the conduction of the tube is not directly proportional to DC grid-cathode bias, but also takes into account the signal conditions in the grid circuit.

In a few instances, slow operation may be traced to the oscillator. (Perhaps someone previously installed too large a capacitor in place of C102, or too large a resistor for R103, trying to "fix" another defect by redesigning the circuit!) If this happened, you would recognize trouble in the oscillator by noting that the AFC cathode voltage was more *positive* than normal—this stage would be vainly trying to overcome an excess of bias generated by the oscillator.

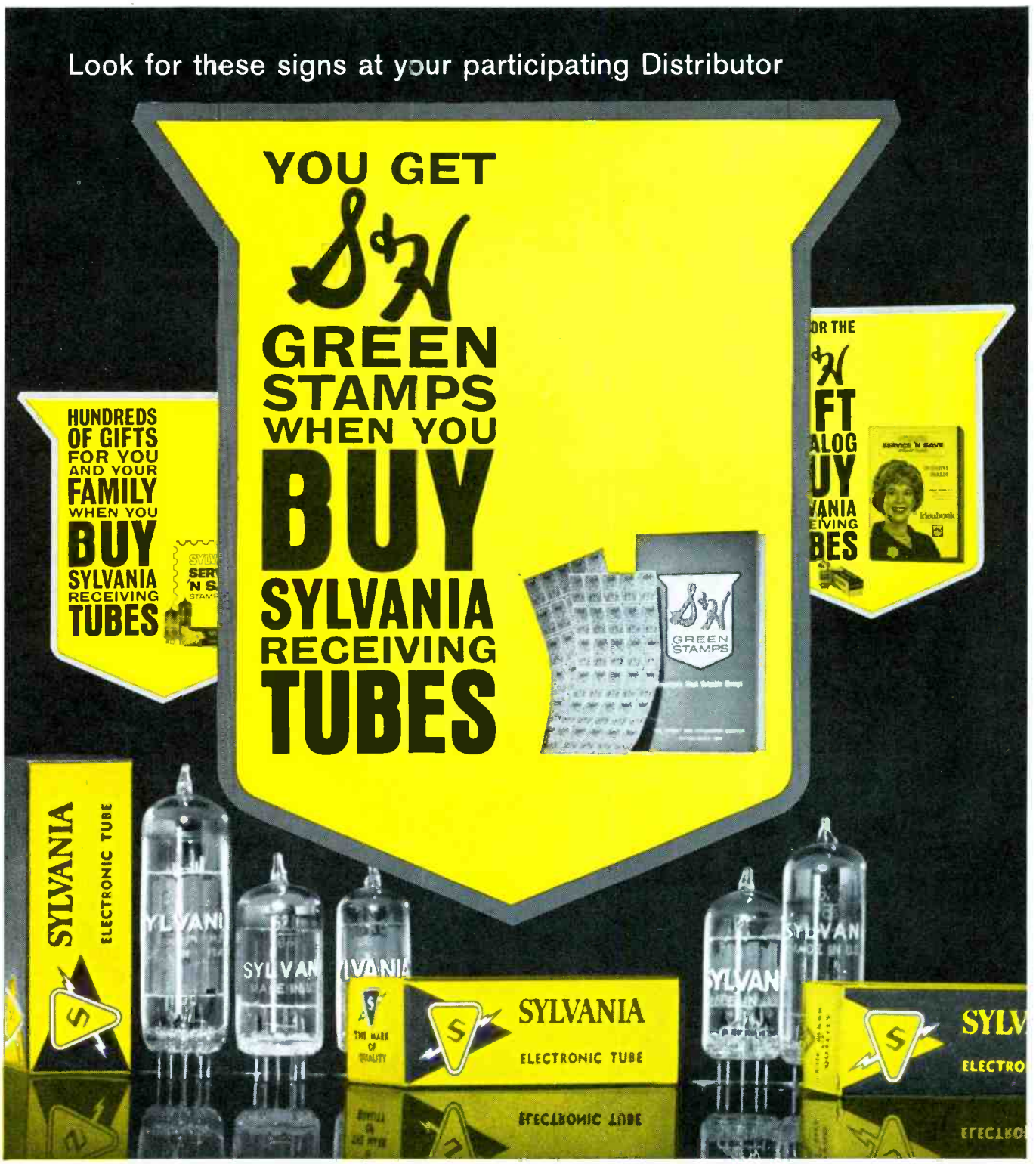
Frequency Too High

When squegging and a loss of width tell you that the oscillator is running too *fast*, you'll save time by making a quick isolation check to see whether the fault is in the oscillator or in the AFC. The most satisfactory test procedure is to ground the cathode of the AFC section. This removes the variable element from the grid-leak bias circuit of the oscillator, allowing tests of the latter circuit by itself. In making this check, keep in mind that it lowers the over-all grid resistance of the oscillator circuit; thus, you can expect the oscillator to be slightly out of sync when "free-running" in this manner. A few turns of the frequency slug should be sufficient to pull in a picture, either "floating" across the screen or rolling horizontally. If not, the oscillator circuit is either badly misadjusted or defective.

When the customer complains of a sudden and severe loss of sync, the most likely troubles are that the horizontal frequency coil has developed shorted turns, or that C102 has just "sprung a leak." C103, across the waveform coil in the plate circuit, is likely to affect drive amplitude or to cause critical sync before it will force the oscillator very far off frequency.

If the oscillator seems normal when free-running, but goes wild with the AFC cathode ungrounded, several points in the AFC circuit should be checked. First of all, look for leakage in the sync and sawtooth coupling capacitors in the AFC grid circuit (C95 and C98), which would allow positive DC voltage to reach the grid circuit.

Faulty cathode-circuit capacitors are more likely to produce bending and "pie-crusting" than frequency



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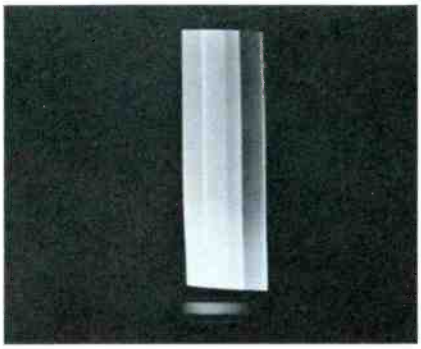

Fig. 4. Extreme loss of width caused by drastic rise in oscillator frequency.

errors. An important exception is C101 (not included in all versions of the *Synchroguide* circuit). If it becomes severely leaky or shorted, its frequency-raising effect will be almost as great as that of a leaky C95 or C98. In one RCA set where this capacitor became shorted, the AFC grid voltage climbed all the way from −26 to +85 volts; the cathode voltage went up from −9 to +105 volts; and the oscillator grid voltage shifted from −85 to only −55 volts. With such a great loss of bias on the oscillator, the frequency went so high that the raster was even narrower than shown in Fig. 4! The oscillator frequency was estimated (by counting cycles on the scope trace) as almost three times normal; drive amplitude fell from 100 to 60 volts peak to peak; and high voltage was only 8 kv. Oddly, the cathode current of the horizontal output tube did not noticeably increase, but a 50-volt drop in screen voltage showed that a greater proportion of cathode current was going to the screen circuit. That's rough on horizontal output tubes, as well as on screen resistors!

Conclusion

As we have mentioned, off-frequency operation of a *Synchroguide* horizontal oscillator can often be stopped by simply readjusting the tuned coils in the circuit. Nothing may have been wrong with the circuit in the first place, except for misalignment. However, there are certain danger signals that can warn you of oncoming trouble. If you notice frequency drift, have to set a slug toward the end of its range, or make a callback a short time later to correct the same symptom, you'd better check the trouble spots named in this article. ▲

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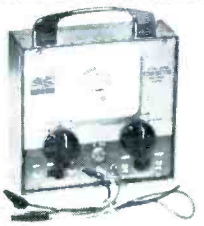

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For testing PNP, NPN, power transistors, diodes and Rectifiers (Semiconductors). The Tester's basic measurement capacities are Open Test, Short Test, Leakage—ICO, Gain—BETA, Out of Circuit. Operates on 2 penlite batteries which should last for life under normal operating conditions.

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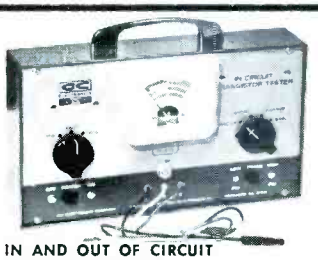

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"Can I help it if it won't fit in my checker?"

Free Tube Testing

. . . at a profit !

by Ernest Tricomi

The do-it-yourself tube tester in the hardware store, drug store and gasoline station has, without question, dug deeply into the profits of television and radio service shops. In several areas of the country, however, machines have been installed to the point of saturation, and retailers report declining tube sales. It now appears that an energetic, determined service-shop owner can combat the competition from these machines, and stand a chance to win.

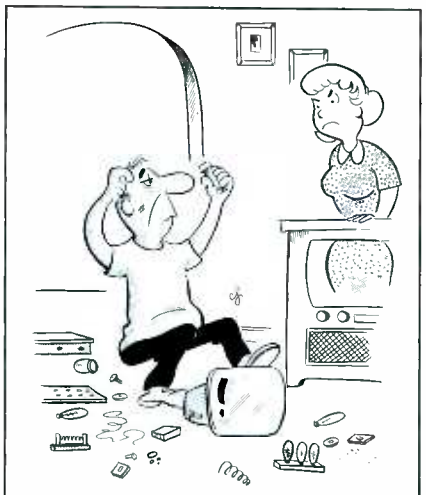
Back in the early 'fifties, manufacturers and distributors of the then-new self-service tube checkers approached many a service dealer with the proposition that he act as the franchised agent for the machines in his area, placing them in strategic locations in neighboring retail shops. The servicer wrongly supposed he could stem the tide by refusing to handle the checkers, and because he was not properly organized for selling and servicing them, he usually turned down the proposition.

Now, with the usual hindsight, many of these same service dealers could kick themselves for their lack of foresight and initiative. The business has gone to enterprising individuals, not always connected with the service business, who aggressively took up the idea and sold it to neighborhood retailers. The retailer was delighted. Not only did he make a profit from the sale of tubes, but the tube tester represented still another inducement to increase his store traffic. Almost entirely self-service, the instruments did not require attendance by skilled help, and even inventory control was semi-automatic. The idea boomed, and today service shops are losing untold thousands of dollars which they might well have had for the asking a few years ago.

Know Your Competition

Never before has it been so true that, if you can't fight it, you should join it. Now that the idea of self-service testing has gone full cycle, service shops have a golden moment in which to turn the tide and win back most, if not all, of the tube sales that have been lost to the testing stations.

If you want to fight competition, you first need to learn all you can about it, just as the general in battle tries to fathom his opponent's next move. There appear to be two plans in competition with the service technician—the ownership plan and the franchise plan.



Guess who said, "The set just needs a simple adjustment. I'll fix it myself."

Ownership Plan

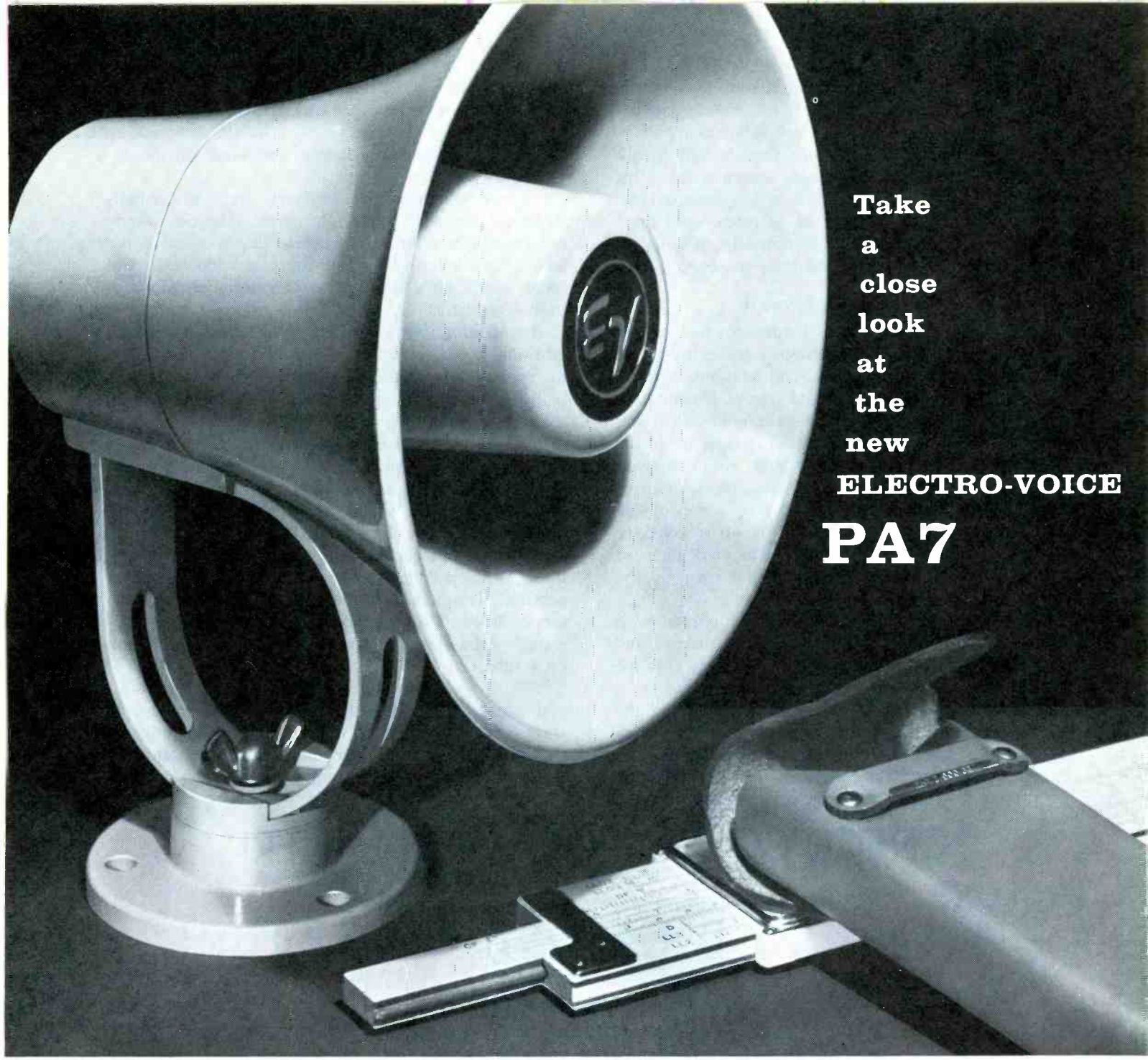
In the ownership plan, the retailer actually purchases the tube tester, the stock cabinet, and an initial stock of tubes. The tester and cabinet cost about $130, not a large investment for a moderate-sized retailer.

Most of the tube-testing stations sold to retailers under the ownership plan are made by manufacturers, who market the instruments under their own brand names. Selling is handled by the manufacturer's regular distributor organization, who have the responsibility for selling, installing, maintaining, and stocking the testers.

Franchise Plan

In the franchise plan, the retailer does not buy the instrument; it is owned and serviced by a franchised agent. The machines used in this type of plan are usually, but not always, made by small manufacturers who, in the absence of a regular distributor organization, turn to individuals for help in marketing the machine and the tubes.

The successful franchise agent can make a very comfortable living, indeed. A "string" of 20 or 30 machines in fair locations can gross as much as $12,000 to $15,000 annually. All the agent has to do is call on each of his stores once every



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Although the PA7 is light in weight, the ingenious swivel mounting is strictly heavy-duty for quick, absolute positioning anywhere . . . mobile or fixed!

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Measure this remarkable new paging speaker against your personal yardstick of quality. No matter how critically you judge the Electro-Voice PA7, you'll find it's better than you expected. Except the price. That's much better!

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week or two, replenishing the stock and checking the performance of the instrument. Occasionally, it becomes necessary to dispatch a technician to repair it.

For his part, the retailer must provide four square feet of floor space somewhere near the entrance to his store, where customers can't fail to see the machine. He pays only for the initial stock of tubes—and these are sometimes provided on a guaranteed-sale basis, so the retailer risks nothing but the floor space.

The Customer Loves It

Now comes the part that is hardest for the service-shop owner to realize—the customer loves the whole idea! Far from being suspicious and cautious, Mr. Set Owner is enthusiastic. At the first sign of trouble with his set, he recklessly pulls out every tube he can reach, dumps them all in a paper sack, and charges off to the hardware store for a relaxing half-hour. And if they all test "good," he's disappointed! Nothing pleases him so much as to find a "bad" or "weak" tube in the lot. He cheerfully calls over the clerk, holds up a defective 6DQ6, and asks for a replacement. The clerk digs out a new 6DQ6, consults a price list, and rings up the sale on the cash register.

