TELE-TECH

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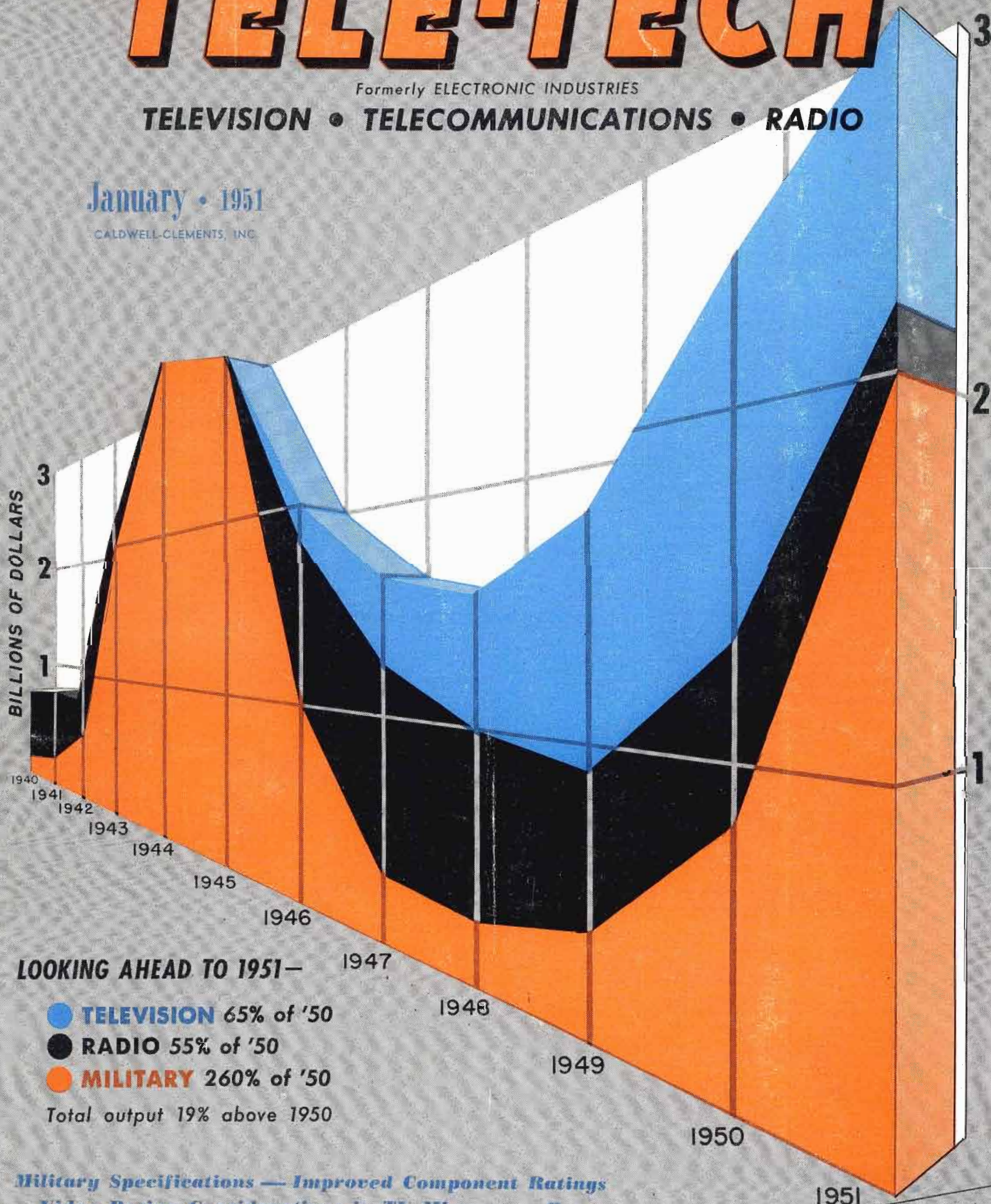
TELEVISION • TELECOMMUNICATIONS • RADIO

January • 1951

CALDWELL-CLEMENTS, INC.



LOOKING AHEAD TO 1951—

- **TELEVISION** 65% of '50
- **RADIO** 55% of '50
- **MILITARY** 260% of '50

Total output 19% above 1950

Military Specifications — Improved Component Ratings
Video Design Considerations in TV Microwave Repeater
New Editing Machine for Magnetic Tape Recording

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Please Route to

Nearly 5,000 miles of Microwave by Motorola...

Actual Experience...

- with proved field-tested installations
- with complete engineering service
- for over 20 years specialists in mobile radio

Already installed or under construction, across all kinds of terrain, Motorola-Microwave offers low cost reliable communications. Each Microwave transmitter provides multi-channel operation and gives you simplified, economical, private, cross-country communications that are constantly dependable and efficient.

Motorola's Current Research Program Includes:

- Microwave • Fire Search • Guided Missiles
- Nucleonics • Teleswitching • Direction Finders
- Countermeasurers • Carrier Relay Equipment
- Radar Search • Radar Beacons • Digital Computers
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- Gamma Ray Technique • Pulse Code Modulation
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- Production-Proven Sectionalized Sub-miniaturization

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JANUARY, 1951

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CALDWELL-CLEMENTS, INC., 480 Lexington Ave., New York 17, N. Y., Tel Plaza 9-7880. Publishers also of RADIO & TELEVISION RETAILING

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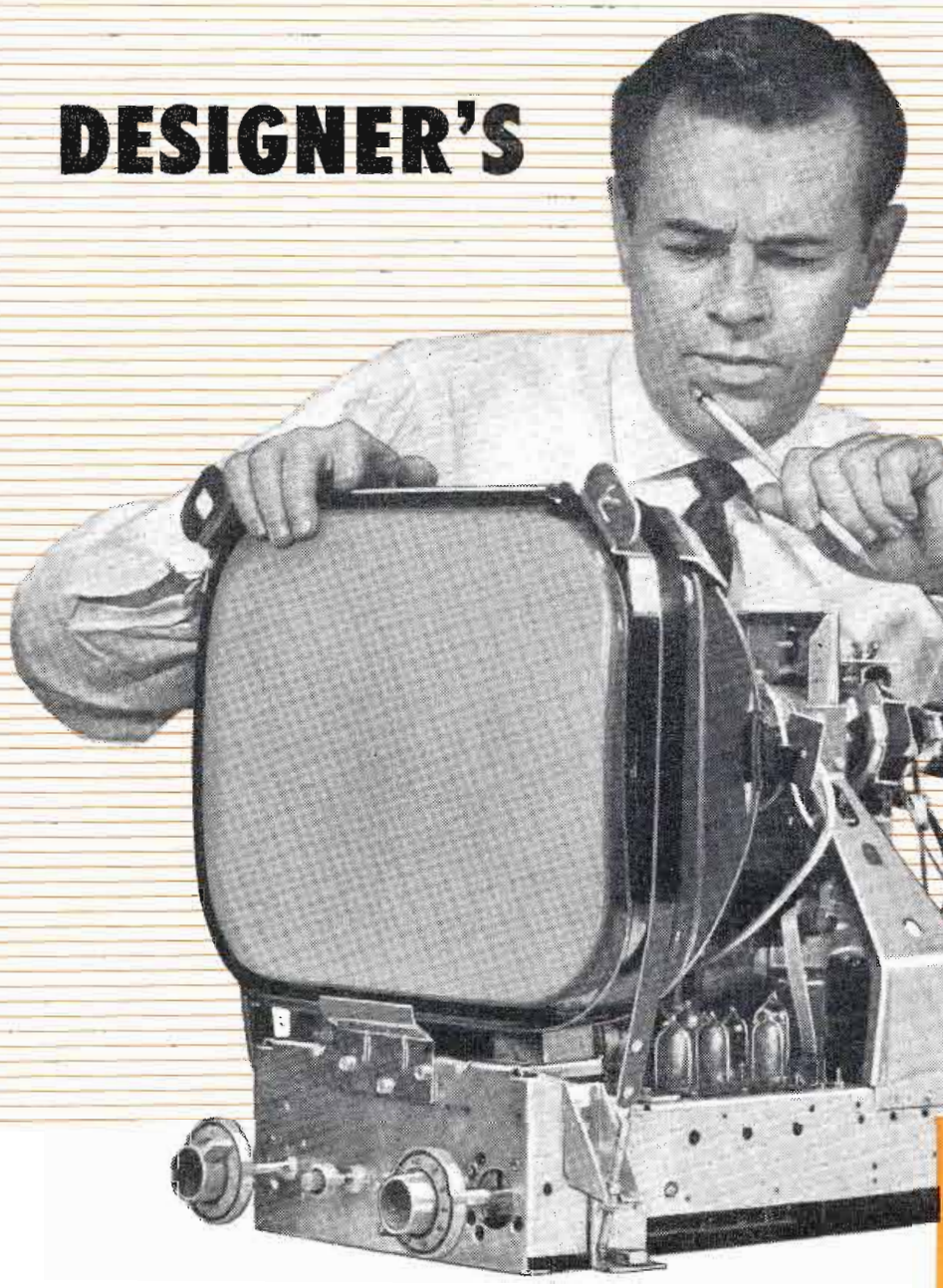
DESIGNER'S DILEMMA



"How can I save, in order to trim the price of this set another $2.50?"

THE answer, Mr. TV-set Designer, is simple: *G.E.'s 6BN6 gated-beam tube.* It replaces three tubes and associated components, serving as a combined limiter, discriminator, and audio-amplifier.

6BN6 cost is right in line with other receiving types. You get three tubes' performance, yet you pay for only one!

Ask for Bulletin ET-B28, which tells the full story of this amazing G-E *economy* tube, also charts its performance. Or if you prefer to discuss the 6BN6 in person, an experienced G-E tube engineer gladly will call on you. Wire or write *Section 10, Electronics Department, General Electric Company, Schenectady 5, New York.*

6BN6

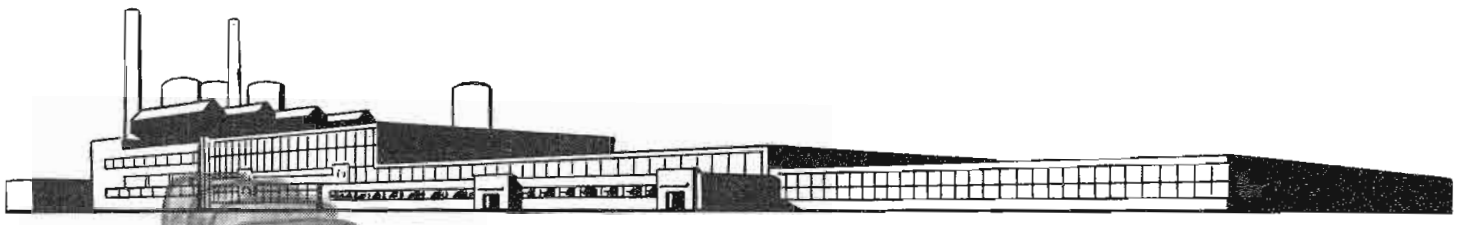
GATED-BEAM MINIATURE

Typical Operating Conditions, TV Application, 4.5 mc

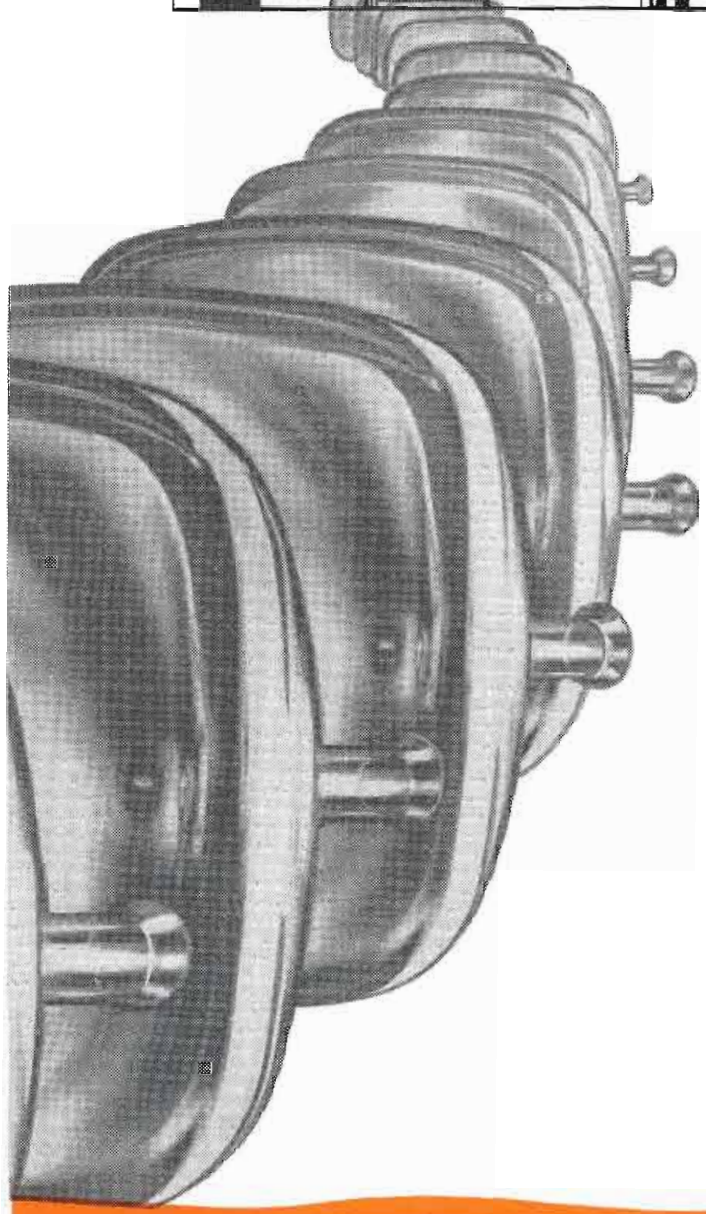
Plate supply voltage	270 v
Plate load resistance	.33 megohms
Accelerator voltage	100 v
Cathode resistance	200 to 400 ohms
Min signal voltage for limiting action	1.25 v RMS
Audio output voltage	12.5 v RMS
AM rejection, with 2-v input signal	25 db

GENERAL ELECTRIC

161-K1



New Corning Plant at Albion, Michigan, devoted exclusively to television bulb manufacturing is now in operation. The latest in equipment and efficient layout provides additional volume production of the finest all-glass television bulbs.



television bulbs

When television was still a laboratory curiosity, Corning made the *first* experimental bulbs. All during the early stages of T-V set production, Corning was the principal manufacturer of television bulbs. In keeping with this tradition, and in answer to demands from the Television Industry, Corning has introduced the *all-glass 20″ rectangular bulb!*—the largest T-V bulb in volume production today.

The first of this size on the market, the new 20″ bulb combines all the improvements developed through years of research at Corning. Among these are light-weight, lead-free glass ideally suited to electronic applications, stronger bulb assemblies from electric sealing, and constant quality from improved glass melting and forming techniques. The new Corning 20″ all-glass bulb is the last word in quality, durability and size.

CORNING GLASS WORKS, CORNING, N. Y.

Corning means research in Glass

ELECTRONIC SALES DEPARTMENT—ELECTRICAL PRODUCTS DIVISION

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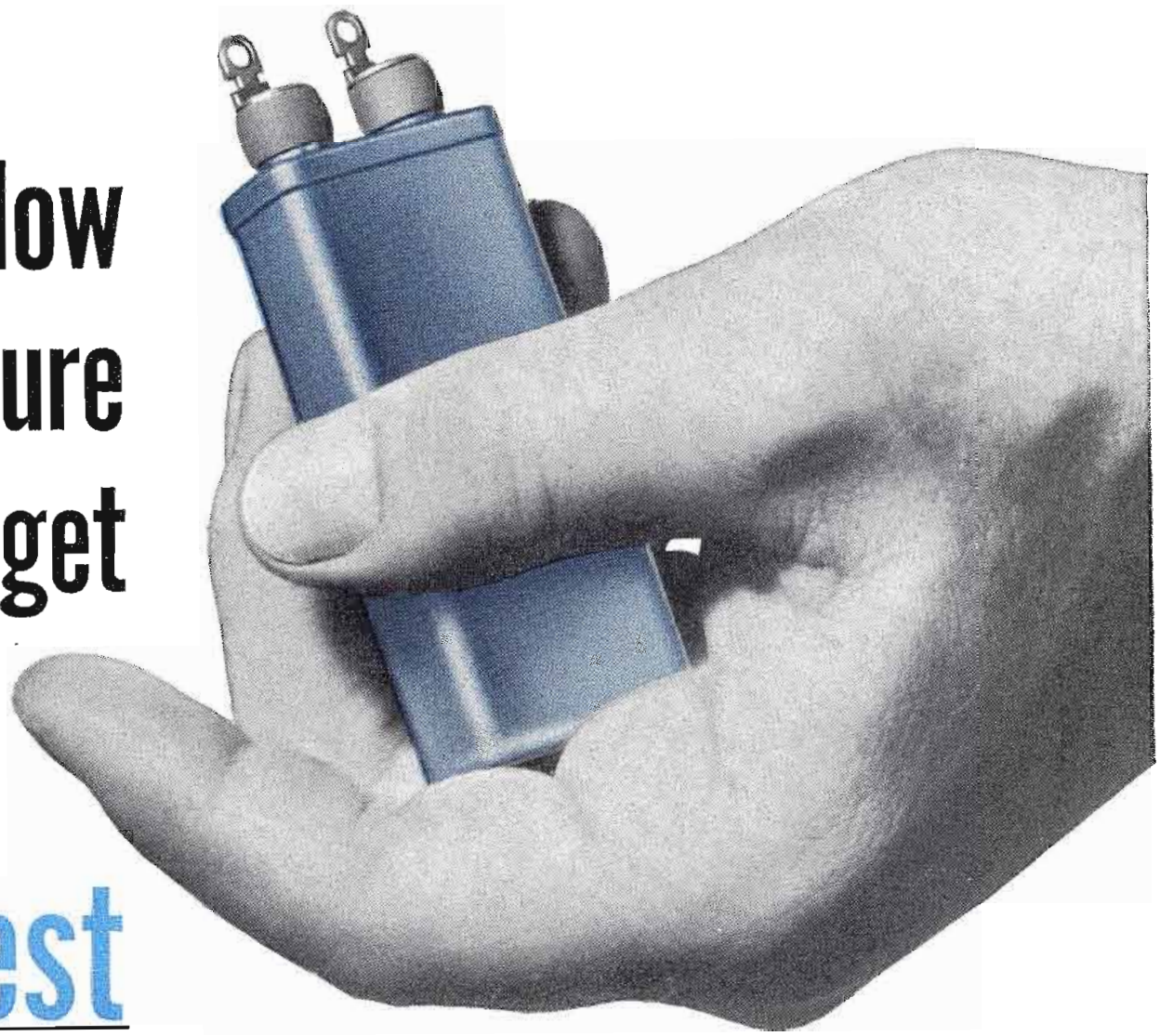
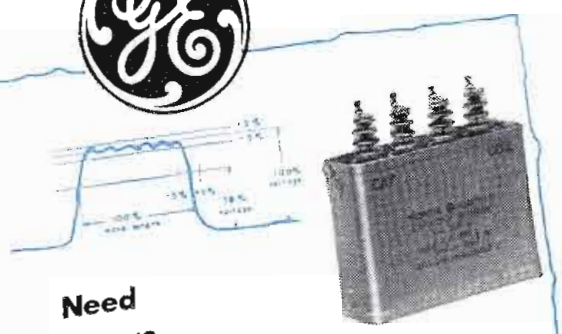
How to be sure you get the Best Capacitor





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Pulse-forming networks are used where the normal capacitor discharge wave shape is not suitable, and where an impulse must have definite energy content and duration. Their design involves several tricky problems—one being suitability for high temperature operation. Nevertheless, networks are one of our specialties—we have built them by the thousands, and our experienced and capable engineers will be glad to discuss any of your design problems. We invite your inquiries.

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And then test the foil for thickness . . . purity . . . softness of the anneal . . . freedom from oil . . . cleanliness of surface . . . absolute smoothness.

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GENERAL ELECTRIC

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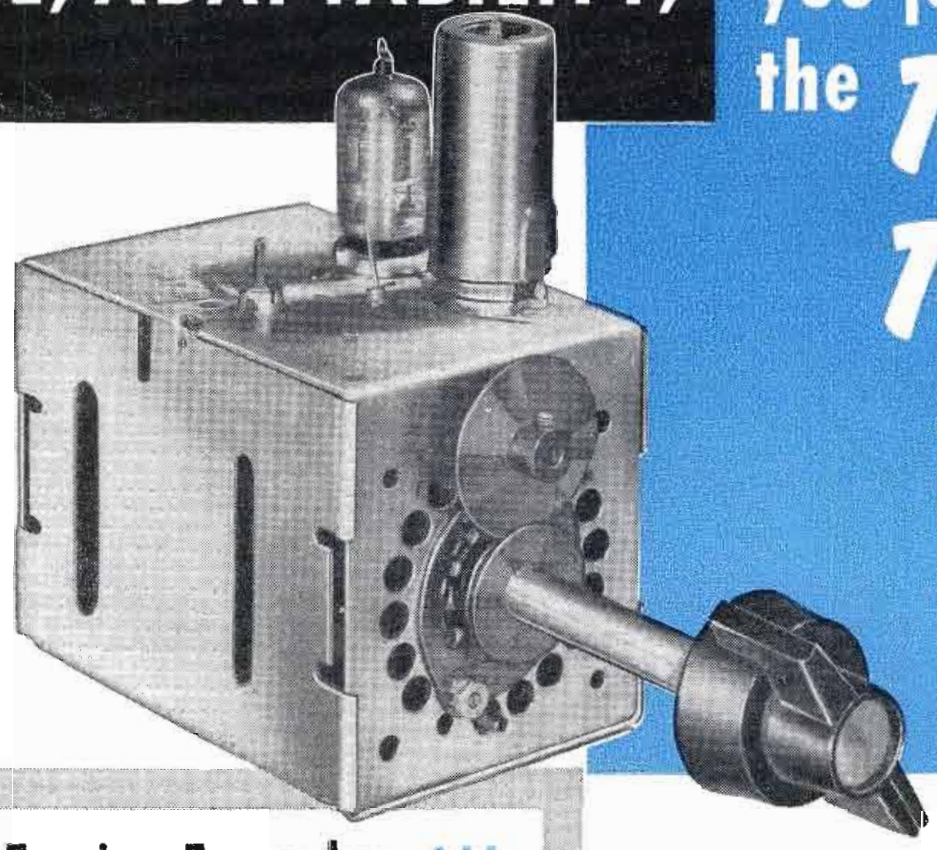
For PERFORMANCE, PRICE, ADAPTABILITY,

you just can't beat the *Tarzian Tuner!*



A compact, precision-built "package," offering maximum performance per dollar cost. And, backed by TARZIAN engineering "know-how."

Only Tarzian Tuner has ALL of these desirable Features

- Low oscillator radiation
- High gain and low noise
- Designed for 21 or 41 megacycle I.F. systems
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- Three tube performance with two tubes
- Each channel individually aligned for maximum performance
- Good input balance—no tracking difficulties
- Completely shielded
- Oscillator tube shield provides rigid horizontal and vertical positioning of the tube
- Extra terminals provided for tie-points

Write for complete information, specifications and technical data.

Since the time it was first introduced, the TARZIAN front-end tuner has won the acclaim of the industry. It is small, skillfully designed, well-built and low-priced. That's why 17 of the nation's set manufacturers today are specifying the TARZIAN tuner as a component for their products.

Engineering service available upon request

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WTTS - WTTV

5000 Watts Channel 10

TELE-TIPS

STUDYING COMPATIBLE TV SYSTEMS—Under the chairmanship of David B. Smith of Philco, a new "ad hoc" committee of leading color-TV technical personalities has been set up for the further study of compatible-system improvements, with field tests. Other members are I. J. Kaar, General Electric Co., A. V. Loughren, Hazeltine; Dr. T. T. Goldsmith, DuMont; and Dr. Elmer Engstrom, RCA Laboratories. After some 12 months' study, recommendations of this committee will be referred to NTSC (Dr. W. R. G. Baker, chairman) for consideration as an industry-wide compatible color-TV system, embodying best features available from all sources.

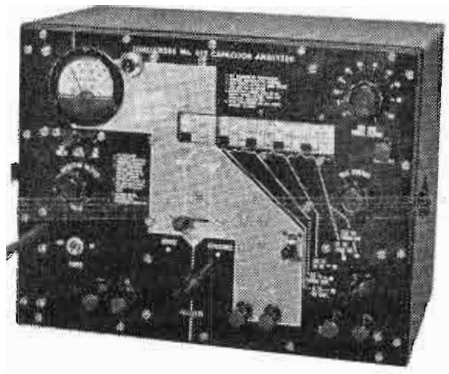
"BAROMETER, 27.9"—On a routine November morning a news announcer on New York's WOR droned a commonplace weather report ending with the barometer reading—"27.9". "Hey, that guy on just now got his figures reversed", phoned in a keen young transmitter engineer. "He musta meant 29.7! Why, 27.9 would mean a hurricane coming!" Three hours later five of New York's stations were off the air as towers toppled or water rose over the transmitter houses. The announcer sure had the right barometer reading, after all!

360 MILES PER HOUR is the peripheral speed of the color-wheel, rotating at 1440 rpm, needed to give FCC color effects on a 30-inch DuMont receiver, as demonstrated by Dr. Allen B. DuMont before the Radio Executives' Club at the Waldorf, New York City. A model of such a 7-ft. color wheel was exhibited, but of course to drive it anywhere near the required operating speed would have torn wheel, color windows, and housing to pieces under the terrific centrifugal forces developed.

RADIO STARS in the sky—stars in the firmament which have been observed to be sources of radio-frequency radiations as well as light, now number 50, according to Harvard astronomer Dr. Harlow Shapley. Most of these discoveries of radio stars were made by British and Australian astronomers during the past year.

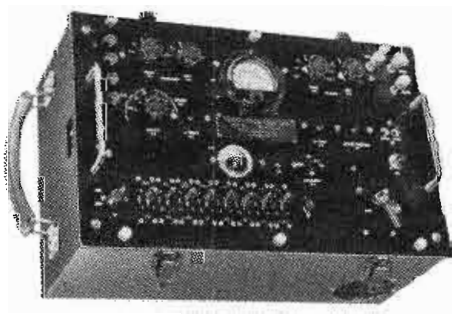
(Continued on page 12)

Something New



WIDE-RANGE, DIRECT-READING CAPACITOR ANALYZER

A laboratory-type Capacitor Analyzer meeting the need for a highly accurate, wide-range, direct-reading measuring instrument capable of determining the essential characteristics of capacitors has been announced by the Shallcross Manufacturing Co. This versatile instrument will determine capacitance values between 5mmf. and 12,000 mfd.; insulation resistance from 1.1 to 12,000 megohms; also leakage current, dielectric strength, and percentage power factor. A divided panel carrying an outline of the operating instructions makes it readily possible to use the instrument without reference to an instruction book. The Shallcross analyzer operates on 110 volt, 60-cycle alternating current. Literature giving full details will gladly be sent on request to the Shallcross Manufacturing Company, Collingdale, Pa.

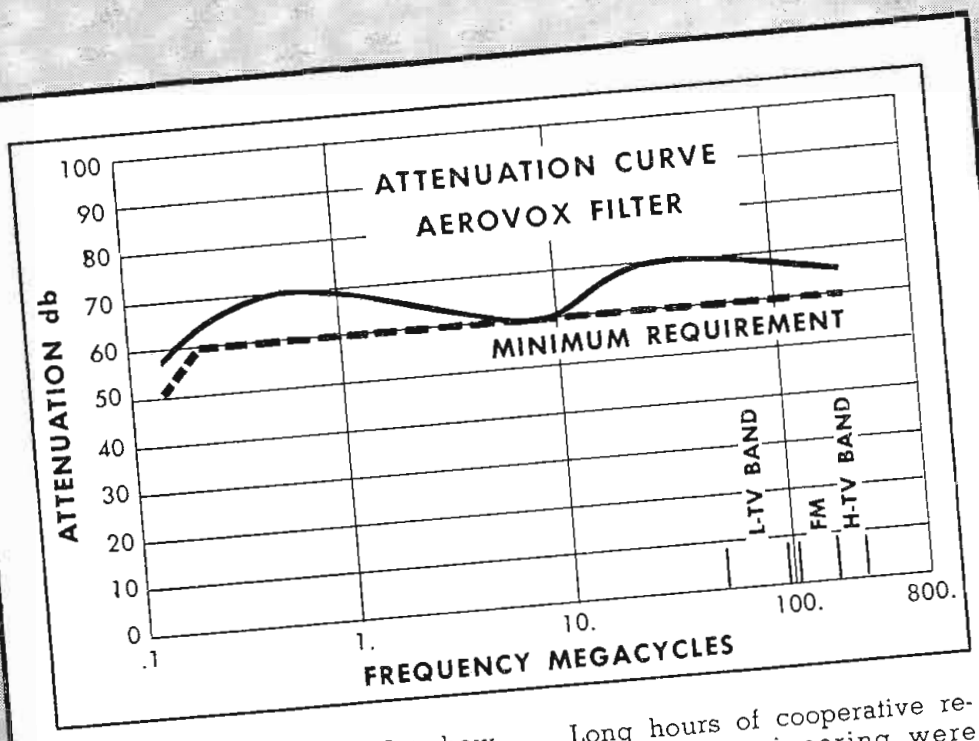


MULTI-PURPOSE TRANSMISSION TEST SET

In addition to measuring the electrical characteristics of telephone lines and equipment the new Shallcross multi-purpose transmission test set may be used for efficiency tests on local and common battery telephone lines and sets, carbon microphones, receivers, and magnetic microphones. It also provides a fast, efficient means of testing capacitors, generators, ringers, insulation resistance, dials, and continuity. Key switches and dials are used to select and control the test circuits. The 693 Transmission Test Set is powered by external batteries. It features compact, substantial construction and is fully portable, thus making it ideal for either field or laboratory use. Details may be obtained from the Shallcross Manufacturing Company, Collingdale, Pa.—Adv.

Uncle Sam's latest jeep as quiet as proverbial mouse, because of AEROVOX

Interference Filters



● The chart sums it up. Note how radio interference generated by the ignition system and other electrical equipment is suppressed well in excess of requirements.

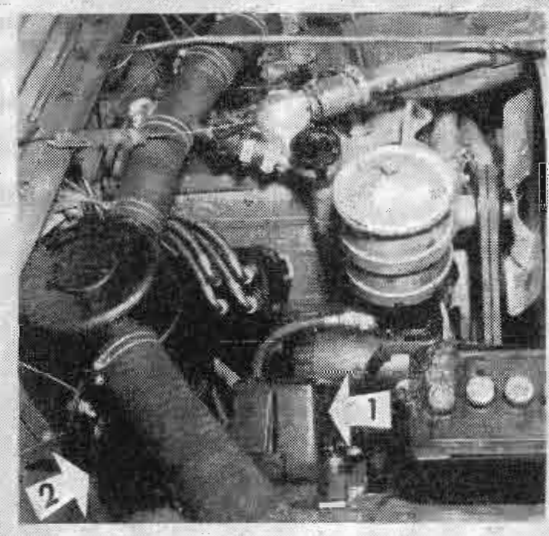
Uncle Sam's new jeep includes The Electric Auto-Lite Company's 24-volt waterproof electrical equipment. It must operate efficiently even under water. And radio interference must be minimized in the interests of dependable military communications.

Long hours of cooperative research and engineering were spent on this noise-suppression problem. The main considerations were filters to minimize interference originating with the voltage regulator, the generator and the ignition system. Aerovox finalized the complete answer based on the three major units here presented.

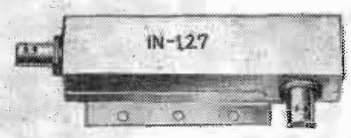
• • •

And *thoroughly waterproof, weatherproof and shockproof,* of course.

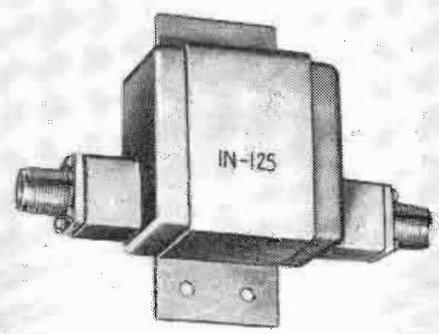
● *Capacitance applications such as this are all in the day's work for Aerovox engineers. Whatever your capacitance problems and requirements may be, Aerovox will fit the right capacitors to the right applications. Address Dept. FT.*



Aerovox Type 89ZAY using a metallized-paper capacitor and mounting inside voltage regulator case to work in conjunction with IN-127.



Aerovox Type IN-127 mounted inside voltage regulator (Arrow No. 1) and acting as interference eliminator for voltage regulator and generator systems.



Aerovox IN-125 which mounts on bulkhead of jeep (Arrow No. 2) and suppresses interference originating in ignition system.