The customer returns home in triumph, tells his wife he just saved them five bucks in labor charges, and plugs in all the tubes. In far too many cases (for the service-shop owner's welfare), the set works!

Where "name-brand" tubes are stocked, and the tester is in good condition, the do-it-yourself system is good business for the franchise operator, the distributor, the retailer, and the customer. The only one left out in the cold is the serviceman—you!

But the news can't be all bad; let's look at the other side of the coin. Like anything else, the competition has some flaws and weaknesses, and these can be exploited by the alert servicer.

Weakness number one, of course, involves the limitations of the self-service tube tester. The do-it-yourself type of machine isn't built to detect some of the intermittent failures to which tubes are addicted. And some tubes, while inoperative in certain circuits, are usable in others.

In addition, some retailers have taken to stocking off-brand tubes, many of which are nearly impossible to trace to any well-known source. These tubes generally fail earlier than others (often as soon as they are installed), leading many formerly enthusiastic users of the tube testers to have some doubts.

Part of the reason self-service tube testers have enjoyed such great success can be traced back to the black eye suffered by the service business in the early days of television service. Exaggerated stories about the malpractices of unscrupulous operators certainly contributed to the tendency to avoid a service call whenever possible. The present-day revival of confidence in the service business should definitely help restore the technician as the man best qualified to judge the condition of a tube.

The best way to fight the competition of the do-it-yourself tester is to join it. Free tube testing is here to stay—and *you* might as well be the one to offer it. Customers can bring their tubes into your shop as easily as they can to the drugstore around the corner.

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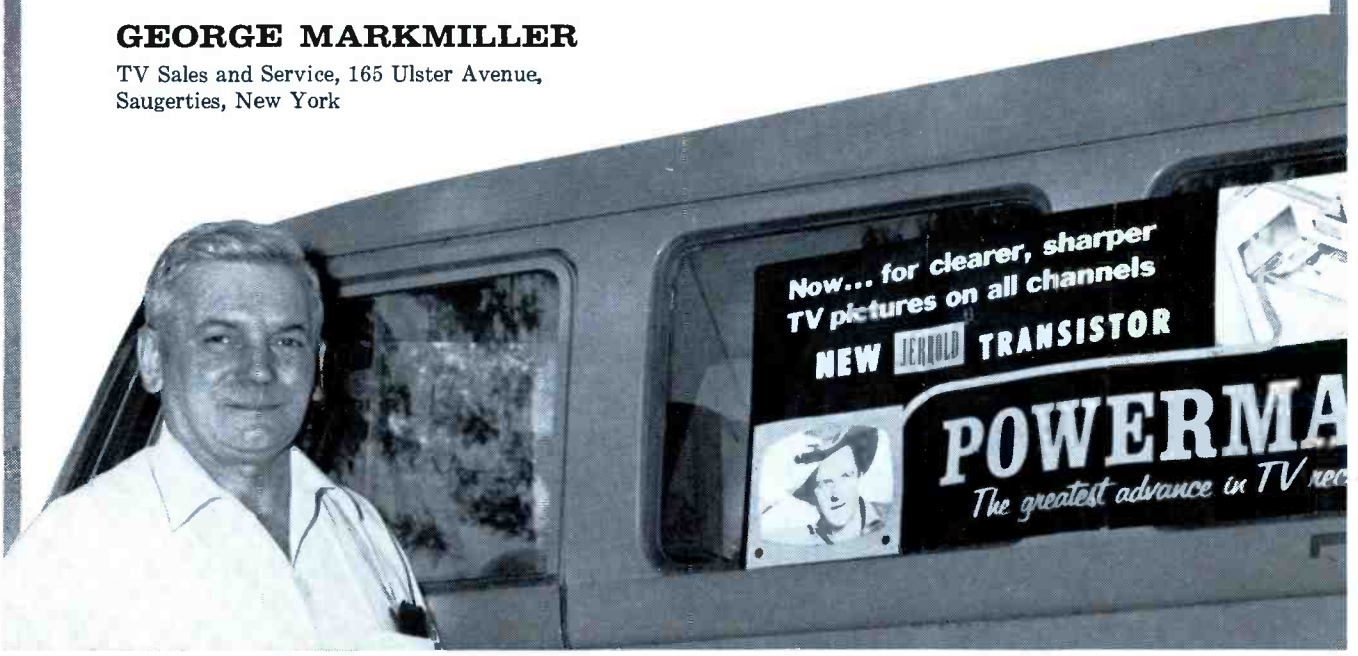

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George Markmiller's customers "were from Missouri" where TV reception was concerned. The products they had tried, in spite of high claims, had not produced snow-free TV from the distant New York stations. With the help of his Jerrold distributor, George used the potent promotional kit to tell his customers the POWERMATE performance story. Newspaper ads, truck banners, stuffers and store displays presold POWERMATE because the promotion was *custom-designed* for his area.

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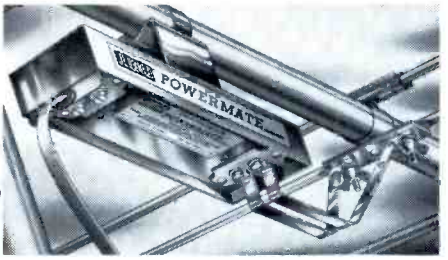

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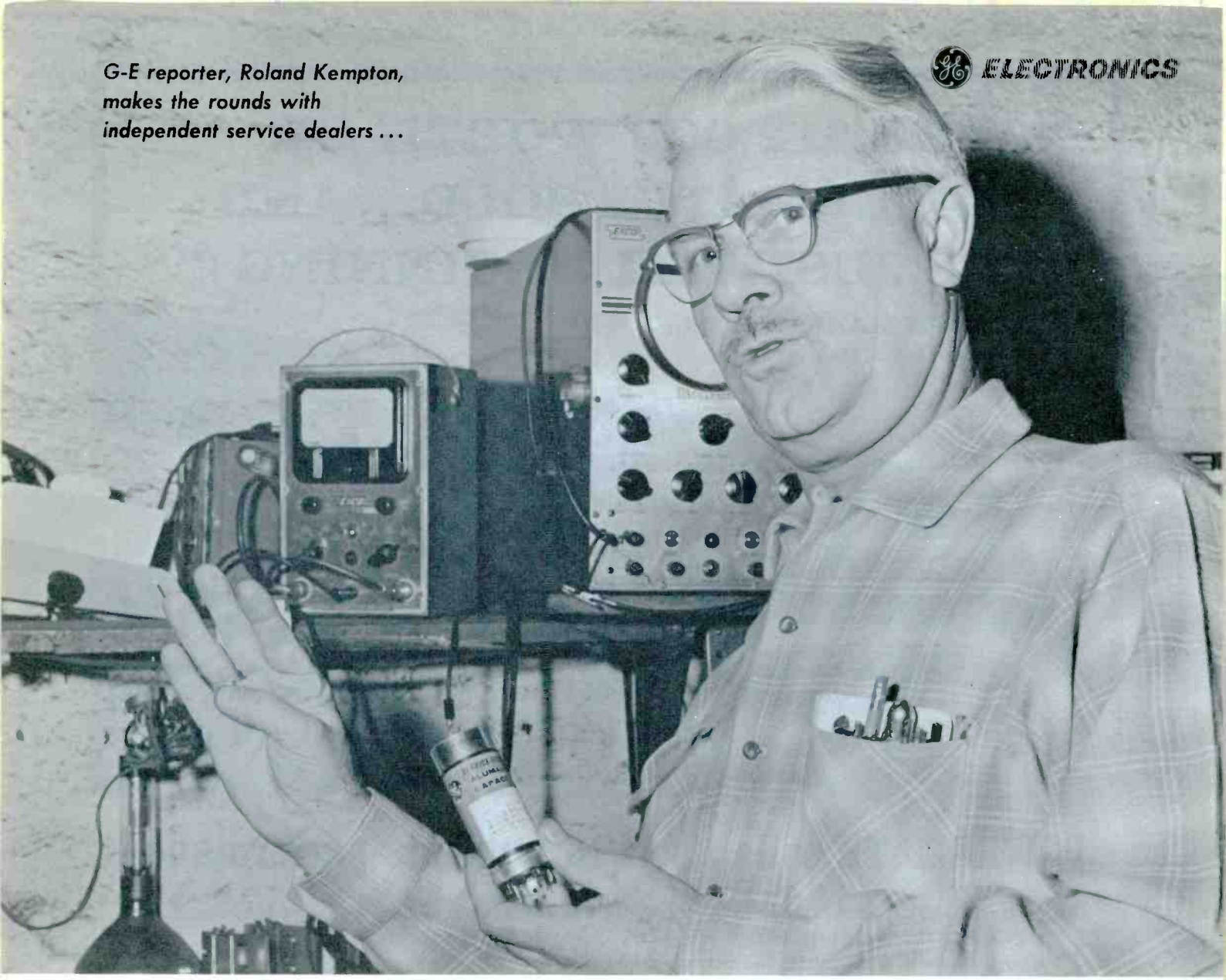

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To Ben Follrath, and service dealers throughout the country, this means it pays to stock G-E Service-Designed capacitors. They save time, reduce costs of single-unit ordering and pickup, speed customer service. Like having 4 capacitors in each box.

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"Yep—touch the wrong thing on that set of yours and bingo! Curtains—just like that!"

To get customers into your shop, you must work out a strategy in the form of convincing arguments, and then apply them to every possible situation in the form of advertising and promotion. Your copy themes should be:

First, bring out the fact that you offer *free* tube testing in your shop —and that *you* do the work, not the customer.

Second, educate the prospect that do-it-yourself instruments do not disclose every possible failure, that certain intermittent faults are not revealed at all.

Third, point out that a customer may replace a tube unnecessarily when he tests it himself. Often, a tube shows up as weak and gassy, but it will actually function satisfactorily in some circuits. These situations require the diagnosis of an expert.

Fourth, assure the customer that from your shop he will get brand-name tubes which are guaranteed by the manufacturer. While not all do-it-yourself tube-testing stations are stocked with off-brand names, enough prospects will have been "stung" by unknown brands at one time or another to give your message a telling effect.

When you have worked out your message containing these four important points, be sure to exploit every medium at your disposal for disseminating your message.

Besides advertising your free tube-testing service, you can do these things:

1. Be sure to locate your own tube tester at or near your counter, so the customer can see for himself when a tube tests weak or bad. Place signs on your counter and in your window saying, "Tubes tested free by qualified technicians on high-grade testing instruments."
2. Print your message on product stickers, invoices, door-knob hangers, letterheads and business cards, your shop vehicles, job tickets, etc.
3. Get your local servicemen's association to sponsor a series of advertisements bearing the message.
4. Talk to your friends among the retailers who have tube testers in their establishments. Many of them may be on the verge of discontinuing this service, because competition has reached the saturation point; a timely word from you may be all that is needed to swing them over to your side.
5. Or, try another tack—check into the possibility of acting as agent for a "string" of tube-testing stations. A retailer who might otherwise be reluctant to install a tube tester may think better of the idea if he has an experienced service technician standing behind the instrument, and name-brand tubes to sell. Put a notice on the machines that *you* are the one to see if tube testing fails to solve the TV problem.

Competition from the do-it-yourself tube-testing station is similar to a one-sided fight—for several years now, the service shops have been taking all the punishment. But the opponent's arm is beginning to tire, and now is the time to bounce back with all you've got! ▲

Two Service Aids Included in New G-E Auto Radio Capacitor Kit

Kit K-202 contains 10 electrolytic twist-prong capacitors (8 most popular types) that will meet the majority of auto radio replacement needs. As a bonus, each kit contains a magnetic service light, tab adjuster and replacement guide . . . all at no additional charge.

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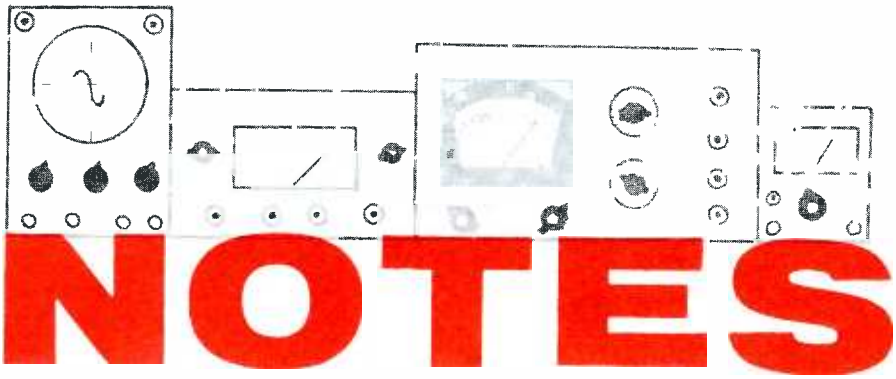

NOTES ON TEST EQUIPMENT

Color, Color Everywhere

Fig. 1 illustrates a completely self-contained NTSC-type color-bar generator, the Model 656XC by Hickok Electrical Instrument Co. of Cleveland—an accurate signal source for color television.

Specifications are:

1. *Power Required—105-125 volts AC; 50-60 cps; 125 watts.*
2. *RF Output—Channels 2, 3, 4, 5, and 6, fixed-tuned; from 200 to 1000 uv available; 75, 90, or 300 ohms.*
3. *Video Output—Choice of: 15 horizontal bars, 20 vertical bars, crosshatch (consisting of 15 horizontal and 20 vertical bars), or approximately 300 dots; color-bar signals: choice of B -Y, R-Y, G-Y, or -G-Y signals, or 7-color display; approximately 2.5 volts peak to peak of signal available; 75, 90 or 300 ohms.*
4. *Sound-Channel Output — Frequency controlled by 4.5-mc crystal (supplied); VHF sound-channel crystal available as optional equipment.*
5. *Controls and Terminals—Four rotary switches:* DOT-BAR-COLOR BAR *selector,* DOT-BAR *selector,* COLOR-BAR PATTERNS *selector, and* RF CHANNEL *selector; seven toggle switches:* VIDEO POLARITY, MODULATION ON-OFF, SOUND ON-OFF, Y-SIGNAL ON-OFF, CHROMA ON-OFF, B–Y/G–Y ON-OFF, *and* G–Y/R–Y ON-OFF; *three crystal sockets: 3.579545-mc crystal, sound-channel crystal, and 315-kc crystal; two potentiometers:* VIDEO OUTPUT *attenuator and* RF OUTPUT *attenuator; three coaxial connectors:* VIDEO OUTPUT, RF OUTPUT, *and 3.58-*MC OUTPUT; *one fuseholder; 19 potentiometers (under covers) for circuit adjustments.*
6. *Size, Weight, Price—18⅜" x 16¾" x 7½"; 34 lbs; $525.00.*

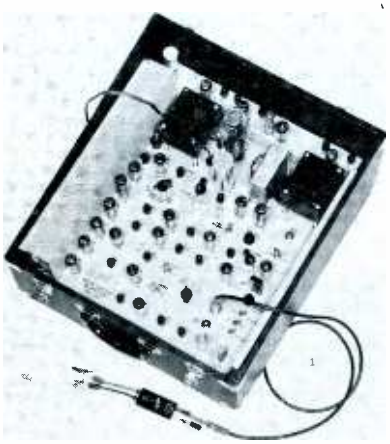

Fig. 1. Portable color generator is complex, with many tubes and adjustments.

The Model 656XC can be used by the color-service technician for all adjustments which must be made to the chroma-bandpass, color-sync, phase detector, demodulator, matrix, and convergence circuits in a color television receiver. The color-bar output of the generator is a standard NTSC (National Television Systems Committee) signal which contains the components of an actual color telecast. The unit directly generates three primary colors—red, blue, and green—and provides the three intermediate colors—yellow, magenta, and cyan—by using certain combinations of primary-color bars.

Fig. 2 shows how this is done: Equal-amplitude bars of Y-signal (brightness) information are fed into a mixing device, but the width of each bar is varied according to diagram A so they add as shown, creating the Y levels shown at B. This Y signal is mixed with the various amounts of chroma signal shown at C. The result is the video information included in D, an NTSC color signal.

The remainder of the composite NTSC color signal consists of a horizontal synchronizing pulse and a few cycles of the burst (3.58 mc) signal. The sync pulse synchronizes the set to the line rate of the generator, and the burst signal syncs the receiver circuits to the generator color signal. The entire color signal is shown at D in Fig. 2, with the various colors labeled: green, yellow, red, magenta, white, cyan, and blue—in that order.