AEROVOX capacitors

FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

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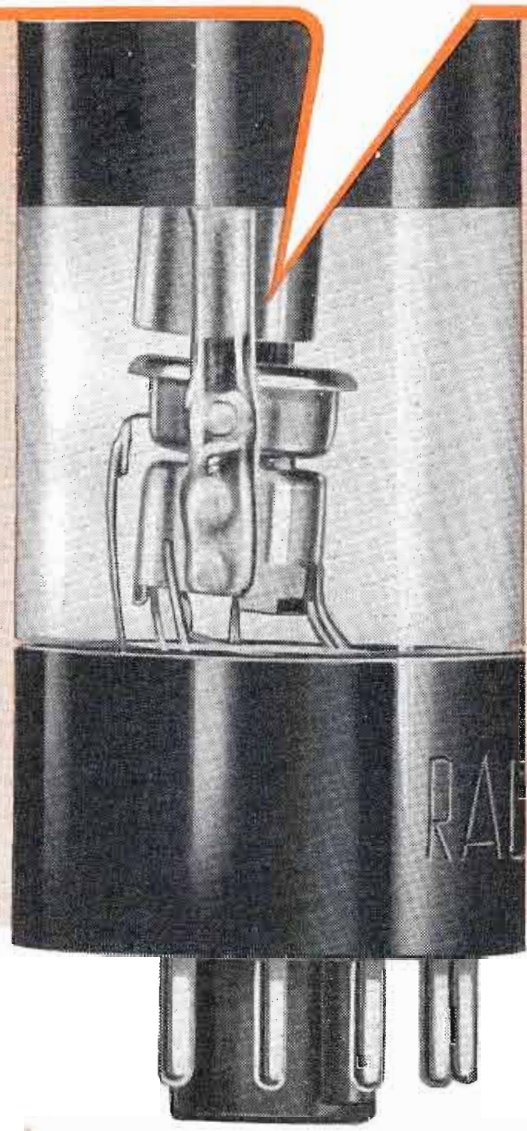
NEW INDICATOR ION TRAP

a Rauland "Exclusive"



Helps you Cut Production Costs

Rauland's new Indicator Ion Trap can help you in your battle to cut pennies off production costs and thereby to price receivers competitively.

First of all, the Indicator Ion Trap completely eliminates the need for any equipment and any trained judgment in the adjustment of ion trap magnets. Adjustment can be made faster than equipment could be attached. The ion trap magnet is simply moved until the green glow signal is reduced to minimum. It can be done in seconds with absolute accuracy—without even seeing the front of the picture tube.

Second, the Rauland Tilted Offset Gun which incorporates this Indicator Ion Trap requires only one Ion Trap Magnet instead of two, nibbling a little more off production costs. Yet it gives better results—the electron beam is bent only once and is focused to maximum sharpness.

Specify Rauland tubes with these exclusive advantages, and get the benefits that only Rauland offers.

For further information, write to . . .

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Tilted Offset Gun

Indicator Ion Trap

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Reflection-Proof Screen

Aluminized Tube

THE RAULAND CORPORATION

Perfection Through Research

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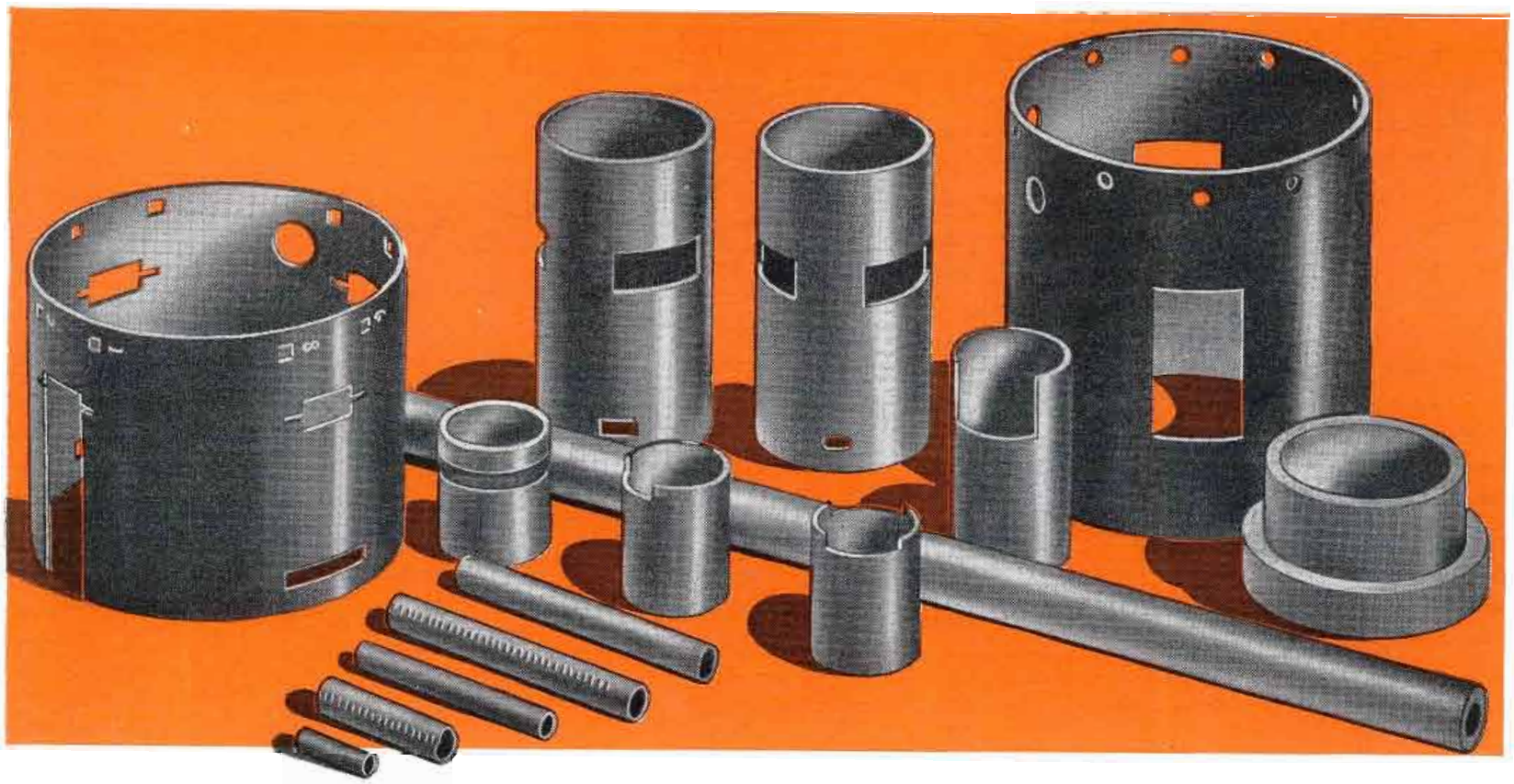
TELE-TIPS (Continued)

SOUTH OF THE BORDER television is growing rapidly. Mexico City has two stations operating on US standards. Havana, Cuba, has one station on the air, Union Radio Television, and another, CMQ-TV, will commence operations shortly. Both these stations use US standards. In Brazil, a rather unique situation obtains. Sao Paulo uses US standards and has a 60-cycle power supply. But Rio has a 50-cycle power supply and uses the proposed European standards of 625 lines and 25 frames a second. However, there is the possibility that within five years the supply may be changed to 60 cps, at which time the TV system will also be modified. Mexico, too, has areas where the power frequency changes from 50 to 60 cps, but the decision to use US TV standards was based on the need to have adjacent countries use similar standards.

CONFETTI IS NOW to be expected on television receivers. Nomenclature developed by the entertainment and engineering world is interesting. First we had "snow" for monochrome noise, now we have **"confetti"** for color noise! Funny thing is that it looks just like confetti!



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PHENOLIC TUBES

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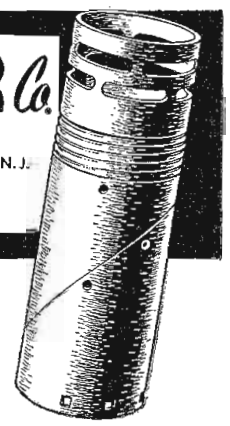
PROMPT DELIVERIES are available through our large production capacity.

Inquiries invited . . . Samples gladly sent.



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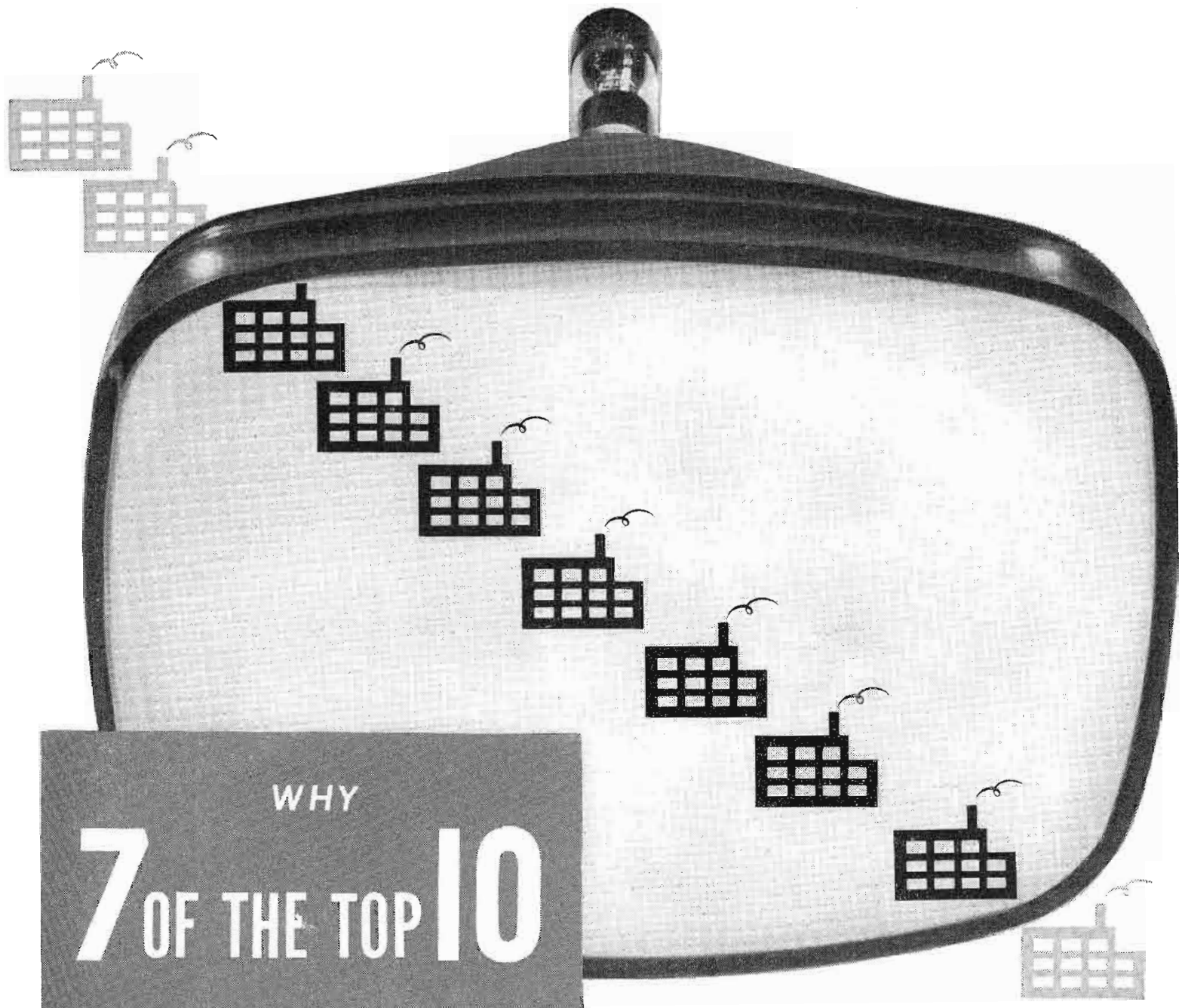


WHY 7 OF THE TOP 10 TELEVISION SET MANUFACTURERS USE SYLVANIA PICTURE TUBES

The important reasons behind the steadily increasing demand for Sylvania TV Picture Tubes are: (1) high quality performance, (2) broad national recognition.

Sylvania's picture tube experience includes leadership in 4 specialized fields . . . all basic to TV picture tube production. These are *radio, electronics, lighting, and phosphors.*

A Sylvania tube engineer, for example, invented the famous Ion Trap now generally adopted, under special Sylvania license, by other leading picture tube makers.

Sylvania's 25 years of lighting research, including advances in phosphors and filamentary wire techniques and coatings, has also contributed to the outstanding clarity and long life of Sylvania picture tubes.

Popular TV show tells millions

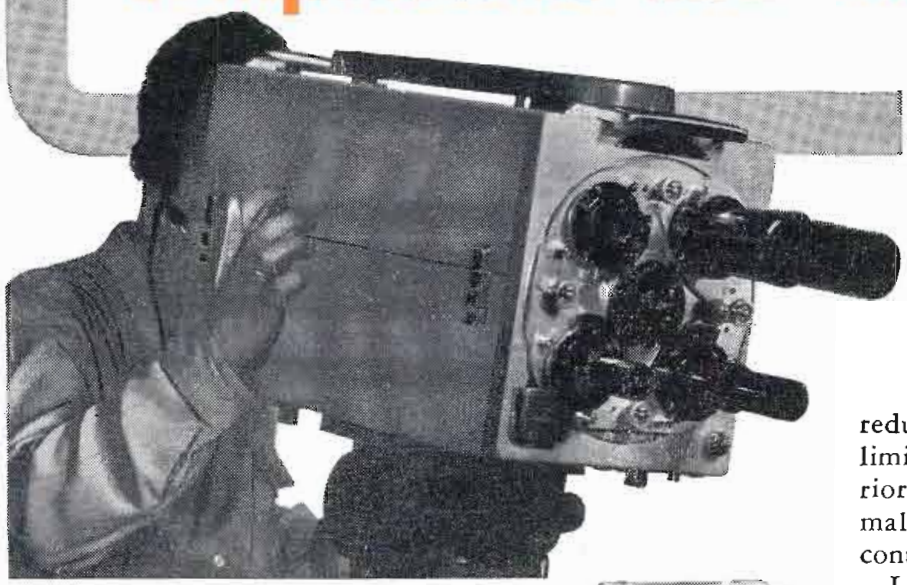
Set owners are being kept informed of Sylvania's leadership by the big, popular television show, *"Beat the Clock,"* on CBS-TV. Every week this program emphasizes Sylvania's unique background and the fine quality of all Sylvania products, thus assuring you that Sylvania picture tubes are an added selling aid to the sets you manufacture.

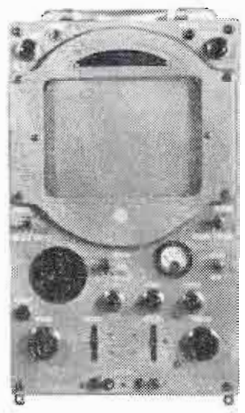
New folder, giving complete descriptions and ratings of all Sylvania TV Picture Tubes is yours for the asking. For your copy address: Sylvania Electric Products Inc., Dept. R-1401, Emporium, Penna. *Sylvania Representatives are located in all foreign countries. Names on request.*

SYLVANIA ELECTRIC

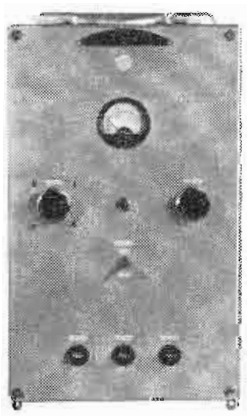
RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

GPL Introduces First TV Camera Chain Designed from Start to Finish for Compactness and Ease of Operation





Compact GPL camera and control unit have been "human engineered" for easy, efficient use. Camera provides uniform focus adjustment for all lenses; iris is motor-controlled from rear of camera or from control unit, with lens opening shown on dials at both locations. Control unit has 8½" monitor tube.



IMPROVED SYNC GENERATOR

The sync generator, with its power supply, is a single unit, packaged for field use. Because binary counting circuits are used, and pulse width is controlled by delay lines, it provides circuit reliability better than present studio equipment. With this circuitry, all operator adjustments are eliminated.

Built with the compact precision which distinguishes a quality watch from an alarm clock, GPL's new image orthicon camera chain is smaller, lighter, easier to use. It is the first camera chain that has been "human engineered" – designed from motion studies of cameramen and control personnel. It is the first with type and location of controls based on minimum movement and maximum ease and efficiency.

This simplification, together with size and weight reduction has been accomplished without any sacrifice or limitation whatever in performance or accessibility. Superior GPL circuit design provides a better picture than normally obtainable with image orthicon equipment. Complete control is provided for every studio or field requirement.

Logical components have been combined . . . fewer units make up a chain. A single chain consists of only 4 units; a triple chain, 12 including switching unit and master monitor. The camera, *with integral view finder,* is only 10¾" x 12½" x 22", weighs 75 lbs. instead of 100-105 lbs. The sync generator is a single portable unit including its own power supply. It may be easily removed from its case to go into a standard relay rack.

SIMPLIFIED CONTROL

All controls are at the finger-tips of cameramen and camera control operators. Focus adjustment of all lenses is uniform; a given rotation of focus control produces the same shift in plane of focus for all lenses. The iris is motor-controlled, either from the rear of the camera or from the camera control unit. Dials on both camera and control unit indicate the lens opening. Negative feedback is used to stabilize video frequency response, eliminating an adjustment. Target and beam are controlled by thumbwheels next to convenient knobs for pedestal and gain.

READILY ADAPTABLE

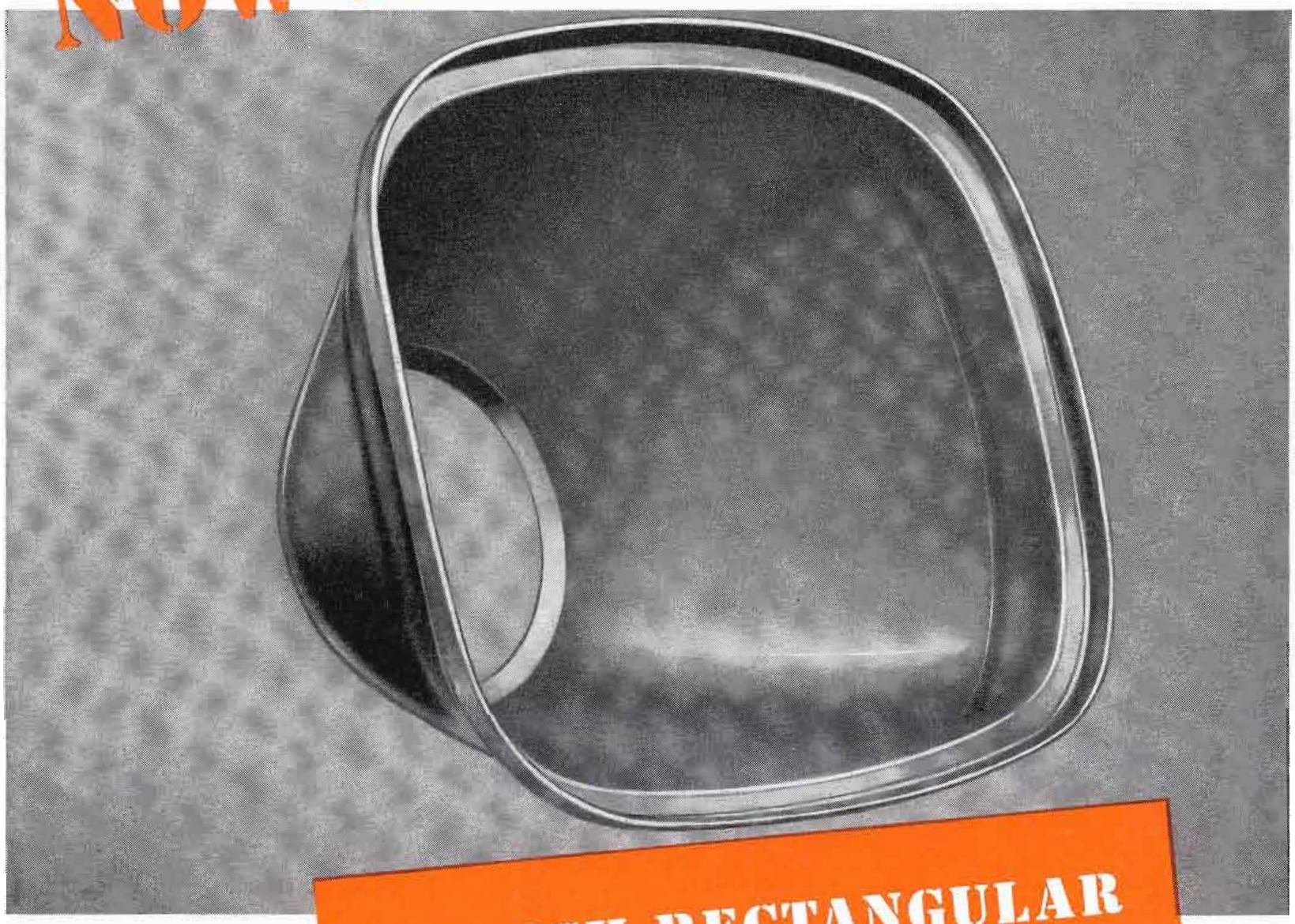
GPL Camera Chains completely meet all studio and field requirements or may be readily adapted to supplement existing installations. *Before you make any camera chain investment, get all the facts on this new addition to GPL's outstanding line of TV studio equipment.*

Write, Wire or Phone for Details

TV Camera Chains • TV Film Chains
TV Field and Studio Equipment
Theatre TV Equipment

General Precision Laboratory
INCORPORATED
PLEASANTVILLE NEW YORK

NOW AVAILABLE!



Pictured is the 17-inch United Specialties rectangular picture tube shell.

17-INCH RECTANGULAR TELEVISION SHELL

by United Specialties Company

Mass production facilities of United Specialties Company permit volume output of both 16-inch round shell and 17-inch rectangular metal shell for television picture tubes. This pioneer manufacturer of oil bath air cleaners, ignition and turn signal switches and a great variety of other metal stamping products, has successfully produced and sold metal shells for picture tubes since December, 1949. Factories at Chicago, Philadelphia and Birmingham.

Our sales engineer will be happy to discuss the application of United Specialties facilities to your particular needs. We invite your inquiry.

UNITED SPECIALTIES COMPANY

Chicago 28 ★ ★ ★ ★ ★ **Philadelphia 36**

TELE-TECH
Formerly ELECTRONIC INDUSTRIES
TELEVISION • TELECOMMUNICATIONS • RADIO

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

Compatible Color-TV Is Ready

As 1950 closed—compatible all-electronic color-TV met and vanquished every indictment which the FCC had earlier charged against it.

The Washington demonstration proved—

(1) That adequate electronic *color fidelity* is here—for all spectral hues and for even the most delicate flesh tints.

(2) That *picture texture and detail* are satisfactorily provided by the 600,000 color-dots of the new screens (as compared with the 351,000 dots of the early-1950 models).

(3) That *picture brightness* (now doubled or tripled) is ample at 20 ft-lamberts, and is comparable with best 1951 black-white.

(4) That color-receiver *operation* is stable and runs along hour-after-hour, needing *no adjustment.*

(5) That *no flicker, no color-breakup,* and *no misregistration* are noticeable on closest scrutiny. And

(6) That new circuitry provides *greater simplicity* of control and design in both receivers and transmitters.

In short it has now been demonstrated that engineers know how to deliver *bright, clear, sharp, color-true all-electronic pictures,* which, being *"compatible," can also be received on any present set as good black-white.* Thus, when the stations can get ready to start color broadcasts (which because of war shortages may be in say one to two years) compatible color programs can make an *easy and economically-safe transition* from black-white reception to color reception, as the audience converts or adds color receivers.

Let the Public Decide

Overwhelmed by the uproar resulting from its recent decision, the FCC—taking merely the testimony of its own senses—now needs only to *authorize compatible color-TV to go on the air,* along with the present-approved abortive non-compatible system. Then the public, industry, and trade will quickly decide for themselves which system they want—which system must survive! Thus in a single logical and democratic step, the FCC can provide the *soundest future for color,* and meanwhile *save the television enjoyment of millions.*

There will be many improvements still to be made in compatible color-TV (as all engineers working on the problem will be quick to admit). Improvements will come from individual inventors, from company laboratories, and from cooperating industry groups. Already committees are at work on the polishing-up process, even to the extent of trying for an "all-industry system" which will "combine the best features" of all TV inventions and all systems.

Main Problems Are Solved

But the main outlines of compatible color-TV are now well established. From now on in, it will be a matter of improving details, and enlarging picture sizes. (For with the electronic compatible system it becomes *easier to provide big pictures* than small ones!)

If the war situation darkens, we may want to hold up all color-TV activities while American boys are dying in the Orient or elsewhere. But outside of war, and rearmament-created shortages, we feel that a compatible color-TV system should certainly be quickly authorized, so that field experience can be obtained by manufacturers' engineers with the aid of the millions of home sets now in use, in both TV centers and fringe areas.

In this democratic American way—by trial and test—let the public get fullest enjoyment out of its present ten million sets—while it prepares for or adopts the new magic of *color-TV in the home.*

Once put *compatible* color-TV on the air, and the public itself will quickly settle forever the color-TV issue.

Given a chance, *the public will decide.*

RADIO-TV CIVILIAN &

SEGMENTS OF RADIO-TV MANUFACTURING

Activity	Estimated 1950 Production
Television Receiver Manufacturing	$1,070 Million
Equipment for Government & Military	750 "
Radio Sets (AM & FM)	325 "
Fixed, Mobile, Aircraft Communications	160 "

Activity	Estimated 1950 Production
UHF & Microwave	$104 Million
Test Equipment	95 "
Sound Recording & Reproducing Equipt.	72 "
Broadcasting (New stations, studios & maintenance)	30 "

THE RADIO-TELEVISION INDUSTRY

Data Covers Year Ended December 31, 1950	Total Investment	Annual Gross Revenue	Number of Employes	Annual Payroll
All radio-TV manufact'g, as above (1500 companies)	$185,500,000	$2,650,000,000	249,000	$ 495,000,000
Radio and TV distributors, dealers, etc.	500,000,000	2,500,000,000	200,000	600,000,000
Broadcasting stations (3,046), including talent costs	203,000,000	496,000,000	*40,000	260,000,000
Commercial communication stations	75,000,000	.....	17,000	60,000,000
Listeners' radio and TV sets in use (101,000,000)	5,000,000,000	.....	.....	†1,000,000,000

* Regular staff — not including part-time employes, artists, etc., who number at least 40,000 more.

† Annual operating expense for listeners' sets, for tube replacements, electricity, servicing, etc.

PRODUCTION OF CIVILIAN RADIO SETS — 1922 TO 1950

	Total Civilian Radio Sets Manufactured		Total Civilian Tubes Manufactured		Automobile Sets Manufactured		Total Radio Reception Equipment	Auto Sets in Use	Homes with Radio Sets	Total Radio Sets in Use in U. S.	At Close of
	Number	Retail Value	Number	Retail Value	Number	Retail Value	Value	Number	Number	Number	
1922	100,000	$ 5,000,000	1,000,000	$ 6,000,000	.....	.....	$ 60,000,000	.....	260,000	400,000	1922
1923	550,000	30,000,000	4,500,000	12,000,000	.....	.....	151,000,000	.....	1,000,000	1,100,000	1923
1924	1,500,000	100,000,000	12,000,000	36,000,000	.....	.....	358,000,000	.....	2,500,000	3,000,000	1924
1925	2,000,000	165,000,000	20,000,000	48,000,000	.....	.....	430,000,000	.....	3,500,000	4,000,000	1925
1926	1,750,000	200,000,000	30,000,000	58,000,000	.....	.....	506,000,000	.....	5,000,000	5,700,000	1926
1927	1,350,000	168,000,000	41,200,000	67,300,000	.....	.....	425,600,000	.....	6,500,000	7,000,000	1927
1928	3,281,000	400,000,000	50,200,000	110,250,000	.....	.....	690,550,000	.....	7,500,000	8,500,000	1928
1929	4,428,000	600,000,000	69,000,000	172,500,000	.....	.....	842,548,000	.....	9,000,000	10,500,000	1929
1930	3,827,800	300,000,000	52,000,000	119,600,000	34,000	$ 3,000,000	496,432,000	.....	12,048,762	13,000,000	1930
1931	3,420,000	225,000,000	53,000,000	69,550,000	108,000	5,940,000	300,000,000	100,000	14,000,000	15,000,000	1931
1932	3,000,000	140,000,000	44,300,000	48,730,000	143,000	7,150,000	200,000,000	250,000	16,809,562	18,000,000	1932
1933	3,806,000	180,500,000	59,000,000	49,000,000	724,000	28,598,000	300,000,000	500,000	20,402,369	22,000,000	६६६1
1934	4,084,000	214,500,000	58,000,000	36,600,000	780,000	28,000,000	350,000,000	1,250,000	21,456,000	26,000,000	1934
1935	6,026,800	330,192,480	71,000,000	50,000,000	1,125,000	54,562,500	370,000,000	2,000,000	22,869,000	30,500,000	1935
1936	8,248,000	450,000,000	98,000,000	69,000,000	1,412,000	69,188,000	500,000,000	3,500,000	24,600,000	33,000,000	1936
1937	8,064,780	450,000,000	91,000,000	85,000,000	1,750,000	87,500,000	537,000,000	5,000,000	26,666,500	37,600,000	1937
1938	6,000,000	210,000,000	75,000,000	93,000,000	800,000	32,000,000	350,000,000	6,000,000	28,000,000	40,800,000	1938
1939	10,500,000	354,000,000	91,000,000	114,000,000	1,200,000	48,000,000	375,000,000	6,500,000	28,700,000	45,300,000	1939
1940	11,800,000	450,000,000	115,000,000	115,000,000	1,700,000	60,000,000	584,000,000	7,500,000	29,200,000	51,000,000	1940
1941	13,000,000	460,000,000	130,000,000	143,000,000	2,000,000	70,000,000	610,000,000	8,750,000	29,700,000	56,000,000	1941
1942	4,400,000	154,000,000	87,700,000	94,000,000	350,000	12,250,000	360,000,000	9,000,000	30,800,000	59,340,000	1942
1943	.....	.....	17,000,000	19,000,000	.....	.....	75,000,000	8,000,000	32,000,000	58,000,000	1943
1944	.....	.....	22,000,000	25,000,000	.....	.....	85,000,000	7,000,000	33,000,000	57,000,000	1944
1945	500,000	20,000,000	30,000,000	35,000,000	.....	.....	105,000,000	6,000,000	34,000,000	56,000,000	1945
1946	14,000,000	700,000,000	190,000,000	200,000,000	1,200,000	72,000,000	900,000,000	7,000,000	35,000,000	60,000,000	1946
1947	17,000,000	800,000,000	220,000,000	260,000,000	2,500,000	150,000,000	1,100,000,000	9,000,000	37,000,000	66,000,000	1947
1948	16,000,000	700,000,000	200,000,000	230,000,000	2,800,000	200,000,000	950,000,000	11,000,000	40,000,000	74,000,000	1948
1949	10,000,000	500,000,000	200,000,000	350,000,000	3,500,000	240,000,000	1,500,000,000	14,000,000	42,000,000	81,000,000	1949
1950	14,000,000	650,000,000	380,000,000	615,600,000	4,060,000	261,874,000	2,800,000,000	17,000,000	45,000,000	90,000,000	1950

Figures for sets give value with tubes in receivers. Whereas in normal years, replacement tubes have run 25% to 40% of total tube production, the figure for replacement is currently between 15% and 20%. All figures are at retail values. (Statistics Copyrighted by Caldwell-Clements, Inc.)