In addition to the color signal, the Model 656XC also provides vertical and horizontal bars, dots, and a crosshatch pattern. The bars are developed by chains of blocking-oscillator dividers, using a crystal-controlled 315-kc oscillator as the master timer. The vertical bars are generated directly by the 315-kc oscillator, and are shaped by a gating circuit into the thin line seen on the color-receiver CRT.

The horizontal bars result from a chain of dividers—a 31.5 kc blocking-oscillator divider, a 4500-cps divider, and a 900-cps divider. The output is fed to a gating circuit, where the pulses are shaped into thin horizontal lines. The crosshatch pattern is formed by mixing the two bar signals (horizontal and vertical) before they enter a special shaping circuit, while the dots are formed by eliminating the crosshatch bars and using only their junctions or crossover points.

Vertical and horizontal deflection-sync pulses are developed by other divider networks, but are keyed by the same 315-kc timer which controls the bar signals. A 15,750-cps divider follows the 31.5-kc oscillator-divider mentioned earlier; the 15,750-cps signal is fed through a pulse-shaping amplifier to a sync adder. Vertical sync signals come to the sync adder from a 60-cps divider stage, which follows the 900-cps divider in the horizontal-bar circuit.

The sync signal from the adder is combined with the bar signals in a video-mixing stage, and the composite signal is fed to a cathode follower. At this point in the circuit, the video signal is coupled to a VIDEO OUTPUT jack on the panel of the instrument, so it can be fed directly into the video amplifier of a color set, if desired. As an alternative, the MODULATION switch connects the video signal to a channel oscillator, and enables the signal to be fed into the antenna terminals. A channel switch allows the choice of any TV channel from 2 through 6.

A crystal-controlled 4.5-mc oscillator can be turned on by the SOUND ON-OFF switch. Its output is mixed with the channel-oscillator signal output to form a sound carrier 4.5 mc away from the video carrier.

The color signal is developed by a complex of shapers, dividers, adders, gate circuits, and delay lines. Fig. 3 shows a simplified block diagram of the sequence by which the NTSC signal is developed. The 15,750-cps signal is used to trigger the color multivibrators via a delay line, passing through a shaper for each multi-

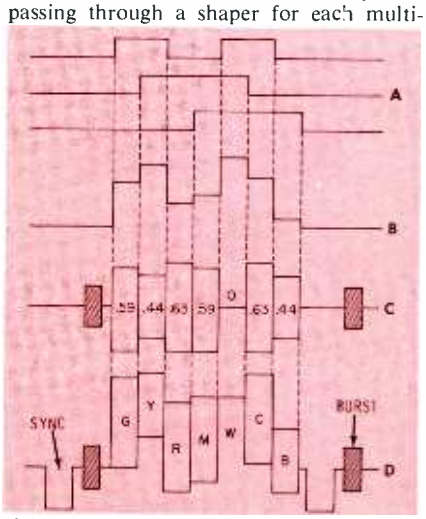

Fig. 2. Composite color signal consists of several components, pictured here.

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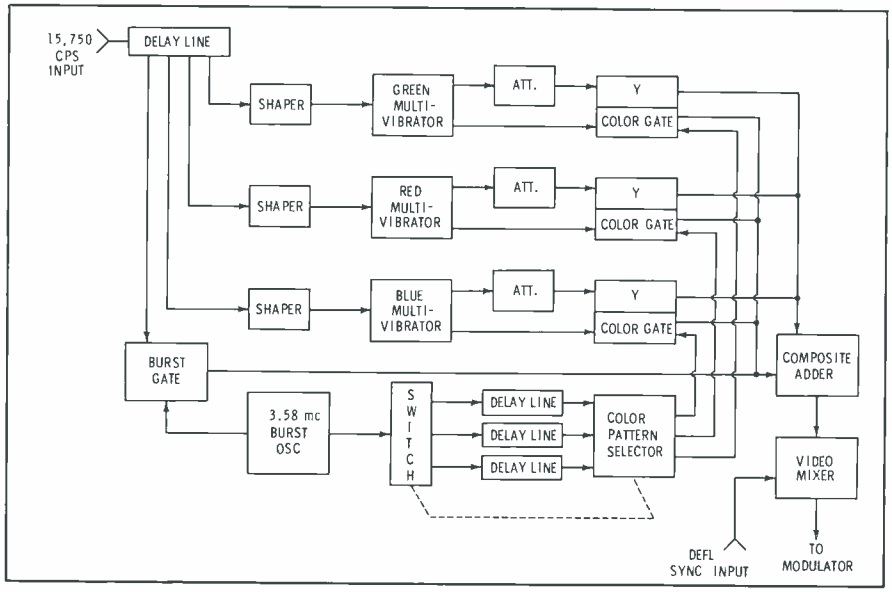

Fig. 3. Functional block diagram shows how the chroma signal is developed.

vibrator. The delay line is tapped at several points, to offer varying degrees of time lag to the trigger signals; as a result, each signal has a differing phase relationship with the beginning of each scanning line, and its position on the line is thus controlled. These positions are represented by the presentation in Fig. 2, which shows the beginning and end of each bar in the display.

The output of each multivibrator is split, and a portion is fed to a Y-signal adder. This circuit sets the height of the bars in A of Fig. 2; presentation B shows how these three bars appear when they are combined in the composite-adder circuit. This is the Y, or brightness, component of the color signal, representing the saturation of each bar.

The other portion of each color-multivibrator output is fed to a gating circuit.

Meanwhile, the 3.58-mc burst oscillator is fed to one or more of the color-gate stages, where it is mixed with the color-multivibrator signal. The outputs of these three stages are combined, resulting in the signal represented by C in Fig. 2, and fed to the composite adder.

The output of the composite adder contains the C and B signals. To this is added, in the video mixer, the deflection-sync pulse—resulting in the NTSC composite color-bar signal shown at D. This is the signal fed to the modulator, for impression on the video carrier.

Using the Model 656XC was simple, with no problems such as jitter or bounce of the bar patterns. The blocking-oscillator-divider arrangement is extremely stable for frequency division, resulting in good pattern stability on the CRT screen. We tried convergence using all four patterns, and succeeded in adjusting our test receiver quite well.

Next, we undertook color-AFC alignment, refining the phase and AFC adjustments by using the color-bar presentation. For demodulator alignment, the Model 656XC offers another color presentation, which we haven't described as yet. It consists of either of two signal combinations— G–Y (90°) with –G–Y, or B–Y with R–Y. On the screen, either combination results in a special display which facilitates adjusting the demodulator or matrix circuits in the color chassis.

The tubes used in the 656XC are mainly 12AT7's, 12AX7's, 12AV7's, and 6U8's. A 12BH7, two 6BJ7's and three 5963's (the blocking oscillator-dividers) round out the complement of signal tubes. For the B+ supply, an OA2 regulator tube maintains a constant output from a type 83 mercury-vapor rectifier. Field adjustments appear uncomplicated, and

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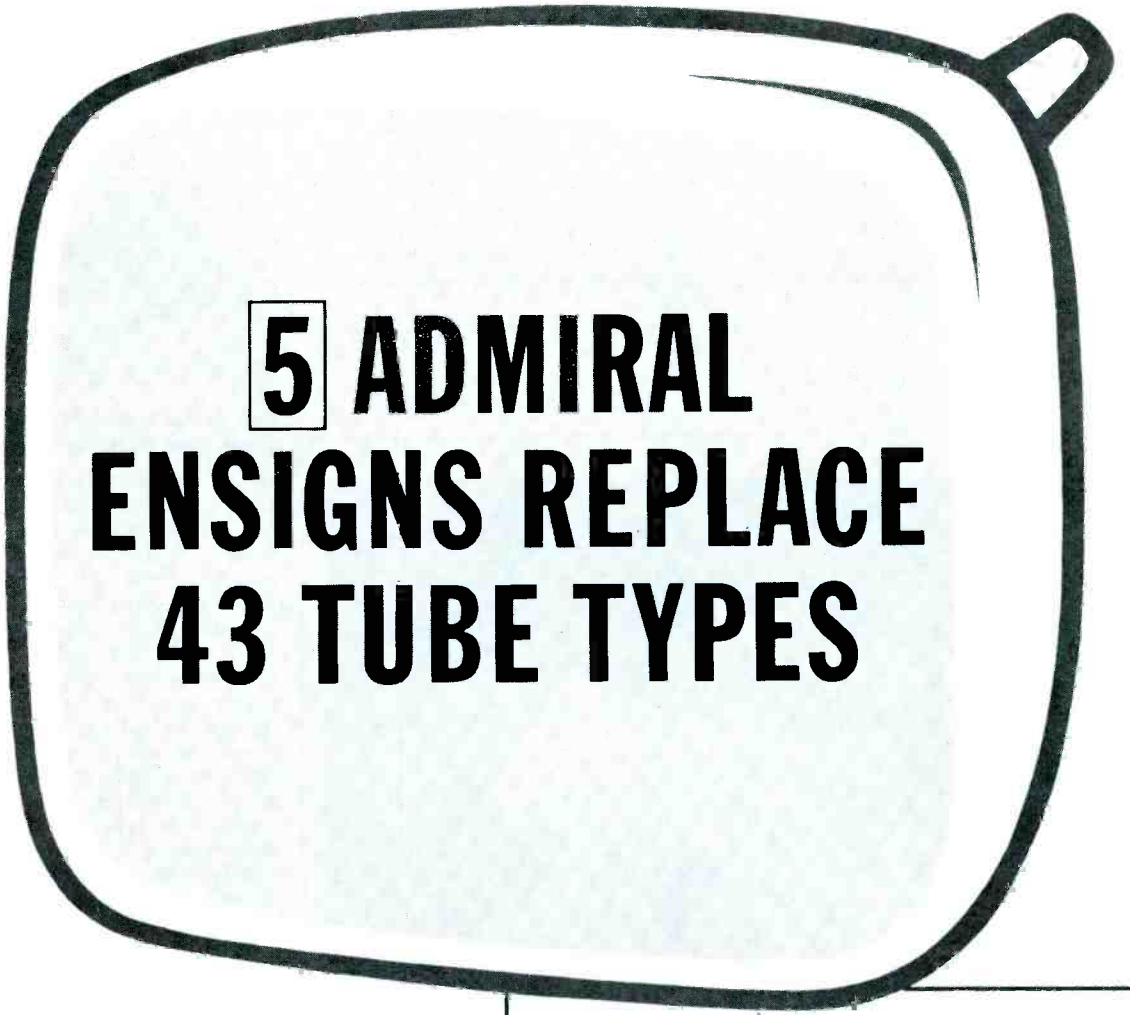

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seldom will be required. If they are, the controls are easily accessible without disassembling the unit.

Checks Connected Capacitors

A new capacitor checker (Fig. 4) is available from EICO. The Model 955 is designed to perform in-circuit or out-of-circuit tests for shorts or opens, and to measure capacitance of large-value units. In-circuit measurements are possible even when the shunting resistance is comparatively low, due to the incorporation of a Wien bridge that balances out the circuit resistance.

Specifications are:

1. *Power Required—117 volts AC; 60 cps.*
2. *Capacitor Tests—shorts, opens, and capacitance.*
3. *Capacitors Checked—shorts, all values up to 2,000 mfd (60-cps test signal); opens, checks values as low as 15 mmf (test signal, approximately 19 mc); capacitance, from .1 to 50 mfd.*
4. *Panel Indicator—EM84/6FG6 electron-ray tube (bright-bar pattern).*
5. *Controls and Terminals—*TEST *switch;* LINE ADJ *switch;* RC RANGE *switch;* RC BALANCE *potentiometer;* CAPACITANCE *dial; coaxial connector; special cable with two alligator clips on one end and microphone-type connector on the other.*
6. *Size, Weight, Price—8½" x 5¾" x 6"; 4 lbs; $19.95 (kit), $39.95 (wired).*

The Model 955 uses a 6C4 and a special indicator tube to perform all checks. The TEST switch changes the circuit configuration to conform to the test desired. When the shorts test is being made (see Fig. 5), the capacitor under test is connected between J1 and ground. 330 volts AC is applied to the plate of V1 through R3, and 6.3 volts AC, of opposite phase, is applied to both the capacitor under test and the grid of V1 through R1 and C1. When the impedance across the test leads is greater than 10 ohms, the voltage appearing at the grid of V1 is sufficient to keep the tube near cutoff. This produces very little voltage drop across R3, allowing V2 to conduct heavily. This conduction causes a large voltage drop across R5 and keeps the indicator bars wide open (see Fig. 6A).

When the impedance at J1 is zero (such as when the test leads, or capacitors under test, are shorted), the 6.3 volts will all be developed across R1. The tube current increases, causing conduction in V2 to decrease. The voltage drop across R5 decreases and the bars close (see Fig. 6B). Impedances between 1 and 10 ohms are indicated by partially open bars (see Fig. 6C).

The instrument can also be used as a continuity checker in the SHORT position of the TEST switch. When the TEST selector is in the OPEN position, the circuit configuration shown in Fig. 7 is used; V1 is connected as a Hartley oscillator. Whenever the tank circuit comprised of C1 and L1 is oscillating, the grid voltage at V1 is slightly negative, and the bars will be open. Conversely, when there is no oscillation, the bars will close. The presence of oscillation depends on the impedance connected across the test leads

Fig. 4. The Model 955 measures capacitance and tests for shorts and opens.

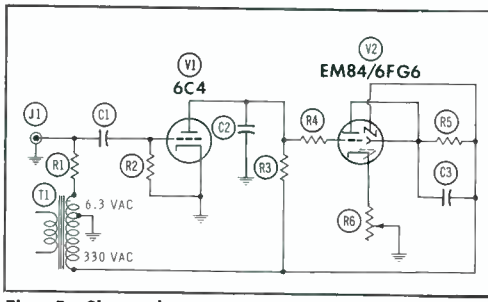

Fig. 5. Shorted capacitor across J1 removes cutoff voltage from grid of V1.

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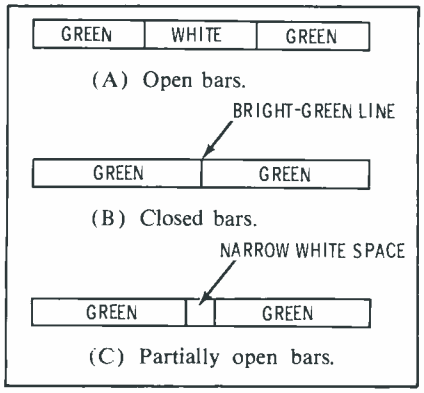


Fig. 6. Indicator-tube bar patterns.

at J1. The test cable, together with L2, R1, and C3, is approximately one-quarter wavelength at 19 mc (the frequency of the tank circuit). When there's an open circuit across the test-lead tips, a short is reflected at J1, because of the critical length of the test cable. This action shorts out a portion of L1 and causes the tank circuit to stop oscillating; therefore, the bars close. A capacitor greater than 15 mmf will represent an impedance of sufficient value to sustain oscillations and cause the bars to remain open.

Fig. 8 shows the circuit arrangement used when capacitance measurements are made. The circuitry ahead of C2 represents a comparison bridge. When this bridge is balanced, there is no voltage applied to the grid of V1 from the bridge; so the bars are closed. An unbalanced bridge causes the bars to open. The bridge is balanced by using R4A or R4B (depending on the position of S2) in series or in parallel with standard capacitor C1. When the impedance of the entire combination equals that of the capacitor under test (and its shunt resistance), the bridge is balanced.

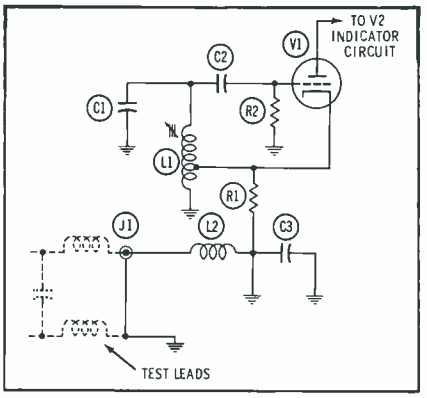


Fig. 7. An open circuit across the test leads causes V1 to stop oscillating.

Capacitance measurements with this instrument require more than usual care. The R-C product (the expected value of the capacitor under test multiplied by the shunt resistance) should be either calculated or estimated and set up on the RC RANGE and RC BALANCE controls. If this value cannot be determined, you should set both controls to infinity. Rotate the CAPACITANCE dial until the indicator bars reach the point of maximum closure; then, adjust the BALANCE control to improve the closure. The CAPACITANCE dial and BALANCE control are alternately adjusted until maximum closure is found; the dial then reads the value of the capacitor.