1950 PRODUCTION OF RADIO, TV, FM, PHONO PLAYERS, RECORDS, RECORDERS, TUBES, ANTENNAS

RADIO

Type	Number Units	Retail Value
Table	6,770,000	$147,586,000
Console	1,210,000	162,140,000
Portable	1,960,000	78,400,000
Auto	4,060,000	261,874,000
Total	14,000,000	$650,000,000

TV ANTENNAS and ACCESSORIES

Retail Value $125,000,000

TELEVISION

Total Units	Retail Value
7,000,000	$2,149,000,000

RECORDS

Total Units	Retail Value
198,886,500	$226,131,200

TUBES

Total Units	Retail Value
380,000,000	$615,600,000

PHONOGRAPHS (combinations)

Total Units 5,570,000

HOME RECORDERS (Wire, Tape, Disc)

Total Units	Retail Value
250,000	$50,000,000

MILITARY PRODUCTION

U. S. CONSUMPTION OF CRITICAL RAW MATERIALS

METALS

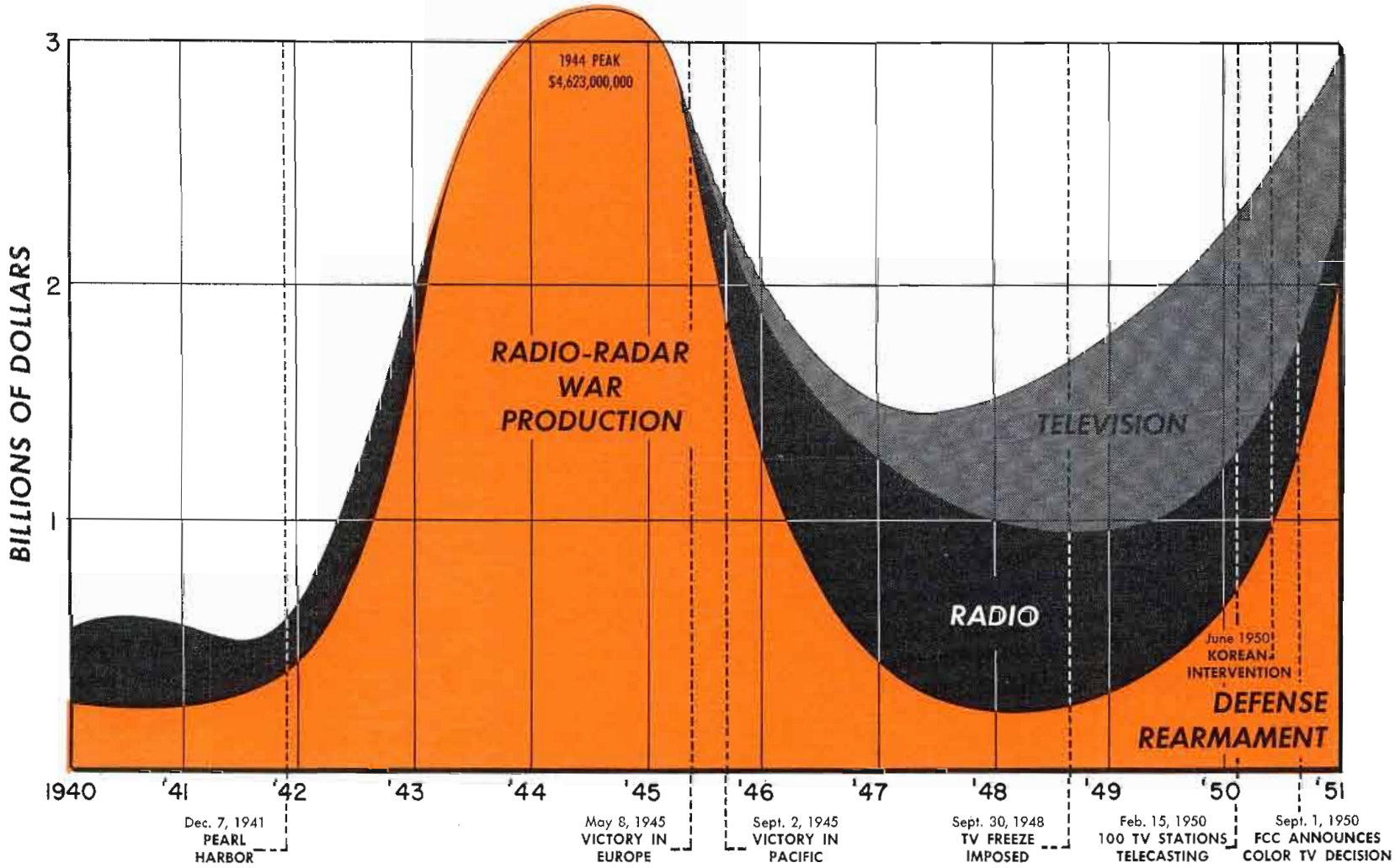
Material	1946		1947		1948		1949		1950	
	Quantity (tons)	Est. $ Value	Quantity	Est. $ Value	Quantity	Est. $ Value	Quantity	Est. $ Value	Quantity*	Est. $ Value
Aluminum	409,630	115,812,000	571,750	161,626,000	623,456	180,755,000	603,462	181,000,000	700,000	232,000,000
Cobalt	2,053	6,780,000	2,083	6,880,000	2,525	8,660,000	2,301	8,100,000	3,643	12,400,000
Copper	1,797,000	51,800,000	1,789,000	75,200,000	1,719,000	74,500,000	1,824,750	71,600,000	,007,200	83,900,000
Iron	70,843,113	215,006,427	93,091,520	320,804,981	101,003,492	394,460,751	84,937,447	332,000,000	101,000,000	395,000,000
Lead	956,476	7,750,000	1,172,000	17,200,000	1,133,895	20,400,000	1,087,400*	17,400,000	1,033,223	12,400,000
Nickel	80,015	53,400,000	80,757	56,500,000	93,558	69,200,000	98,228*	72,600,000	103,138*	81,200,000
Tungsten	3,229	80,700	3,906	91,009	4,427	110,000	2,479	62,000	3,050	76,200

PLASTICS

Cellulose	41,500	41,500,000	29,500	29,500,000	24,500	24,500,000	28,000	28,000,000	48,000	48,000,000
Phenolic	70,000	2,800,000	69,500	2,800,000	85,000	3,400,000	66,000	2,600,000	120,000	4,800,000
Polyethylene	.....	.....	.....	.....	.....	.....	.....	.....	25,000	25,500,000
Polystyrene	33,500	23,400,000	47,500	33,200,000	73,500	51,500,000	91,500	64,200,000	145,000	103,000,000
Vinyl	30,500	33,300,000	36,500	40,200,000	37,000	40,700,000	40,500	44,500,000	60,000	66,000,000

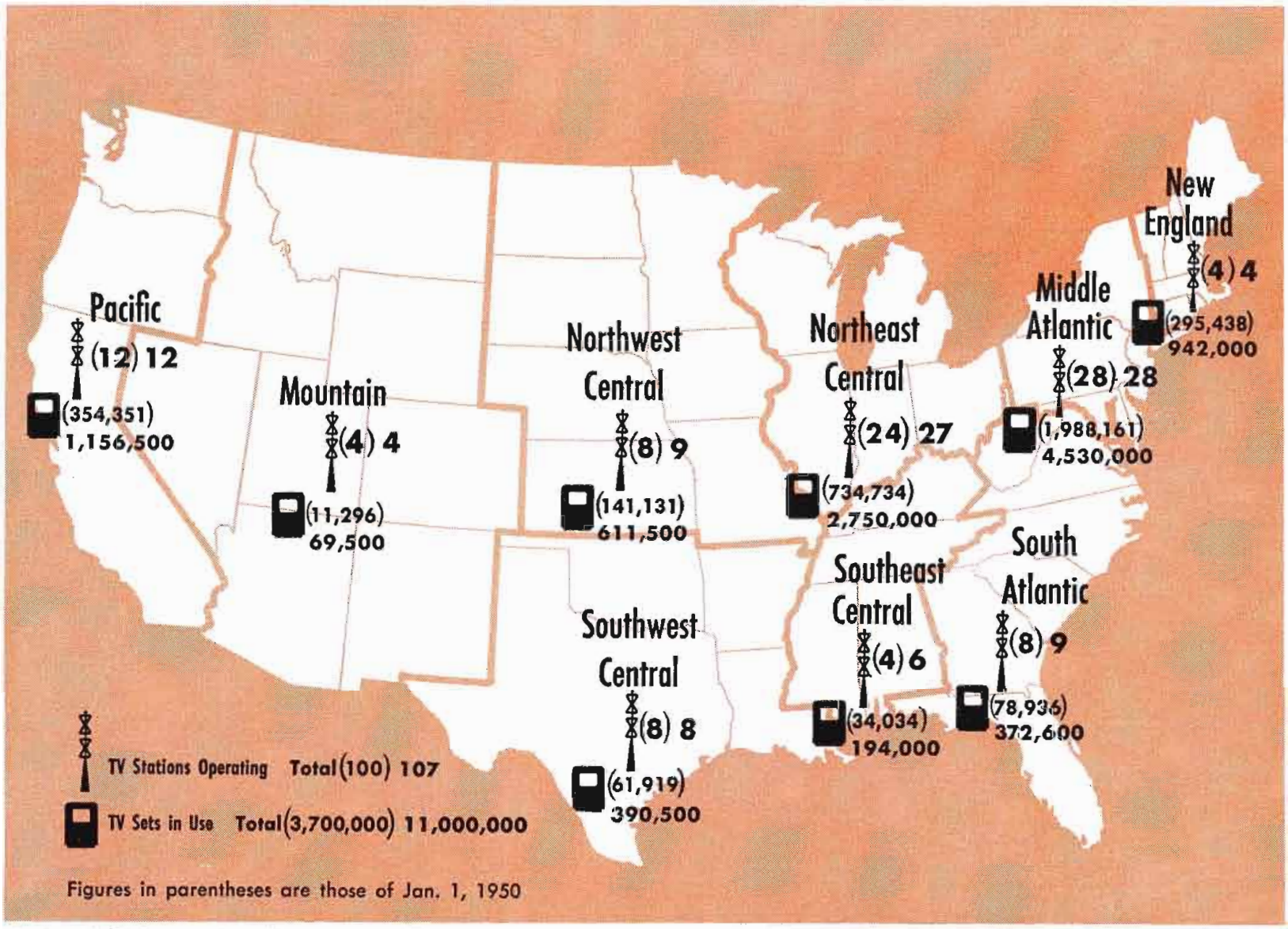
Tons indicated are short tons.
* Estimated.

IN 1951 RADIO INDUSTRY OUTPUT WILL APPROACH PEAK OF WORLD WAR II



From left to right, these curves show (1) pre-war scale of home radio production, (2) tremendous rise of military production during war years—with erasure of civilian radio, (3) sudden cutback of military radio after V-J day with resumption of civilian radio, (4) rising volume of TV output with contraction of radio, (5) recent and future increases in military and defense production. In 1944-45, output of industry was 4.6 billion dollars. Figure, however, includes production from plants not normally engaged in radio manufacture. Curve peak shows top production of regular radio factories.

TELEVISION STATIONS & SETS IN UNITED STATES, 1951 (Also 1950)



During 1950 the number of commercial TV stations increased to 107. An additional seven million receivers were distributed and sold throughout the United States. By areas, percentage increases of TV receivers are approximately: Pacific—300%, Mountain—600%, Northwest Central—400%, Southwest Central—650%, Northeast Central—400%, Southeast Central—500,% New England—300%, Middle Atlantic, 250%, South Atlantic—45%. Total TV sets in use in U.S. increased 300%.

TELEVISION OUTSIDE THE USA

Country	*TV Status*	*No. Sets*
Australia	In preparation	100 sets appr. (exp.)
Canada	In preparation	45,000 sets in U.S. border area
Cuba	In operation	8,000 sets appr.
Denmark	In preparation	500 sets appr. (exp.)
France	Two systems operating	30,000 sets appr. (building at rate of 1000 per month)
Holland	Exp. operation	500 sets appr.
Sweden	In preparation	50 sets (experimental)
United Kingdom	In operation	500,000 sets
Switzerland	In preparation	200 sets (experimental)
Mexico	In preparation	10,000 sets appr.
Germany	Experimental	20,000 very vague (includes prewar, postwar sets)

Foreign Countries with TV Activity

Country	*TV Status*	*No. Sets*
Belgium	In planning	50 sets appr. (exp.)
Brazil	In operation	10,000 sets appr.
South Africa	In planning	200 sets appr. (exp.)
Italy	In operation	500 sets
India	No apparent activity	
Japan	U.S. proposal to install TV run by U.S.	
China	No activity	
Russia	No definite activity (information) but probably about 25,000 various types.	
Middle East Countries	No signs of activity	
Spain	Interested	No figures
New Zealand	No apparent activity	
	TOTAL	600,100

STATISTICS OF THE U.S.; WORLD

ANNUAL BILL OF U. S. FOR RADIO-TV

Sales of time by broadcasters, 1950	$ 496,000,000
Talent costs	80,000,000
Electricity, batteries, etc., to operate 101,000,000 radio and TV receivers	380,000,000
14,000,000 radio receivers, at retail value	650,000,000
7,000,000 television receivers, at retail value	2,149,000,000
Phonograph records 199,000,000	226,000,000
Radio repairs and supplies:	
60,000,000 replacement tubes	96,000,000
Radio-TV parts, accessories, etc.	200,000,000
Labor	250,000,000
	$4,527,000,000

RADIO AND TV SETS IN U. S.; WORLD

	January 1, 1951
United States homes with radios	45,000,000
Secondary sets in above homes	24,000,000
Sets in business places, institutions, etc.	4,000,000
Automobile radios	17,000,000
TV Sets	11,000,000
TOTAL sets in the United States	101,000,000
Total radio sets in rest of world: North America, 7,000,000; South America, 7,000,000; Europe, 61,500,000; Asia, 12,000,000; Australia, 2,500,000; Africa, 2,000,000	92,000,000
TOTAL sets in world	193,000,000

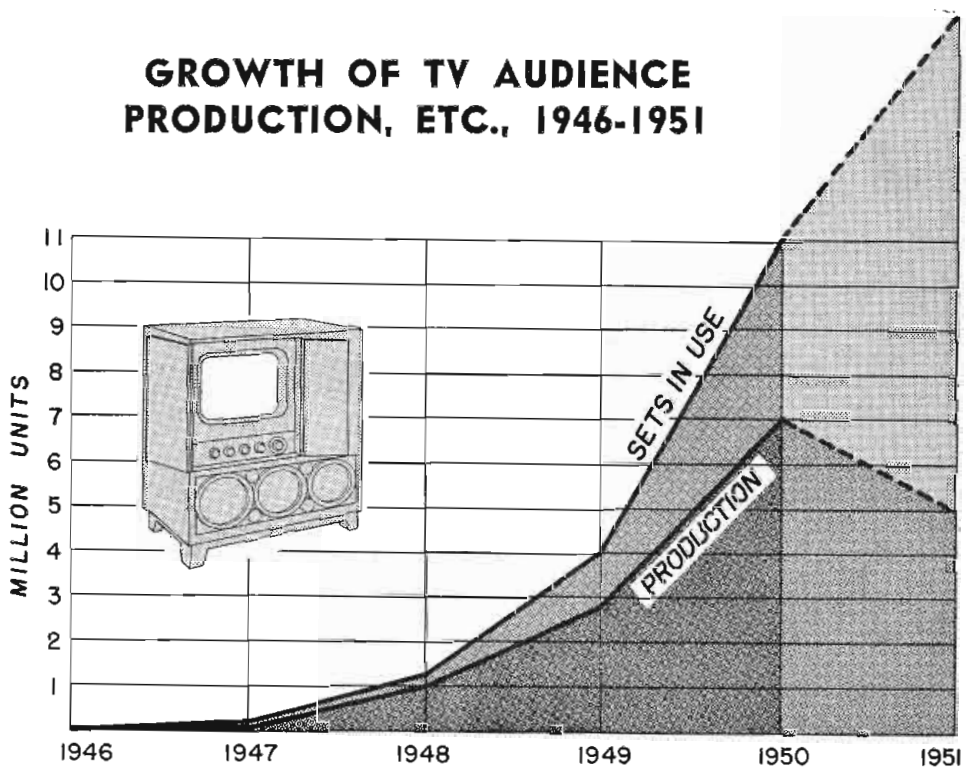
TV Receivers Sold During 1950

Table models	3,570,000
TV only consoles, consolettes	2,730,000
Combinations with FM and/or AM	140,000
Combinations with phono	560,000
Total	7,000,000

TV-Receiver Sales 1946-1950

	Number	Retail Value
1946	10,000	$ 5,000,000
1947	250,000	100,000,000
1948	1,000,000	350,000,000
1949	3,000,000	950,000,000
1950	7,000,000	2,149,000,000
Total to date	11,260,000	$3,554,000,000

GROWTH OF TV AUDIENCE PRODUCTION, ETC., 1946-1951



MOTION PICTURE FILM

In 1950 TV used:
300 million feet of 16 mm film—Appr. Cost $12,000,000
3 million feet of 35 mm film—Appr. Cost $200,000
All TV stations use 16 mm projectors
Appr. 30 TV stations use 35 mm projectors

SOUND RECORDING

In 1950 Radio & TV used:
400 million feet of magnetic recording tape—Appr. Cost $1,200,000
3.5 million transcription discs (all types)—Appr. Cost—$8,750,000

LICENSED RADIO STATIONS

Total AM Broadcast Stations Operating	2,259
Total FM Stations Operating	680
Total Television Stations Operating	107
Population Served by TV Programs January 1, 1951	95 million people
Total special service stations: marine, aeronautic, railroad, industrial, public safety, mobile, etc.	384,000
Radio operators licensed	700,000
Amateur stations	88,000

TURNTABLES IN USE JAN. 1, 1951:

78 RPM only	15,400,000	78-33 RPM	400,000
33 RPM only	1,065,000	3-Speed	2,600,000
45 RPM only	2,450,000	TOTAL in use	21,915,000

New Ratings for Components

Using a "point" grading system rather than acceptance, the output of industry can be

By E. F. SEAMAN,
Electrical Engineer

P. D. BELL,
Electronics Engineer
Navy Dept., Bureau of Ships
Washington, D. C.

THE science of semantics has provided man with a method of thought communication through the spoken or written word, but a challenge to the adequacy of this means of thought transfer arises in the evolution and use of a purchase specification. Starting with the premise that we are a part of a literate environment it is certain that combinations of words in specification form will always convey meanings to the producer that may or may not be consistent with the interpretation intended by the consumer and specification writer.

The hazard of ambiguity is present in all types of specifications (design or formulation and performance[1]) and it is therefore essential that the finished document be tested by the questions: Does any statement in the specification have more than one interpretation? Have the test methods for measuring performance characteristics been accurately defined and are they reproducible? Has the intent of the consumer to get the most for his money been frustrated by giving a poor or mediocre product the edge over a superior product? Each of these questions are in themselves the basis for lengthy discussion but this paper is primarily concerned with the last and with the availability of ready and workable answers.

There is considerable leeway in the handling of business matters in industry, for the exercise of engineering judgment in the acceptance or rejection of a bid on a product covered by a specification. There are many cases where a product falls below the specified limit for a relatively minor characteristic but exceeds the minimum requirement by a wide margin on an important performance factor. The obvious thing would appear to be acceptance of the better product having the best overall performance but with slight departures in some respects from the specification requirements; such action can be taken in non-government procurement. If, however, this practice were followed during government purchase it would immediately give rise to the question of discrimination, or, expressed in another form; how could all competitive bidders have the same chance to compete if all of the rules for acceptable bids were not made known?

Disadvantages of Readvertising

The most obvious corrective step is to readvertise under revised specifications that lower the unimportant limit and raise the important ones, if in making this latter change it is still possible to get adequate competition and availability. This practice, however, has many drawbacks, one of which is the time consuming procedure of rewriting a specification and readvertising. It also poses another problem of how much a minimum limit can be lowered before it is under the level of adequate performance. There is no good answer to the man who points out that his product will pass a dielectric stress test of 1390 volts per mil compared to a specified minimum of 1400 v/m, so why not lower the minimum requirement since a decrease of 0.7 percent is not really significant? The contention may be true but the ultimate conclusion of successive reductions is a gradual approach to zero.

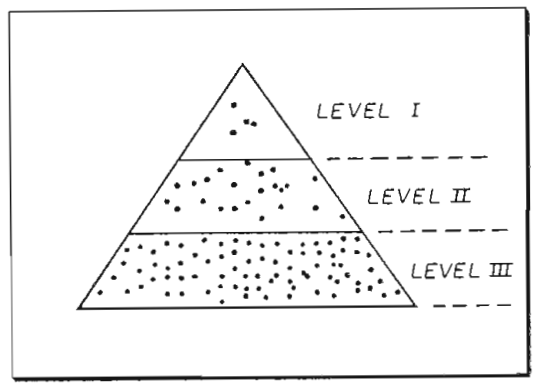


Fig. 1: Excluding exceptional or nonstandard cases, preferred strata of potential supply should fall in vicinty of level II, where dots represent supply sources

It is the aspect of quality that makes evaluation of a product difficult by conventional performance specification technique. It is known from engineering experience that exceptionally high performance for one characteristic usually results in the compensatory lowering of performance for another factor. The engineer tries to allow for this by predicting where the different levels of performance will occur and then reflecting his conclusions in minimum specification requirements. A difficult problem occurs when the products of different producers all have the lower performance values occurring for different characteristics. One type of magnet wire may have improved heat resistance but less ability to remain concentric within the insula-

SUMMARY OF TESTS, TYPE CM35E562K

Test	Par. No. of JAN-C5	No. Tested	No. Failed	No. Failures Permitted
As received				
Visual	F2c	48	0	0
Dielectric Strength	d	48	0	1
Insulation Resistance	e	48	0	0
Q	f(1)	48	0	0
Dissipation Factor	f(2)	48	0	0
Temperature Coeff.	h	6	0	0
Capacitance Drift	h	6	0	0
Capacitance	i	48	1	0
After Thermal Cycle & Immer.	j			1
Dielectric Strength	d	12	0	
Insulation Resistance	e	12	0	
Capacitance	i	12	0	
After Vibration & Corrosion	k			2
Visual	c	12	0	
Dielectric Strength	d	12	1	
Insulation Resistance	e	11	0	
Capacitance	i	11	0	
Life	l			1
Visual	c	12	0	
Dielectric Strength	d	12	1	
Insulation Resistance	e	11	0	
Capacitance	i	11	1	

in Military Specifications

the "individual test" as the basis for item greatly increased; costs materially reduced

tion than a second type where the reverse is true. The acceptance of minimum performance values taken from a summarization of all competitive products can result only in general reduction of quality.

The difficulty arises out of the inflexible nature of the conventional type of specification that is available for use. The criterion here is that the product must qualify as many times as there are characteristics to be met; it is not the summation of performance of the decathlon where an individual win or near win will accumulate point credits commensurable with competitive skill shown, but where ultimate victory requires the greatest show of total competence regardless of individual successes or failures. Assuming that the decathlon principle or the integrated total performance is applied to the specification how could it be worked out so as to be administratively practical, non-discriminatory in character and technically sound by acceptance of the good and exclusion of the poor?

It was suggested[2] that the work of Walter B. Pitkin in his book "Psychology of Achievement" might furnish the clue that would lead to the answer. In this work the author analyzes the careers of various types of people from moron to genius. Each characteristic of the man contributing to success or failure is plotted in magnitude on one of the spokes of a wheel emanating from a central hub. When the parameter is analyzed for the completed curve it is remarkably coordinated in the genius circle for personages like Paderewski and Edison; for others of lesser calibre parameters of lower magnitude occur. In using this principle for industrial products it would be impracticable and unrealistic industrywise, to require the genius level of performance and unsatisfactory from the service reliability standpoint to drop below the median level. Excluding the exceptional or non-standard cases, the preferred strata of potential supply should fall in the vicinity of level II, Fig. 1, where dots represent sources of supply.

Performance Factor Evaluation

A study of these ideas has developed one technique of evaluation that follows the basic concept of integrated evaluation. The more complicated integrated area of the wheel spoke arrangement has been eliminated in favor of the bar graph type of computation. The number of samples has been equitable considered by reducing performance of all samples to an equivalent single sample. Points are credited to the score for each test that is made and the total score is called the "Performance Factor".[3] The performance factor value is arbitrarily established based on engineering knowledge, consumer needs, and commercial availability of the product. The factor is a valid one if it does not reject obviously good components or accept poor ones.

In using this approach to acceptability of a product under a performance specification it is important to establish certain rules for its application. It is consistent with the philosophy of this discussion that performance factor technique should apply only to product quality and not to factors involving minimum functional requirements or dimensional interchangeability needs. These two latter categories involve usability of a product and should be measured by the "go" "no go" limits. If a relay coil does not operate at the right "pick-up" voltage or if the mounting dimensions do not fit the space available then the product cannot be used. These categories are therefore not within the scope of performance factor evaluation.

It is obvious after study that any system of evaluation will involve a question of relative importance of different performance characteristics and the assignment of proper weights. One solution to this and other problems is now proposed using the capacitor as a specific product example.

The chart illustrated by Fig. 2 represents a method of analyzing

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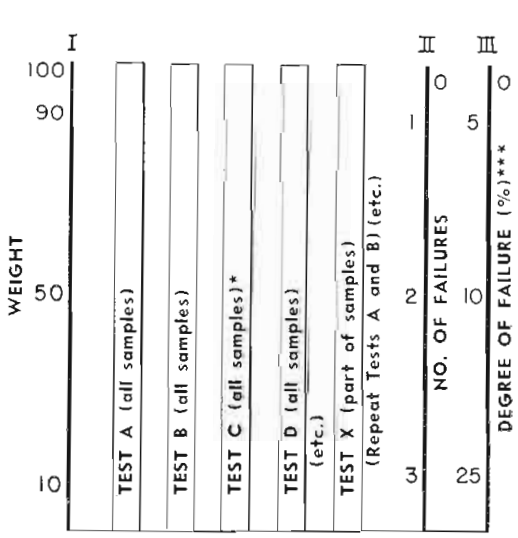
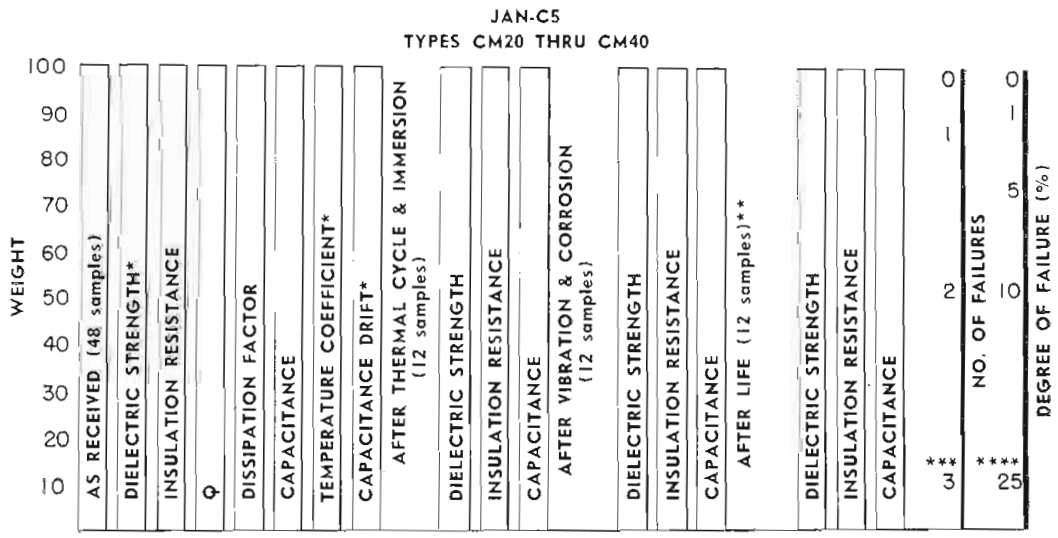
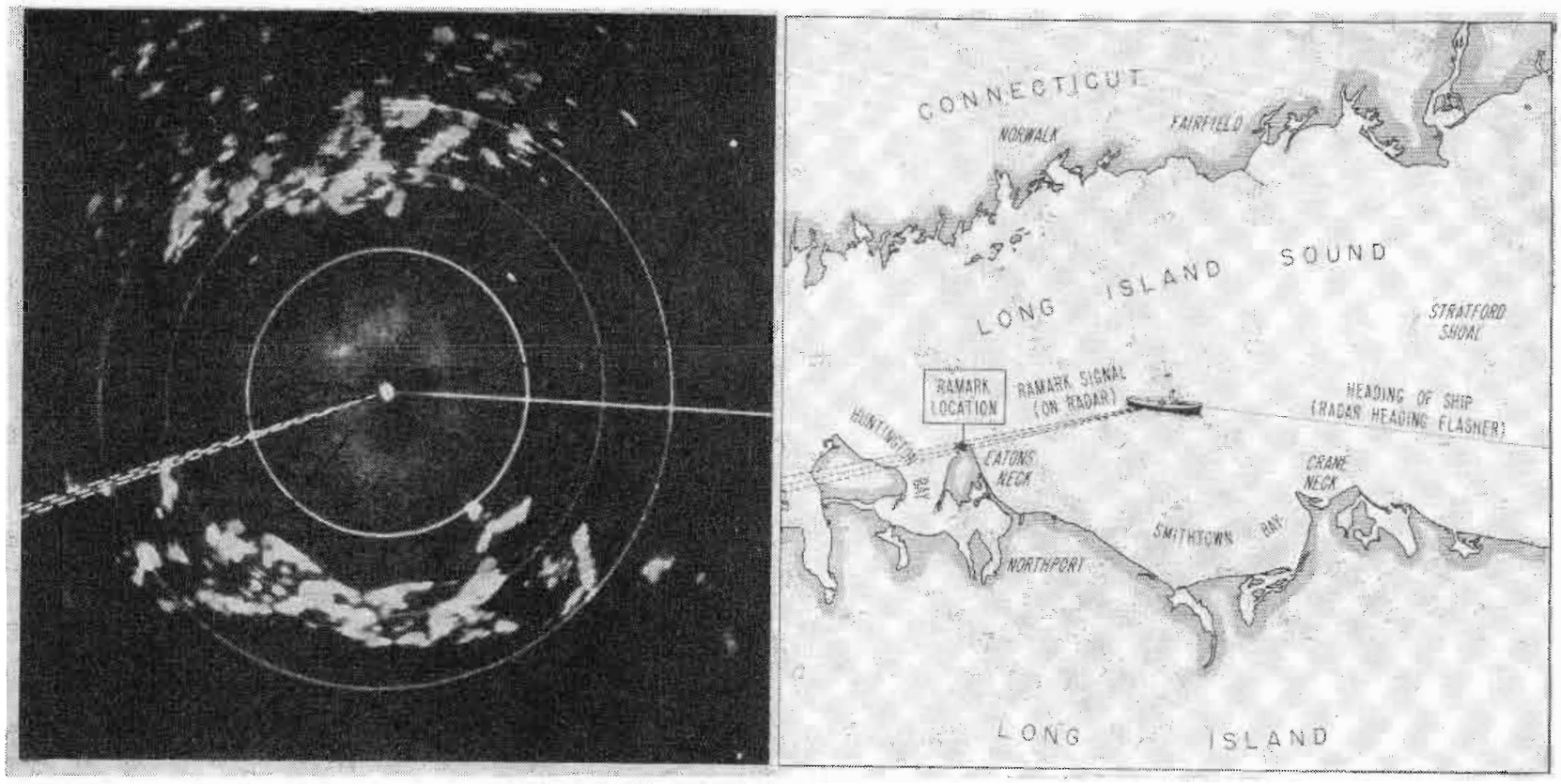
Fig. 2: (left) Integrated specification product performance chart. Fig. 3: (right) Chart for testing capacitors under JAN-C5 specs.



*Not applicable to "Degree of Failure". ***If "Degree of Failure" is over 25% score zero.



*Not applicable to "Degree of Failure". **Samples failing in the course of the life test shall be considered, for analytical purposes, as having failed "Dielectric Strength". ***Not more than 3 samples shall fail any test. ****If % is more than 25, Weight is 0.



New Crystal-Controlled

Designed to serve as a marine navigation aid, the TB-140 x-band ramark beacon operating at 9310 MC is characterized by excellent frequency stability coupled with relatively high power output

MODEL TB-140 x-band ramark transmitter is a new radar beacon which the Coast Guard now has in operation as an aid to marine navigation. The locations of three of these units now in operation are: on Ambrose Lightship outside the New York harbor, on Detour Reef Lighthouse on Lake Huron, and on Lightship 116 in Chesapeake Bay. This beacon transmits, continuously and omni-directionally, a pulsed signal on the x-band beacon frequency of 9,310 MC, and the received signal appears on a marine radar scope as a bright radial line or *radar mark*. The name ramark was coined from these words. Ramark was adopted in contrast to *daymark*, a well-known visual navigational aid. The position of the beacon can easily be determined since its bearing can be read on the marine radar indicator and the range can be determined by switching the radar from beacon operation to radar operation and noting the intersection of the ramark line and the target appearing on the radar scope. A composite photograph of this presentation is shown in Fig. 1.

As a class, the ramark beacons are characterized by continuous transmission at low peak power but with a high duty cycle and are intended primarily for marine use. This is in contrast to the more common racon type used in air navigation, which, after being interrogated, transmits a coded reply at high peak power but with a low duty cycle.

The r-f signal transmitted from the ramark is actually square-wave modulated (50% duty cycle) at any one of three preselected frequencies: 100, 200, or 300 KC. By the use of different modulation frequencies, it may be possible to identify beacons.

Excellent Frequency Stability

The characteristic of the Model TB-140 which distinguishes it from previous models is that it has excellent frequency stability combined with relatively high power output. The frequency control is accomplished by the use of a temperature-controlled crystal oscillator followed by a chain of frequency multipliers. This crystal control is operationally desirable since it means unattended on-frequency operation. The previous ramark beacons used a 2K39 reflex klystron as an oscillator, and frequency stability was a problem since most of them did not have automatic frequency control. Because of temperature variations and changes in loading of the 2K39, which has a coaxial output, the systems exhibited inferior frequency stability. This instability seriously impaired the usefulness of a beacon since practically all existing x-band marine radars use a tunable T-R tube (1B24) and have a receiver bandwidth of the order of 6 MC. Consequently, the constant attention of an operator was necessary to keep the beacon within these narrow limits.