Another point to watch out for when measuring parallel capacitors: When the value of a capacitor is being measured in the circuit, the tester will indicate the total parallel capacitance. This could cause false indications, especially if the parallel unit is a large-value electrolytic filter.

We used several known-good and known-bad capacitors to put the Model 955 to work. Everything went fine, with the instrument spotting all opens and shorts both in and out of the circuit. We measured the values of several capacitors that were within the range of the instrument. The electrolytics all measured within 10% of their rated value, and the paper and *Mylar* tubulars above .1 mfd read within tolerance.

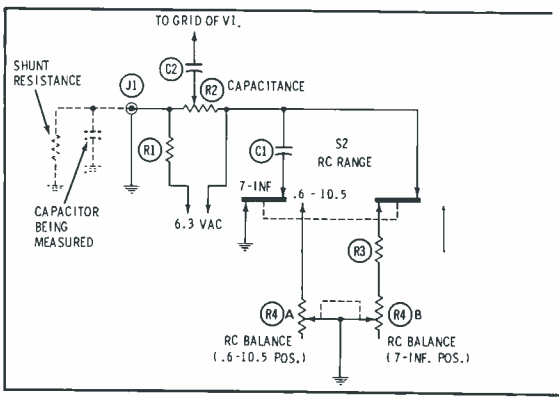
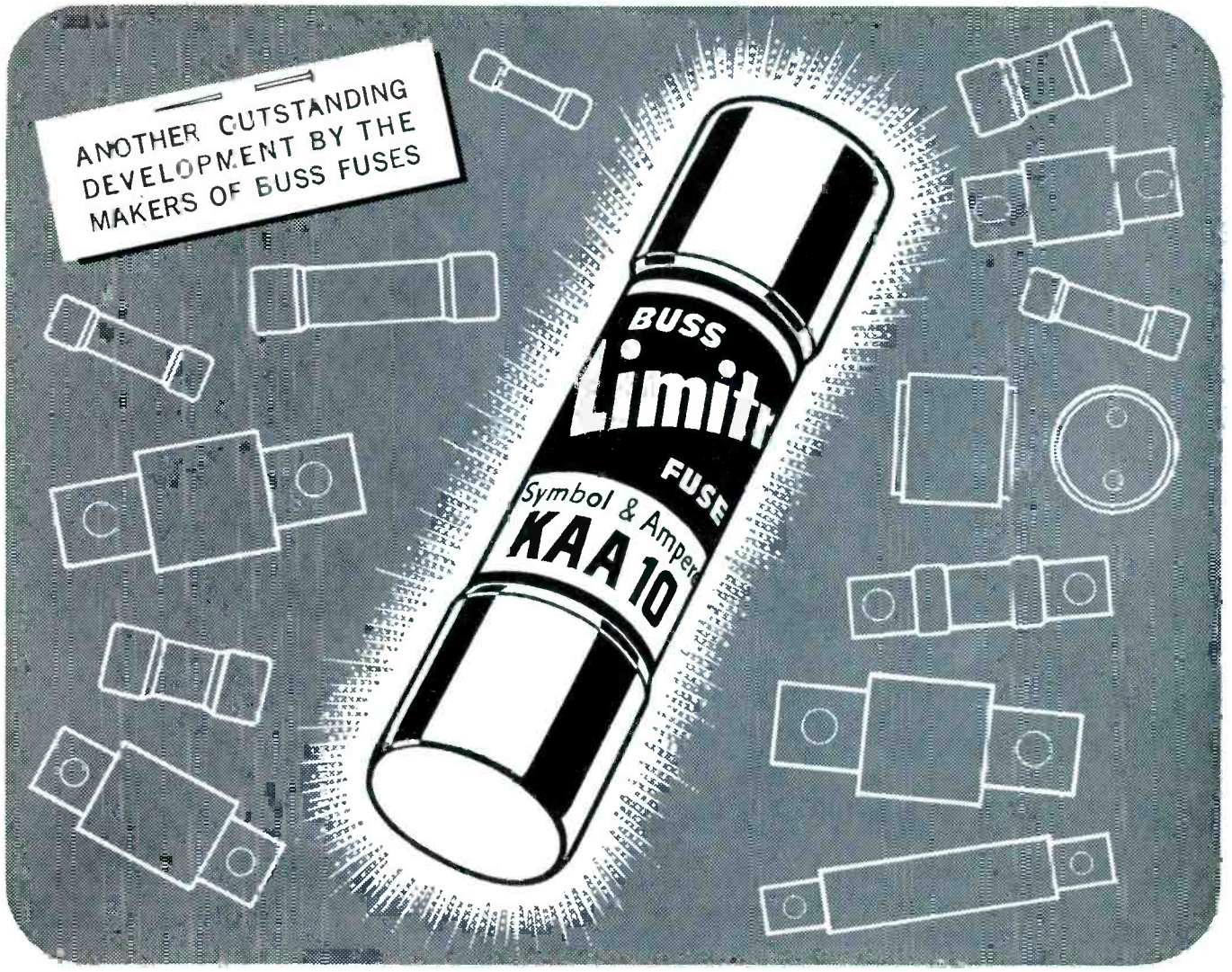


Fig. 8. When bridge circuit is balanced, capacitance is shown on the dial.



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We also discovered that with the instrument sitting upright on the workbench, it is very difficult to see the indicator bars. If you try to lay it on its back, you will find that the fuseholder protruding from the center of the back panel might become damaged. The best location for the 955 is on a shelf at or above eye level; with it in this position, you can look directly at the indicator tube.

In conclusion, we found the Model 955 to be a handy tester for checking opens and shorts, but its capacitance range limits its use to measuring only the larger values of capacitors.

Tube Tester—Plus

Facilities for testing picture tubes, batteries, and transistors are included in Mercury Electronics Corp.'s Model 1200 *Mutual Conductance Tube Tester* (Fig. 9).

Specifications are:

1. *Power Required—117 volts AC; 60 cps.*
2. *Tests Performed—mutual conductance; cathode emission in diodes and CRT's; grid leakage and gas, sensitivity over 150 megohms; shorts; transistor beta (direct-reading); battery quality.*
3. *Tubes and Transistors Tested — all receiving types including novars, compactrons, 10-pin novals, and 5-pin nuvistors; monochrome and color CRT's; most popular transistors and diodes.*
4. *Panel Meter—face size 6"; sensitivity 1 ma; scales read mutual conductance in two ranges, emission, condition (BAD-WEAK-GOOD), beta, and gas.*
5. *Controls and Terminals—*FUNCTION *selector switch; filament* SELECTOR *switch; 26 push buttons (and two release buttons) for setting up tests and selecting elements;* LOAD *potentiometer; universal transistor socket; 13 sockets for various tubes; 7- and 9-pin straighteners;* TRANSISTOR - BATTERY *function rotary switch;* BATTERY VOLTAGE *rotary switch;* LEAKAGE-GAIN *slide switch; three pin jacks for testing batteries and transistors; neon* SHORTS *indicator; red* POWER *indicator; CRT test cable with sockets for monochrome and color tubes; various clip leads for connecting top caps, transistors, and batteries.*
6. *Size, Weight, Price—18¼" x 10¾" x 4¾"; 11½ lbs; $119.95.*

The tube-test portion of the Model 1200 is very similar, circuitwise, to the Model 1000 covered in August *Notes*. The same

Fig. 9. Tubes and transistors both can be tested on the Mercury Model 1200.

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bridge circuit is used to measure mutual conductance; gas, emission, and shorts tests are also performed by similar circuitry. The most important differences are in the switching arrangements for connecting tube elements to the test circuits.

Each push button in the top row, when it is depressed, connects its corresponding socket pin to a source of B+ voltage (see Fig. 10). In the released position each is connected to the corresponding button in the lower row. These lower buttons connect to ground, in their normal position; when depressed, they connect to bias-and-signal voltages. Thus, any lower switch, which has been selected by an upper switch, ultimately either grounds the corresponding tube element or applies an operating voltage.

This arrangement simplifies the testing procedure and reduces the chance of setup errors; if a top button is depressed, its corresponding lower button is entirely disconnected from the circuit. This feature goes a long way toward preventing damage to either the tube or the tester.

In order for a tube to be tested, its identification number is first found in the setup booklet. The proper filament voltage is picked by the SELECTOR switch, and the LOAD potentiometer is set to the value listed in the chart. Next, the tube is inserted in the correct socket, and the FUNCTION switch is turned to the SHORTS position. The release button for the top row is held down and buttons "A" through "J" are pressed, one at a time, while the SHORTS indicator is watched; a steady glow indicates a short. Usually, when two elements are shorted together, the neon lamp will glow as either corresponding button is pressed. However, the lamp will go out if both buttons are held down at the same time.

For the mutual conductance (Gm) test, the FUNCTION switch is advanced to the GM-EM position and the buttons listed in the setup chart are depressed. The value of Gm indicated on the panel meter is compared to that listed under "Rated Gm" in the chart. If there is no Gm value listed (as in the case of diodes and CRT's), the tube is being given a dynamic emission test; emission quality is read on the BAD-WEAK-GOOD scale of the panel meter.

Gas tests are quick and simple with the Model 1200. The FUNCTION switch is advanced to the GAS-GRID LEAKAGE position and the listed buttons are pressed. A meter reading in the small green area of

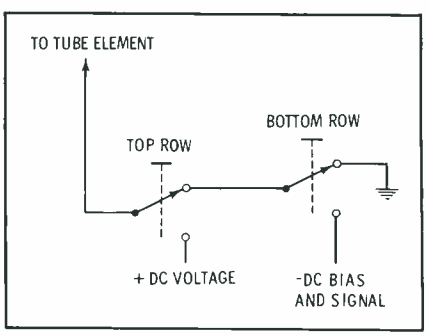


Fig. 10. Unique push-button arrangement provides DC to tube elements.

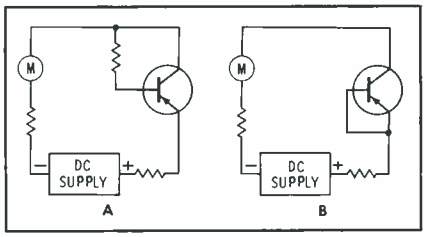


Fig. 11. Gain and leakage tests are performed by these simplified circuits.

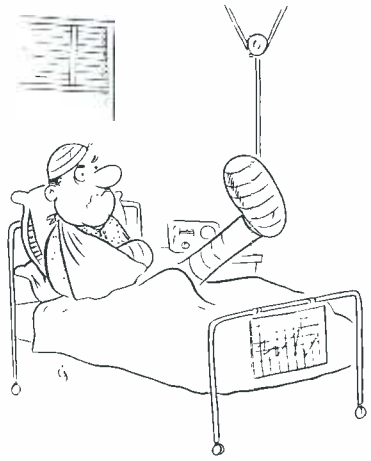
the GAS scale indicates some gas is present in the tube, but not enough to impair its operation. If the meter reads in the large red BAD area, the tube should be rejected.

A meter indication will be obtained in the leakage test if the leakage resistance is 150 megohms or less. A resistance below 100 megohms will produce enough leakage current to deflect the meter into the BAD zone of the scale. Only in extremely critical circuits will a tube need to be replaced if the gas reading falls in the small green area at the left end of the scale.

A multiple-socket adapter is provided with the tester, to allow testing of both monochrome and color CRT's. These tubes are checked in a manner similar to that used with receiving tubes, except they are tested for emission rather than Gm. CRT's can also be tested for gas content and shorts.

The adapter also contains a COLOR GUN switch to check, individually, each gun of a color CRT. The switch is first set on the RED position and the tube tested the same as a monochrome type. Then, the green and blue guns are checked in like manner, with the switch set to their corresponding positions.

The transistor socket and battery jacks can be seen on the right side of the instrument. Transistors are checked for gain by the simplified circuit shown in Fig. 11A. A transistor is either plugged into the universal socket or connected to the three pin jacks on the front panel (clip leads are provided with the tester). No setup charts are used to test transistors; the value of DC beta is read



Guess who wasn't going to pay a TV repairman to put up a roof antenna.

directly from the meter scale, and any indication between 20 and 100 indicates the transistor is conducting. Even though the unit conducts, leakage checks should be made in order to test the semiconductor completely. Fig. 11B shows the circuit employed for leakage tests. The slide switch is set to the LEAKAGE position, and the amount of leakage is indicated on the GAS TRANSISTOR-DIODE LEAKAGE scale of the meter.

Power transistors and diodes are given a forward-to-reverse current ratio test by reading reference values on the BETA scale. A small DC voltage is impressed across the component, and the current is measured by the meter.

Batteries are checked under full load current by the tester. The BATTERY VOLTAGE switch is set to the rating of the battery under test. This applies the correct load and allows the battery quality to be read on the GOOD-WEAK-BAD scale of the meter.

Using tubes and transistors of known quality, and batteries in various conditions, we tried out the Model 1200. The shorts tests not only showed up all known shorts in the tubes, but also indicated tube elements which were internally tied together. A notation in the setup booklet pointed out when to expect this indication of internal connections. As was mentioned previously, the gas test performed by this unit is extremely sensitive. Even those tubes which contained very slight amounts of gas were detected by the Model 1200. The Gm readings taken on amplifier tubes conformed closely to the known value for those tubes; tests performed on CRT's were accurate, too, and spotted the defective ones in our "library."

The transistor test, while it does not provide a complete analysis of semiconductors, does give a quick check to determine whether the unit is good or bad. The leakage test proved most dependable, quickly spotting our leaky and shorted samples.

Front-to-back tests were made on several diodes, and the results evaluated according to information contained in the instruction manual which accompanies the tester. Acceptable ratios are listed for all types of rectifiers, including silicon, germanium, and selenium units. The ratios obtained in our tests were crosschecked with a VOM and found to be reasonably accurate.

The Model 1200 tester is useful in the shop that services both tube and transistor equipment. Except for those rare cases where unusual transistor troubles require a complete analysis of the component, the Model 1200 provides the shop with complete testing facilities for tubes and transistors. ▲

now in our lab . . .

We're analyzing these test instruments for future Notes columns.

B & K Model 625 3-in-1 Tester
Electro Model EC-2 Power Supply
Paco Model G-34 Sine-Square Gen.
Seco Model 250A Transistor and Tunnel Diode Tester
Sencore Model PS120 Scope

Servicing Industrial Electronics by Barron Kemp

TESTING MAGNETIC AMPLIFIERS

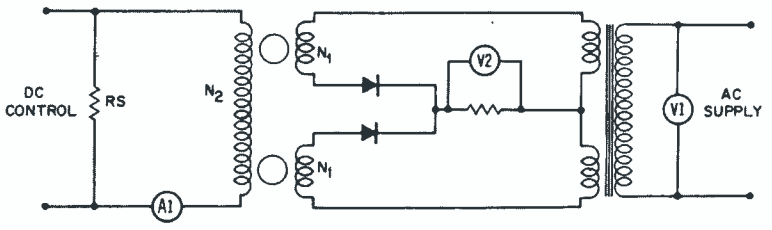


Fig. 1. Test arrangement for obtaining amplifier control characteristics.

Of all the unusual electronic devices which are enjoying increased popularity, magnetic amplifiers are probably the least understood. The reason seems to stem from the fact that they utilize certain principles which are unfamiliar to most electronic servicemen. Actually, many technicians don't even regard them as electronic devices. In reality, however, magnetic amplifiers use components which are familiar to every serviceman; the only difference between them and other electronic circuits is the method of energy transfer, or (more accurately) controlling the energy transfer. (For a complete discussion of the operating principles of magnetic amplifiers, see PF REPORTER, November, 1960.)

Even relatively trouble-free equipment eventually needs routine maintenance and testing. The technician responsible for maintaining "mag-amps" should familiarize himself with the various methods of checking transfer characteristics, transient response and temperature rise.

The material used in the preparation of this article was taken from the Howard W. Sams book "Fundamentals of Magnetic Amplifiers" by Barron Kemp.

Transfer Characteristics

The test circuit of Fig. 1 can be

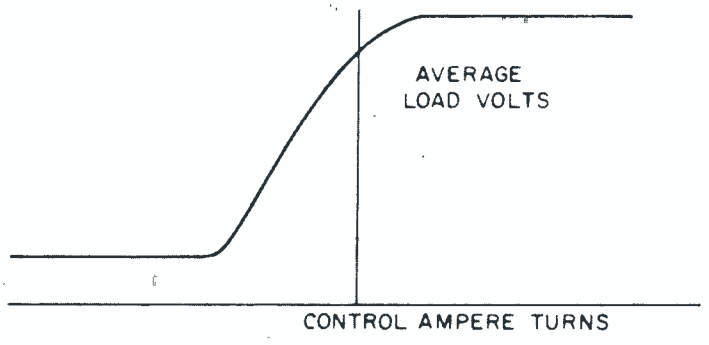


Fig. 2. Plotting load voltage vs control ampere-turns yields transfer curve.

used for obtaining data relating the load-circuit response with the control ampere-turns. The plot of average load-voltage versus control ampere-turns is called the control, or data, transfer-characteristics curve. A typical curve is shown in Fig. 2. The frequency, amplitude, and waveshape of the AC supply all affect amplifier characteristics. Hence, when obtaining data using the circuit of Fig. 1, care should be taken that the frequency does not vary, the supply voltage is maintained constant throughout the test, and the supply-voltage waveshape is not distorted.

For AC output-circuits, it may be desirable to plot rms output-current versus control ampere-turns. In this case, the average value of the AC load-current, or voltage, is obtained through bridge rectification. It is then multiplied by a form factor which allows for the use of rms rather than average voltage and current. Several magnetic amplifier manufacturers use a form factor of 1.1 (approaching a sinusoidal wave); however, it is only during maximum output that the waveshape is essentially sinusoidal. At other levels, the varying nonsinusoidal character of the output pulses causes the form factor to vary with the magnitude of the output voltage—in such cases, the form factor is greater than 1.1. As the output is decreased to near cutoff, the form factor may approach 1.5, the exact value depending on the type of core material among other factors. On the basis of 1.1, the rms value of output current would be equal to or greater than the rms value of the sine wave with the same average value as the output current. For these reasons, control characteristics based on rms values can only indicate comparative performance of magnetic amplifiers. For absolute comparison, average values should be employed.

The power gain of an amplifier is generally expressed as the average output power divided by the input control-power, although the heating power (I^2R) of the output differs from the average power due to the pulsating character of the output. The power gain is measured on an incremental basis; that is, the change

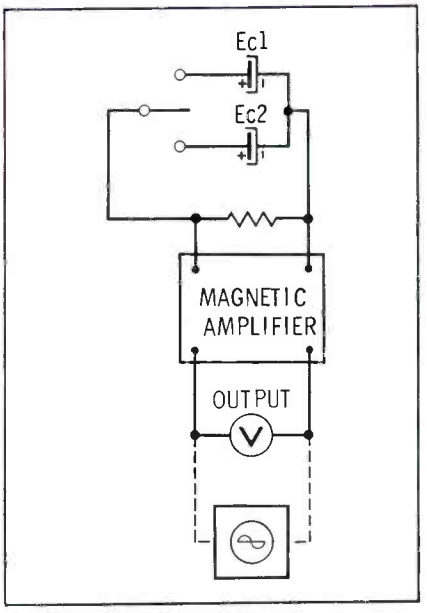


Fig. 3. Long time-constants are measured with a stop watch and indicator.

in output brought about by a change in control current.

Transient Response

Measurements involving magnetic-amplifier response time may be accomplished by several methods. The measurement of time response involves determining the time that it takes for the output to change between two specified levels with a given step of control signal. (A step input-signal is a non-sinusoidal signal whose amplitude changes in discrete levels; it appears as a series of joined square-wave pulses each having greater amplitude than the preceding one and thus forming a composite signal resembling a stairway). Some manufacturers define the output swing to be 63% of the steady-state value, while others refer to 95% of static operation.

"Son, run see if daddy's got the TV set fixed yet,"

Stop Watch and Indicator Method

One of the simplest means for measuring a long time-constant is by use of a stop watch and an output indicator (voltmeter or oscilloscope). Once the input circuit has been adjusted for the proper swing with a simple switch arrangement (Fig. 3), the output indicator is calibrated for the starting point, and 63% or 95% of the transient. The average output is measured with the voltmeter. While using a scope, the change in the firing angle or peak voltage (when operating below half conduction) is observed. The step input-signal and the stop watch are activated simultaneously. The watch is stopped when the proper magnitude of output is achieved. Since great emphasis is placed on the ability of the operator, both in observation and in manual dexterity, the degree of accuracy available with this method varies. For time responses of one second or longer, this method is sufficiently accurate when several tests are averaged.

Recording Oscillograph Method

Another measuring method employs a recording oscillograph connected across the output as an indicating device (Fig. 4). This system yields more accurate data than the stop-watch technique because the entire transient can be recorded and the number of cycles carefully calculated. Two precautions must be heeded when using this method: the amplifier must not be loaded down by the recorder; and a sufficiently small output should be applied to avoid damage to the mechanism. One of the disadvantages of the recorder is its low carrier-frequency limit.

Square-Wave Generator Method

Another common measuring technique for response time employs a low-frequency square-wave generator of variable pulse width and phase, and a dual beam oscilloscope connected as shown in Fig. 5. The response time is determined by counting the number of cycles in the transient directly presented on the oscilloscope once the proper frequency, pulse width, and synchronization are achieved. This type of measurement is suitable for fast

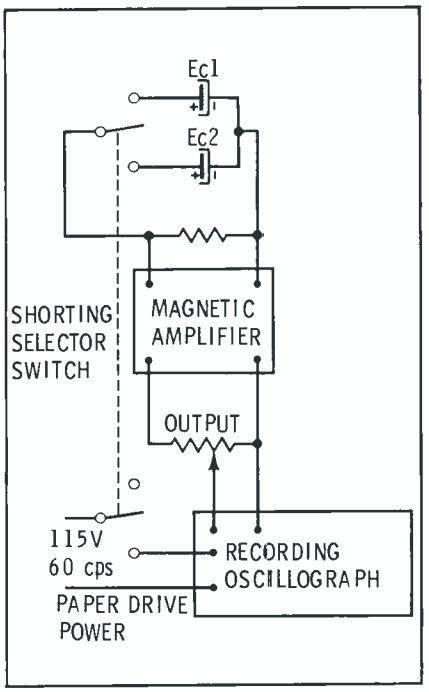


Fig. 4. A recording oscillograph is used to obtain an accurate measurement.

time-response values which are in the order of several cycles at the supply frequency.

Photographic Method

Time response measurements can also be made by photographing the transient waveform with an oscilloscope camera. Such a measurement is readily accomplished for fast responses in the order of 10 cycles or less. External synchronization of the scope sweep and the step impulse to the magnetic amplifier are actuated simultaneously. The system involves opening the camera shutter, initiating the transient, and closing the shutter. The photographic technique

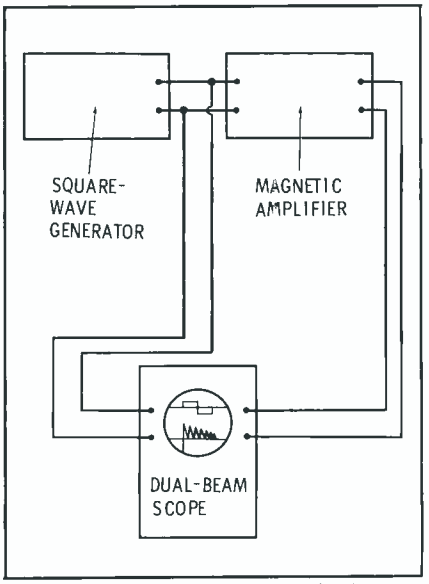
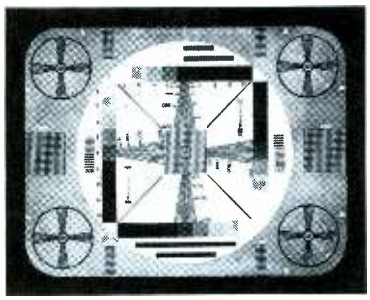


Fig. 5. This method uses a dual-beam scope and a square-wave generator.

TV TIPS FROM TRIAD

NO. 18 IN A SERIES



Joe stood frowning at the parade of Mr. 5 x 5 characters waddling across the screen. The raster was filled vertically, but the figures looked like they had been run over by a steam roller and only partially restored. "No width control on this one," he muttered.

Bill, the Senior PTM, glanced up from a rush job, "Hmm, looks like a new picture tube and yoke have been installed."

"Correct," confirmed Joe. "Customer installed it himself. Said something about removing all the 'packing' and wants the set adjusted."

Bill squinted along the picture tube neck, then went over to the junk box. He pulled out a piece of impregnated paper and a small sheet of brass shim stock which he deftly wrapped around the neck and inserted into the yoke. The picture returned to normal. "Missing metal collar," he said. "The metallic sleeve absorbs some energy from the yoke, and width control results in proportion to insertion."

"How come height is not affected?" queried Joe.

Bill explained, "The horizontal coils are always nearest the picture tube neck, so the metal collar absorbs more energy from the nearest coils. However, a word of caution. There's as much as 3500 peak-to-peak volts in the horizontal coils with only the varnish coating insulating it from the width collar. To reduce shock hazard, install an insulator between the yoke and the collar."

MORAL: Triad includes a special treated sleeve — the *Saf-T-Liner* — in yokes using this type of width control. Next time you go to your favorite Triad distributor, note the red and white boxes on his shelf. They contain highest-quality components engineered for the professional serviceman. For our helpful new catalog TV-62 and other literature, write Triad Distributor Division, 305 No. Briant St., Huntington, Indiana.

A DIVISION OF LITTON INDUSTRIES

can be employed for a time constant longer than 10 cycles, but not long enough to be measured with a stop watch, by use of a slowly-driven calibrated sweep. Where the supply frequency of the amplifier is greater than 60 cps and a dual-beam oscilloscope is available, the sweep rate can be calibrated by applying the internal test voltage of the scope to the second channel while using a common control for the two channels.

Temperature Rise

Temperature rise is a very important factor in magnetic amplifier performance; however, the temperature rise measurement need not be too elaborate. Usually, the temperature is measured by mercury thermometers or themocouples applied to the hottest accessible points on the reactor. A small amount of putty is used to shield the thermometer bulbs from the surrounding air, and care is taken to avoid external air currents, varying ambient temperature, or other factors which may introduce errors.

The preferred method of making a full-load temperature test is to maintain rated voltage, current, and frequency until the temperature becomes constant—readings are taken every half hour. The highest temperature reached at any time during the test is taken as the correct value.

For the totally-enclosed or electrically-insulated reactors, it is often preferable to determine the change in temperature by the rise of resistance method. In this case, the cold resistance of the windings is measured (usually after the reactor has been inoperative overnight) at uniform room temperature. The hot

resistance is at the highest value obtained during operation. Over moderate ranges of temperature, such as 100° C, the change in resistance is proportional to the temperature change. The temperature rise can therefore be calculated.

$$T = \frac{R_h - R_k}{234.5 - T_h}$$

where,

234.5 is the temperature for 100% conductivity in degrees C,

R_h is the hot resistance of the windings in ohms,

R_k is the cold resistance of the windings in ohms,

T_k is the winding temperature, when the cold resistance was measured in degrees C.

It is important that all tests be made under the same circuit conditions. For example, consider the case with a resistance in the control circuit to reduce the time response. Time-constant measurements of the circuit will yield an improved response, whereas the power gain will be reduced. Also, the control characteristics will be materially affected by a change in the circuit resistance.

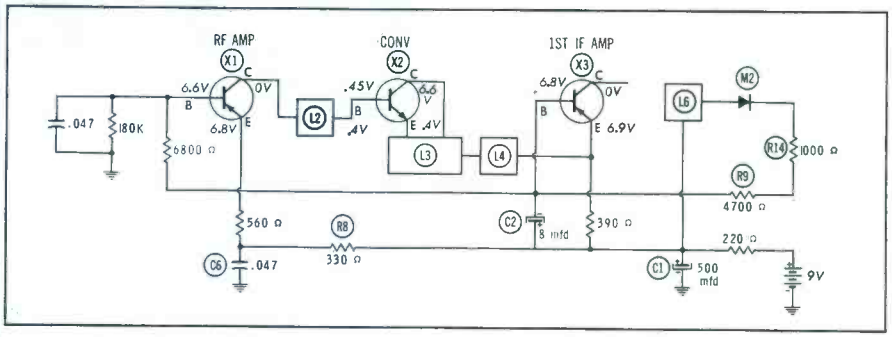
Conclusion

Of course, there are other factors that determine the operation of magnetic amplifiers. However, the three characteristics covered above are those on which equipment design is usually based. Should these values change, the amplifier must necessarily deteriorate in efficiency. Any complete operating check of a unit should include tests in these areas. ▲

"I'm getting just a little suspicious of these late emergency calls!"

THE TROUBLESHOOTER

answers your service problems



Transistor Stumper

I have been asked to repair a G-E Model P780A transistor radio (covered in PHOTOFACT Folder 485-10) which has me stumped. When it came in, it had static, much like an AC/DC set with a bad IF coil; since I started checking, it has gone completely dead. I can get a signal through the set from the collector of X1, but applying a signal to the base accomplishes nothing. This led me to change X1, but to no avail. By touching my finger to L3, I can get the set to pick up a few local stations, but I can't get X1 to amplify. Most of the voltages on the transistors read high. For example, on the bases of X1 and X3, the voltages are considerably higher than normal; on their emitters the measurements are somewhat higher than usual, but not so much as on the bases. I hope you can get me on the right track.

BILL BANKS

Banks Radio & TV
Clarence, Iowa

The peculiar voltage symptoms you describe lead me to believe you have a short between the two power-supply lines in this receiver. You'll notice, in the simplified schematic, that M2, R9, and R14 form the decoupling resistances in this supply circuit—an unusual job for M2, I might add, since it is the detector diode. If M2 shorted, the circuit resistance would be lowered, as would be the case if

COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

Chassis: RCA CTC7, –9, –10, and –11

Symptoms: Intermittent horizontal sweep.

Tip: Before checking voltages or waveforms in the horizontal circuits, press on the horizontal-oscillator printed board at different points, and see if horizontal sweep collapses. If it does, attach a clip lead to the chassis and touch the other end to each of the board-grounding points indicated in the photo. When one of these connections is defective, touching it with the clip lead will restore normal horizontal sweep. (This test must be made quickly; otherwise, lack of drive may damage the horizontal output tube.) These ground terminals often break contact with the chassis lugs to which they are soldered, thus causing the horizontal oscillator to cease functioning. In some cases, the open lug can be spotted visually when you apply pressure. While you're repairing one of these connections, it's a good idea to resolder the remaining ground lugs on this board.

R9 or R14 decreased in value. The result would be a higher voltage on the transistor elements fed by this leg of the supply line—the bases of X1 and X3. Besides the parts already mentioned, C2 is connected between the two lines; if it became shorted, or even leaky, the same voltage symptoms would result. You'd better check its polarity, too, and make sure it hasn't been replaced and wired into the circuit backwards.

Another fault could cause the voltages to be upset in this manner: A short in either X1 or X3 could affect the voltages on the other of these two transistors, because each is connected between the two supply lines.

Lastly, it would be well to go over the printed-circuit board very carefully for any signs of leakage between conductors. This is a not-uncommon source of many strange symptoms in electronic equipment using printed boards.

One caution, to prevent inadvertent damage to transistors: When using signal-injection troubleshooting procedures, be sure to use an isolating capacitor in series with the signal-source lead. Doing this will prevent an accidental ground connection from causing an overload which may burn out a transistor.

Restless Remote

I'm having trouble with the RC-50 wireless remote control used in a Philco Chassis 10L31 (PHOTOFACT Folder 479-1). After it has warmed up for about 10 minutes, it will take spells of tripping itself and changing channels. Sometimes it won't stop unless I turn off the TV.

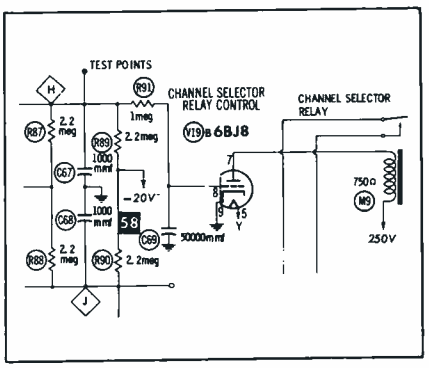
L. D. PAYNE JR.