Output power of the model TB-140 is approximately 2½ watts, which is high when compared to the ¼-watt output of the 2K39-type transmitters. This power increase is necessary for reliable operation at ranges of more than 10 miles.

The design of the Model TB-140 was made possible by the development of a new klystron, the SMX-32. Prior to the SMX-32, there was no tube available which would

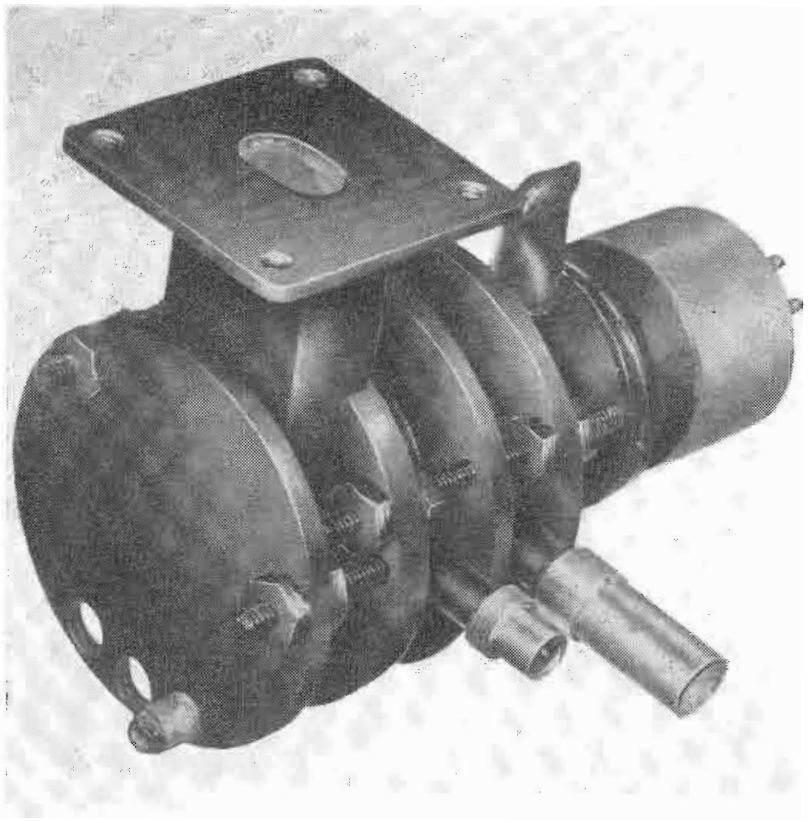


Fig. 1: (extreme left) Portion of photograph of radar oscilloscope and chart of same area. Beacon responses and heading flasher have been transferred from PPI photo to chart. On photo, circular variable range mark intersects ramark location and ramark signal at 7.7 miles

Fig. 2: SMX-32 klystron. This recently developed tube has three resonant cavities. It operates as a frequency multiplier-power amplifier on a frequency of 9310 MC with an output of 2.64 watts. (Over-driven operation)

Radar Beacon

By JOHN W. BUSBY *Radar Project Engineer, Sperry Gyroscope Co., Great Neck, L. I., N. Y.*

act as a frequency multiplier with an output at 9,310 MC. The SMX-32 shown in Fig. 2, is a frequency doubler which has three resonant cavities, the first two of which are tuned to the input frequency. The use of three cavities enables the tube to be used as an effective power amplifier.

The transmitter is rack mounted as shown in Fig. 3 and consists of five chassis and a dust cover. An omni-directional antenna and connecting waveguide are included to make a complete system. Two of the five chassis, the L-band exciter and the klystron deck, comprise the r-f system; the titles of the other three (modulator and control deck, klystron beam power supplies, and blower deck) are self-explanatory. The r-f output frequency of 9,310 MC is obtained by generating a crystal-controlled frequency of 5,387.-729 KC and multiplying it through several multiplier stages. The crystal frequency is multiplied 144 times in the L-band exciter and 12 more times by two multiplier klystrons. This signal is then applied to the output waveguide and the antenna. A system block diagram, Fig. 4, shows the function of the various system components.

Square-wave modulation is obtained by generating a sine wave at the preselected modulation frequency and squaring the sine wave in a later stage of the modulator. The modulation frequency is crystal controlled within ±0.02%. The square wave is used to grid modulate the final stage of the L-band exciter. The system, therefore, operates on a c-w signal up to the final stage of the exciter and thereafter on a pulsed r-f signal.

L-Band Exciter

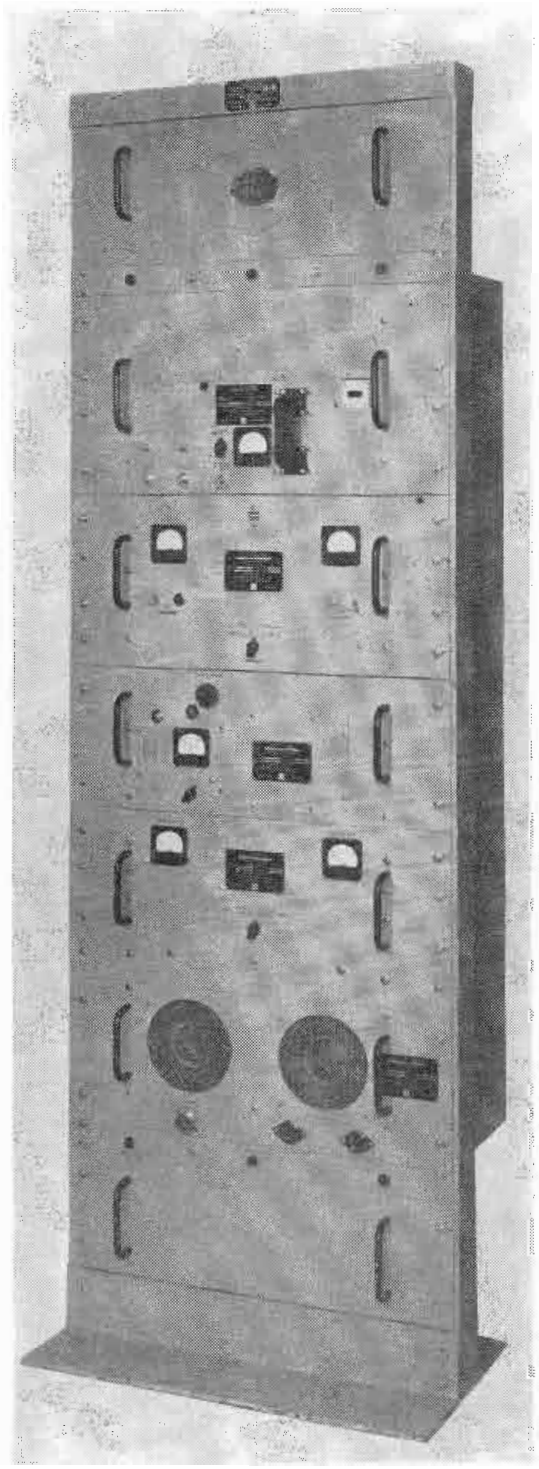
The L-band exciter generates a stable, fixed frequency of 775.833 MC and supplies a pulsed signal of approximately ¾-watt peak power to the first multiplier klystron. The oscillator is controlled by a 5,387.-729-KC crystal which is contained in a sealed unit, the temperature of which is kept constant by means of thermostatically controlled oven heaters. For an ambient temperature range of —20 to +50°C, the frequency stability is within 0.0006% (6 parts per million).

The exciter is a self-contained unit with a low voltage power supply located on the chassis. All grid currents and several plate currents can be monitored by means of switching a front panel meter.

Power output of the exciter is controlled by varying the plate voltage on the lighthouse tubes by means of a front panel control. The maximum output power is two watts, thus affording a comfortable safety factor since the drive required for the succeeding klystron multiplier stage is approximately 0.75 watts. (See Fig. 6)

The klystron deck, the second half of the r-f system, contains the two multiplier klystrons, output waveguide components, and asso-

Fig. 3: Ramark transmitter rack. From top to bottom: blank panel, klystron chassis, modulator and controls, L-band exciter, klystron beam supplies, blowers



CRYSTAL-CONTROLLED RADAR BEACON (Continued)

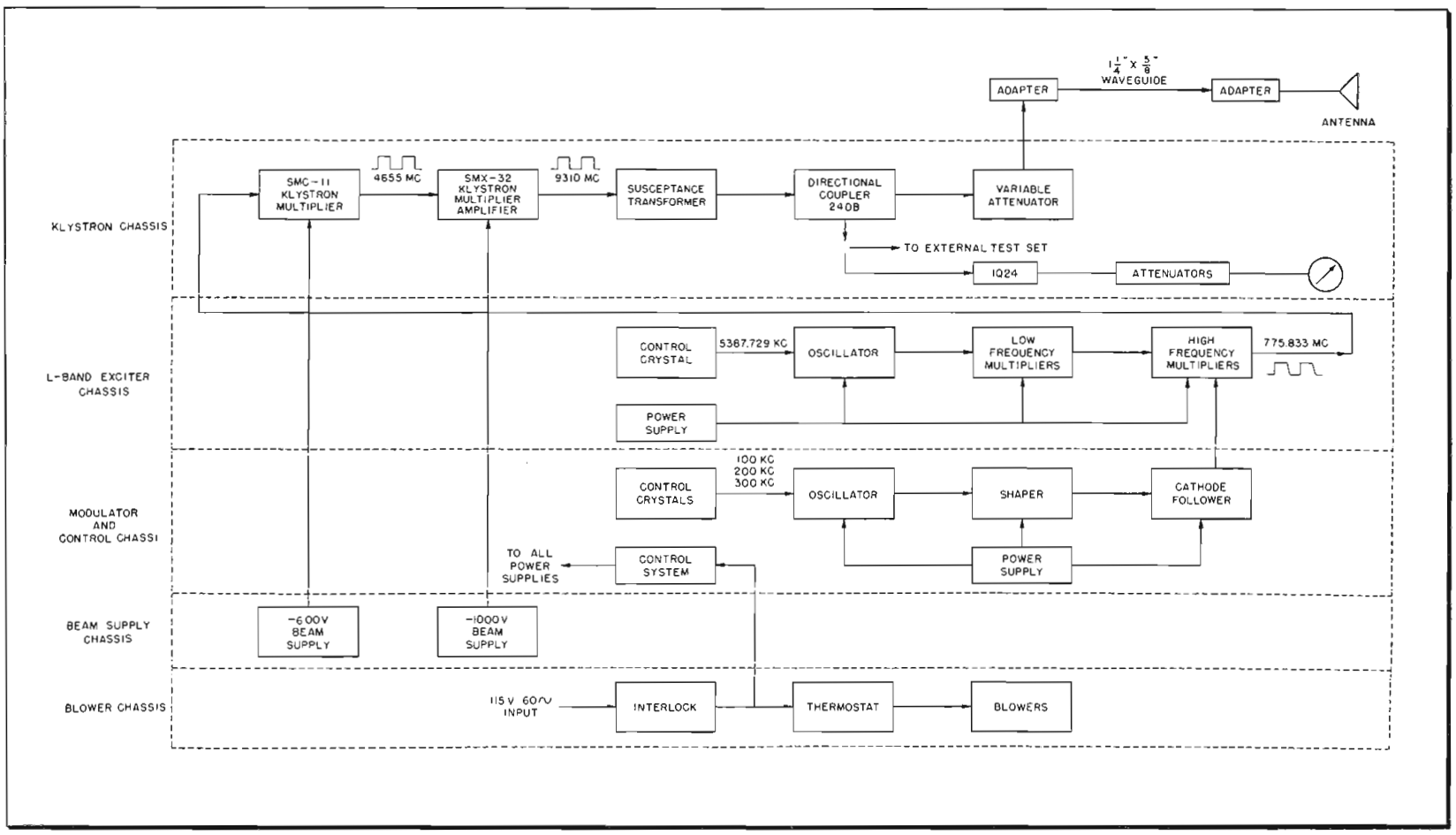


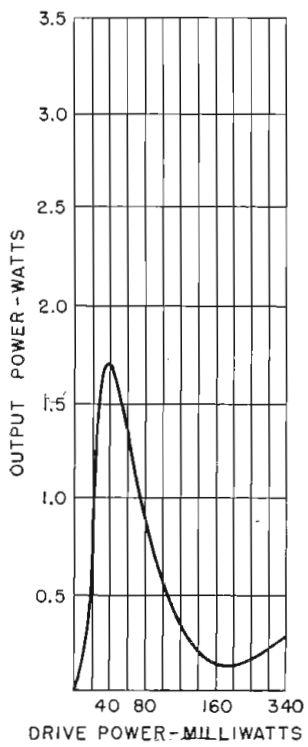
Fig. 4: Block diagram of model TB-140 Ramark radar beacon showing elements contained in rack chassis as illustrated in Fig. 3.

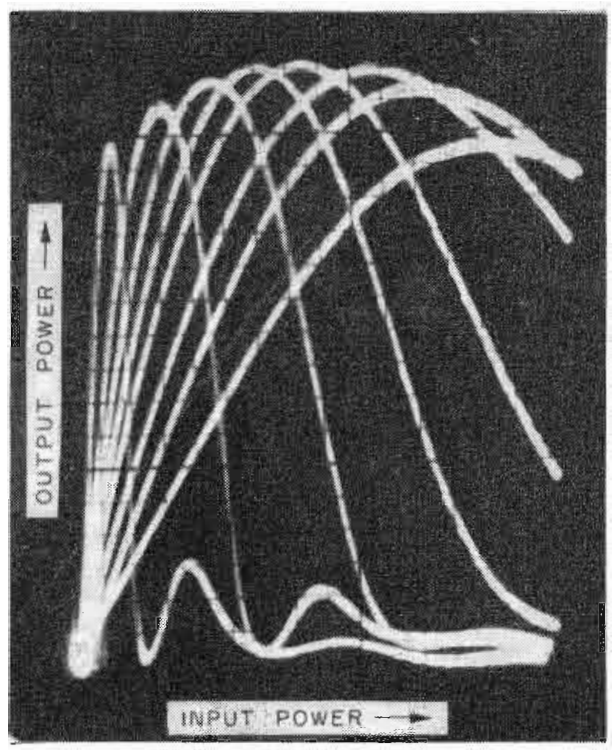
ciated test circuits. The first klystron, the SMC-11, is a two-cavity tube with a frequency multiplication factor of x6. The SMC-11 is driven by the output of the L-band exciter, 0.75 watts at 775.833 MC, and its output, as shown in Fig. 6, is approximately 125 milliwatts at 4,655 MC. The output of the SMC-11 drives the output klystron, the SMX-32.

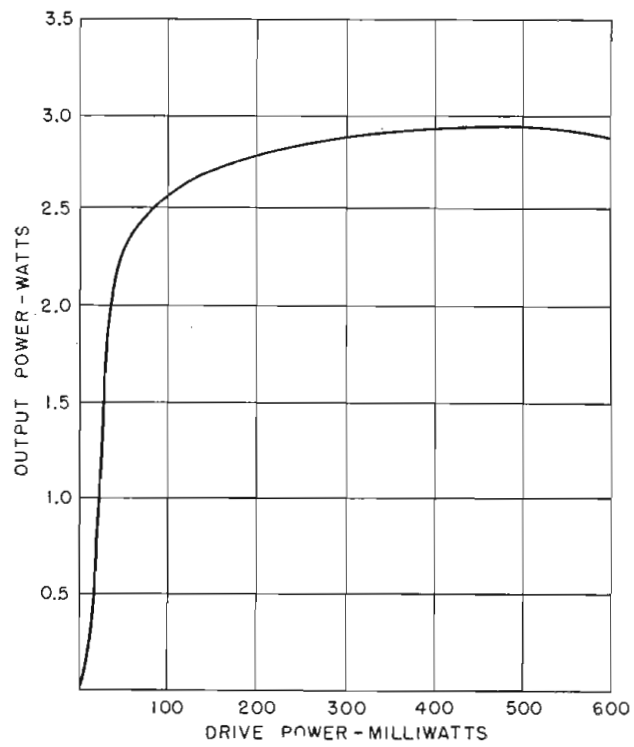
The SMX-32 is both a frequency multiplier (x2) and a power amplifier. Fig. 5a shows the relationship of output power to drive power. The condition of maximum efficiency (optimum drive) occurs when the first two cavities are tuned to the input frequency (4,655 MC) and the output cavity is tuned to the second harmonic (9,310 MC). However, the harmonic content at the output cavity can be increased by tuning the center cavity to a slightly higher frequency and by increasing the drive. This condition, which results in greater power output at the sacrifice of efficiency, is called over drive. Since power output is of prime importance in this system, the SMX-32 is operated in the over drive condition. Fig. 5b shows the family of

(*Continued on page* 65)

Fig. 5a-c: (l to r) Output vs. drive power at optimum drive; family of curves resulting when drive is increased as center cavity is retuned; envelope of curves in center illustration; All curves are with condition of 1000-v beam voltage, 9310 MC







How Engineer Can Become "Top Brass"

Self-training and inculcation of leadership, judgment, executive action, maturity and balance are needed*

By Dr. W. R. G. BAKER, Vice-president, General Electric Co., Syracuse, N. Y.

MORE than half of the young engineers of today, it is reported, aspire to end up as executives and managers. But certainly the more than 50 per cent of engineers who want to join the "top brass," as general manager or chairman of the board, have not given any thought to the occupational hazards of congressional investigations, high income taxes, or indigestion.

The reasons why the majority of young engineers wish to attain management positions are not always clear. It may be there is a rather widespread feeling that recognition, which the psychologists tell us is one of the major goals of human beings, is more readily grasped, or more willingly granted to those who accomplish things by managing people than by those who create by dealing with physical laws.

Whatever the driving force that impels more than half of the engineers to work towards management posts, the fact that they do, builds some very real problems for industry and for the profession, as well as for the individual engineer. Let me point out briefly, what happens during the transitional period, which may encompass a score of years, during the metamorphosis of manager from engineer.

"Breaking-In" Period

The young engineer emerges from school, and after a "breaking-in" period of some months, or perhaps a few years in which he familiarizes himself with the industry in which he has accepted employment, through assignments in drafting, or testing, he is named as one of the engineers working upon a definite project. His principal concerns are with the accomplishment of assigned tasks. His only dealings with people are limited to his associates and with his boss. When he is promoted to project engineer, with other engineers reporting to him, he is for the first time, called upon to "manage", to direct the work of others. No longer is he able to evaluate his work and his duties in engineering terms. He now is dealing with human values. Now he consciously or unconsciously has to determine what incentives bring the best results from the men whose activities he was directing.

The next step of the transition is to a chief project engineer. At this point his engineering training becomes principally a background upon which he draws in the formation of minor policies or the solving of problems. His problems no longer are engineering problems but impinge upon law, accounting, marketing and the managing of people. Again promoted, this time to engineering manager, his actual engineering work is limited to evaluating the recommendations of his subordinates. Another step up the ladder, and as vice president he depends upon the experts in the various fields, weighing their views against his own experience and judgment. He now is a manager.

Dr. Oliver E. Buckley of Bell Telephone Laboratories in discussing how inventions are created, made the statement that "When an inventor becomes an executive, he usually ceases to be an inventor." I believe we can substitute the word engineer for inventor. When an engineer becomes an executive, he usually ceases to be an engineer. His accomplishments depend upon how well he is able to manage people, his decisions are made in the light of whether people will be able to carry them out, whether people will want to buy, how people will be affected, whether people will like or dislike.

Since so many engineers have set their sights on management positions as their goals, industry, certainly and the engineers themselves, must take a realistic view of this trend. Certainly one of the first questions to be asked is "Why should an engineer make a good manager?" Surely if we are right in saying that a manager is one who accomplishes by directing the activities of people, then we must ask whether the engineer is qualified by education, by experience, by training for that important job.

Some engineering schools have awakened to the recognition that their responsibilities are more than merely equipping the student with the knowledge for successfully accomplishing engineering tasks. In the past decade or so some schools have added courses designed to permit the engineer to take his place in society, and of course, I am not using the word "society" loosely.

Training is Task of Industry

I am not sure that we can or should criticize the colleges for not grounding the student engineer in the fundamentals of management. I would rather believe that the task rightly belongs to industry, for it is industry's responsibility, and management's job, to create, maintain and continually build a reservoir of management talent from which they can draw in response the ever increasing demand of our expanding economy for more and more and better qualified managers.

Further, I do not believe it is possible to establish a school which successfully could train its graduates to step into management positions. What school, for example, could imbue its students with such qualities as maturity, balance, and leadership, all of which are so essential to good management. I do not mean that good management practice cannot be taught, and I will admit that knowledge of what is good management *practice* is a pre-requisite of good management, but can the schools teach judgment, and the ability to see all sides of a problem involving human as well as material values?

(*Continued on page* 60)

THE ENGINEER

who has done such a magnificent job of giving us the world's best transportation, communications, and industrial machinery, has (compared with members of other professions) failed to give sufficient effort to solving the problems of human relations. Yet it is these same problems that the engineer, turned manager, must concern himself with, in his new job.

*Extracted from Dr. Baker's address before recent IRE-RTMA meeting at Syracuse.

Video Design Considerations in a TV Repeater Link

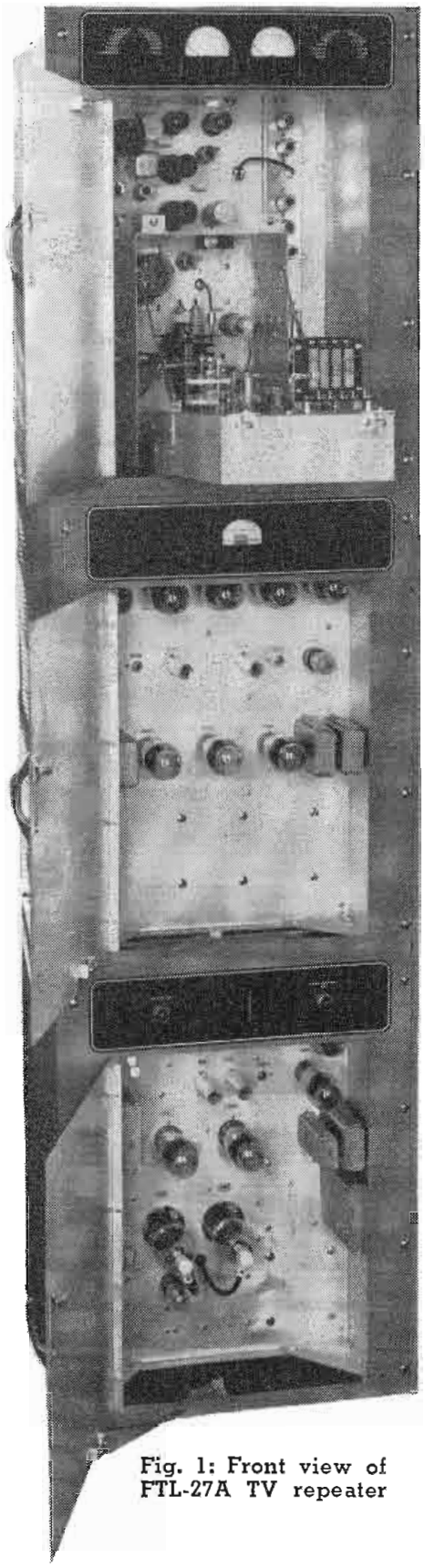


Fig. 1: Front view of FTL-27A TV repeater

A discussion of the frequency and transient response factors in a microwave system involving ten repeaters

by M. SILVER, L. STASCHOVER, H. FRENCH,
Federal Telecommunications Labs. Inc., 500 Washington Ave., Nutley 10, N. J.

THE rapid expansion of television broadcasting throughout the country and the attendant need for network facilities have established an immediate demand for high quality, wide band, and point to point communications. Early in 1948, the Federal Telecommunication Laboratories Inc., undertook the design of a television relay link of ten repeaters (now known as FTL-27A) to operate in the assigned 2000 Mc band.

The system involves direct frequency modulation at 2000 Mc, the deviation being 7.5 Mc peak to peak. Amplification is accomplished at intermediate and video frequencies. A typical transmitter-receiver unit is shown in block-diagram form in Fig. 2.

The video input to the transmitter is amplified by a video amplifier, whose output frequency modulates a 200 Mc reflex klystron oscillator. The oscillator has a power output of 10 watts and feeds a high-gain parabolic antenna.

A similar antenna is employed at the receiving end to feed a conventional superheterodyne receiver. Included are a pre-selector, crystal mixer, and klystron local oscillator. The intermediate frequency is 120 Mc, which is amplified by an i—f amplifier, having a gain of 90 db., then passes through two cascade limiters, to be detected by a balanced discriminator. The demodulated video signal is amplified by a video amplifier equipped with three separate 75-ohm outputs. Both transmitter and receiver klystrons are stabilized by automatic frequency control systems based on crystal comparison.

The system is adjusted, so that 2 v. peak to peak video input into the transmitter will result in 2 v. peak to peak output from the receiver. The equipment is designed so that 10 repeaters may be cascaded without sacrifice of certain requirements of transient response, noise, and compression. This paper is concerned primarily with design problems in the video sections of the system.

We shall first consider the transmitter video amplifier whose requirements are determined primarily by the characteristics of the high frequency oscillator tube. A readily available power oscillator for the 2000 Mc band is the Sperry SRL7 klystron which requires a repeller signal voltage of about 100 v. peak-to-peak for 7½ Mc peak to peak frequency deviation. Since the minimum video input signal to the transmitter is specified as 1 volt peak to peak, the modulator must have a gain of 100 and be capable of supplying 100 v. peak-to-peak at low distortion.

High Frequency Response

Foremost among video design problems is that of providing satisfactory high frequency and transient response. The RMA Standards for TV Relay Facilities merely specify that there be "no appreciable discrimination as to amplitude or phase shift in the band from 60 cps to 4.5 Mc", which is not considered sufficient as a specification for design. We can readily measure the frequency response of a video amplifier, but its phase response is not easily investigated.

Since the primary objective is to provide good picture quality, meaning adequate transient response, a more tangible and definite approach is to specify the response of the system to a step voltage of known rise time and overshoot.

The results of a design based on transient rather than steady state response may be checked conveniently by means of a good pulse generator and a wide-band, high-speed, cathode-ray oscilloscope.

The characteristics of the input test pulse must, of course, be realizable in practice without undue difficulties. A specification for the lead-

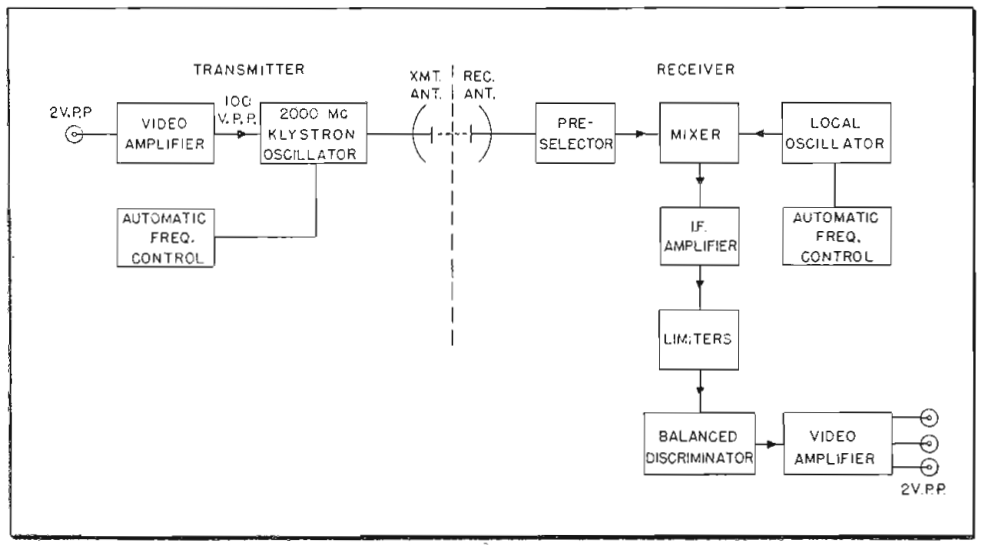


Fig. 2: (left) Block diagram of transmitter-receiver unit of repeater link.

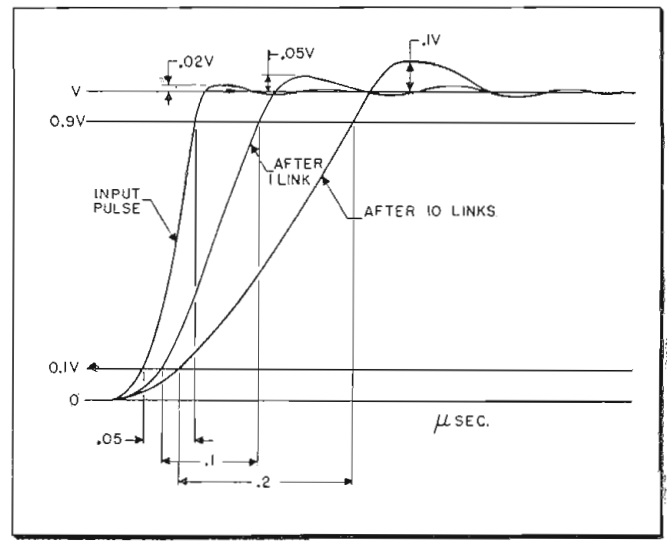


Fig. 3: (right) Transient response specification.

ing edge of .05 μsec. rise time and 2% overshoot, as shown in Fig. 3, seems quite reasonable. To meet present-day TV standards, this test pulse must not deteriorate to one of more than 0.1 μsec. rise time after one transmitter-receiver unit and .2 μsec. rise time after ten repeaters. The overshoot should not exceed 5 and 10% for 1 and 10 links respectively. We define rise time as the time required by the leading edge to rise from 10% to 90% of the final amplitude of the pulse. To achieve these requirements, some type of video compensation must be employed.

Coupling Network

From various investigations of the transient response of compensated video amplifiers,[1] the simple shunt peaked circuit of Fig. 4 appeared to be a satisfactory video coupling network from the point of view of performance and simplicity of adjustment. R represents the load resistance, C the lumped wiring and tube capacitances, and L the peaking inductance.

The response of a shunt peaked stage to an ideal unit step may be expressed conveniently in terms of the Q of the circuit at ω_{LC}, the resonant frequency of L and C. The Q is defined as $\omega L/R = \omega_{LC}$. By some algebraic manipulations, Q may be shown to equal the ratio of ω_{RC}, the cut-off frequency of the uncompensated stage, to ω_{LC}, where $\omega_{RC} = 1/RC$ and $\omega_{LC} = 1/\sqrt{LC}$. For a given amplifier stage, ω_{RC} corresponds to the 3 db point on the frequency characteristic of the uncompensated stage taken with L shorted out. ω_{LC} may be readily determined by means of an absorption type wavemeter, with R shorted out. As the value of Q is increased, the rise time is shortened at the expense of rapidly increasing overshoot. A compromise design results in 2% overshoot and a rise time of 1.33 RC, corresponding to Q = 0.6.

It is not too difficult to obtain information as to the response of a single stage to an ideal unit step. The response of a number of stages in cascade presents a somewhat more involved problem. As a good approximation, for small values of overshoot per stage of the order of 1 to 2%, the overshoot remains practically constant as the number of stages is increased. For stages having the same rise time per stage, the total rise time will vary as the square root of the number of stages.

If we assume n compensated video stages in 10 links, and design each stage with a Q of 0.6, the overshoot will not be much larger than 2%, and the allowable rise time per stage will equal 1.33 RC or $T/\sqrt{n}$; where T is the allowable rise time after 10 links, and n the total number of compensated stages. The minimum uncompensated cut-off frequency per stage:

$$f_{RC} = 1/2\pi RC = 1.33\sqrt{n}/2\pi T$$
$$f_{RC} = 0.211\sqrt{n}/T$$

As mentioned before, the cut-off frequency of each stage may be checked experimentally by shorting out the peaking coil and determining the 3 db point on the frequency response curve. For Q = 0.6, L is then resonated with C at $\omega_{LC} = \omega RC/0.6$. It may be shown that at Q = 0.6 the frequency response of the compensated stage is 3 db down at $\omega = \omega_{LC}$. With the test pulse applied to the video amplifier, final coil adjustments are made by observing the rise time and overshoot on a wide-band oscilloscope.

The problem now is to select amplifier tubes to obtain the required gain at low distortion with the RC product dictated by transient response requirements, considering also the inter-related parameters of tube capacitances, transconductance and current swing capacity.