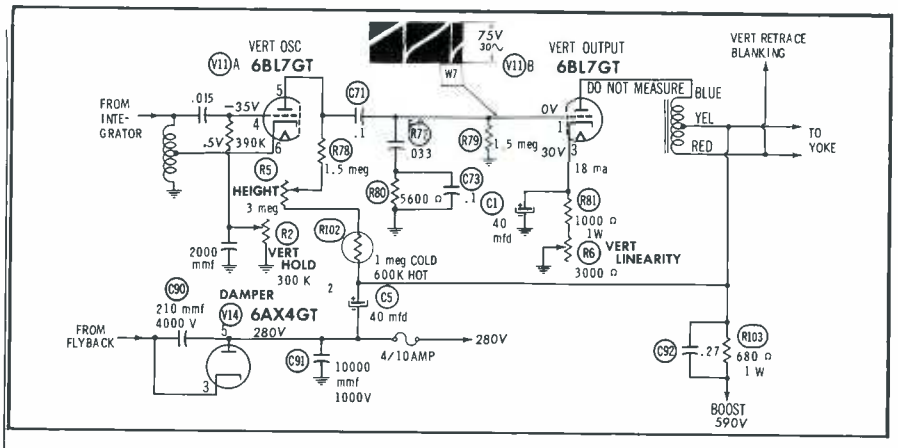
Port Lavaca, Texas

First, substitute for the 6BJ8 channel-selector relay tube, which may be developing gas or leakage after warm-up.

The grid voltage of this tube should be –22 volts when no signal is being applied. If it is less negative than this while the trouble is present, and a new tube doesn't help, try replacing C69; also check the bias-rectifier circuit (negative 20-volt source).

There's a chance the trouble may be ahead of the discriminator. With the disturbance present, pull the 39-kc amplifier tubes one by one, starting at the head end. If the channel-changing stops, replace the tube you've just pulled. If you can restore normal operation only by disconnecting the input microphone, look for trouble outside the set.





Elusive Height

I have a G-E Model 21C1552 receiver (covered in PHOTOFACT Folder 391-1) on the bench. The set performs fine for about 15 minutes, at which time the raster shrinks, pulling up from the bottom and developing nonlinearity. I've changed the output transformer, C5, C90, C91, C92, R102 and R103. The boost voltage is normal. I tried two different blocking-oscillator transformers; both of them make the lack of height worse. I have a 150-volt peak-to-peak drive signal at the grid of the output stage, but still not enough height. Can you help me find where the height has gone?

ROBERT RATELON
Westernport, Md.

From the fact that you mention finding an abnormally strong drive signal (150 volts) at the output grid, I'd surmise the outjut stage isn't doing its job. While you can't measure the voltage on the plate of the output tube, you can check it almost as effectively by touching the voltmeter probe to the yellow lead of the output transformer. Did you try a new capacitor in place of C1D, and measure the value of R81? Also, there's the possibility that the controls (R2 and R6) are changing value.

One thing which bothers me is the fact that the trouble affects the height more than the linearity. This effect hints at trouble in the oscillator stage—notwithstanding the apparently high drive signal. R102 is a special unit, and you should be sure to use the correct replacement. R78 and C71 will have a direct bearing on the height of the raster, as will ALL the components in the waveshaping network—R80, C72, and C73. Lastly, be sure R79 hasn't developed such a high resistance that it is upsetting the bias on the output stage.

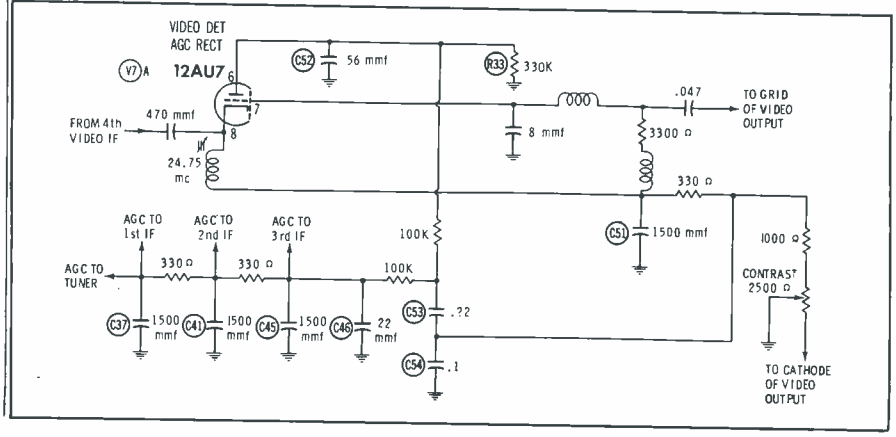
Pulling and Weaving

A Philco Model 52T2110 (covered in PHOTOFACT Folder 132-10) has come into my shop with what appears to be AGC or video trouble. After about 20 minutes, the picture begins to pull; it weaves all over the screen, but is worst at the top. I have eliminated the possibility of tube or filter trouble, and have checked the AGC circuit thoroughly.

A. DAMRON
Damron's Radio & TV
Pikeville, Ky.

You've a difficult trouble to pinpoint, because of possible interaction between various sections; this difficulty is common with AGC faults. However, in this particular model, the symptom you describe is often caused by a defective bypass capacitor (C51, C52, C53, or C54) or by a leaky sync-coupling capacitor C78. Besides these possibilities, the AGC filters —C37, C41, and C45—commonly cause weaving and bending such as you describe. If all of these are okay, check the components in the –17 volt supply—C5, R123, and R133.

The best method of troubleshooting this symptom would be to first clamp the AGC line with a bias supply having a low internal resistance. If the trouble clears up, you should look for a fault in the AGC system. Otherwise, use your scope to check all the way from the video detector through the sync separator circuits for any distortion of the horizontal sync pulses. Somewhere, you'll probably find that some of the horizontal pulses are being clipped or distorted. This should clue you right onto the point of trouble.



Solenoid Solution

I have a Bell & Howell tape recorder Model 300B, which has developed a loud hum. The volume control varies the hum level in the speaker. I've tried to locate the cause by several methods, with no luck. Also, when the PLAY or RECORD button is depressed, the solenoid (which I assume is DC-operated) fails to energize, and I can detect no voltage at the solenoid terminal or at the output of rectifier M1. Can you answer some questions for me? They are: What is the correct voltage across the solenoid, and how should I measure it? What is the DC resistance of the solenoid?

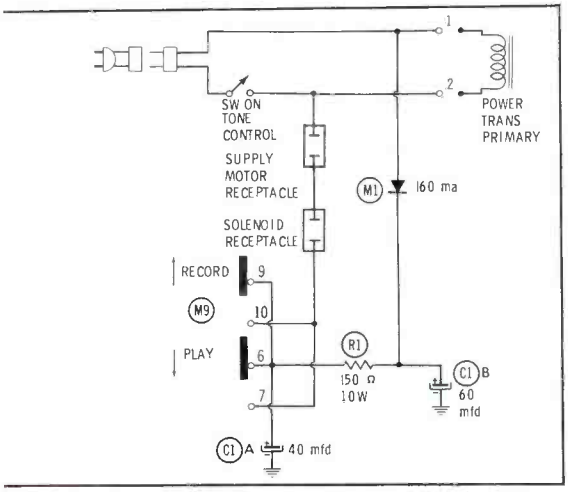
W. L. NELSON

Colton, Calif.

The hum problem you mentioned sounds like a poor ground. The bad connection is probably in the preamp section, since you can vary the hum level with the volume control. Have you carefully checked the preamplifier tube for cathode-to-heater leakage? Even a small amount can cause noticeable hum in the preamp stage. Check the leads and shields to the recording and playback head(s), check the head-lead disconnect socket, and check—by shorting across the pins—to be sure the head itself isn't picking up the hum.

I assume the solenoid you refer to is the capstan/pressure-roller solenoid; it is DC-operated, with a voltage (about 130 volts DC) developed by rectifier M1. To troubleshoot the absence of actuating voltage at the solenoid, check for AC input to the rectifier, and then trace the DC output voltage through resistor R1 and the contacts of switch M9 (in PLAY position) to the solenoid receptacle; from here, the voltage should go directly to one terminal of the solenoid itself. The ground, or return, side of this DC supply circuit is at the on-off switch, since the AC input for this supply circuit is taken off prior to the power transformer. Be very sure rectifier M1 and filter capacitor C1B are both connected with the polarity shown in the schematic.

To answer your other question: The DC resistance varies from coil to coil, but generally will measure only a few hundred ohms. ▲



Closed Circuit TV

(Continued from page 31)

rangement, and occasionally through line or distribution amplifiers.

Some CCTV cameras include a modulator and VHF oscillator. The modulated RF output signal can be fed to a conventional TV receiver or into a VHF distribution system. The RF oscillator in some cameras is adjustable to TV channels 2 through 6; in others, it is crystal-controlled at any one of the TV-channel frequencies.

Typically, the direct video signal is fed to video monitors at a level of 1 to 1.5 volts peak to peak, through 72-ohm coaxial cable. In RF cameras, the signal output is usually 50,000 to 100,000 microvolts. In a few camera types, video and RF outputs are available simultaneously.

The sweep and sync signals are generated by a master oscillator operating at 31,500 cps, which is phase-locked to the 60-cps AC line. Horizontal sweep and blanking signals at 15,750 cps are derived by dividing the master-oscillator frequency by two. The vertical sweep and blanking signals (at 60 cps) are developed by dividing the master oscillator signal by 525 through a chain of frequency dividers. The resulting 60-cps signal is compared with the AC line frequency in a phase detector which feeds an AFC correction voltage to the master oscillator.

Other Circuits

The vidicon tube is protected from burn damage by a circuit which cuts off the grid in the event of either horizontal or vertical deflection failure.

In some CCTV systems, the sweep and sync circuits are contained in the camera. In others, the camera housing contains only the vidicon tube and the video amplifiers; the sweep and sync signals, as well as supply voltages, are fed to the camera through a multiconductor cable from a remote unit.

While many cameras employ tubes, there are several transistorized cameras on the market, some of which can be operated from a 12-volt DC source as well as from AC.

Some cameras are equipped with

CCTV operator can observe any operation he desires, from remote location.

automatic light compensators which duplicate the performance of modern film cameras. Various types of lenses are available. Remote controls for lenses, and for the pan and tilt functions, are often employed.

A CCTV video monitor is similar to a TV set except for the omission of the RF, IF, and detector circuits. Generally, the monitor is designed for higher resolution and stability than a conventional TV set. When a professional TV monitor is used, picture resolution of 600 to 650 lines is possible with some cameras. But, when a conventional TV receiver is used, with a VHF signal fed in, resolution is often limited to as little as 350 lines by the bandwidth of the RF-IF circuits.

Systems

The camera and monitor may be separated by any distance over which a suitable transmission path can be provided. The video transmission line must be capable of passing signals from near DC to several megacycles. Audio signals, if they are used, are generally run through a separate line. In a few systems, however, the audio signal from a microphone is fed through a preamplifier to a modulator unit and mixed with the video signal from the camera. The audio-video modulator unit produces an RF signal similar to that transmitted by a TV broadcasting station. The composite signal can then be applied to the antenna terminals of standard TV sets.

Microwave systems are being used, and will be used even more widely in the future, for CCTV transmission between buildings. These microwave stations must operate in the 12,000-mc Business Radio Band—or in the proposed 17,000-mc Citizens band — if the system is licensed to commercial firms. Schools, whose microwave systems must also share these bands, may later be eligible to operate stations in the 2,000-mc ETV band.

In some systems, only the TV signal is transmitted via microwave; the audio channel (if used at all) is transmitted over a leased phone line. However, the audio may be transmitted along with the video, as illustrated in the typical microwave system shown in Fig. 3.

In such a system, the microphone signal is fed to a subcarrier transmitter—sometimes called the audio duplexer. The audio signal frequency-modulates a subcarrier at around 6 or 8 mc. The resulting FM signal is combined with the video information, and both are fed to the stages which modulate the microwave klystron.

At the microwave receiver, the FM subcarrier is separated from the video signal, and demodulated in a special FM-subcarrier receiver stage. The video signal is handled the same as if the sound were separate.

Opportunities

Most CCTV systems are sold by independent distributors who generally serve an extremely large area, making the service problem difficult. Many of these distributors would welcome the assistance of local service-shop owners who could take over installing and servicing CCTV systems located at distances too great for convenient handling by the distributor.

It is not likely that many industries, banks, or other users will employ electronics technicians on a full-time basis; the cost would be too great. Furthermore, it will seldom be practical to train plant electricians to handle CCTV maintenance.

Manufacturers and distributors of CCTV equipment can sometimes furnish maintenance service on a direct basis, but this is costly. The customer must be charged enough to cover direct labor costs and overhead, plus travel expenses. Generally, labor is charged for on a portal-to-portal basis. It would be much cheaper to engage a local service technician on an "as-required" basis, even at rates of $10 per hour or more, if a competent man were available.

Tips On Servicing

The most essential test instruments for servicing CCTV equipment are an oscilloscope and a VTVM. Most service problems result from tube defects and aging components. Tubes with excessive leakage (which may pass muster on a simple tube tester) are a common cause of instability, especially in CCTV cameras. Trying new tubes or using a grid-leakage type of tube tester is a quick way to determine if tubes are at fault, before checking other components.

Many new CCTV techniques are being devised—such as this portable unit.

Cable connections are another frequent cause of trouble. Connectors must be secure and free of faulty contacts to avoid hum, noise pickup, and erratic operation. Often, the trouble is caused by improper installation of cable connectors. Also, don't forget that coaxial cable can develop signal leakage from moisture absorption.

It is easy to get started in CCTV servicing. One way to become familiar with CCTV equipment is by studying the technical information provided by manufacturers. When you write to equipment manufacturers, you can also state your availability and describe your qualifications and facilities.

The CCTV business is still in its infancy. It is getting a real boost through federal subsidies for ETV, and, as business firms begin to grasp its money-saving values, CCTV will become one of the more important segments of the electronics industry. Now is the time to get ready to share in this rapidly expanding business. ▲

Weak Washed-Out Pix

(Continued from page 29)

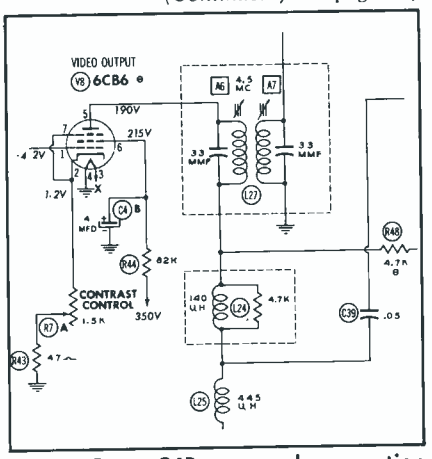


Fig. 4. Open C4B causes degeneration in video amplifier, lowering contrast.

control turned all the way up, forget about the picture tube—you almost certainly have video-amplifier trouble. This is a logical time to make DC voltage and resistance tests in the circuitry between the detector and the CRT.

In some situations, an extreme voltage error will lead you straight to the trouble. For instance, if the screen voltage of V4A in Fig. 2 measured 50% of its normal value, the appropriate action would be to check R31 for an increase in resistance, and C18 for leakage.

Sometimes, though, low screen or plate voltages are merely reflected symptoms. Consider the two-stage amplifier illustrated in Fig. 3; in case video-coupling capacitor C51 should become leaky, the control-grid voltage of V7 would be driven positive, and the plate voltage would fall as a result of the stepped-up DC plate current. The cathode voltage would also rise because of the abnormal flow of plate and screen current. However, among these three voltage errors, the one which actually holds the key to the problem is the grid voltage.

Worse leakage in the coupling capacitor would have a different reflected effect on the plate voltage. If the grid voltage were positive enough to produce heavy grid-current flow, the grid would steal electrons from the stream intended for the screen and plate; then the voltages on the latter elements would be at a normal or higher level. Of course, the tube would run very hot and would be damaged.

There are occasional situations in which all DC voltages and resistances are within tolerance, but the picture cannot be brought up to full contrast. Excessive negative feedback is a suspect in this situation. How can this occur? Refer to Fig. 4, which shows a circuit arrangement with an 82K-ohm screen resistor (R44) normally bypassed to ground by a 4-mfd electrolytic capacitor (C4B). When C4B loses a substantial amount of its capacitance, or becomes open, a signal is induced on the screen grid. The resulting degeneration considerably cuts down the picture contrast.

Another instance of poor contrast, with DC voltages and resistance values normal, is found when a coupling capacitor is nearly open. For example, if C51 in Fig. 3 loses

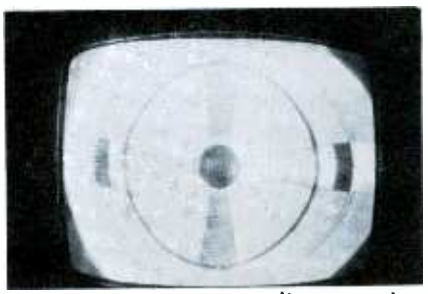


Fig. 5. Nearly open coupling capacitor causes this type of picture smearing.

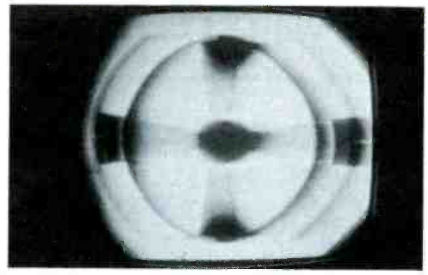


Fig. 6. Smear and loss of high frequencies, due to a defective peaking coil.

almost all its capacitance, it passes a greatly attenuated video signal containing only the higher frequencies. The lowest frequencies among those which get through are shifted in phase, and the result is a smeared picture in addition to low contrast (Fig. 5). In this situation, the picture symptoms are more distinctive than a simple "washed-out" appearance, and you can eliminate many circuit areas from suspicion at the outset.

High-Frequency Attenuation

A different type of smearing appears when a peaking coil such as L25 in Fig. 3 is open. In this case, the circuit is completed by the 12K damping resistor R53. The DC plate voltage of the video-output tube is reduced enough to cast suspicion on the open peaking coil, and even more conclusive evidence is obtained from symptom analysis. The picture (Fig. 6) is smeared and has low contrast, but differs from Fig. 5 in that high video frequencies have been eliminated. This effect results from the low-pass filter action of R53 and the shunt capacitance of the picture-tube input circuit.

Will sync lock be affected in these trouble situations? The answer depends upon where the sync-takeoff point is located in the signal channel. Properly evaluated, good sync lock (or the lack of it) can often help considerably in localizing the trouble area. For example, if the sync takeoff is between the first and second video-amplifier stages (as in Fig. 3), and sync lock is tight but the picture contrast is poor, the defect will probably be found in the second stage. The same general logic applies to keyed AGC systems—the AGC action will not be affected if the keying-tube input signal is taken off prior to the defective video circuit. Sound reproduction is a less clear-cut clue, because

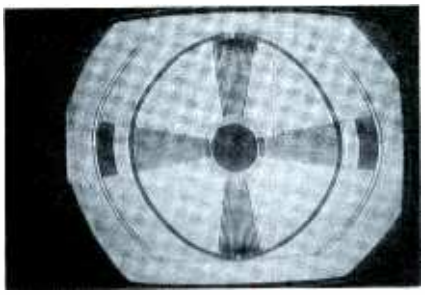


Fig. 7. Replacement of peaking coil with wrong value may cause ringing.

the sound often seems to remain about normal in spite of considerable attenuation.

Peaking-Coil Replacement

Beginners sometimes make the mistake of replacing a defective peaking coil with just any coil which happens to be handy. This practice can lead to ringing, as seen in Fig. 7, or to poor high-frequency response. Hence, always check the receiver service data for recommended values of peaking coils.

Summary

Complaints of poor picture contrast and associated symptoms can be run down in a short time by following the procedure just outlined, using proper test equipment. Here are some general rules:

1. Identify the receiver, and consult the service information so you will know what can reasonably be expected from the chassis.
2. Check the video-detector output to find out whether the video amplifier is receiving normal drive from the front-end circuits.
3. Restore a normal detector output, if necessary, before tackling the video amplifier.
4. Check with a calibrated scope to confirm the suspicion that the CRT is being fed insufficient video.
5. If the gain of the video amplifier is low, judging from a comparison of its input and output signals, make DC voltage and resistance measurements in this circuit.
6. If results of DC tests are inconclusive, use the scope to pinpoint any open coupling or bypass capacitors.
7. Replace any defective parts only with types recommended in service data. ▲

Resistance Measurements

(Continued from page 22)

22-meg reading!

Connecting his meter across pins 2 and 3 *on the printed unit itself,* he got the same indication, thus pinpointing the trouble within this unit. Referring again to Fig. 2, notice that printed foil conductors serve as the wiring paths for the individual parts. A close check of the unit in this case showed the copper foil was not soldered, as it is in the photo; neither were the small clips which retain the various components on the board. The technician soon located a poor contact between the foil and the clip which held one end of the 1-meg resistor; this accounted for the high-resistance path and the intermittent trouble in the receiver.

Pressing on the clip, or moving the printed unit, established good contact and restored the correct resistance reading. (Take a tip from this experience: Don't move these combination units if you can help it, especially when you have an intermittent fault to deal with. You might temporarily cure it, and days might pass before it would show up again.)

The technician scraped the copper foil and soldered the poor contact; as a preventive measure, he also cleaned and soldered all the other contacts on this unit. This finally solved his problem. If he had only checked the resistance across these pressure contacts before taking time to replace the resistor, he could have cured the trouble much more quickly.

Multipath Measurements

Some circuit points have several parallel DC paths back to the reference point from which resistance is to be measured. When you're looking for such paths, they're easily spotted, and the resistance readings you obtain will be easier to understand. Let's take an example of multiple parallel and series-parallel paths, using the same schematic (Fig. 1) we used for the "case of the poor contact."

If we have reason to measure the resistance from the plate (pin 1) of the 6EA8 to the output of the rectifier circuit (the 250-volt source), what resistance should we read? At first, there appears to be a "straight shoot" through the two 22K resistors and the 2700-ohm, 7-watt dropping resistor located in the power supply—a total of approximately 46K. But an ohmmeter will read only about 27K! Where's our low-

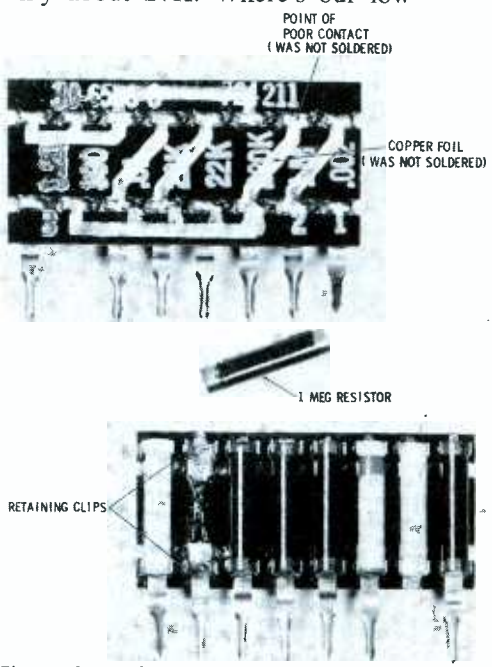


Fig. 2. Special printed component board used in noise-limiter and sync stage.

resistance path? The answer is simple, if not quick — through R2 (22K), R4 (1000 ohms), and R5 (5300 ohms) directly to the 250-volt source!

Remember one of the first rules you learned in electronics—the total resistance of a combination of resistors wired in parallel is always lower than the lowest one. The inset in Fig. 1 gives a plainer view of the path we just traced, but there's no need to redraw a circuit to this simple form unless it's very complex. The point is: no matter where you measure to or from, trace each path connected to the takeoff point until you reach a capacitor or some other DC-blocking component. If a multiple path *does* exist in any leg of the circuit, note the approximate resistance. Once you find the path having the least resistance, you can estimate the total value, and reasonably expect your estimate to come close to the actual reading you'll get with a meter.

Sometimes, during troubleshooting, you may find it necessary to simplify the task of resistance measurement by opening one or two legs of a circuit which has four or five different paths. When this occasion arises, don't just break the circuit at any old place; analyze it first, then open it where you can measure the largest number of resistors without an undue amount of unsoldering.

The use of printed wiring in a set doesn't necessarily restrict the use of this technique. Even when it isn't convenient to unsolder individual components, they can still be disconnected from the circuit by temporarily cutting one or more printed foil conductors with a sharp knife or razor blade. Afterwards, the cuts can be repaired by bridging with a short piece of wire and resoldering. (This and other hints for easier circuit-tracing and testing on PC boards will be more fully discussed in an upcoming issue.)

A good place to try disconnecting parts is in the complicated AGC circuits used in some TV sets. These circuits may have as many as 15 or 20 resistors (or more!), all working to develop and filter the AGC voltage and distribute it among the tuner and IF stages. But unsoldering a few strategic connections will allow you to break the circuit into sections for easier analysis.

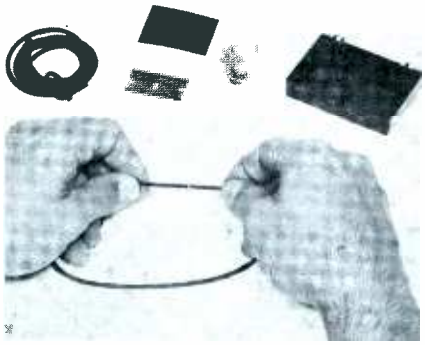
Another place where judicious unsoldering will simplify resistance measurements is in circuits connected to B+ lines. If you can remove electrolytic capacitors from the circuit you're measuring, you'll eliminate a shunt path of uncertain resistance — thereby gaining accuracy. With an electrolytic in the circuit, you know the meter pointer is going to kick down to a low reading, and then slowly rise; but how do you know where it should come to rest? The answer to this question depends on the size and condition of the B+ filters, as well as the amount of additional series resistance in the circuit being measured. A low-resistance shunt across a 'lytic can be measured without difficulty, but readings aren't reliable if the shunt resistance across the capacitor approaches the value of this unit's own final resistance reading.

Fortunately, many sets have a relatively low total DC resistance shunting the power supply, and you can obtain acceptably accurate readings from plate and screen circuits to ground. You only need patience

to wait while the large electrolytic filters build up a charge from the ohmmeter battery. To avoid reverse leakage current which could produce an incorrect low reading, check the battery polarity of the ohmmeter to make sure it agrees with the polarity of the capacitor.

Summary

You might wonder why you need to worry about resistance measurements, or adopt measuring shortcuts—why not just unsolder each component and check it individually? To answer this question, take a close look at some of the sets you're servicing today. The advantages of avoiding unnecessary soldering on printed-circuit boards are obvious. Furthermore, certain components and subassemblies are designed and physically mounted in such a way that unsoldering can add hours to servicing time. For example, there are printed boards whose undersides are completely shielded; you can't gain access to the solder connections without first removing the board itself. Then, too, unusual chassis shapes often make removal of the picture tube imperative before you can locate or reach certain components. Think of all the places you can touch with an ohmmeter probe, but not with a soldering iron—and you'll readily see the advantages of knowing all you can about in-circuit resistance measurements!



Instant Drive Belts

The product shown above was originally part of a roll of ordinary-looking rubber material. In less time than it will take you to finish reading this article, a precise length was measured and cut from the roll, and the ends merged (by a special fluid) to create the endless belt shown.

The belt was fashioned from materials contained in the *Mak-A-Belt Kit,* a new product developed by Techni-Parts Corp. of West Hempstead, New York. The kit includes several feet of rubber material, a vial of the special merging fluid, and a razor blade for cutting the belt.

For those who have taken the time to disassemble certain tape recorders for drive replacement, the Mak-A-Belt Kit will represent an unusual timesaver. The belt can be threaded around the wheels and into position without taking the recorder apart; the "weld" is made afterward. Besides saving repair time, the Kit is intended to cut down inventory. When you need a drive belt, you can simply measure the length of the old one, and make a new one from the Kit; there is no need to stock various sizes.

To make the belt shown in the picture, a length was cut from the roll, a drop of the merging fluid was applied to one end, and the other end was pressed firmly against it while we slowly counted to thirty. The result? The picture tells the story. ▲

TV Remotes

(Continued from page 33)

counterclockwise rotation, while section C causes clockwise rotation of the antenna.

As mentioned before, the three sections of S2 operate in a certain sequence. One complete cycle, starting from the *off* position, can be described as follows: Initiated by a press of the transmitter button, S2 operates; sections A and B close, and the rotator moves in a counterclockwise direction. When the rotator motor is actuated, it continues to run until the transmitter button is depressed again. Then S2 returns to the off position—all sections of the switch open — and the rotator stops. When the unit is pulsed once again, sections A and C close, moving the rotator in a clockwise direction. The next pulse again opens all sections of the switch and turns the rotator off. With the next series of four pulses, this sequence repeats itself.

Any time S2 is closed, the motor will be operating. If it is run continuously for too long a time, damage to the motor and transformer is possible. For this reason, some protective device is needed for these components, other than the line fuse in the input circuit. Shown in the schematic is a timed *thermal switch,* wired in parallel with S1. If this switch closes, due to thermal action (after four or five minutes of continuous operation), it will cause relay M2 to energize and move S2 to the next position—which will always be *off*. Remember. the off position occurs *every other* time the receiver is pulsed.

M2 will remain energized as long as the thermal switch is closed. In this state, M1 cannot cause S2 to move to the next position—even if M1 is keyed by the transmitter. After a few minutes, however, the thermal switch will cool and open; the system will then resume normal operation.

Trouble Isolation

Locating the cause of an inoperative remote system will be quicker and easier if you'll use the following outline as your guide:

First, manually close each set of relay contacts (using an insulated tool) and see if this initiates the expected action. If channel changing and other functions occur as they should, proceed to check the remote receiver.

Apply a DC "unbiasing" voltage to the base of each relay-control transistor—that is, feed in a voltage which will counteract the fixed bias on the transistor and allow it to conduct. With the PNP transistors commonly used in these units, about –2 volts on the base should cause the relay to kick in.

You can use a bias box or a battery for this test. Don't short the base of any transistor to ground in an effort to remove the bias. It probably won't harm a relay-control transistor, but it won't help, either. In any case, it's not a good habit to start, because using this type of test in some other circuits is likely to cause transistor damage.

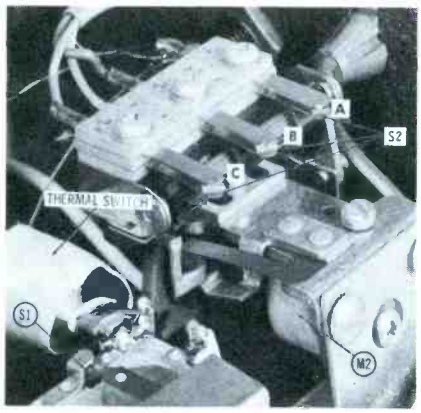
If no relay action takes place during this test, check the output stages. If the relays do operate with the negative voltage applied, the next check is to see if a signal is being received from the remote transmitter. For this test, use another transmitter of the same type (if

available) or use the following hookup:

Take a CW signal generator that covers the 40-kc band, hook a small speaker to the output leads, and place the speaker near the input transducer of the receiver. With medium-low output from the generator, tune it through 40 kc and see if the relays operate. If so, the receiver is working properly, and the transmitter is probably faulty.

If the receiver doesn't operate, advance the generator output and again tune through 40 kc. If the relays still don't kick in, or require a very strong signal to react, the receiver has an open signal path or a weak stage.

Try signal injection with the generator to help isolate receiver faults. Tune the generator to some subharmonic of the desired frequency (such as 8 kc); this gives a more useful test than direct feed-in of the 40-kc signal, which tends to be hampered by stray pickup of signal radiated from the generator leads. Tuning to a subharmonic also allows the use of a higher output from the generator, which results in more accurate stage-gain checks.



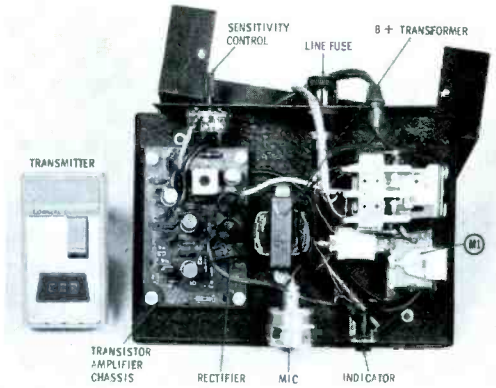


Fig. 5. Rotator control is self-contained unit equipped with stepper relay.

Start at the base of the last 40-kc amplifier stage, feeding in a signal through a coupling capacitor (approximately .05 mfd). Begin with a very low output from the generator, and tune through the frequency range where keying of the relays is expected. When a relay operates, remove the input signal, and note whether the relay *stays* closed. If it does, the test is inconclusive because the relay is being energized by stray signal pickup. Reduce the generator gain and try again. If the relay *did not* energize the first time around, *increase* the generator gain on the second try.

Repeat this injection test, working back toward the input of the receiver. Progressively less signal should be required to actuate the relays, except when the signal is fed into an emitter follower. If you note a lack of stage gain in an amplifier, or if one stage refuses to respond, carefully check the static DC operating voltages (with no signal input) in the suspected circuit—and check the transistor, too. Voltage and resistance checks should pinpoint the defective component. With a little practice, you can learn to check a receiver by this method in a matter of minutes. ▲

PRODUCT report

For further information on any of the following items, circle the associated number on the Catalog & Literature Card.