The distortion problem is complicated by the asymmetrical nature of

Fig. 4: Diagram of shunt-peaked stage

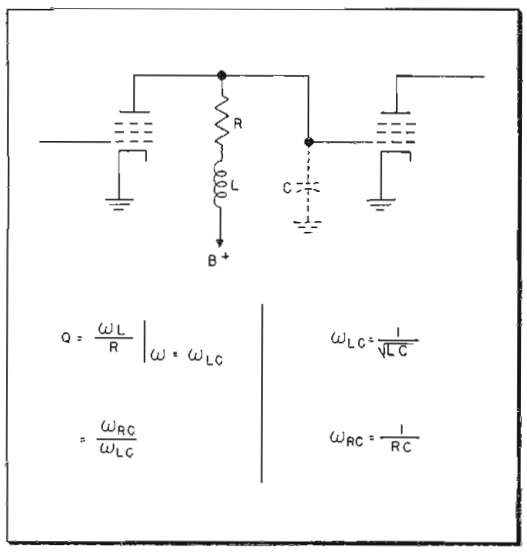
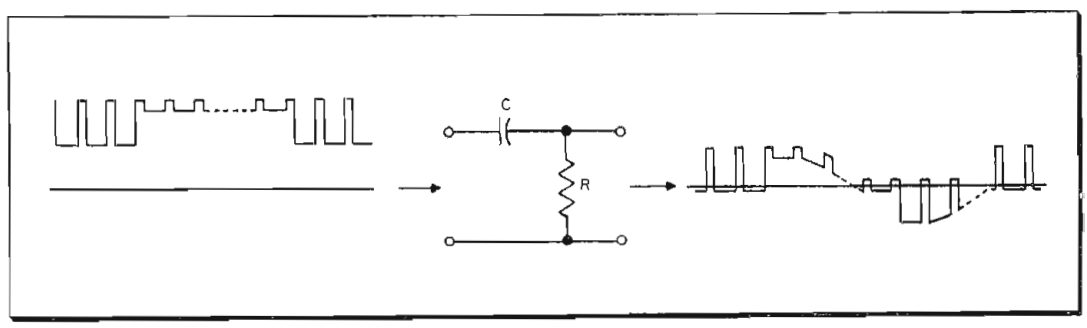


Fig. 5: Diagram illustrating the effect of losing the dc component of signal



VIDEO DESIGN CONSIDERATIONS (Continued)

the composite television signal. Loss of the dc component due to capacitive coupling between amplifier stages results in substantial increase in the peak to peak signal excursion. In Fig. 5 a television signal changing from white to black and then back to white is applied to an RC circuit. Since the capacitor blocks dc, the output voltage will, in the steady state, adjust itself to zero dc component. This steady state condition is approached at a rate determined by the RC time constant. At the same time the capacitor acts as a short-circuit to transient changes of input voltage.

Output Waveform Increased

Assuming the synch pulses to occupy 25% of the white signal amplitude, the peak to peak excursion of the output waveform is increased by 75%. This requires greater signal handling capacity of the video amplifier tubes and much larger bandwidths in the radio and intermediate frequency stages.

This increase in signal swing may be avoided by reinserting the dc component at critical points in the system. The process by which this is accomplished is illustrated in Fig. 6. E_s is a composite video signal in which the synch peaks have been misaligned by the time constants of preceding video circuits. A switch, representing the ideal dc inserter, is closed during synchronizing pulse period T_1, and open during T_2, the remainder of the horizontal line interval. During the synchronizing pulse period, capacitor C charges or discharges instantaneously to the peak of the synch voltage, maintaining it throughout the line scanning interval until the advent of the next synch pulse. Capacitor voltage e_c is shown as the dotted curve in Fig. 6. The video output voltage is the algebraic sum of e_s and e_c. Its waveform shows perfect alignment of the synch peaks, which implies that its dc component has been restored. If the dc inserter can follow rapid variations of synch peak levels, it is not necessary to provide low frequency compensation, since the synch pulses occurring at a 15 Kc rate act as amplitude reference markers for low frequencies.

The ordinary dc restorer, consisting of the parallel combination of a diode and a high resistance, fails to meet these requirements in several respects. Without going into details regarding the operation of this circuit, the difficulties may be ascribed primarily, to the large difference between charging and discharge time constants. The charging time constant through the diode is normally small, but the discharge time constant through the resistor must be made very large to avoid horizontal picture shading and so-called vertical sync error, i.e. lowering of the vertical sync pulses with respect to the level of the horizontal sync pulses. As a very undesirable result, the dc restorer will readily charge up to noise peaks, but recover from them very slowly. An impulse noise pulse may therefore result in a streak of horizontal blank lines across the picture. A much superior type of circuit is the so-called "driver clamp", in which the charging and discharging time constants are equally small. A noise pulse will therefore merely manifest itself in anywhere from a dot to a single line. In these circuits, clamping pulses, coinciding in time sequence with the video synchronizing pulses are applied to an electronic switching circuit, alternately short and open circuiting the output terminals. No switching voltage should appear

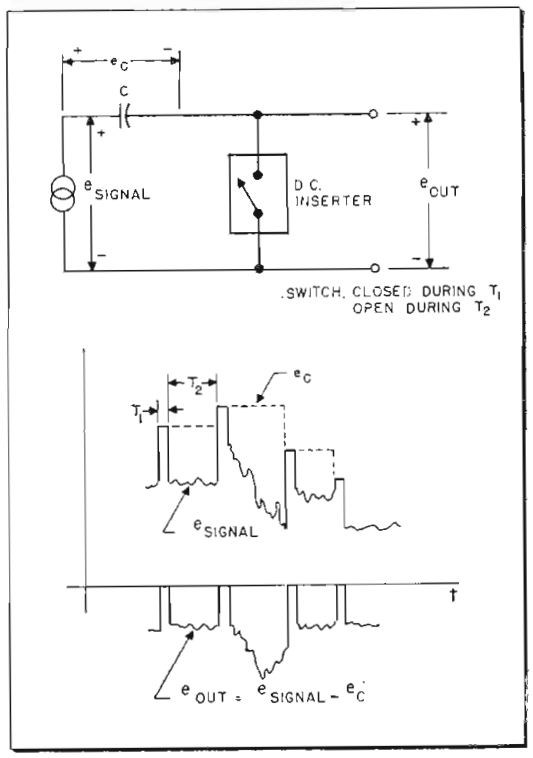


Fig. 6: Action of the dc inserter

across these output terminals.

The heart of the clamping system, shown in Fig. 7, is a blocking oscillator which supplies 1 μsec clamping pluse at the horizontal synch rate. The balanced output of this oscillator drives 4 clamps. Every stage in the modulator is clamped, except the first stage, which handles comparatively low signal levels and the cathode follower which has inherently low distortion. The blocking oscillator is synchronized by synch pulses derived from the incoming video signal. The synch separator is a pentode amplifier which is biased so as to amplify only the synch pulses above the black level. The absolute level of the synch pulse peaks must be constant, so that the video signal must be clamped at that point. Hence clamp #4.

The synch pulse waveform includes horizontal synch pulses as well as vertical equalizing and serrated pulses which occur at a 60 cycle rate, resulting in 60 cycle current compon-

(*Continued on page* 61)

Fig. 7: (left) Video modulator and clamping system.

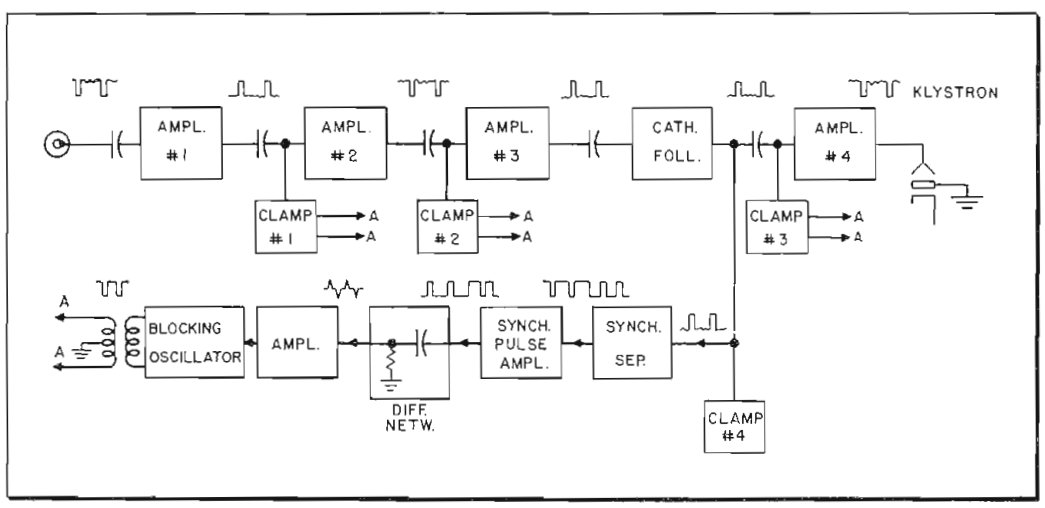
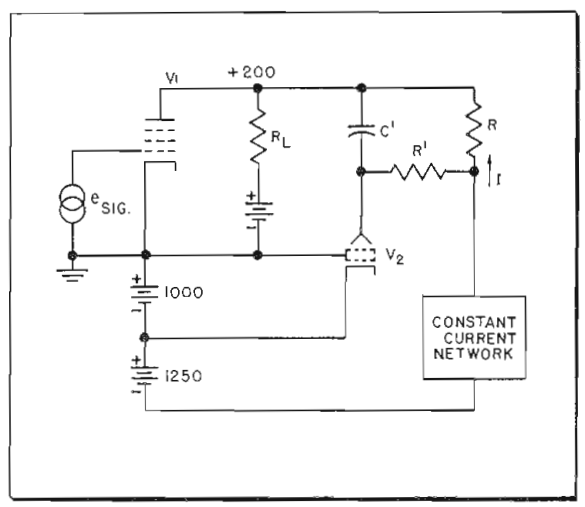


Fig. 8: (right) Scheme for dc coupling video output to klystron.



Improved RCA Color TV

Demonstrations show tremendous progress in all-electronic color TV; 3-gun, 3-color tube has 600,000 screen dots

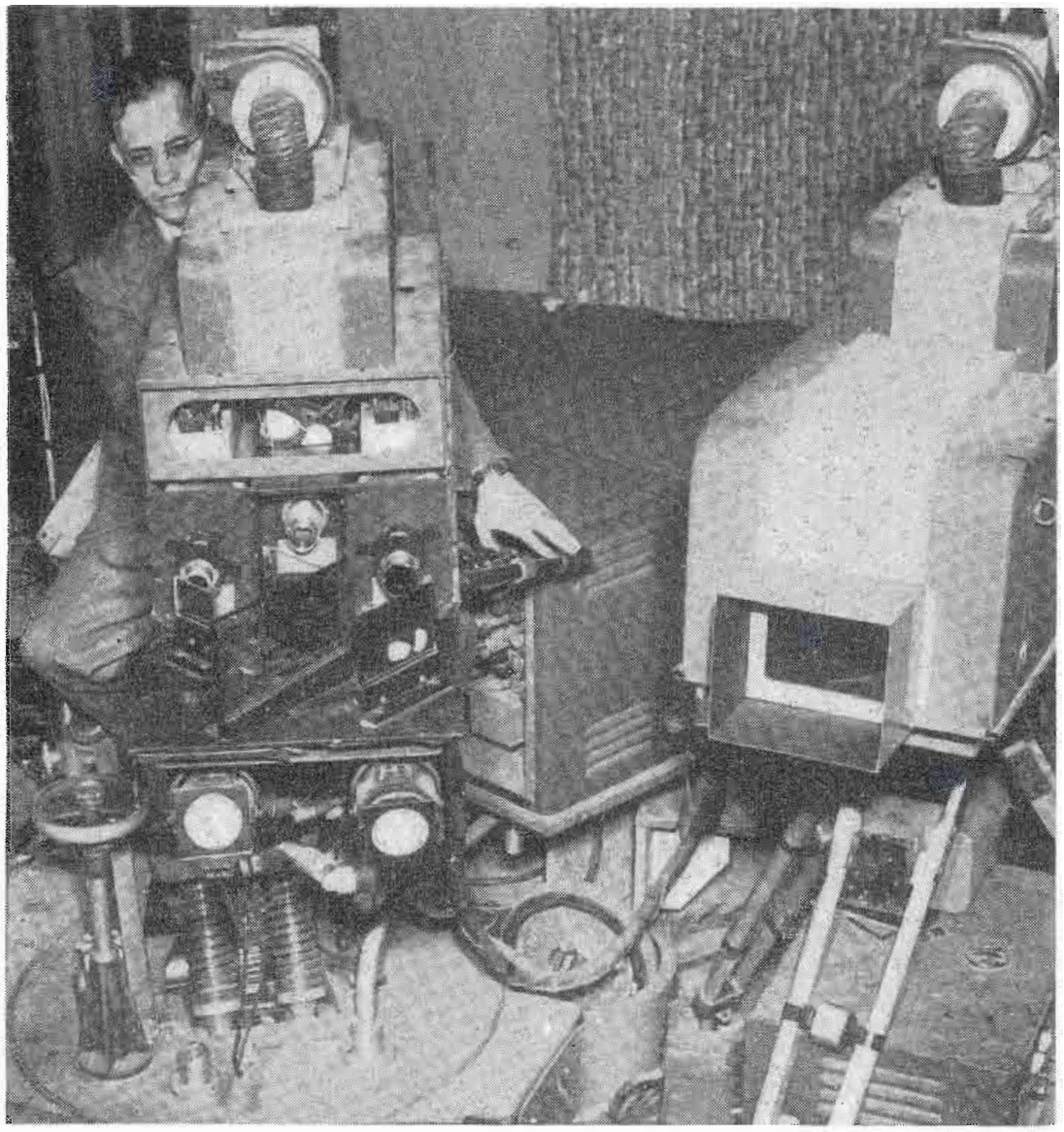
MEMBERS of the FCC should have attended informally and seen for themselves the series of demonstrations of the improved RCA color system which began in Washington December 5, and were viewed by a thousand or more engineers and manufacturers.

To the ordinary, non-technical observer these new 43-tube color-TV receivers showed a distinct improvement in picture brightness, detail, color fidelity, and texture.

In addition to the special color sets (one pictured on this page), compact color converters of two types were shown. In one standard RCA black-white set, the regular 16-in. black-white picture-tube had been replaced by a 3-gun tri-color tube, and the extra components, including 13 tubes, were mounted on a shelf at the back of the cabinet. The second type of standard-set converter was in the form of a "companion set" or "slave" model, utilizing a second cabinet and a separate picture-tube for color. The performance of both was thoroughly acceptable, although Dr. C. B. Jolliffe in presenting them, commented that neither was more than 75% as good picture-wise as a specially-built color-TV receiver.

Cross-section of opinion of the picture on RCA's new color receiver indicated that its picture quality now meets the high standards of the critical American home, and is superior to the remembered CBS picture in every feature, except possibly over-richness or depth of color. A few observers said the picture still had a slightly "soft" effect but all agreed that the reproduction of flowers, vegetables and fruit was the best they had seen.

All-electronic RCA color-TV receiver. Color tube has 600,000 phosphor dots



Color-TV cameras using three pick-up tubes and dichroic mirrors to produce signals in color for all electronic transmission

Engineering Evaluation

Television engineering observers would note features in addition to those above and would endeavor to find the reasons for the improvements.

For instance: *Improved Definition,* due to increase in tri-color tube from 360,000 to 600,000 picture points; *Increased Brilliance* (now 20 ft.-lamberts) and *Improved Color Fidelity,* due to new red phosphor, permitting elimination of former red filter; *Improved Texture,* due to "filtering out" dots by by-passing monochrome signal at transmitter and receiver as suggested by Hazeltine; *Simplified Circuits,* now 43 tubes in receiver and 2 additional controls (these could be at rear of set because they are for color phasing and chromo-control, latter establishes balance between monochrome and color components in picture); *Color Balance,* in special test for this, excellent "whites" with no contamination were shown (misadjustment of one set

(*Continued on page* 59)

New Editing Machine for Professional

Unit features rapid, yet simple means of spotting, marking, cutting and splicing tape; incorporates high quality audio reproducing system

THE need for an instrument designed to facilitate the editing and play-back of magnetic tape recordings has become apparent with the rapidly increasing use of tape as a recording medium. Such a machine should provide a rapid, yet simple means of spotting, marking, cutting and splicing the tape as well as incorporating all those features to be found in a professional quality tape recording mechanism.

The ultimate performance of an editing machine depends, to a large extent, upon the quality of its tape handling facilities. Consequently, a considerable amount of time was spent in the design and development of a drive system providing performance equivalent to that of a professional tape recorder. Rapid starting and stopping of the tape as well as fast rewinding action is essential for accuracy and speed in editing magnetic tape. Excellent performance in these respects has been obtained by driving each reel with its own torque motor and providing fast acting solenoid operated braking mechanism on each reel drive.

Three reel drive mechanisms are shown on the top panel in Fig. 2. The left hand reel is used to supply program material to be edited, while the other two reels are used to take up the edited tape. The control circuits are so arranged that edited or discarded tape may be either run into a basket or wound on either reel as required providing a flexible arrangement for editing operations. Normally, the center reel is used for the edited program while the right hand reel is used to hold the unwanted tape.

Rewinding and Stopping

Using an N.A.B. standard 10½ inch reel as a basis for measurement, the editor will completely rewind 2400 ft. of tape in one minute if started from a dead stop. Equally fast stopping and starting is available so that a complete stop from playing speed is made in approximately 0.1 sec. and a stopped tape can be started to wow-free speed in approximately 0.5 sec.

Experience has shown that accuracy of timing and the high rewinding speeds attained by the editing machine necessitate the use of a positive locking reel retaining knob on each reel drive. The knob, shown on top of the reel drives in Fig. 1, meets all requirements without decreasing editing speed or ease of operation in any way. It is equipped with a retaining device that locks when the knob is pushed over the drive shaft. A finger-tip operated release provides an instantaneous opening of the locking device to permit a rapid change in reels. The knob is designed to accommodate all standard reels by using its base as a hub for the standard 10½ inch reel and by setting it on top of the 7 inch reel. A special retaining ring in the base of the knob allows the 10½ inch N.A.B. standard reels to be removed or pressed on over the knob without necessitating removal of the knob itself.

Additional protection against accidental release or slippage over a long period of operation is provided by a knurled locking bushing which permanently locks the knob to the drive shaft.

Synchronous operation at tape speeds of 7.5 and 15 inches per second is obtained by driving the capstan with a hysteresis—synchronous motor through a cogged belt and gear arrangement. High stability with a resulting low percentage of wow and flutter is obtained through the use of a high inertia system properly stabilized and operating continuously. Timing accuracy is such that 30 minutes of playing time is within ±2½ sec. of synchronous tape speed.

Fig. 1: Photo showing overall front view of the new magnetic tape editing machine

Control System

The control system, located in the lower left hand corner of the motor board, as shown in Fig. 2, is built around a three position push button switch, by means of which the operator selects the required mode of operation.

The tape is started in Fast Forward or Rewind by pushing the designated button and stopped by the Play button. Switching from Rewind to Fast Forward or vice versa, is accomplished by pushing the but-

Tape Recordings

By D. C. YARNES,
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Engineering Products Dept.,
Radio Corporation of America,
Camden, N. J.

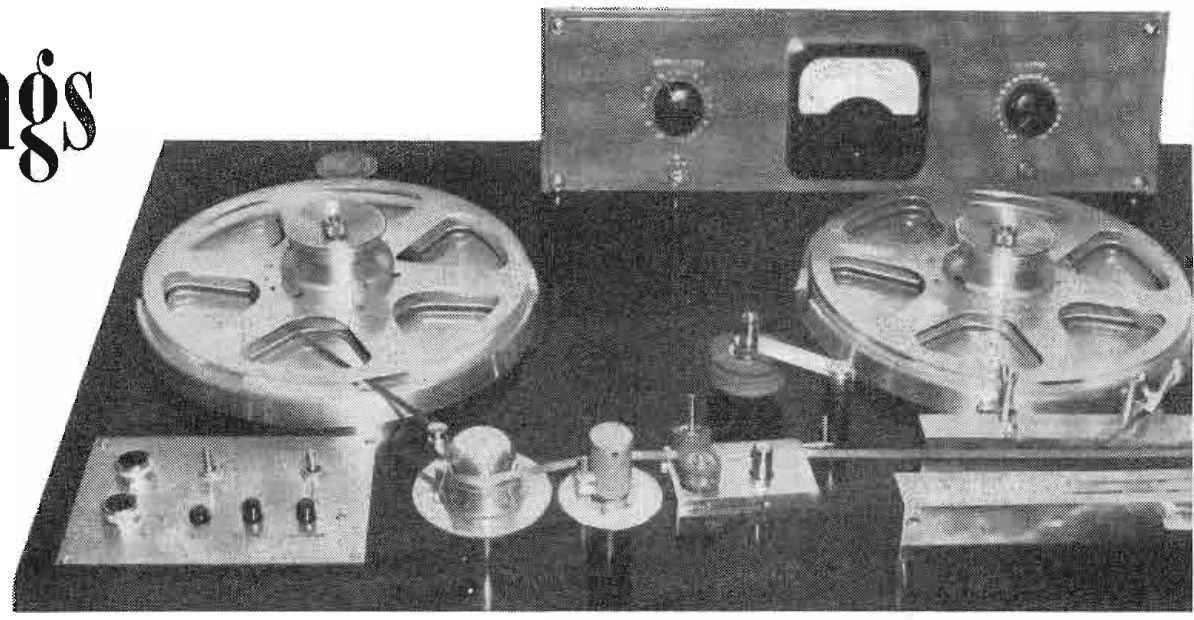


Fig. 2: Editing accessories and machine components shown from left to right include: Control panel, stabilizer, reproducing head, tape marker, capstan tape cutting and splicing bars, vacuum system switch and one of reel drive tape take-up arms

ton for the desired operation.

The tape is played back by pushing the Play Button and manually lowering the capstan pressure roller. Raising the roller stops the tape.

Various interlocks, at the same time, act in conjunction with the selector switch to prevent operation with improper tape threading, as well as to stop the reel drives in case of tape breakage.

Each of the two take-up reel drives is provided with an independant control circuit actuated by its own tape take-up arm. In addition, the control system is so arranged that the editor, if he wishes to gain the time required for threading the tape into the take-up reel, may run the discarded tape into a basket by putting the machine in "Play" position and allowing the capstan to pull the tape from the supply reel.

Tape speed is easily changed from 7½ to 15 inches per second by operating a toggle switch conveniently located on the control panel. A relay controlled speed compensation in the Reproducing Amplifier is also actuated by the speed change switch making possible a rapid change in tape speed with a minimum of operational effort.

Threading the tape and manual operation of the reels for spotting the tape in editing are greatly facilitated by a brake release on the reel drive mechanism. This release is effected by a sequence type foot switch located in a foot ramp, shown in Fig. 2, which energizes the brake solenoids by means of a relay. This operation is entirely separated from the normal control circuits, allowing the operator to release the brakes at any time regardless of the position of the tape or control switching at that instant.

The audio system shown in Fig. 3 consists of a Reproducing Head, Reproducing Amplifier, Amplifier Power Supply, Program attenuator and provision for speaker or head set monitoring.

The plug-in Reproducing Head shown in Fig. 1 has been designed to combine professional quality reproduction with ease of adjustment. A single screw azimuth control and a simple means of rotating the head enable the operator to obtain optimum performance wth a minimum of adjustment.

The output of the Reproducing Amplifier is supplied to two 150/600 ohm monitoring receptacles at the back of the equipment through a Bridged Tee attenuator. A maximum output of +24 dbm at maximum recording level is available for supplying an external monitoring amplifier or magnetic tape recording equipment.

A VU meter, with a variable attenuator, and head phone jacks have been supplied to furnish local monitoring as desired by the operator.

Marking the Tape

The time consuming and tedious task of marking, cutting and splicing the tape has been reduced to a rapid process by three accessories that have been added to the tape editor.

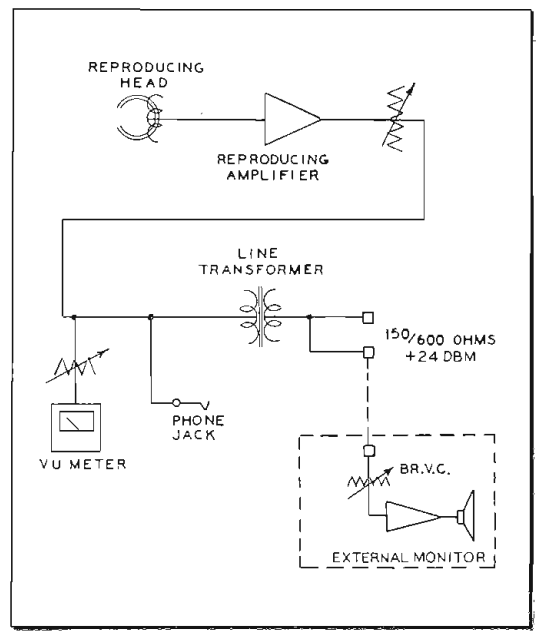
The tape marking device is shown located between the Reproducing Head and the capstan shaft in Fig. 1. It is composed of a rubber pinch roller and a rubber marking roller between which the tape is passed. The marker is actuated by releasing the pinch roller and drawing the tape manually between the two rollers. The marking roller measures the tape and makes a pin prick coinciding to the center of the Reproducing Head, allowing the operator to make an accurate cut in the recorded tape. Increased editing speed is obtained in practice by marking both ends of a section to be cut before performing any cutting or splicing operations. Finger-tip control of both the release and return of the pinch roller allows the operator full use of both hands while carrying on the marking operation at the same time, increasing the speed and improving the accuracy of the marking operator.

The tape cutting bar is located near the center of the motor board above the tape path as shown in Fig. 1. It is composed of two hollow ground stainless steel cutting knives mounted on a single bar. Either a 45° or 90° cut can be made at the option of the operator providing the versatility demanded by the normal editing operations, while complete freedom of hands and greatly increased cutting speed are facilitated by a special vacuum system that holds the tape firmly to the cutting bar.

The tape splicing bar, shown in Fig. 1 below the tape cutting bar, completes the special accessories on the editing machine. It is composed of a single bar upon which a pair of

(*Continued on page* 58)

Fig. 3: Outline diagram of the audio system incorporated in the editing machine



Elargol Low-Cost Printed Circuits

Photographic type printing and fixation by heat and chemical change are used to set circuit connections on plastic

By P. P. HOPF,
Ward, Blenkinsop & Co. Ltd.
6 Henrietta Place, London, Eng.

Part Two of Two Parts

PRINTED circuit production gives only first quality items and rejects, but the percentage of the latter should be very small. In fairness it should be stated that there is no production of anything in industry today without some rejects.

In the Elargol Process a prepared metallic powder (which may be silver, or for resistor printing a poor conductor like carbon, graphite or an alloy like nichrome) is dispersed in volatile materials with slightly depolymerising properties to ensure good contact with the plastic. The mixture is then evenly applied to the chassis surface and a photographically-produced warm printing block is lightly applied to the surface. The conductor then undergoes a chemical change corresponding to a recrystallization or reorientation wherever the block is in direct contact. The change takes only a fraction of a second and the unchanged material may be washed or brushed off. The required pressures and temperatures are so small that even the most sensitive commercial plastics like polythene may be used. The design may be as intricate as desired and lines down to 0.00025 in. in width have been printed successfully. Prints executed by this process meet all the requirements set out above.

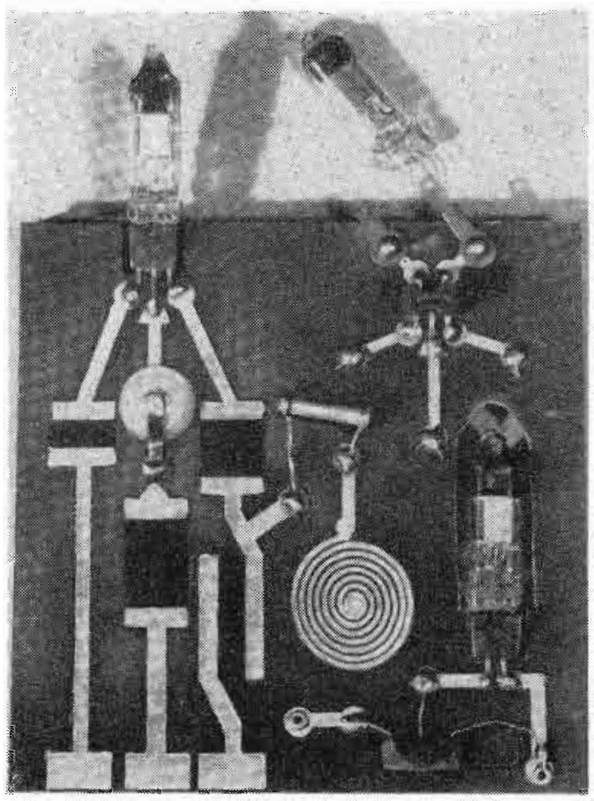
Requirements for Design

The first technique of printed circuitry described invariably relied on the printed circuit as an integral part of orthodox design, the designer simply replacing wiring by printed lines and connecting the components to those lines by means of eyelets or rivets. This is a costly business. A good print should in itself include the maximum number of components and be capable of being soldered to directly. In isolated instances rivets or eyelets may be necessary but, generally speaking, the print itself, being metallic and of perfect adhesion, should not present any difficulties in soldering. A solder joint even when done by semi-skilled labour should be as strong as the plastic itself. If a laminated plastic is used an exerted pull should break the lamination before breaking the contact between solder and print.

For soldering it is important that the heat of the iron should not damage the plastic. To prevent this, contact time between iron and print should be a minimum and the temperature of the iron should be just above (5°C.) the freely running temperature of the solder.

Most commercial resin cored solders are suitable; specially recommendable are 60/40 solders, and those saturated with silver. With the latter, exceptionally easy working is experienced if the temperature is kept down as the saturation applies naturally only to one particular temperature. If this temperature is exceeded the solder will again tend to dissolve silver. Fine results, easy working and low temperatures are possible with bismuth solders. These are, however, very hard; the plastic chassis is usually at least slightly flexible and as the bismuth solder is completely rigid the joint will break even on slight vibratory motion.

For connections between front and back of chassis, eyelets tend to fatigue, thereby breaking the contact. It is better to connect by the application of a conductive paint through a punched or drilled hole, even though the paint may not be as conductive as the metallic print, or better still by inlaying a suitable solder peg prior to printing the circuit. Sometimes a sub-assembly is printed for mounting into a case, or several sub-assemblies have to be mounted on a number of chassis into



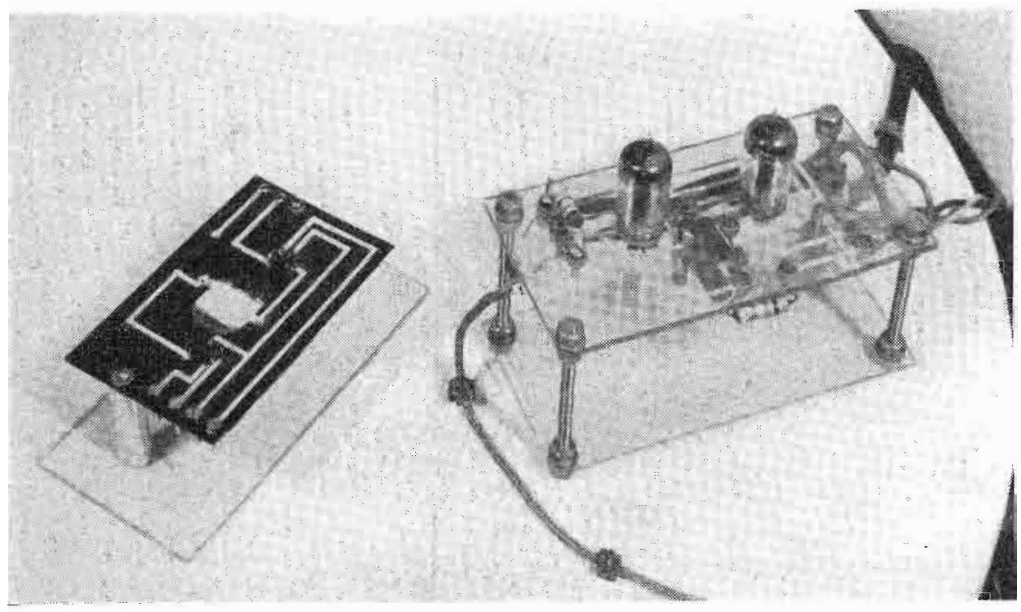


Fig. 4: (left) Printed circuit assembly Fig. 5: (below) Bottom view of two stage printed amplifier circuit at left and top view of circuit at right show mounting of associated components

one final assembly. In printed circuit technique this is best done by spring clip contacts. Printed spring clip contacts have stood 10,000 switchings with a 5 amp. current running through the switch without being impaired in any way.

Before describing assemblies consisting of resistors and capacitors mounted together, it is necessary to say something about components. These can be roughly divided into components that can or can not be printed. Amongst the latter are valve holders, coils of low frequency and certain precision capacitors and resistors. High frequency coils, capacitors and resistors are in the former class. In the case of coils it is, of course, necessary to decide in each specific case whether the surface area available and the required characteristics of the coil allow it to be printed with advantage. If so, it just becomes part of the wiring and is printed as part of it, otherwise it is soldered in as an outside component.

Similarly capacitors may be printed as part of the wiring by including metallic areas located with regard to each other on opposite sides of the chassis using the plastic as a dielectric. As the permitivity of plastics is normally low, this is applicable only where sufficient surface space is available, or the required capacity low.