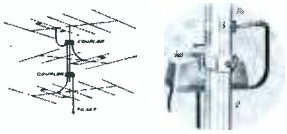
Tube-Tester Adapter (43S)

Five- and seven-pin nuvistors, novars, compactrons, and 10-pin miniature tubes can be tested on any manually-operated tube tester that has an octal socket, when it is equipped with **Hickok's** CA-4 universal adapter. Each of 14 possible pin locations is controlled by eight individual selector switches, thereby providing facilities for testing future tube types.

Soldering Tip (44S)

A new iron-clad thread-on soldering tip specifically designed for pin, tube-socket, and connector soldering work has been introduced by **Ungar Electric Tools.** This tip (No. 6481) is designed to thread onto any of three "Imperial" heat cartridges in approximate wattages (and tip temperatures) of 25W (690°), 30W (750°), and 40W (860°). A total of 44 different tips are currently available for "Imperial" irons.

Yagi Couplers (45S)



A new series of mast-mounted couplers by **Winegard** allow single-channel TV and FM yagis to be connected together so a single lead-in wire can be used to carry the signals into the building. These couplers are available in 12 VHF models and one FM model. The FM coupler can also be used inside the house as a signal splitter. Models CA-2 through CA-13 list at $5.50 each; Model CA-FM sells for $4.50.

CB Transceiver (46S)

An "S" meter and a transmitter-tuning meter are incorporated in **Sonar's** Model "G" Citizens-band transceiver. Eight crystal-controlled channels are featured in the unit, which weighs only nine pounds. Capable of five watts output, the transmitter employs high-level class-B modulation. The receiver is dual-conversion, tunable over 23 channels, with adjustable squelch and a crystal-spotting switch. Price is $229.50.

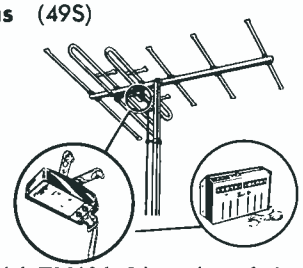
Ceramic Cartridges (47S)

Two ceramic stereo cartridges, the **Sonotone** 16TA and 18TA, are designed to replace many existing original-equipment units. Output voltage of the 16TA is .65 volt, while the 18TA delivers 1 volt. Channel separation for both cartridges is 25 db, and frequency response is 20 to 10,000 cps ±1 db; tracking force is from 4 to 7 grams. List price on each of these "turnover" units is $6.00 with sapphire styli, and $9.75 with a diamond-sapphire combination.

PA Baffles (48S)

Two basic designs with identical styling make up a new line of ceiling or wall baffles from **Argos Products**. The surface-mounted units are 3½" deep and can be either permanently fastened to the wall or ceiling, or hung on the wall like a picture. The recessed model projects only 1½" from the surface; a 6" circular hole is required to accommodate the speaker. Six models are available in each version.

FM Antennas (49S)



A built-in transistorized amplifier is featured in **JFD's** Model TNTFM350-AC "Transis-Tenna" FM antenna. Twin-driven dipoles deliver 34-db gain to meet the stringent demands of stereo reception. The antenna can be purchased without the amplifier as Model AFM350, and the amplifier may also be bought separately as Model FM106. List price of the complete preassembled antenna is $54.95.

Three-Way Pliers (50S)

Installation of electrical outlets is speeded up by the use of new electricians' pliers from **Champion DeArment.** This tool performs three separate jobs. Basically a diagonal cutter, the tool contains two wire-stripping notches which allow stripping of 12- and 14-gauge wire. The pliers are offered under the name "Channellock" No. 337-W.

Appliance Dolly (51S)

A deluxe model of the **Yeats** #7 appliance dolly is now available. Designated Model #14, the new type has two strap - and - ratchet assemblies. The second strap, located near the bottom of the dolly, keeps the appliance from shifting—especially when it is being moved up or down stairs. The Model #14 is constructed of aluminum and weighs 40 lb. Price is $79.50.

Background Music (52S)

Plug-in tape cartridges are utilized in **Cine-Sonic's** new series of background-music players. Model ET #10 features a built-in paging system, while Model #40 is a tape-only machine. Continuous - tape cartridges allow completely unattended operation. Typical applications include systems in hotels, supermarkets, factories, stores, banks, and shopping centers. Three sizes of plug-in cartridges are available; the choice depends on the repetition requirements of the program.

Nutdriver Set (53S)

Ten pocket - size nutdrivers and a special "torque-amplifier" handle are contained in a new set from **Xcelite.** This special extension slips over the handle of any pocket nutdriver to give it a length and torque equivalent to a standard type. The drivers, which range in size from 3/32" to 3/8", are contained in a see-through plastic case which can be carried in a pocket or stood on a workbench. List price is $8.25.

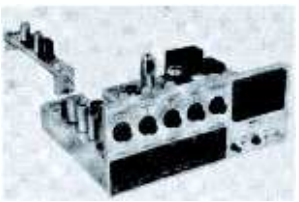
Soldering-Iron Handle (54S)

A new pencil-iron handle made from nylon is available from **Sidco.** The handle has vertical vents which keep it cool during use. The device, which will not break or crack in use, weighs 3 ounces with cord and is 6" long. A patented internal design keeps tips tight in the handle. List price is $1.80.

CB Transceiver (55S)

A five-channel selector switch is featured in the "Globe Star" CB transceiver from **Globe Electronics.** Utilizing a dual-conversion superhet circuit, the unit contains 10 tubes plus rectifier, and has a squelch circuit that can be triggered by a .1-mv signal. Mobile-to-mobile range of the transceiver is up to five miles depending on terrain and antenna location. User net price is $159.95.

PA System (56S)



A new series of public address systems from **Harman-Kardon** utilizes modular construction to make them more versatile. The 'Galaxy" series consists of three amplifiers, a preamplifier chassis, and three booster amplifiers. Various combinations can be made up from these basic components to suit particular requirements. A wide choice of preamplifier input modules makes provision for almost every type of program source, including override and compression operation.

UHF Booster (57S)

Five different boosters, each covering a portion of the UHF band, are included in the **Blonder-Tongue** UB series. These units have 300-ohm inputs and 75-ohm outputs, and are rated at 14-db gain. Designed for easy installation and servicing, the boosters have swing-down chassis and stripless connections. For MATV and CATV systems, a professional model UBP is available.

Hi-Fi Baffles (58S)

A new line of baffles and speaker - baffle combinations is announced by **RMS Electronics.** These wall-mount baffles are available with speakers (BS series) or without them (SB series), in sizes from 5" to 12". Cabinets are finished on four sides in mahogany, walnut or blonde. The decorator grille cloth is recessed ¼" from the front face of each baffle.

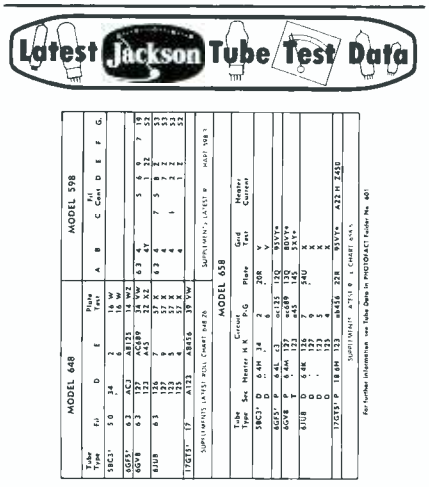
Stereo Tuner (59S)

Both the front end and the four-stage IF board are prewired in **EICO's** Model ST97 FM Multiplex Stereo Tuner kit. No test or alignment instruments are needed to assemble the unit. Specifications include an audio - frequency response within ±1 db from 20 cps to 15 kc, and 30 db of channel separation; full-limiting sensitivity is 10 uv. The unit weighs 17 pounds and measures 5⅛" x 15⅞" x 11⅜". Price is $99.95 (kit) or $149.95 (wired).

INDEX TO ADVERTISERS

CATALOG AND LITERATURE SERVICE

October, 1962



ANTENNAS & ACCESSORIES

1S. BLONDER-TONGUE — 15-page technician's guide, "Quick Reference Manual of Master TV Systems," containing diagrams for home, TV-shop, apartment-house, and motel systems. *See ad page 80.*

2S. CUSH CRAFT — 8-page catalog (No. 62) describing complete line of amateur communications antennas; both UHF and VHF types included.

3S. GAM—Catalog sheet giving specifications on miniaturized TG-2-R VHF mobile antenna designed to mount on top of vehicle or in other restricted spaces.

4S. JERROLD — 4-page catalog containing information on APM-101 *Powermate* transistorized TV/FM preamp, and FMX *Range Extender* for FM use; also includes equipment for TV distribution systems. *See ad page 65.*

5S. JFD—Descriptive and promotional literature plus sales aids for new *Transis-Tennas;* also complete set of specifications for outdoor and indoor TV antennas and accessories, including exact-replacement antenna data. *See ads pages 17, 93.*

AUDIO & HI-FI

6S. ATLAS SOUND—Catalog No. 562 listing specifications on microphones and loudspeakers for public address, commercial, and industrial use.

7S. EICO—New 32-page catalog of kits and wired equipment for stereo and monophonic hi-fi, test equipment, Citizens-band transceivers, ham gear, and transistor radios. Also "Stereo Hi-Fi Guide" and 'Short Course for Novice License." *See ad page 83.*

8S. FISHER—1963 component catalog, 1963 handbook for custom installations, and complete information on Model 300 Multiplex Generator. *See ad page 97.*

9S. SONOTONE—Sheet SAH-51 describing stereo and mono record/play and erase heads. *See ad page 76.*

COMMUNICATIONS

10S. COMMUNICATIONS, INC. — Data sheet on "Speak Easy" audio compressor/amplifier for use with Citizens-band mobile or base transceivers.

11S. CREATIVE PRODUCTS—Complete information on LCF series of loading coils and other antenna accessories for CB use.

12S. MONITORADIO — Catalog sheet describing complete line of FM receivers for both mobile and fixed-station use.

13S. SAMPSON—Data on integrated components for complete CB base station; also sheet describing Model VM-12-120 modulator.

14S. SHURE — 4-page catalog describing Model 488 noise-cancelling microphone; also lists microphones for both special- and general-purpose applications.

COMPONENTS

15S. BUSSMANN — 24-page booklet (SFB) giving detailed information on complete line of *Buss* and *Fusetron* Small Dimension fuses and fuseholders used for protecting electronic equipment. *See ad page 75.*

16S. BRITISH INDUSTRIES — Sheet describing *Multicore* solder; discusses how *Savbit Alloy* extends tip life of soldering irons.

17S. CENTRALAB—Brochure, "Modern Controls for Modern Equipment," describing push-pull and push-push switch controls. *See ad page 85.*

18S. LITTELFUSE — Illustrated catalog showing prices and specifications on complete line of fuses, holders, and merchandising aids. *See ad 4th cover.*

19S. SARKES TARZIAN—Catalog sheet listing silicon rectifier types used as plug-in replacements for rectifier tubes. *See ad page. 89.*

20S. SPRAGUE—Chart C-457 (designed to hang on wall) showing all popular TV-radio-hi-fi replacement components. *See ad pages 13-14.*

SERVICE AIDS

21S. BERNS—Data on 3-in-1 picture-tube repair tools, on Audio Pin-Plug Crimper that lets you make pin-plug and ground connections for shielded cable without soldering, and on *ION* adjustable beam bender. *See ads pages 78, 97.*

22S. CASTLE—Leaflet describing fast over-haul service on television tuners of all makes and models; also illustrated lists describing universal and original-equipment tuners available. *See ad page 46.*

23S. GC ELECTRONICS—Catalog FR-62-S, new products supplement for general catalog FR-62; lists replacement antennas, test equipment, and service aids. *See ad page 61.*

24S. INJECTORALL—Catalog of electronic chemicals, including New No. 20 *Lens Kleen* (for removing scratches from plastic TV safety windows) and No. 30WC *Renew Spray* (for polishing cabinets and removing scratches); also pocket-sized catalog, "Open the Door." *See ad page 102.*

25S. PRECISION TUNER — Information on repair and alignment service available for any TV tuner. *See ad page 86.*

26S. RCA (PARTS & ACCESSORIES DIV.) —Form TK-331, "Color Cross Reference," and TK-310 "Color Accessories and Parts." *See ad page 15.*

27S. YEATS—Literature describing the new Model 14 appliance dolly, featuring all-aluminum I-beam construction.

SPECIAL EQUIPMENT & SERVICES

28S. ACME — Illustrated catalog sheet 24-B01 giving specifications and listing applications for magnetic amplifiers designed for control uses; includes units with capacities from 5 to 1000 watts and voltage ranges from 24 to 160 volts. *See ad page 104.*

29S. ATR — Literature on new series of *Karadio* models, including Series 600 tube-equipped types and Series 400 transistorized versions. All sets available as "universals" or customized. *See ad page 16.*

30S. INTERNATIONAL WIRE & CABLE —28-page catalog listing lead-in wire, coaxial cable, guy wire, and other wire and associated products.

31S. TELEPROMPTER CORP.—Descriptive literature on *Amphicon 190* large-screen television projector that provides 12-foot pictures for classrooms, clubs, etc.

32S. TRANSVISION ELECTRONICS — 12-page catalog listing black-and-white TV kits and wired chassis for custom installation; also catalog of color-TV kits. *See ad page 98.*

33S. VOLKSWAGEN — 60-page illustrated booklet, "The Owner's Viewpoint," describing how various business enterprises use VW trucks in their operations; also booklet giving complete specifications on VW truck line.

TECHNICAL PUBLICATIONS

34S. MOTOROLA TRAINING INSTITUTE —Literature describing two-way radio correspondence course available to qualified electronics technicians. *See ad page 104.*

35S. HOWARD W. SAMS — Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics, including brand-new Fall-Winter 1962 Book Catalog and descriptive flyer on 1962 Test Equipment Annual. *See ads pages 73, 84.*

TEST EQUIPMENT

36S. ANTRONICS—Detailed information on the CA-378 *Kine-Color* Circuit Analyzer.

37S. MERCURY—New master catalog showing complete line of test equipment and service aids. *See ad page 91.*

38S. SECO—New folder describing complete line of tube and transistor testers and two-way radio test instruments. *See ad page 79.*

39S. SENCORE—Latest catalog listing line of test equipment; includes information on new color analyzer, Model CA122. *See ads pages 41-44.*

TOOLS

40S. EVERSOLE INDUSTRIES—Sheets describing and listing prices on *DeSod* desoldering tools for removing and replacing parts on printed-circuit boards. *See ad page 92.*

41S. KEMODE MFG. CO.—Descriptive literature on new cartridge-heated *Quik-Shot* soldering irons for use in remote locations where power is not available.

TUBES & TRANSISTORS

42S. AMPEREX — 16-page semiconductor handbook and 34-page tube reference book. *See ad page 37.*

This many picture tubes from one box?

YES!

Because RCA Universal Silverama® Picture Tubes Make Possible Multiple Replacements!

78 Universal Silveramas replace virtually every type on the market

Every time you open an RCA Universal Silverama Picture Tube carton, you get the equivalent of *many replacements*—not just one!

RCA—pioneer of the Universal Picture Tube concept—has today achieved the greatest simplification of picture tube types.

First in the RCA Universal series—the 21CBP4A that replaces 19 industry types . . . or just about 25% of your replacement needs.

Next in the series, a family of four Universal Picture Tubes (the 21CBP4A, 21AMP4A, 21ZP4B, and 21YP4A) to replace 33 industry types—about half your replacement needs.

Now, 78 Universal Silveramas to replace 291 industry types—covering nearly any picture tube need.

This makes for an inventory simple enough that your RCA Distributor can easily keep a full stock. For you this means no more lost time hunting high and low for special, unusual, or infrequently-used types.

The whole story is conveniently set out for you in a handy slide-guide. Simply look up the Universal Silverama type you want and the guide shows you all the standard types it replaces. In addition, look up the industry type you find in your customer's set, and the guide shows you its RCA Universal counterpart. Be sure to get a Silverama slide-guide from your Authorized RCA Silverama Distributor.

RCA ELECTRON TUBE DIVISION, HARRISON, N. J.

Every RCA Universal Silverama Picture Tube is made with an all-new electron gun, the finest parts and materials, and a glass envelope which, prior to reuse, has been thoroughly inspected, cleaned, and rescreened.

RCA® The Most Trusted Name in Television

FASTER THAN A SHORT CIRCUIT

SUB-MINIATURE MICROFUSES

and microfuse holders for internal connection and panel mounting.

1/500 AMP. thru 5 AMPS. @ 125 volts. Will interrupt 10,000 AMPS. DC short circuit.

8AG INSTRUMENT FUSES

1/500 AMP. thru 5 AMPS.

For instrument and meter protection, Littelfuse pioneered the design and development of reliable fast-acting fuses.

LITTELFUSE

Des Plaines, Illinois