The advent of disc capacitors made of high K ceramics has helped printed circuits considerably. These discs may be soldered directly into the circuit, and thereby become part of the print. On the design a space corresponding to the metallized surface area of the ceramic disc is printed as a silver area; on top of this printed area a small piece of resin cored solder wire is placed on which the capacitor disc rests. The whole chassis is then treated to the temperature at which the solder fluxes. This operation is carried out before other components are assembled, but several discs may be applied at one heating. As the disc itself possesses no elasticity a bismuth solder melting at about 130°C. may be used with advantage. Where the nature of the plastic requires lower temperatures still, the solder can be replaced by a conductive adhesive, made by the inclusion of fine silver powder into an adhesive. The top of the capacitor disc is connected by a soldered foil directly to any point in the circuit.

Additional Capacitors

Where capacitors of greater precision are needed these are soldered in as outside components. Frequently this has an additional advantage. Capacitor discs take up space on what may be an already crowded chassis surface, while a capacitor as an outside component may be situated above the chassis and soldered between any two points which need neither be adjacent nor on the same side of the chassis.

The same applies to resistors soldered in as outside components. The printed resistor in its truest sense is, however, a serviceable standard component. In earlier methods this was inserted into the metallic print by brushing or silk screen printing a mixture of graphite, carbon black, and a binder. The mixture is adjusted to give roughly the required value applied in known thickness to the allotted area. These resistors usually suffer from poor contacts, low stability, high noise level, and large variation in value. They are, however, in use and often serve their particular purpose quite well. Higher accuracy may be achieved by laying down a resistor of too-low a value between two terminals and scratching out two parallel lines extending from one edge of the resistor to about three quarters of the way across it. A third line is then carefully scored extending from the opposite edge to some point between the two first lines. The current path may be lengthened considerably in this way to very accurate limits. The operation may even be carried out automatically.

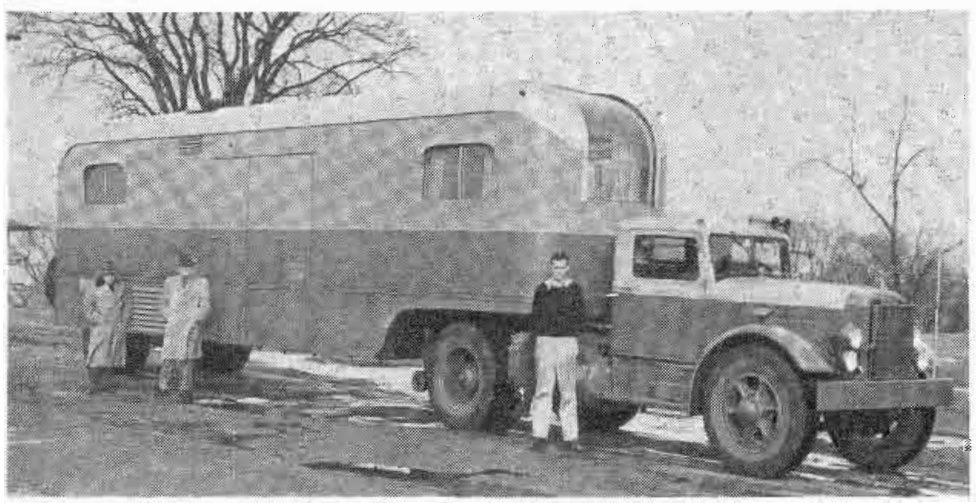
One such device in operation is claimed to adjust a printed resistor to 1% of its nominal value in one minute. It is, however, recognized that this technique is not universally applicable and printed resistors have to be made an integral part of the print itself to achieve any economic advantage. The best and cheapest method is by making use of aspect ratios in the design stage, using the formula R KL/W where K is a known constant which may be pre-adjusted by the printer from experience, and represents the resistance per unit square of surface area. L and W are length and width dimensions.

It is quite clear that the values are identical for a square millimeter or a square mile as L/W equals unity. The only quantity affected will be the wattage rating which may generally be taken as 1 watt per square centimeter.

The designer, therefore, assesses a unit value for K convenient to fit most values situated on any one side

(*Continued on page* 56)

RADIO ENGINEERING LABORATORY AND AN APARTMENT MOUNTED ON WHEELS



Every radio engineer has dreamed of a roving radio laboratory with living accommodations attached, which could be maneuvered anywhere across the continent. John Hays Hammond, Jr., famous radio inventor and originator of remote control for military and naval projectiles, has made his dream come true with this 20-ton truck fitted up with radio laboratory, master and guest suites, kitchen, and several bathrooms, one with shower. Latest addition is an automatic road-sander to prevent slipping on icy pavements. Electrically operated sprayers throw crushed oyster shells directly in the path of the wheels. The Hammond land-yacht's home port is the inventor's palatial estate at Gloucester, Mass

Principles of POLYCASTING

New concept of radio coverage revealed by use of many low power stations in lieu of one large unit

By RAYMOND M. WILMOTTE Consulting Engineer, Washington, D. C.

FACING the FCC lies the major problem of providing truly national service of television, not only to large cities, but also to small ones and rural areas. The twelve channels of the V.H.F. band are clearly inadequate for this purpose, and with that in mind the Commission reserved the U.H.F. frequencies from 470 to 890 megacycles. But the majority of field information to date indicates that the service from a single high powered station at these frequencies would be poor.

It is suggested that a solution, possibly the only solution, to this dilemma is Polycasting. It is believed that Polycasting may be able to provide excellent service at U.H.F. It can also be used effectively to serve large rural areas at V.H.F. by bringing within a single service an area covering a sufficient number of small towns to make television service economical.

Polycasting is a system using a number of low powered stations, on the same or different frequencies instead of a single high powered station.[1] The obvious advantage of such a system is that by spreading the radiated power from a number of points over the area, less power is needed to "illuminate" the area than by concentrating the power in a single source. The advantage is particularly large because at these frequencies the signal intensity varies over a wide range in a decline of only a few feet. Statistical analysis shows that the gain produced under conditions of several sources of power is much greater than is obtained by the simple "illumination" concept.[2]

The effect on the service of the variation of intensity from point to point may be explained as follows: To obtain good service at a point it is necessary that the ratio between the signal picked up and an interfering signal be more than a certain amount. When the signal varies over a wide range from point to point, the chance of signals from two sources producing a large ratio of field intensity at a particular site is good—even when the sources are equal and at equal distances from the site. If there were no variation in intensity from point to point, as is the case at lower frequencies, there would be interference at the point and at all adjacent points.

Ghost Problem

The obvious disadvantage of Polycasting is the ghost problem. With more than one station on the same frequency, the ghost problem increases. A statistical analysis shows that with the present television standards the loss of service due to ghosts would be serious with two or more co-channel stations serving the same area. For that reason, the Polycasting proposal provides giving an operator the use of two channels. The use of two channels for one operator appears to be fantastically expensive in frequencies, but that is not so. With the reduction in power that is possible and the reduced interference that inherently follows, the stations can be put much closer together and thus make up for the use of more channels.

The statistical analysis of the service obtainable from four stations, two on each channel, shows that surprisingly large service areas may be served with little power.[3] Generally a total of 8 kilowatts of Polycasting provides service similar to 1,000 kilowatts from a single station.

Estimated Field Intensity

Examples of the estimated field intensity for Grade A service (as defined in the proposed rules of the Federal Communications Commission) are given in Figures 1 and 2. Both refer to the service provided by four stations at the corners of a square with the stations on the same channel located at the opposite ends of a diagonal.

The case for rural service is particularly interesting. For Grade C service the Polycasting stations may be located much further apart in selected small towns, so that these receive a strong signal equivalent to Grade A service. The rural area between them is served on the Polycasting principle with Grades A, B and C. Thus with a Polycasting system of four stations, four small towns may be well served together with a rural area of some 5,000 square miles. Such a system has, therefore, a two-fold advantage. It provides good service in towns too small to support a television station, and provides a service to a large sparsely populated area which is uneconomical to serve without the support of the towns.

The estimates are based on relatively little data. The principle of Polycasting as regards its phase of operation where more than one station on the same channel is used, still has to be proven by experiments. But no experiments are necessary to be sure that great gains will be obtained when the component stations are on different channels. It should therefore be to the advantage of television operators to petition the Commission for the use of two channels,

(*Continued on page* 57)

TABLE I

Comparative Powers of Polycasting and Single Station Operation

Type of Area	Grade of Service	Area Sq. Mi.	POLYCASTING (300 Feet) Number of Stations	POLYCASTING (300 Feet) Total Power	SINGLE STATION 300 Ft.	SINGLE STATION 500 Ft.	Fading At Extreme of Service: Polycasting	Fading At Extreme of Service: Single Station[1]
RURAL								
Small	A	1400	4	8 Kw	55 Kw	30 Kw	—	—
	B	2500		8	80	30	—	—
	C	4100			120	40	9 db	15 db
Large	C	5500	4	8	1000	300	7 db	20 db
Very Large	C	19000	12	24	300×10^6	200×10^6	7 db	72 db
CITY								
Circular	A	1100	4	8 Kw	1100	340	—	—
	B	1600			180	50	—	—
	C	3500			190	40	10 db	13 db
Elliptical	A	46x30	4	8	4700	1200	—	—
	B	60x44			1800	400	—	—
	C	76x58			850	150	7 db	17 db

[1] The fading is given for height of 300 feet. At 500 feet, the fading is 3 db to 4 db less.

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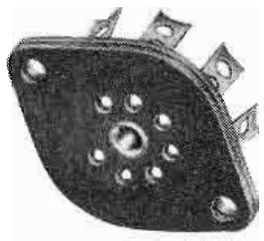
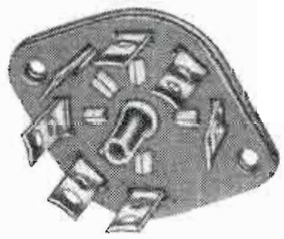
Grip Pin Type Socket

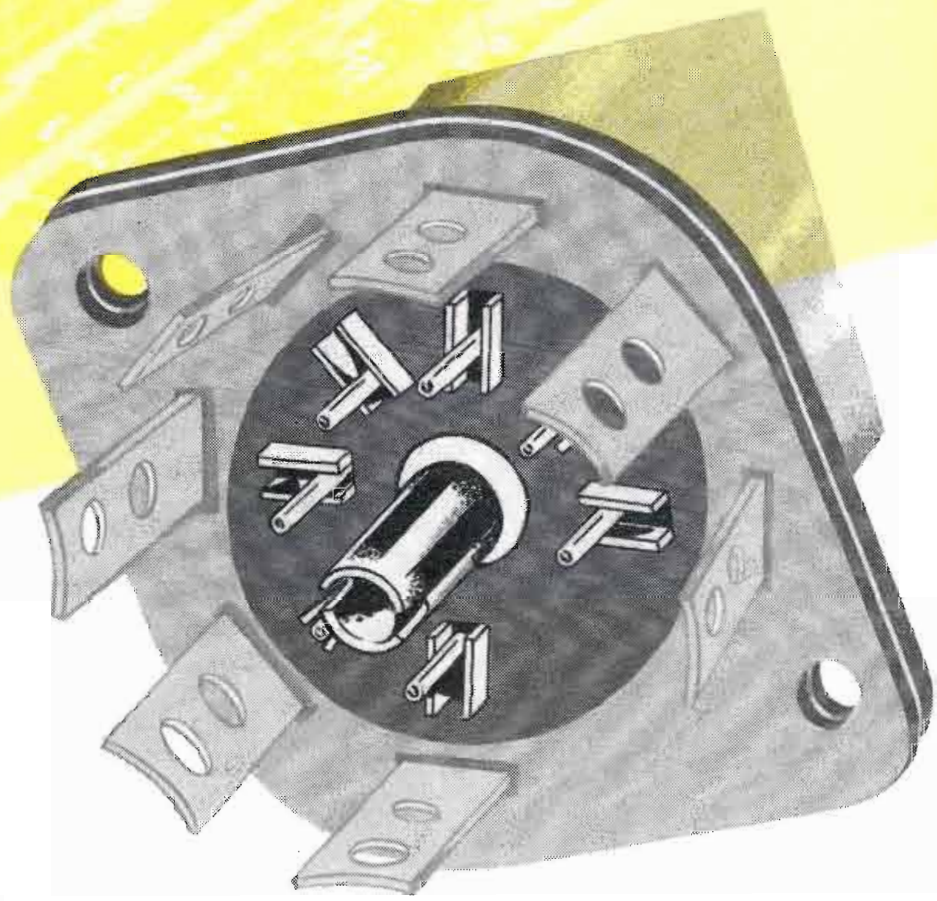


U. S. PATENT
No. 2,519,121



. . . with and without shield, Mtg centers: 1" and 1-5/16"; also available in grounded types or with 8 contacts and noval.

The Grip Pin type is the locking grip miniature socket. Precision tooled—contacts provide high extraction pull out . . . supplying maximum tube retentivity, mandatory in automotive set production. Available in any quantity.



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CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Edited by John H. Battison

Duplex Switching Without Relays

R. S. HOUSTON, 18 Oak Lane, Haverstown, Pa.

IN the control of audio signals, as in a sound system or broadcast station, there occasionally arises a need to control the change from one source to another from more than one control point. This often is accomplished by the use of relays and push buttons at the appropriate places. However, in the event relays are unavailable, or undesirable, the circuit shown can be put to good use. It is merely a variation of a three-way lighting circuit. As it is arranged, it is possible to change from one input to the other from either point, without the necessity of having any special arrangement of switches. When the switches are in the same direction, they are connected for input one, and when they are different for input two.

This has been used in a projection booth to change between projector sound heads from either projector position and has worked very successfully without trouble, or switching clicks. In this case, a six-pole double throw rotary switch was used, but such an arrangement can easily be made with a key switch such as that used in broadcast work. No provision has been made for terminating the unused input, as no trouble has been encountered from this source. Another use to which it has been put is switching between consoles in a broadcast station. With the addition of the pilot lamp circuit shown, it would serve as a cue much in the manner of a preset or interlock system.

$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is preferred. Our usual rates will be paid for material used.

Intercom System

I. C. MENNITT, Chief Engineer, WVCG, Coral Gables 34, Fla.

IN many radio stations where the transmitter is several miles distant from the studios and there are two interconnecting telephone lines, the following circuit has been found to be very versatile.

In most consoles, a key switch is provided to switch incoming remote lines from the console to external equipment. This is represented by K1 in the diagram. In the "up" position, the remote line is fed out to the transmitter on the spare line to the "talk back" amplifier and to the speaker. By operating K2, the transmitter operator can talk back to the remote or feed cue thereby relieving the announcer of this job.

When the telephone at the studio is picked up, the hanger contacts operate the relay and switch the spare line to the telephone to the line in place of the remote line and can be used for communication with the transmitter. Standard field magneto ringers and bells are used for signals connected from the repeat coil center-taps to ground.

Remote Loop Monitor

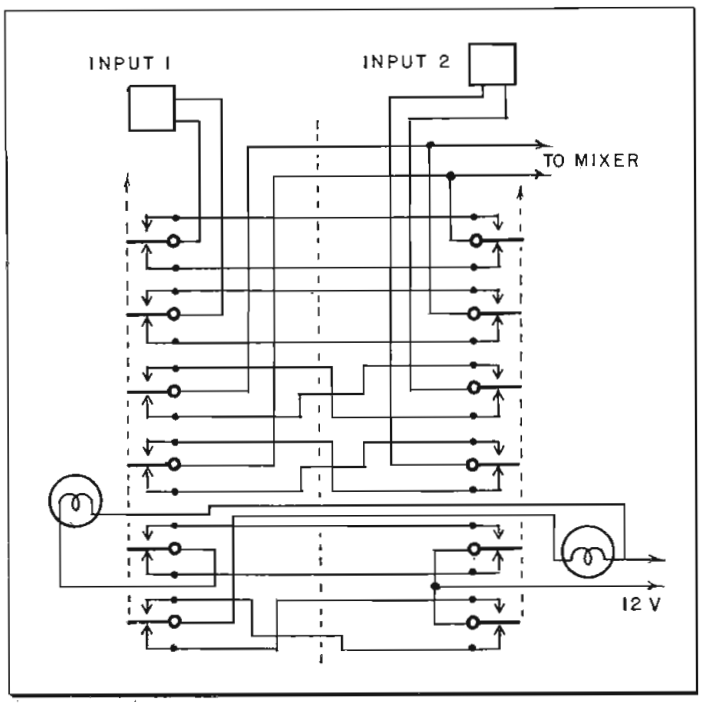
LLEWELLYN JONES, WSBA, *WSBA-FM, York, Pa.*

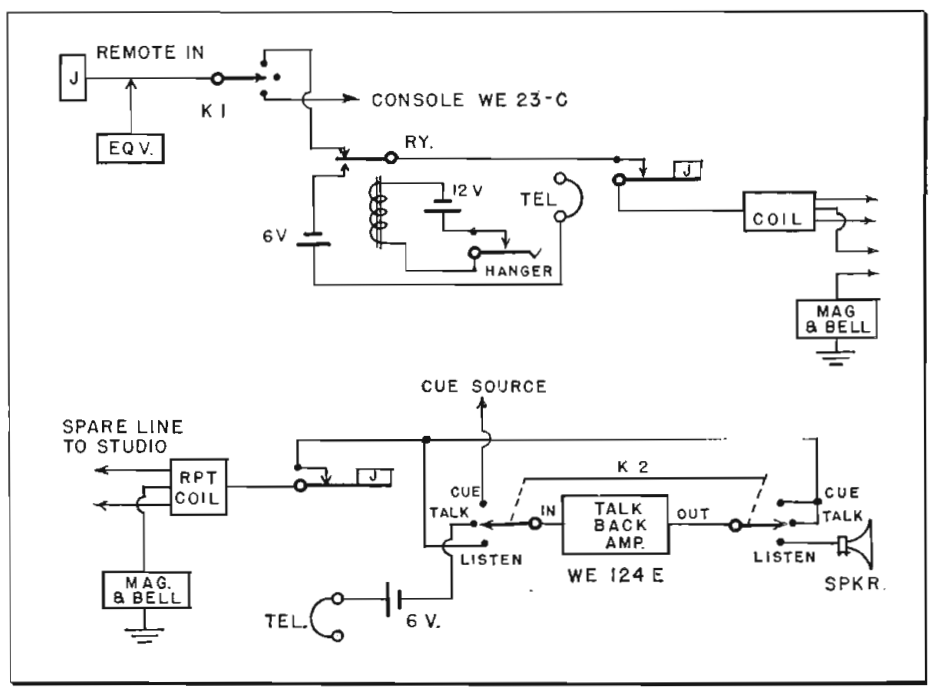
IN the past WSBA had many headaches with a remote loop being inoperative when a remote pickup was scheduled. The operating condition of the loop was not known—either by the telephone company or the studio engineer prior to broadcast time.

A small, completely enclosed audio oscillator was constructed and installed on a church loop at the church end. The loop is checked three times a day. If no tone is present the engineer calls the telephone company for a line check. Since installation of this device no scheduled remote pickups have been missed. The oscillator is straight-forward, and can be constructed cheaply. For check purposes it is not necessary to match the output to the line, although pad

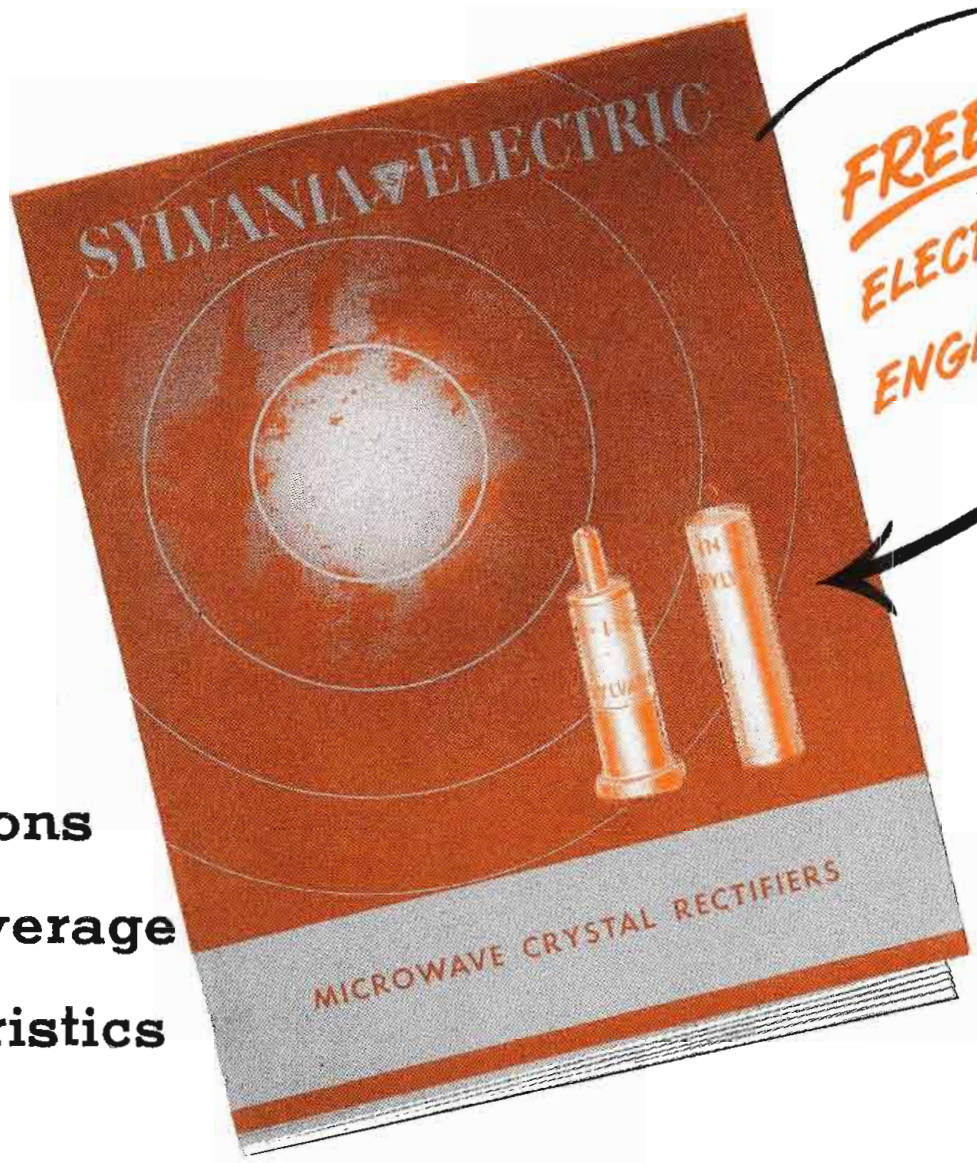
(*Continued on page* 54)

Left: Duplex control switching without relays. Right: Transmitter—remote intercom system provides cue and program lines





The A-B-C's of SYLVANIA SILICON DIODES



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This new 16-page booklet describes crystal rectifiers covering the frequency range from 1000 to 25,000 mc per second. It explains the various types of Silicon Diodes with their ratings and common applications.

The booklet discusses mixer crystals, including the new matched pairs, microwave video detectors and Silicon Diode use in UHF and SHF instrument applications. For your free copy of this new booklet, simply clip the coupon and mail today.

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WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

CIVILIAN TV-RADIO CUTS MUCH DEEPER—With the black clouds of war becoming increasingly more depressing, the radio-TV manufacturing industry enters the New Year with prospects that television-set production, together with radio-broadcasting receivers, for the civilian market, face far deeper slashes than could be anticipated during the last two months of 1950. The reductions in civilian production will come most substantially and speedily during the first three months of this year. For the sake of the maintenance of its manufacturing facilities, engineering staffs and employee forces, the industry only hopes the Armed Services will be able to expedite their procurement contracts at a much faster rate than has occurred during the last quarter of 1950.

$3 BILLION DEFENSE PROCUREMENT—Approximately three billion dollars worth of military procurement in the electronics-radio-communications requirements of the Armed Services now looms as the national defense task of the manufacturing facilities of our industry. This meant the addition of nearly a billion dollars as a result of President Truman's program to the "lame duck" session of the 81st Congress to the nearly $2 billion military electronics-radio equipment and components needs of the national defense which had been previously authorized in appropriations.

GRAVITY OF WORLD SITUATION makes it imperative, if the Armed Services are to keep the radio manufacturing industry for the governmental and Department of Defense leadership strong and able to produce, to speed up the procurement machinery to the highest tempo with all government red tape cut down to the barest minimum. The radio manufacturing industry is all set to plunge into a war-controlled economy to keep the wheels of the nation's defense preparedness moving at the greatest effectiveness possible. But full cooperation from the governmental end must come first.

PERMANENT TOP FREQUENCY BODY—Idea of a permanent top-level frequency allocations board to coordinate and review the division of radio frequency space as established by the Interdepartment Radio Advisory Committee (IRAC) looms as one of the major recommendations to be submitted by President Truman's Temporary Communications Policy Board in its report to be completed by next Feb. 17. Such a permanent frequency allocations policy-making agency would be most beneficial to the electronics-radio field because the IRAC, composed of representatives of all government departments and agencies with radio services, has been long regarded as having favored the governmental bodies in designation of frequency assignments to the detriment of civilian radio services such as television, mobile radio services and common carrier public radiocommunications services. FCC Chairman Wayne Coy fully endorsed the permanent frequency board proposal at meetings of the temporary board, which is headed by West Virginia University President Irvin Stewart. Plan for permanent body, likely to be composed of three members, was to be finalized in board meeting in early January.

TIME WASTING—With the national security in such jeopardy, the FCC, like a number of other government agencies, has seemed to be pursuing a course of time wasting in its continued efforts to gain a court sanction of its color television decision—certainly academic in view of the strategic materials' shortages—and in the slow-plodding hearings on the television allocations and standards. In its recent TV hearings, the Commission carried on educational video hearings for two solid weeks without even holding its regular meetings to act on decisions, orders and other issues.

THOUGH THE BROADCASTING INDUSTRY through the investment of millions of dollars had launched television throughout the country, the educators asked the FCC to grant a VHF Channel in each big city and educational center and 20 percent of the unallocated UHF video spectrum to be reserved for education. The commercial television broadcasters have always been willing to give educators for worthwhile programs "free" time on the channels of their video stations. But the latter is forgotten by the FCC as the educators laid down a barrage of statements alleging the value of education by the visual medium of television and brought into action political supporters.

AIRLINES, MOBILE SERVICES TO BE KEPT GOING—Determination of government authorities in the National Capital to place all essential services in preferred position to continue operations even under war mobilization means electronics-radio manufacturers specializing in equipment for airlines, mobile radio services and communications have excellent opportunity of obtaining strategic short-supply metals such as copper, aluminum, zinc, nickel, etc. for maintenance and repair parts and end-equipment production. Recent concrete example was the directive of National Production Authority for General Electric and Raytheon to supply 12,000 electronic tubes to airlines through Aeronautical Radio Inc.

National Press Building
Washington, D. C.

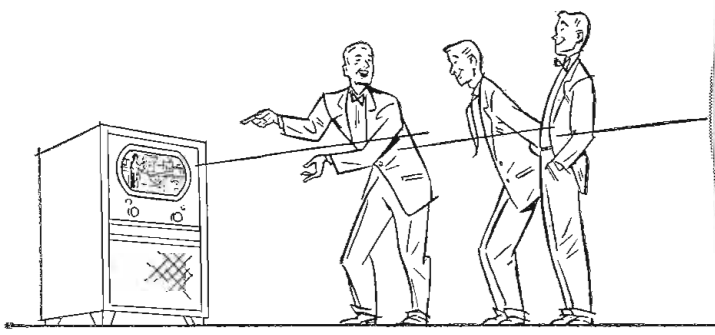
ROLAND C. DAVIES
Washington, Editor

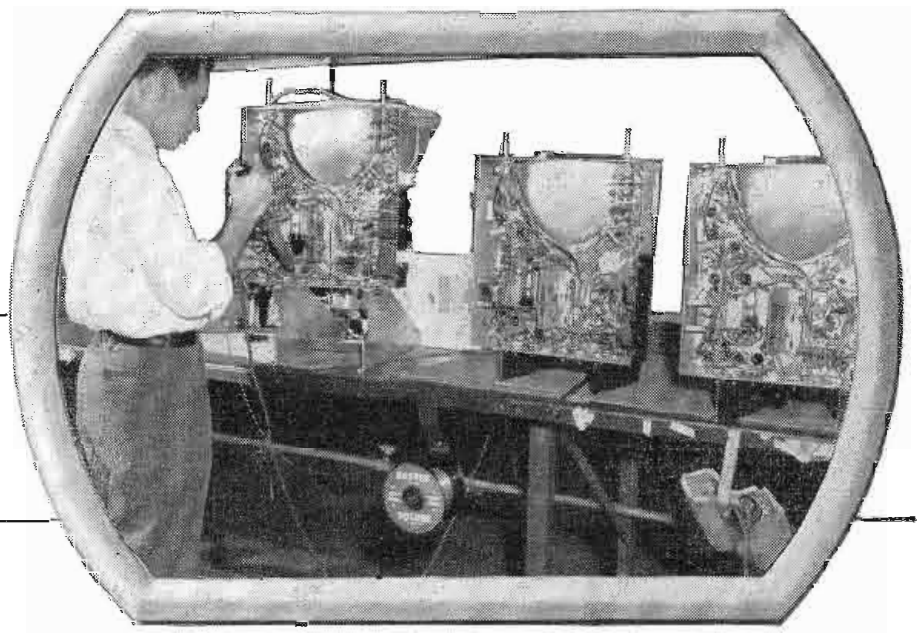
KESTER SOLDER

Build more quality into your TV sets with Kester "Resin-Five" Core Solder

TV—the nation's fastest growing business demands the nation's number 1 solder. Kester "Resin-Five" Core Solder, formulated especially for TV, will out perform any solder of the rosin-core type. It easily solders such metals as brass, zinc, nickel-plate, copper, and ferrous alloys.

MADE ONLY FROM NEWLY MINED GRADE A TIN AND VIRGIN LEAD





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non-corrosive • • • non-conductive

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"Resin-Five" flux is more active and stable than any other rosin-type flux. Yet it is absolutely non-corrosive and non-conductive.

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4-1000A

POWER TETRODE

EIMAC 4-1000A
POWER TETRODE

General Characteristics

ELECTRICAL	
Filament: Thoriated Tungsten	
Voltage	7.5 Volts
Current	21 Amperes
Grid-Screen Amplification Factor (avg.)	7
Direct Interelectrode Capacitances (avg.)	
Grid-Plate (without shielding, base grounded)	0.24 uufd
Input	27.2 uufd
Output	7.6 uufd
AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR	
TYPICAL OPERATION	
Class-AB_1 (Sinusoidal wave, two tubes)	
D-C Plate Voltage	5000 Volts
D-C Screen Voltage	1000 Volts
Max-Signal D-C Plate Current	1.00 Amps.
Effective Load, Plate-to-Plate	10,000 Ohms
Driving Power	0 Watts
Max-Signal Peak A-F Grid Voltage (per tube)	125 Volts
Max-Signal Plate Power Output	3100 Watts
PLATE MODULATED RADIO FREQUENCY AMPLIFIER	
Class-C Telephony—Carrier Conditions	
TYPICAL OPERATION	
(Freqencies below 30 Mc., one tube)	
D-C Plate Voltage	5500 Volts
D-C Screen Voltage	500 Volts
D-C Plate Current	600 Ma.
Driving Power	9 Watts
Plate Power Output	2630 Watts
RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR	
Class-C Telegraphy	
TYPICAL OPERATION, per tube	
(Frequencies below 30 Mc.)	
D-C Plate Voltage	6000 Volts
D-C Screen Voltage	500 Volts
D-C Plate Current	15 Watts
Driving Power (approx.)	.7 Amps.
Useful Power Output	3400 Watts

High-Power Amplifier Oscillator, Modulator

Eimac tetrode type 4-1000A is the electronic workhorse of modern communication systems. It is rated at 1000 watts of plate dissipation and is capable of efficient operation well into the vhf region. Like other Eimac tetrodes, the 4-1000A is readily 100% plate modulated.

At lower frequencies power gains of over 200 can be expected. Below 30 Mc. in normal operation 15 watts drive is sufficient to obtain output power in excess of 3000 watts per tube.

At 110 Mc. in FM broadcast service a pair of these heavy duty tubes will deliver over 5000 watts of useful power output.

In the adjacent column are highlighted typical operation data in more specific applications. Complete characteristics are compiled in a new data sheet . . . available by writing direct.

A 4-1000A is the economical vacuum-tube component for modern transmitters. Initial cost is low . . . tube life is long, consequently replacements are not only infrequent but also inexpensive. Consider it for your applications . . . Price $132.00.

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Just off the press . . .

NEW, COMPLETE 4-1000A DATA...FREE

THE CERAMIC CORES THAT PAVED THE WAY TO BETTER TV

STACKPOLE Ceramag®

- **Lower losses with higher efficiency and lower operating temperatures**
- **Lighter weight, smaller sizes for more compact construction, lower costs of finished equipment**
- **Much higher permeability**
- **Less corona effect**
- **Lower cost**

Technically, Stackpole Ceramag Cores are molded from a metallic oxide powder mixture which, when properly handled during processing, promotes cubic crystal growth. This results in a non-metallic material having low eddy current loss and exceptionally high permeability.

Practically, Stackpole's skill in the highly critical fabrication of these cores in production quantities has resulted in lower costs and higher standards of performance and dependability for the nation's leading television receivers.

Besides the more popular standard Ceramag core types illustrated above, many specials are regularly supplied.

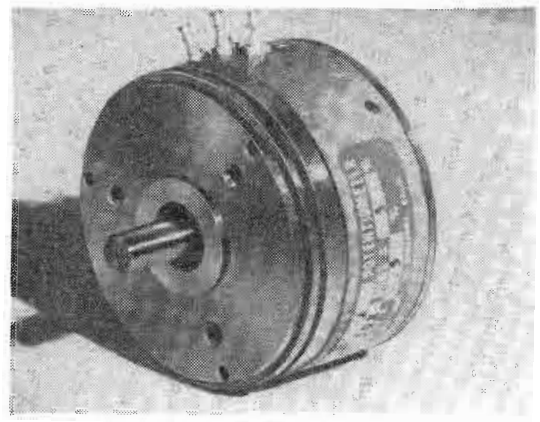
Electronic Components Division

STACKPOLE CARBON COMPANY, St. Marys, Pa.

New Equipment

Potentiometer

Characterized by high electrical precision and extreme mechanical accuracy and reliability, the Model J is a single



turn potentiometer equipped with ball bearings. Its multigang assemblies make it possible to independently phase the individual sections. The unit is 2 in. in diameter, has resistances from 100 to 50,000 ohms and a 5-watt rating.—**Helipot Corp., South Pasadena, Calif.** — TELE-TECH.

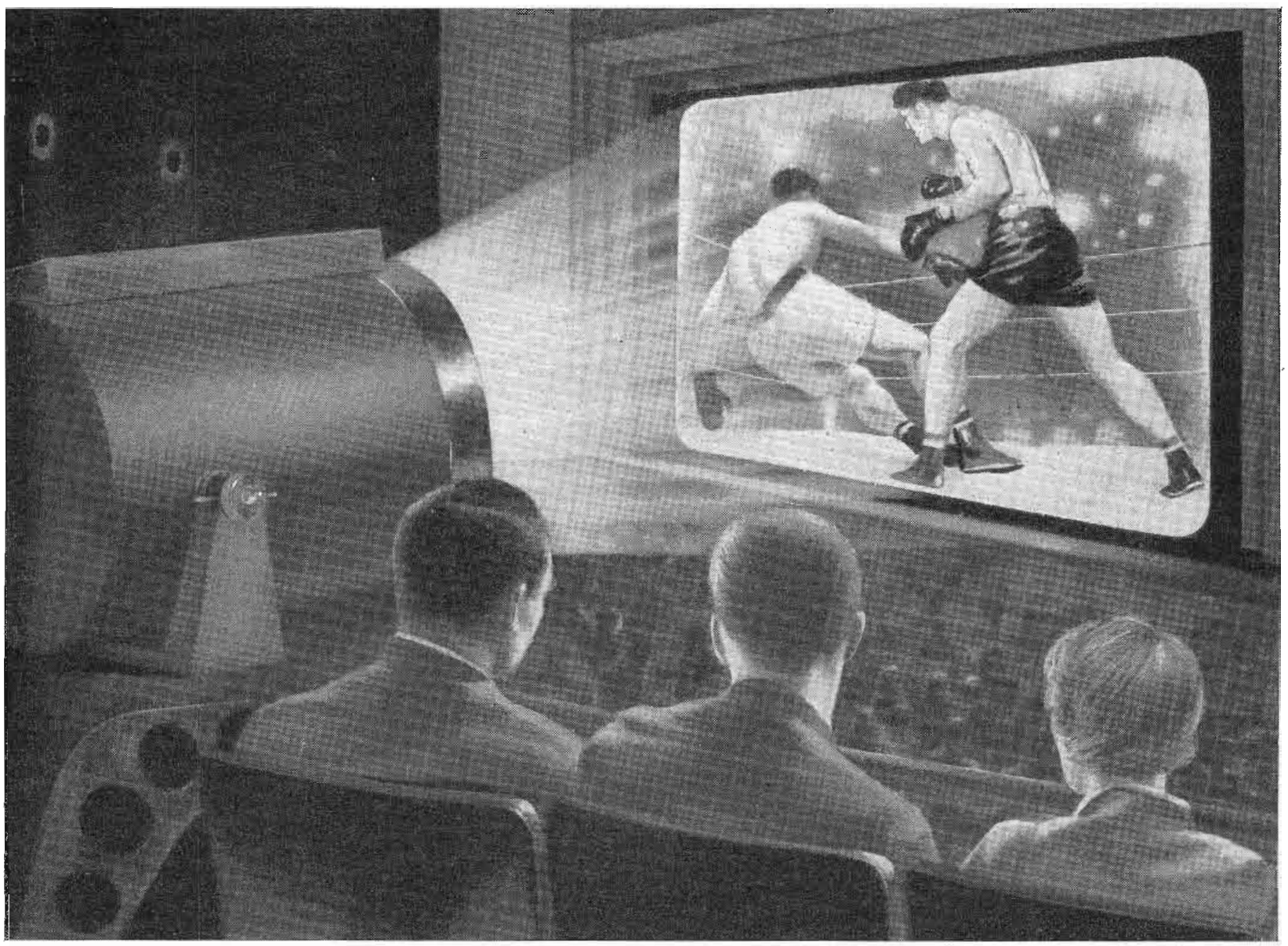
Closed Circuit Link

The necssity for costly, bulky equipment usually required in closed circuit television has been eliminated to a large

extent by the development of the Dumitter. This unit takes the composite video signal from any standard TV camera chain and feeds it via cable to the regular antenna terminals of any standard TV receiver. All the advantages of regular transmission are retained through the use of a carrier signal of the frequency of either Channel 2 or 3, optional at the Dumitter controls. Video and aural signals are fed through a single co-axial cable. Up to 125 receivers can be driven simultaneously. Due to the carrier frequency used, attenuation in the feed line is not serious, and no special termination is needed for equalization. Simply switching from Dumitter line to antenna lead-in permits any receiver in the system to function on either closed-circuit or standard broadcast television. No circuit alterations or component changes are required in the TV receiver for Dumitter reception.—**Allen B. Du Mont Laboratories, Inc., Television Transmitter Div., 1000 Main Ave., Clifton, N. J.**—TELE-TECH.

Mobile Communications System

Two entirely new Fleetfone Station equipments have been developed for fixed-station use in communications systems of public utilities and civil services requiring effective coverage over relatively large areas. They are designed for adjacent channel operation in the 30-50 MC band and consist of a general purpose 70-watt system and a 250-watt system for coverage of extensive areas. The 70-watt equipment is made up of an RCA type CT-10A transmitter and a CR-15A station receiver, each mounted in an individual chassis. Frequency is precisely controlled by an ovenless crystal. A crystal tuning capacitor permits slight variations in frequency over a range of ± .01%. The 250-watt equipment consists of an RCA type CT-11A transmitter and a CR-15A station receiver.—**Radio Corporation of America, RCA Victor Div., Camden, N. J.**—TELE-TECH



New RCA Theatre Television System projects 15x20 foot pictures of television programs.

Giant size Television— "shot from a barrel!"

• You've seen television. Now you'll see it in its very finest form—giant projections of special events, transmitted *only* to motion picture theatres on private wires or radio beams to make movie-going *better than ever!*

Success of the new system comes from a remarkable RCA kinescope, and something new in projection lenses. The kinescope tube, developed at RCA Laboratories, is in principle the same as the one on which you see regular telecasts. But it is *small*—only a few inches in diameter—and produces images of extremely high brilliance. These are magnified to 15x20 feet by a "Schmidt-type" lens system like those used in the very finest of astronomical telescopes.

Because of its size and shape, the new projector is referred to by engineers as the "barrel." It's already going into theatres, where you'll be seeing giant television—shot from a barrel.

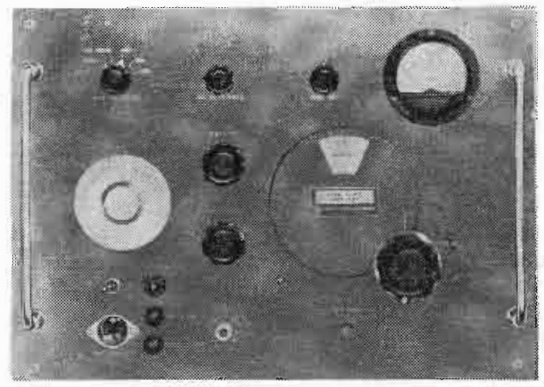
* * *

See the latest wonders of radio, television, and electronics at RCA Exhibition Hall, 36 West 49th St., New York. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York 20, New York.

Radio Corporation of America
WORLD LEADER IN RADIO—FIRST IN TELEVISION

Signal Generator

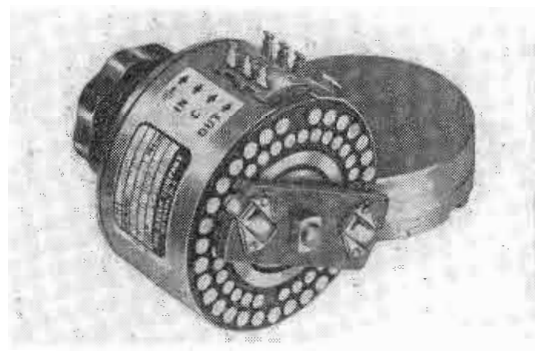
A continuous coverage of frequencies from 3,800 to 7,600 MC is provided by the model 618A SHF signal generator. All



frequencies are read directly from the large central tuning dial. It will deliver a 1 mw signal into a 50-ohm co-axial load at zero dbm. An output attenuator reduces output level to less than 100 dbm. Repeller voltage tracks automatically, and no adjustment is required to select the correct frequency. Accuracy is ½ of 1%. It may be externally frequency-modulated with maximum deviation of + 10 MC or externally pulse modulated, with a positive or negative peak voltage of approximately 15 v. Internal square wave modulation is also provided within the 400 to 1,000 cps range.—**Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.**—TELE-TECH.

Network Attenuator

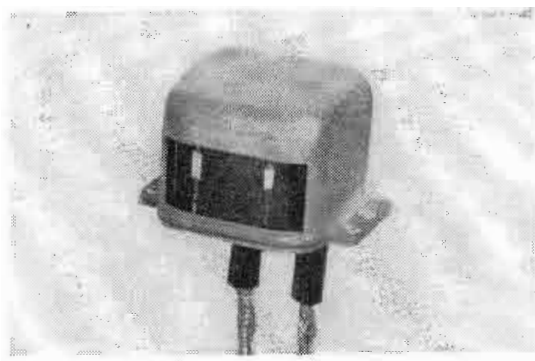
A T-network attenuator (series 730) has been developed which has 30 steps of attenuation in only 2¼ in. diameter.



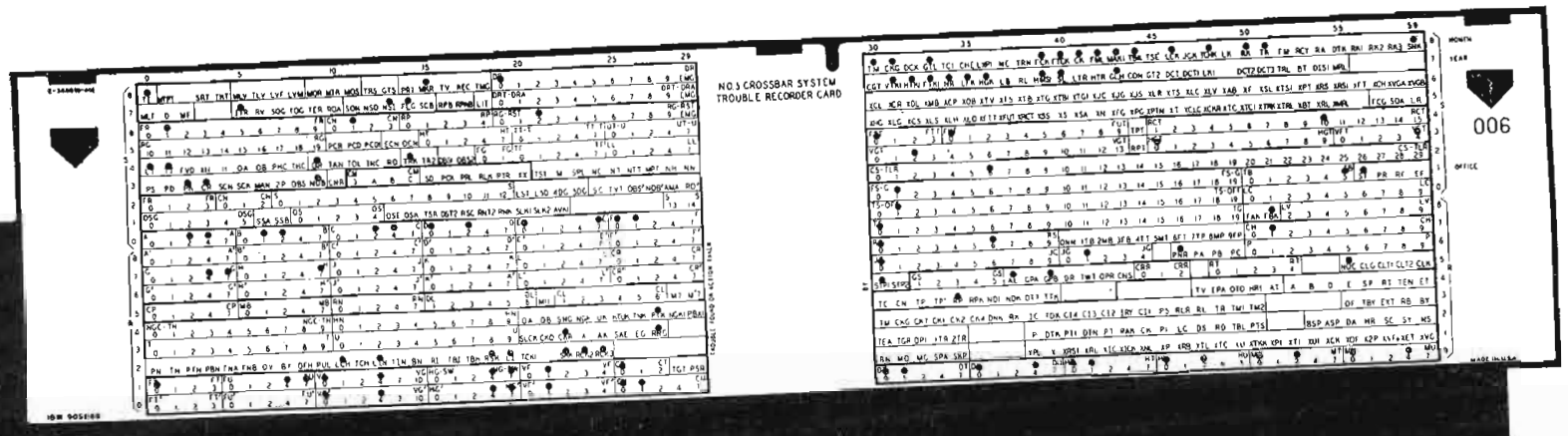
It has zero attenuation loss and constant input and output impedance. Frequency characteristic is flat to 30 KC. On special order, the frequency range can be extended to 200 KC. It is available in steps of 0.5, 1.0, 1.5, or 2.0 db. Standard resistance accuracy is ±5%. Units with accuracies as low as ±0.1% can be provided on request.—**Daven Co., 191 Central Ave., Newark 4, N. J.**—TELE-TECH.

Tape Recording Head

Model TR5 tape recording head combines the functions of record, playback, and erase in a single unit with excellent



frequency response and output level. A special feature is the use of a deep-drawn Mu-Metal shield for optimum hum reduction. Record and playback coil impedance is 1650 ohms at 1 KC, while erase coil impedance is 1,000 ohms at 40 KC. Output level of the unit is 5 db above 1 mv at 1 KC at a tape speed of 3.75 in./sec. Overall dimensions are .685 in. maximum height, 1.240 in. wide, and 1.031 in. deep.—**Shure Brothers, Inc., 225 West Huron Street, Chicago Ill.**—TELE-TECH.



Another reason why your telephone gives so much for so little

Studying punched card record of dial system operation. Each card (top) can report 1080 items

In a large, modern dial telephone office, 2,000,000 switch contacts await the orders of your dial—and 10,000 of them may be needed to clear a path for your voice when you make a single telephone call. Within this maze of signal paths, faults—though infrequent—must be detected and fixed before they can impair telephone service.

The latest system developed by Bell Telephone Laboratories automatically detects its own faults, detours calls around them without delay—then makes out a "written" report on what happened.

The fault may be a broken wire, or a high resistance caused by specks of dirt on switch contacts. In one second, the trouble recorder punches out a card, noting in detail the circuits involved and the stage in the switching operation where the fault appeared.

Maintenance men examine the reports at intervals and learn what needs attention. Between times they go about their own duties in keeping service moving.

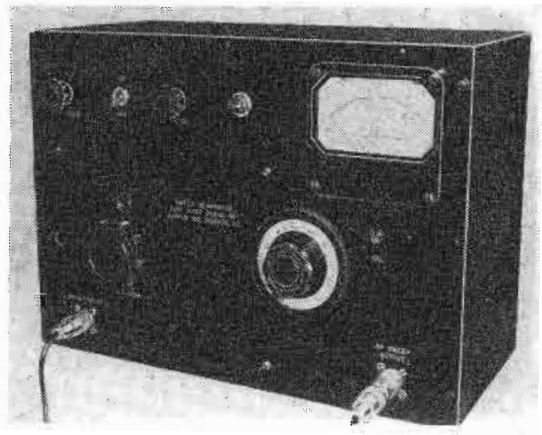
This is another example of how research at Bell Laboratories helps your telephone system operate at top efficiency, so the cost to you stays low.

BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST.

Signal Generator

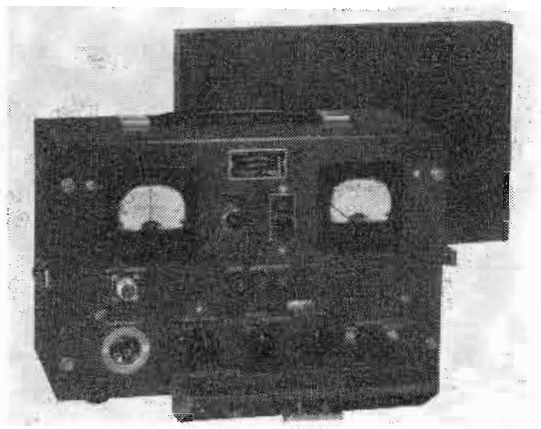
The S-105 sweep signal generator has been designed primarily for rapid and accurate testing of r-f and i-f circuits in



television receivers. It consists of a carrier frequency oscillator, a trombone type attenuator and a voltmeter to read output level, an FM modulator that consists of a magnetically-driven capacitor to sweep carrier oscillator, and a stable power supply. The channel selection is accomplished by a turret-type switch that moves each channel coil into oscillator tube shelf. The attenuator system is coupled mutually to each channel oscillator coil by means of a channel selector knob on the front panel. Output voltage is determined by establishing a fixed carrier level at the output terminal of the generator by means of a peak type reading voltmeter.—**Raypar Inc., 7810 West Addison St., Chicago, 13, Ill.**—TELE-TECH

Sound Channel Equipment

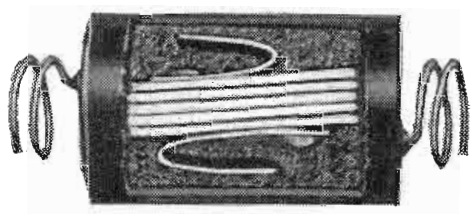
Facilities for the transmission of high-fidelity sound along with video over TV radio relay systems are provided by the



FTL-38A sound channel equipment. It consists of two units: a submitter which transforms the sound program into an FM 5-MC subcarrier; and a subceiver, which detects the subcarrier signal at the receiving end and recovers the original sound program. Video input and output levels are 1 to 2.5 v. peak-to-peak; video input and output impedances, 75 ohms; noise, 50 db below rated output; and distortion 40 db below rated output. — **Federal Telecommunication Laboratories, Inc., 500 Washington Ave., Nutley 10, N. J.**—TELE-TECH.

Selenium Rectifier

The new Plastisel selenium rectifiers resemble electrolytic capacitors in size and shape and are easily mounted by means

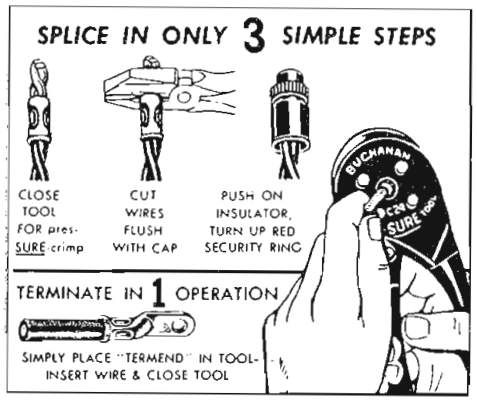


of conventional pig-tail leads. The selenium plates are stacked and sealed in a plastic tube and are guaranteed for at least 100 hours of use, are moisture-

proof, short-proof, shock-proof, and leak-proof. In addition they are said to yield a greater d-c output and will operate at higher temperatures as a result of the new type selenium plates. Delivery is being made on the 40, 60, and 100 ma sizes. Others up to 500 ma will be available shortly.—**Precision Rectifier Corp., 131 Boerum St., Brooklyn 6, N.Y.**—TELE-TECH

Splice Caps

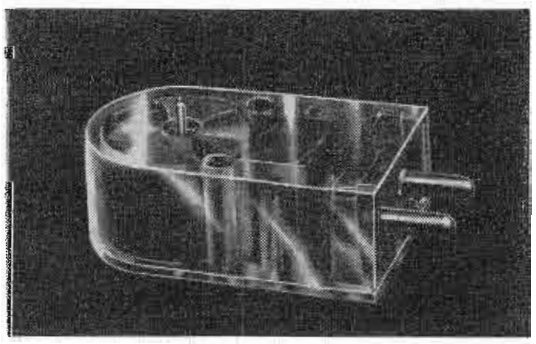
Splice caps for "pigtail" splicing of electrical wires have been developed in an improved open-end construction which



considerably facilitates installation and inspection. Wire insulation is always flush with the splice cap for maximum circuit protection and wires are always inserted to the full depth of the splice cap. Only two sizes of caps are needed for the most frequently-used combinations of two or more wires ranging all the way from #18 to three #8. Quickly applied snap-on insulators of fixed insulating value eliminate necessity for taping of joints and insure against insulation breakdown in service.—**Buchanan Electrical Products Corp., 1290 Central Ave., Hillside, N. J.**—TELE-TECH.

Variable Reluctance Cartridge

A smaller model of the RV variable reluctance cartridge has been developed with an interchangeable stylus so that



microgroove, standard, and transcription recordings can be played. Known as model 204, it is made of crystal clear polystyrene plastic which permits the operator to clearly see the inner components of the pickup at all times. Output is high; only a customary preamplifier is required. The compliance is adequate, so that all types of records may be played without distortion. Model 204 is velocity responsive and is essentially flat according to recording playback standards to above 10 KC.—**Clarkstan Corp., 11921 West Pico Blvd., Los Angeles 64, Calif.**—TELE-TECH

Oscilloscope

An oscilloscope has been developed which consists of eight independent channels, each of which contains a single-gun cathode ray tube, RMA type 3JPH11, and eight a-c amplifiers with a deflection sensitivity of 10 mv/in. Known as the H-81, it has a frequency response from 20 cps to 25 KC ± 20% or 20 cps to 150 KC ± 30%. An eight-channel a-c model, with a sensitivity of 2 mv/in., has also been constructed. Signals are displayed on a horizontal axis for photographing on a film strip or drum with vertical travel. Power supply is independent of the indicator unit.—**Electronic Tube Corp., Philadelphia 18, Pa.**—TELE-TECH

NEWS . . .

Radio-TV Manufacturers' Profits 1946-1950

President Robert C. Sprague of RTMA, during November, 1950, obtained from 49 radio-TV manufacturers producing 50% of estimated 1950 dollar volume of radio-TV sets and 40% of parts, tubes and accessories, their confidential figures which he summarized before the House Committee on Ways and Means at Washington in the totals of the accompanying table, comparing the radio-TV industry's recent yearly profits with those of U. S. industry as a whole.

	Profits of All Corporations	Profits of TV-Radio Industry
1946	$23,464,000,000	$37,888,000
1947	30,489,000,000	71,541,000
1948	33,880,000,000	86,493,000
1949	27,625,000,000	100,107,000
1950 (Est.)	37,000,000,000	217,253,000

	No. of TV Sets Made & Sold	Value at Mfr. Sales Price
1946	6,476	$1,250,000
1947	178,571	50,000,000
1948	975,000	230,000,000
1949	3,000,000	580,000,000
1950 (Est.)	6,500,000	1,100,000,000

"This shows the amazing growth of our industry," explained Mr. Sprague. "While earnings of all corporations increased only about 62% between 1946 and 1950, earnings of our industry expanded almost 6 times or 600%. The increase in earnings of all corporations in 1950 over 1949 is 40%, but in our industry is almost 120%.

"Secretary Snyder's proposal for a base consisting of the 3 highest years during the period 1946 through 1949 results in a base of some $31 billions for all corporations. His formula, which limits the credit to 75% of this amount, leaves approximately $14 billions subject to excess profits taxes in 1950. In other words, 38% of all 1950 corporation earnings would be subject to an excess profits tax.

"Now let me apply the same formula to our industry. 75% of our industry's 1950 earnings would be subject to excess profits taxes compared to 38% for corporations generally.

"The statute should provide that 1950 earnings for this purpose should be either actual earnings or annualized earnings for the first 6 months of 1950, whichever is the lesser. This would exclude companies which have particularly benefited since the start of the Korean war."

President Sprague defined a "growth company" as one whose 1950 earnings are at least 50% greater than its 1949 earnings and said that tax discrimination against "growth companies," (into which TV manufacturing falls) could be prevented by allowing them to apply the 75% credit on the average of the highest three years during base periods, provided this be not less than 62% of 1950 earnings.

IRE Awards Announced

Robert B. Dome, electrical consultant for the General Electric Company, Syracuse, N. Y., will be awarded the Morris Liebmann Memorial Prize for 1951 by the IRE for his contributions to the inter-carrier sound system of television reception, wide-band phase-shift networks, and various simplifying innovations in FM receiver circuits. The award will be presented at the Institute's annual banquet on March 21, 1951, at the Waldorf-Astoria Hotel in New York City.

At the same time, Alan B. NacNee, assistant professor of electrical engineering at the University of Michigan, Ann Arbor, Mich., will receive the Browder J. Thompson Prize for his paper "An Electronic Differential Analyzer," which appeared in the November, 1949 issue of the *Proceedings of the IRE*. The award is given annually to the author under thirty years of age for that paper recently published by the Institute which constitutes the best combination of technical contribution to the field of radio and electronics and presentation of the subject.

The Harry Diamond Memorial Award, given only to persons in government service, will be bestowed on Marcel J. E. Golay, Signal Corps Engineering Laboratories, Fort Monmouth, N. J., for his contributions in the over-all Signal Corps research and development program, and particularly for his accomplishments leading toward a reduction in the infra-red-radio gap.

Willis W. Harman, associate professor at the University of Florida, Gainesville, Fla., will receive the Editors' Award, established to stimulate the use of good English in technical writing, for his paper "Special Relativity and the Electron," which appeared in the November, 1949 issue of the *Proceedings of the IRE*.

New Eitel-McCullough Execs

W. W. Eitel, president of Eitel-McCullough, Inc., has named two new vice-presidents: George F. Wunderlich, vice-president and general manager; and Harold E. Sorg, vice-president in charge of research. Both men have been associated with the company for many years.

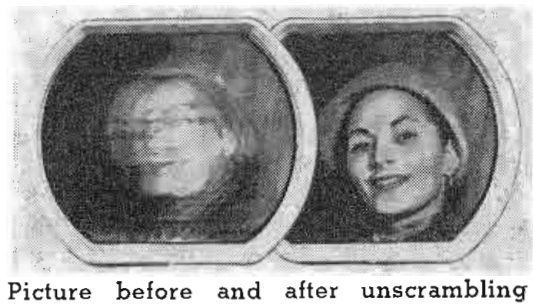
Eitel-McCullough, Inc., are manufacturers of radio transmitting tubes and television picture-tubes bearing the trade-mark EIMAC, with plants in San Bruno, Calif., and Salt Lake City, Utah.

Disc Chemical Developed

Minnesota Electronics Corp., 47 West Water St., St. Paul, Minn., has developed a chemical product which will prevent dust clinging to the surfaces of plastic record discs as a result of electrostatic charges. Known as "Record Life," the new product is sold exclusively through the distributors of Columbia Records, Inc.

Skiatron Subscriber-Vision Under Test in N. Y. Area

WOR-TV, New York City is cooperating with the Skiatron Corp. in conducting the first test in the metropolitan area of the Subscriber-Vision system which operates entirely over the air, without the use of telephone lines. In accordance with the FCC authorization, tests of one hour duration are being conducted on channel 9 immediately after WOR-TV concludes program transmission.



Picture before and after unscrambling

The Skiatron system uses a coder or scrambler unit at the camera and a small decoder at the receiver. In commercial operation, the TV set owner who subscribes would receive a decoder unit and an unscrambler "key" in the form of a Remington-Rand type punch card. When inserted into the decoder slot, the card key immediately unscrambles and clarifies the picture.

Radio Receptor Expands

Radio Receptor Co., Inc., Brooklyn, N. Y., radio and electronic pioneer since 1922, has just completed the purchase of a 90,000-square-foot factory structure with railroad siding and inside truck-loading platforms, at Wythe Avenue and North 3rd Street, Brooklyn, reports Hugo Cohn, Vice-President. This modern fireproof four-story concrete building, in addition to the present plant containing 50,000 feet at 84 North 9th Street, Brooklyn, will house the company's expanding divisions. Sales offices will continue at 251 West 19th Street, New York City.

Guided Missile Computer Developed

A computer that will predict the complete flight path of an anti-aircraft guided missile in the same amount of time that it takes a radar-controlled rocket to reach a moving target (about 60 seconds) was unveiled recently at a joint U.S. Navy—RCA demonstration. Known as "Project Typhoon", the new machine copes with such variables as aerodynamics of the theoretical missile, loss of weight due to fuel consumption and evasive tactics by an "enemy" bomber.

Arthur W. Vance, head of the electronic computer section of RCA Laboratories, emphasized that the computer does not control the flight of guided missiles themselves. He said that the device was built to prevent

unnecessary expenditures of man-hours and taxpayers' money on the development of missile designs which are inherently defective.

Solution of a typical intercept problem involves 250 additions, 67 multiplications, 30 integrations, and 20 aerodynamic functions which are carried out simultaneously with continuously variable factors. As the plotting boards receive directional signals from the computer, 12 recording voltmeters draw curves on paper rolls indicating the position of fins, acceleration, velocity and rate of spin of the missile, as well as remaining distance to the target. Six sets of neon lights on the panel of the computer display numbers representing rates of spin, and sidewise and forward velocities.

British Radio Industry Plans London Show

The 18th (British) National Radio Show is to be held at Earls Court, London, from August 28 to September 8, 1951. This announcement was made by the Radio Industry Council whose exhibition organizing committee is already planning the exhibition.

The show will include British radio, television and electronic equipment of all kinds, as well as tubes and components. The BBC will cooperate in demonstrations and performances of television from a large and fully equipped studio in the exhibition hall.

Coming Events

January 10-12 — High Frequency Measurements, Conference, Sponsored by the IRE, AIEE, and National Bureau of Standards, Hotel Statler, Washington, D. C.

January 18-20 — Society of Plastics Engineers, 7th Annual National Technical Conference, Hotel Statler, New York City.

January 22-26 — AIEE, 1951 Winter General Meeting, Hotel Statler, New York City.

March 5-9 — American Society for Testing Materials, Spring Meeting and Committee Week, Cincinnati, Ohio.

March 19-22 — IRE Annual Convention, Hotel Waldorf-Astoria and Grand Central Palace, New York City.

April 20-21 — Southwestern IRE Conference, Dallas-Fort Worth Section and Student Branch, Southern Methodist Univ., Dallas, Texas.

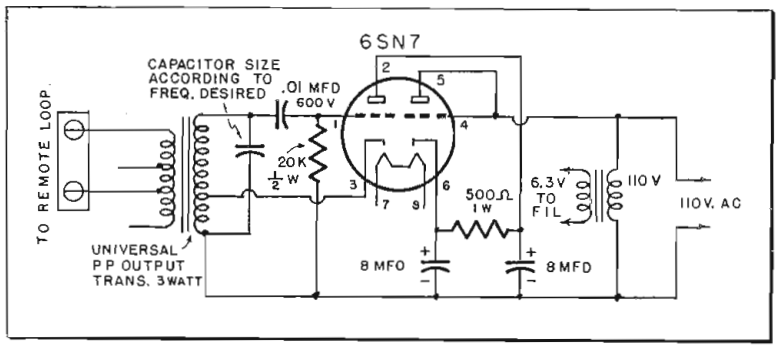
June 18-20 — American Society for Testing Materials, Annual Meeting, Atlantic City, N. J.

June 25-29 — AIEE Summer General Meeting, Royal York Hotel, Toronto, Canada.

August 29-31 — 7th Annual Pacific Electronic Exhibit, IRE and West Coast Electronic Manufacturers' Assn., Civic Auditorium, San Francisco, Calif.

CUES FOR BROADCASTERS

(*Continued from page* 38)



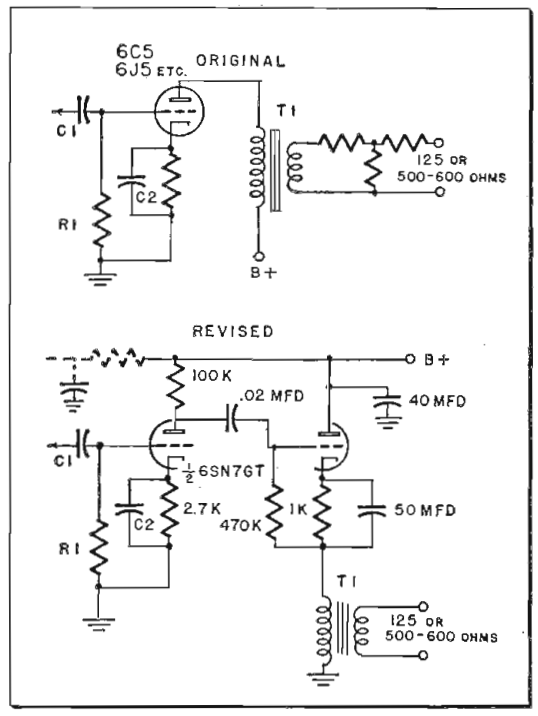
Remote oscillator for checking amplifiers at pickup points

can be installed if desired. During a remote pickup the unit is dis-connected. Power consumption is low—about 4 watts.

Cathode-Coupled Remote Amplifier Output Stage

HAROLD E. ALLEN, Chief Engineer, KGDE, Fergus Falls, Minn.

OLDER "home-brewed" type remote amplifiers which use small triodes plate coupled to line by inexpensive low-level transformers usually have unsatisfactory characteristics when feeding broadcast loops. If the single triode is removed and



6SN7GT used to provide cathode follower stage for remote amplifier operation

a 6SN7GT wired as shown with one triode section as a voltage amplifier, and the other as a cathode-follower, performance can be enhanced with a minimum of re-design and expense.

In some instances, grid coupling condensers may be selected with the intent of restricting response to eliminate "muddy bass" produced when picking up certain electronic instruments. R-C values of the voltage amplifier section should be selected for high peak output voltages.

At 250 volts, static plate current of the cathode-follower stage is about 7 milliamperes with grid at —7 volt, referred to cathode. Condenser across bias resistor should be large enough to retain static voltage value between cathode and grid return throughout drive cycle. Low plate current demand and high undistorted power output suggests that follower circuit may also have possibilities in remote battery powered gear.

Electronicraft Address

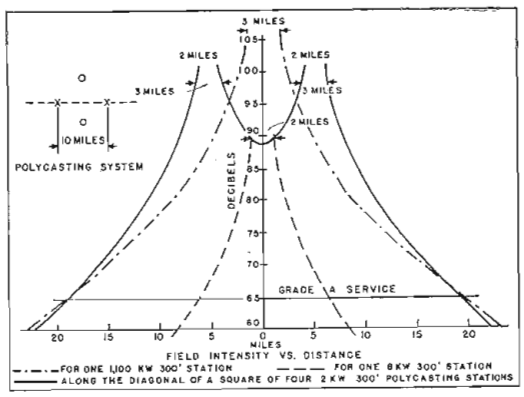
Electronicraft, Inc., formerly of Tuckahoe, N. Y., has moved to new quarters at 27 Milburn St., Bronxville, N. Y.

Polycasting

(*Continued from page 36*)

when there is a good possibility of their being available. The proposal should be that at first two low powered stations would be built (one on each channel) and later, one or more additional ones on the same frequency would be experimented with to ascertain the gain in service area obtained versus the loss due to ghosts. The foregoing estimates indicate that the loss would be small, compared with the gain. It is possible to allocate two UHF channels in all large cities as well as rural areas. In the VHF band, two channels are possible in certain areas which are largely rural.

As to cost, it is difficult to make a comparison between single station operation and Polycasting since equipment capable of radiating power of the order of 1,000 kilowatts is still unknown. Two manufacturers (Westinghouse and Gates) have estimated about $11,000.00 for the equipment of a 2 kilowatt station when in production. With a tower and the glorified doghouse needed for the equipment and four such stations to a system, the total cost installed should be less than $100,000.00. The cost of a single 1,000



Figs. 1 and 2: Showing field intensity at 90% of locations in db. above 1 UV/m., 600 MC. Receiving antenna height 30 ft.

kilowatt station is likely to be considerably more if one is eventually designed.

Other aspects of Polycasting are summarized in the following list which gives the advantages over a single station operation:

1—Provides a high and more uniform signal level over the area due to:
   a. The radiated energy being more uniformly distributed than with a single station;
   b. The large gain in effective power for large percentages of locations (see table I).

2—Fills in shadows by locating sta-

tions so that obstacles receive signals from several directions.

3—Reduces interference because low powers are used in the available system.

4—Reduces blanketing because still lower powers are used at each transmitting point.

5—Provides conditions more satisfactory for "built-in" antennas because the signal intensity is high and steel structures do not effectively shield U.H.P.

6—Makes it possible to pattern the service to the needs of the community, and plan expansion from

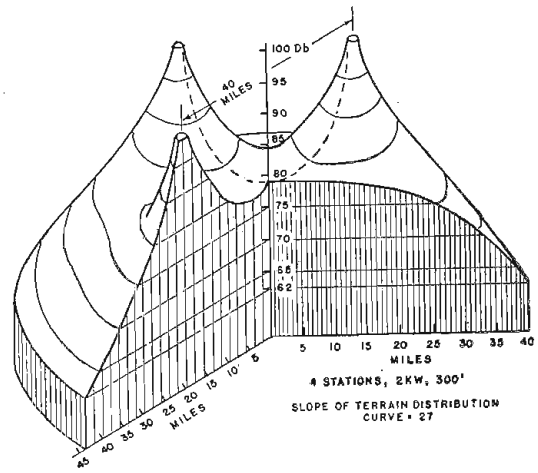


Fig. 3: Rural service—small area, class C

time to time when and where the community needs it.

7—Lowers initial cost.

8—Less fading at the limit of the service area.

1. Another term that has been used for transmitting the same program from several stations is satellite operation, but this term implies that satellite stations are small relative to the main station, and generally indicates the case of a station some distance away from the main station operated for the purpose of serving a new area with little or no regard to the service in the area between the stations. It has also been applied only at frequencies for which the signal intensity does not materially vary from location to location in a small area. Polycasting as the term is now used by the author is specifically concerned in serving a large, continuous area in which the signal intensity varies over a wide range of adjacent locations.

2. It can be shown that under certain conditions, when considering Grade A service, an effective gain of 20 db is obtainable in an area served approximately equally by four sources compared with the service obtained with a single source of the same total power.

3. Table I is based on the assumption that directional receiving antennas are used to reduce ghosts so that if the ghost signal is more than 10 db weaker than the main signal it is not objectionable. If field tests should show that this ratio should prove to be greater, the estimated service will be less in the area between the component stations of the system.

Editing Tape

(*Continued from page* 33)

spring loaded stainless steel knives are mounted. The tape is held to the block in the proper position for splicing by the vacuum system discussed above, while the splice is made.

The knives are then operated by a single crank which causes them to

cut the tape splice in the generally accepted "hour-glass" figure.

This editing machine was the result of joint efforts by the NBC and RCA engineers to design a tool for those engaged in the previously tedious and time-consuming task of editing magnetic tape. Its features incorporate the performance desired by tape editors as well as providing the producer or sponsor of a transcribed program with a high quality monitoring signal comparable to that of the final transcribed program.

Improved Color TV

(*Continued from page* 31)

during early demonstrations gave greenish hue to whites); *Receiver Stability* and *Color Phasing,* 100% reliable, no adjustment during 45-minute demonstration. And finally, *Skin Tones,* good, but questioned by some observers who were misled by reflections from nearby colored objects on faces of performers, though actually well reproduced.

FCC Objections Met

FCC's first report on color-TV had stated that there was " . . . no reasonable prospect that RCA's difficulties could be overcome." But to enumerate, take (a) Color Fidelity, this is now OK; (b) Texture, now OK; (c) "Complex, bulky receivers," no longer bulky, naturally more parts for color, not unduly complex; (d) Complex Transmitter, not unduly complex now; (e) Susceptible to Interference at Sampling Frequency, probably no change, but this is minor point; (f) Transmission over 2.7 MC cut-off co-ax cable, this was demonstrated earlier; (g) Field Testing, now accomplished.

Does a technical basis now exist for FCC's rejection of this system?

Assume the CBS System, approved by FCC, gives picture results (in small size) equal to RCA—which it does not—how can the FCC-CBS system hope to compete in *Picture-Size, All-Electronic Flexibility* or *Compatibility?*

In the light of the new evidence now available, certainly FCC must reopen the Color Hearing!

Atlas Resistor Coating

Atlas Resistor Co., 423 Broome St., New York City 13, has announced that "Thermo-Safe," a new resistor coating, will henceforth be applied to all their wire-wound resistors. The new thermo-setting coating is strong, dense and extremely tough.

Engineer Advancement

(*Continued from page* 27)

Industry cannot agree within itself on the best method of training or selecting management. And even within companies it is often difficult to obtain continuity of and adherence to an established program. Good management must always fight hard to maintain its standard of excellence, while bad, or mediocre management tends to perpetuate itself.

It has been suggested that better collaboration between industry and the colleges, perhaps with industry keeping the colleges well informed as to its successes and failures and the reasons therefore, would be of some assistance. Studies by the colleges of the case histories of their graduates in many companies might well lead to improvements in curriculums as well as in suggestions to industry of better management training methods.

The average engineer, through his very training, lacks qualifications essential to being a good manager. Because engineering is an exact science, because the engineer works continually with figures and facts from which there can be no deviation, he is very prone to lack tolerance, particularly in any deviation from what he believes should be accepted human behavior or necessary human values. The engineer essentially is a poor planner. Again by training, he is most apt to begin with a set of facts and work to a foregone conclusion. The good manager is often called upon to project the few facts he has at his disposal into the future, establish a time table and a goal, and then through management of men as well as materials, arrive at that goal on schedule.

Now what can industry do to overcome these handicaps, or this lack of management qualifications in the engineer. First, industry can provide the basic training which is entirely missing from university or college curriculums.

Secondly, since so many engineers are merely "floating", so involved in day-by-day tasks that they are unable to see the next step toward advancement, industry should rotate the engineer as much as possible. A good system of rotation does more than provide a basis for selecting future managers, for through rotation those engineers who have neither the desire nor the aptitude for management may find the field for which they are the best fitted and in which they will be the most productive.

The third essential is guidance. Again I would like to say that it is

the duty of good management to provide for succession. In other words, the good manager is the one who is always seeking to develop and bring along young people who not only can step into his shoes but who in doing so, can perform a better job than he is able to do.

Stripped of all unnecessary words, the one thing the engineer can do to prepare himself for the responsibilities of management is to seek opportunities for self-training.

If the engineer can apply the same methodology he uses in solving scientific problems; if he can apply the intimate knowledge of machines and measurements to human problems, then he can make a gallant and noteworthy contribution. He will then have proven he is worthy of being a manager of men.

Video Design

(*Continued from page* 30)

ents which may cause undesirable hum modulation. This effect is minimized by differentiating the sync pulses before they lock the blocking oscillator.

The blocking oscillator is set up, so as to respond only to synch pulses of the horizontal line frequency, but will not be triggered by alternate equalizing pulses and other noise peaks occurring during the horizontal line interval.

The reason for including a blocking oscillator in the system may not be too apparent. After all, the clamping pulses may just as well have been derived from the differentiated output of the sync pulse amplifier without the benefit of a triggered blocking oscillator. This, however, would be a closed system which was found to have tendencies toward instability and to be susceptible to spurious oscillations. The blocking oscillator provides effective isolation and does not respond to noise pulses during the line interval. This arrangement will provide stable operation for wide ranges of natural frequencies of the blocking oscillator and amplitude of the incoming video signal.

It is noted that the plate of the modulator output tube is direct coupled to the repeller electrode of the SRL-7 klystron. It is essential to have a clamped signal at the repeller to conserve bandwidth. It is not practical to ac couple to the repeller and then employ a clamp, as the high signal level would require excessive clamping drive. In addition the repeller electrode current, which is a rather unpredictable quantity, will seriously impair the performance of the clamp circuit.

The dc coupling problem is compli-

cated by the fact that the plate of the video output tube is at about 200 v. above ground, while the klystron repeller is approximately 1800 v. below ground. A workable solution is the arrangement shown in Fig. 8. The klystron shell is grounded and its cathode is at about –1000 v. A current regulator drives a constant dc current I through a resistance R. As long as the current regulator is effective, I will remain constant in spite of video voltage variations across R_C, and the repeller voltage will differ from the plate voltage of the modulator tube by a constant amount, IR. However, when, at higher frequencies, the current regulator becomes inoperative, the repeller is RC coupled to the modulator plate through R^1 and C^1.

Video Section Design

There remain merely a few remarks concerning the design of the receiver video section. The discriminator output for full deviation is 1 v. peak to peak. An amplifier gain of 2 is therefore needed to obtain the required output of 2 v. peak to peak. This output must, however, be supplied into 75 ohms at low distortion. In addition, 3 separate outputs are required to provide feedthrough to the next transmitter, local drop-off, and monitoring facilities. It does not seem worthwhile to complicate the receiver by the addition of clamp circuits, nor is it desirable to employ the simpler dc restorer because of noise considerations. The distortion must therefore be kept low for an output swing of nearly 4 v. peak to peak because of capacitive coupling.

A solution was found in the form of a feedback amplifier, having low distortion and very good transient response with approximately 10 Mc bandwidth. Its internal impedance is of the order of 2 ohms and connections are made to three separate output jacks through 75 ohm resistors. Each of the three outputs, therefore, not only operates into 75 ohms, but also has an effective source impedance of 75 ohms, which is particularly desirable in avoiding line reflections and feeding certain types of equalizing networks. The common 2 ohm impedance results in negligible interaction between the three outputs.

The circuits outlined in this paper have been operated in a practical link system and their performance has been observed to justify the validity of the design.

1. Kallman, Spencer, and Singer, "Transient Response", Proc. IRE, Vol. 33, pp. 159-195, March 1945.

Military Specifications

(*Continued from page 23*)

test results under electronic component specifications, offering considerable latitude not obtainable with the method now used. While this chart is general, it can be adapted to any particular specification, by modification of the listed tests, and number of samples tested. It should be noted that the numerical values shown in the figure are somewhat arbitrary, but can be altered as desired.

This method judges test results not on the basis of predetermined failure tables, but on a scale of numerical failures and degree of failure for any test. For test (A), if no samples fail, a score of 200 is attained, 100 each for "No. of Failures" and "Degree of Failure". If one sample were to fail by being 12.5% over the nominal rating where 10% is permitted, then a score of 90 is given for "No. of Failures" plus a score of 10 for "Degree of Failure", or a total of 100 for test (A) out of a possible maximum of 200. If two samples fail by both being out of tolerance by 11% where 10% is permitted, then the score for this test would be 50 for "No. of Failures" plus 50 for "Degree of Failure".

In some tests, indicated by an asterisk in Fig. 2, there is no "Degree of Failure"; the test is a "go —no go" proposition. Dielectric strength is a good example of this. In such cases then a score of 200 is assigned on the basis of "No. of Failures" only. There are still other types of tests which do not lend themselves to this proposed method: "Visual" is such a test. In these cases the "Visual", "Salt Spray" and similar tests can be judged by the test engineer with no attempt being made to write these tests into the score making up an integrated performance factor.

To best appraise the value of this proposed method, let us examine the present method along with the proposed against typical test results. The table on page 22 represents a summary of tests of type CM35E562K capacitors, with ratings of 5600 mmfd. ±10%, 500VDCW, ±100 ppm/°C temperature coefficient, ±0.3% capacitance drift. Armed Service specification JAN-C5 has been selected for purposes of study. According to Table IV of JAN-C5, these samples have failed to qualify and must be rejected. Details of the samples which failed are as follows:

(a) One of 48 samples failed to be within its capacitance tolerance, measuring 6250 mmfd. (with measurement error applied favorably to

the measurement), as against the maximum permissible 6200 mmfd. It failed, therefore, by being almost 1% more than the allowed ±10% tolerance.

(b) After the Vibration and Corrosion test, one of twelve samples broke down as twice rated voltage was being applied.

(c) After the life test one sample measured 6810 mmfd. whereas it measured 6050 mmfd. before the test; it changed capacitance 12.5%.

In summary then, these samples failed to meet the requirements of JAN-C5 as follows: The failing samples not destroyed by the dielectric strength test changed their characteristics by either a small or large enough amount to fall below performance requirements.

From these comments, let us proceed to analyze the data of the Summary of Tests table and in accordance with Fig. 3. For those tests and measurements where no failures occurred, the Weight would be:

Test	
As Received	
Dielectric Strength	200
Insulation Resistance	200
Q	200
Dissipation Factor	200
Temperature Coefficient	200
Capacitance Drift	200
After Thermal Cycle and Immersion	
Dielectric Strength	200
Insulation Resistance	200
Capacitance	200
After Vibration and Corrosion	
Insulation Resistance	200
Capacitance	200
After Life	
Insulation Resistance	200
	2400

Note that if all samples pass all tests, a maximum weight of 3200 can be scored. Now, examining the data for samples that failed we have:

	No. Failures	Weight Degree Failure	
As Received			
Capacitance	80	90	
After Vibration and Corrosion			
Dielectric Strength	160	—	
After Life			
Dielectric Strength	160	—	
Capacitance	80	10	
	480	100	Total 580

En toto then, the Weight of tests of these samples is 2980 of a possible maximum of 3200. We have set an arbitrary figure of 2900 as a minimum acceptable level, and therefore these samples would be accepted. This conclusion would not be the same as that reached in applying current JAN-C5 requirements, as the basis for rejection is obviously not the same. As the simplest example of the advantages of Fig. 3 is the following:

(a) Under JAN-C5, if there are no failures in Dielectric Strength and one failure in Capacitance (of 48 samples "As Received"), the submission fails.

(b) Under Fig. 3, with the same

conditions as (a), the submission need not fail pending results of other tests.

1. Performance specifications are defined as those requirements that specify what is needed by the consumer in terms of end use performance. Design or formulation specifications tell the producer how to make the product by specifying design data and the formulae.
2. Mr. J. N. Hall, Electronics Engineer, Bureau of Ships, Navy Department.
3. This should be distinguished from some so-called "work factor" types of specifications where credit is given for extra high performance but where a fractional departure from specification limits means rejection.
4. The foregoing article is abstracted in part from a paper appearing in the "Journal of the American Society of Naval Engineers." Opinions or assertions contained herein are the private ones of the Authors and are not to be construed as official or revealing the views of the Navy Department or the Naval Service at large.

Radar Beacon

(*Continued from page 26*)

curves obtained when the middle cavity of the SMX-32 is retuned with each variation in drive power. The envelope of these curves is shown in Fig. 5c as a typical curve of output power versus drive power under conditions of over drive. With 125 milliwatts of drive from the SMC-11, it can be seen that a typical SMX-32 would have an r-f output of 2.64 watts.

The output from the SMX-32 is fed to the connecting waveguide through a Model 409 Susceptance Transformer, a 24-db crossguide directional coupler, and a variable attenuator. The susceptance transformer is used to obtain the optimum impedance match between the output tube and its load, the coupler allows a low-level monitoring of the system output, and the attenuator enables the adjustment of output power. The variable attenuator presented a problem since it had to provide 27 db of attenuation at an average power level of 2 watts. Since two watts exceeds the dissipation rating of the resistance card material normally used in low-level attenuators, a new material had to be used.

Provisions for monitoring the system with respect to frequency, relative power output, and wave shapes have been built into the klystron deck. Normally, a 1Q24 reference cavity (fixed tuned to 9,310±0.5 MC) and a 1N23B crystal detector are attached to the 24-db coupler. The output of the detector is connected to both a microammeter and a test jack. If absolute power measurements are required, they can be made by means of an external wattmeter which can easily be attached to the 24-db coupler in place of the test cavity.

The modulator output is a rectangular wave which is flat topped and has a rise time of 0.3 microseconds from 0 to 100% amplitude. This wave shape is not a true square

Radar Beacon

(*Continued from page* 65)

wave since the duration of the positive portion is longer than the negative portion. This is necessary because the exciter stage that is modulated is a central member of a frequency multiplier chain, and each following member has a finite build-up time. Consequently, the modulator output must be more than 50% in duration if the output modulation is to be 50%. Figs. 7a, b, c and d represent the modulator output and the r-f envelopes of the exciter, the SMC-11, and the SMX-32 respectively.

The klystron-beam supply deck contains two regulated power supplies, one being—1,000 volts for the SMX-32 and the other being—600 volts for the SMC-11. Both supplies use a single-stage degenerative voltage regulator circuit.

The antenna is a biconical type which is enclosed in a radome for weather-proofing. The base of the antenna is a transition section that couples energy from the rectangular waveguide to a circular waveguide. Probe-fed slots around the circular waveguide radiate into a conical flare which forms the aperture of the antenna. These slots shape the azimuth or E-plane field pattern into an omnidirectional beam which is circular to ±½ db. The elevation or H-plane pattern is formed by the conical flare. The beamwidth (½ power point) in the H-plane is approximately 22° at the design frequency of 9,310 MC, and the maximum radiation is in the horizontal direction.

Preliminary system reports have been compiled from both a breadboard installation made at the Eatons Point Coast Guard Station on Long Island Sound and the type test conducted on the first Coast Guard unit.

The breadboard installation at Eatons Point operated continuously, 24 hours a day, for 41 days. This performance indicates that the system should give long and trouble-free operation. Numerous checks on the reception of the Eatons Point beacon were made by the WANDERER, several of these during rainfall.

The first system performed satisfactorily during the Coast Guard type test. Over a temperature range from +50 to —20°C, the output frequency of 9,310 MC varied 7 KC and the maximum component temperature rise, exclusive of tubes and resistors, was 18°C. However, the output power varied from 2.7 watts at +20°C to 1.7 watts at +50°C be-

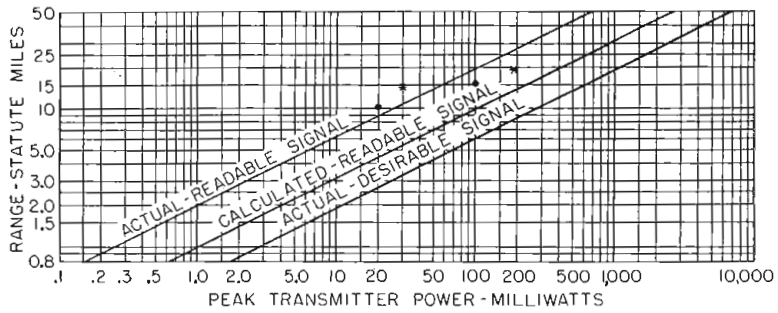
(*Text continued on page* 70)

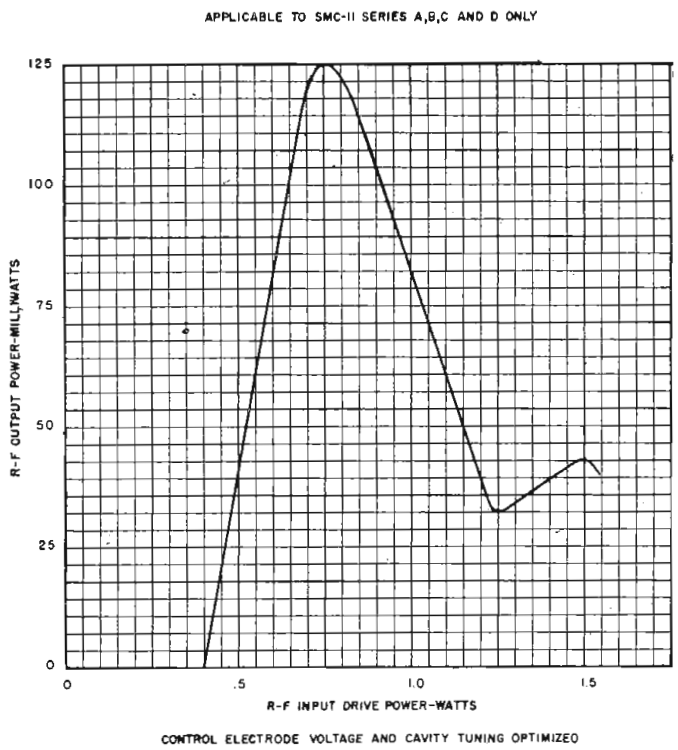
RADAR BEACON (Continued)

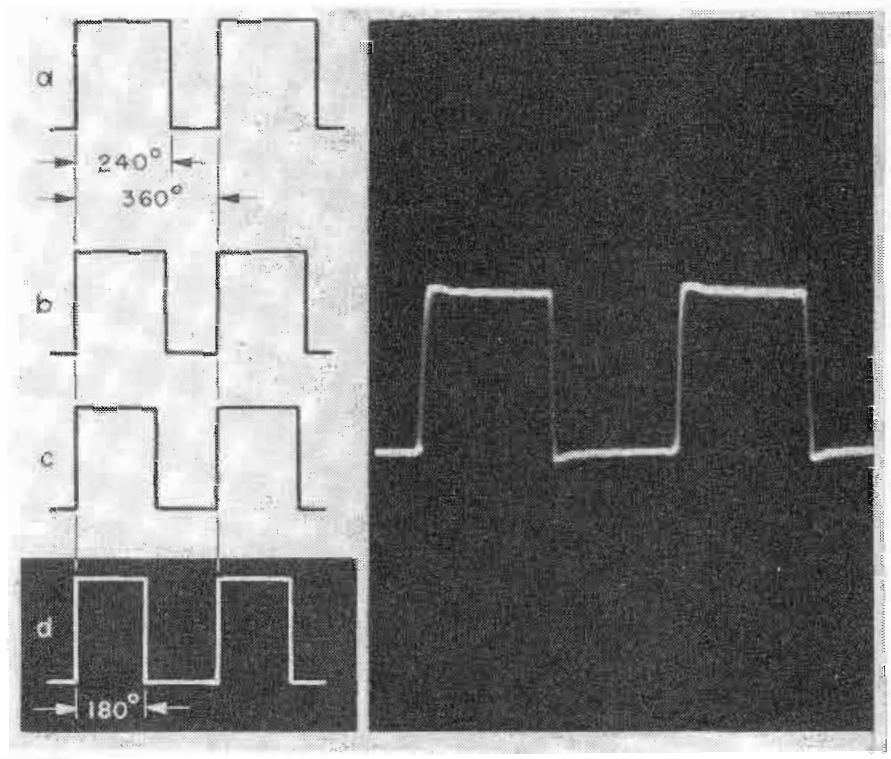
Fig. 6: (Below) Typical curve for SMC-11 klystron r-f output power vs r-f input power at 600 volts beam. Maximum power output occurs with exciter input of .75 watts

Fig. 7a-d: (Lower right) Drawings of oscillograms taken at 100 KC modulation frequency. 7a shows modulation output, 7b the exciter output, 7c the SMC-11 output, and 7d the SMX-32 output. The actual oscillogram (right) supports 7d

Fig. 8: (Right) Curves showing the range vs peak transmitter power for actual and calculated performance. Asterisks and dots on the chart indicate actual measurements







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Radar Beacon

(*Continued from page 67*)

cause the two klystrons were not completely temperature compensated. This condition can, if desired, be eliminated in future models by closer temperature control.

During the early part of the project, checks were made of expected performance range. First, calculations were made, and later a field test was made using the marine radar aboard the WANDERER.

Results of the calculation using standard formulae and the equipment characteristics listed below are shown in Table I:

a. Marine radar receiver sensitivity—130 dbw
b. Marine radar antenna gain—1,000
c. Beacon antenna gain—4
d. Marine radar beam loss—3 db
e. Marine radar scanning loss—12 db
f. Waveguide attenuation—4 db.

TABLE I

Power Versus Range

Statute Miles	R in feet	P_t in watts
0.05	264	2.5×10^{-6}
0.5	2,640	0.00025
5.0	26,400	0.025
25.0	132,000	0.625

$$P_r = \frac{P_t G_t G_r \lambda^2}{(4\pi R)^2}$$

$$\frac{P_t}{P_r} = \frac{(4\pi R)^2}{G_t G_r \lambda^2} \cong 4R^2$$

where

P_r = received peak power in watts
P_t = Transmitted peak power in watts
G_t = Transmitter antenna gain
G_r = receiver antenna gain
λ = wavelength in feet
R = range in feet.

The field test conducted aboard the WANDERER in conjunction with the Coast Guard resulted in taking data showing the minimum transmitter power required to present a readable signal on the radar scope. These data were taken for two different ranges and in two different ways. First, the transmitter power was reduced until the signal was just discernible, and it was then measured with a wattmeter bridge. Another set of data was taken by measuring the sensitivity of the radar with the gain control varied for minimum readable signal with constant transmitter power. The graph of these data appears on Fig. 8 along with another in which a 10-db safety factor has been added to insure reliable operation.

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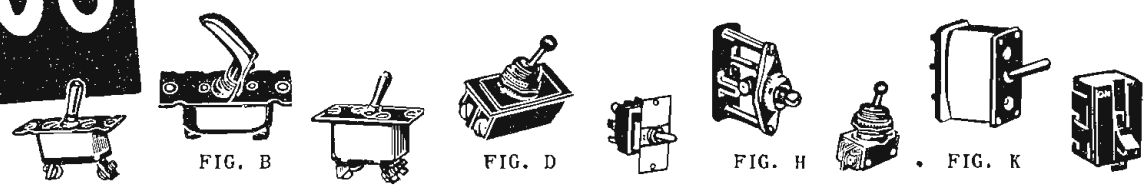

FIG. A FIG. B FIG. C FIG. D FIG. G FIG. H FIG. F FIG. K FIG. L

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PH-503	A	SPDT Center Off Mom Each Side.	B11.	.32
PH-505A	A	SPDT Momentary.	B21.	.30
PH-505	A	SPST.	AN-3022-2B.	.30
PH-506	A	SPDT Center Off.	AN-3022-1.	.35
PH-507	A	SPDT Center Off Mom Each Side.	AN-3022-7B.	.32
PH-513	A	SPDT Center Off.	Cutler Hammer AN-3022-1B.	.38
PH-514	A	SPST.	Cutler Hammer B-5A.	.35
PH-516	A	SPST.	B5.	.35
LT-104	A	SPDT One Side Momentary.	Cutler Hammer 8905K568.	.35
309-168	A	SPST.	168553.	.30
309-178	A	SPDT Momentary.	AN-3022-11B.	.35
309-181	A	SPST Momentary.	Cutler Hammer 8211K6.	.35
305-172	A Spcl.	SPST Momentary.	Cutler Hammer 8905K531.	.35
305-182	A Spcl.	SPST Momentary.	Cutler Hammer 8905K63D.	.45
370-14	A	SPDT Center Off 1 Side Mom.	Cutler Hammer B-7A.	.30
370-4	A	SPDT Center Off.	Cutler Hammer B-9A.	.35
370-25	A	SPST Momentary.	Cutler Hammer B-6B.	.25
309-169	B	SPST Momentary.	Cutler Hammer B-19	.35
PH-509	C	DPST.	AN-3023-2B.	.45
PH-510	C	DPDT Momentary.	Cutler Hammer 8715K2.	.50
PH-511	C	DPDT Momentary.	Cutler Hammer 8715K3.	.50
PH-512	C	DPST Center Off.	Cutler Hammer 8720K1.	.55
303-65	C	DPST.	Cutler Hammer AN-3023-2.	.45
309-163	C	DPDT Center Off Momentary.	Cutler Hammer C-11.	.55
309-162	C	DPST.	Cutler Hammer C-1.	.45
309-164	C	DPST Momentary.	Cutler Hammer 8711K3.	.40
305-87	D	1 Side DPST Mom, 1 Side SPST.	AH & H.	.95
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LT-101	F	SPST Momentary.	AH & H. W/Leads.	.20
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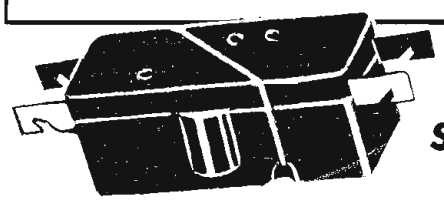
309-161	K	SPST.	Cutler Hammer 8781K3.	1.95
309-170	K	SPST.	Cutler Hammer 8905K656.	2.25
301-41	L	DPST.	AH & H	.75
305-76	L	DPST.	AH & H—Open Frame.	.75
319-50	L	SPST.	Allied Elec. Mfg. Corp.	.28
305-170	Spcl.	SPST.	Cutler Hammer Type B13.	.40



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301-29	CR1070C103-B3	N.O.	End	.47
303-34	CR1070C103-C3	1-N.O. 1-N.C.	End	.47
303-18	CR1070C103-F3	1-N.O. 1-N.C.	Side	.47
303-19	CR1D70C103-E3	N.O.	Side	.47
303-43	CR1070C123-B3	N.O.	End	.47
303-23	CR1070C123-C3	1-N.O. 1-N.C.	End	.47
305-83	CR1070C123-J2	SPDT	End	.47
303-22	CR1070C123-J4	SPDT	End	.47
303-17	CR1070C124-M4	SPDT	Side	.47
303-16	CR1070C128-C3	1-N.O. 1-N.C.	End	.47

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309-158	2D.	Mossman.	3⅞x2¼x1⅜	.85
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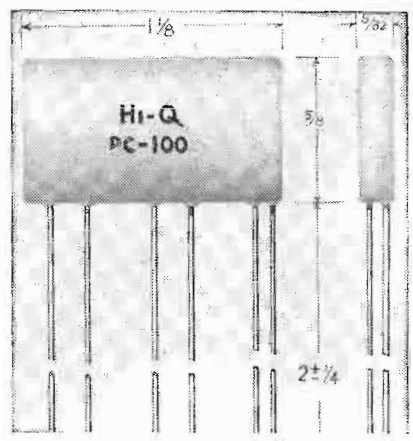

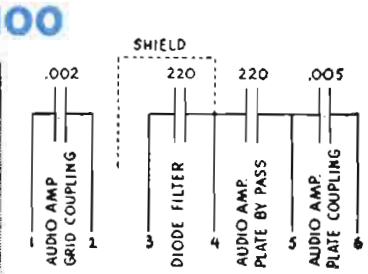

1-2	.002	+ 75 / − 25 %	mf
3-4	220	+ 50 / − 50 %	mmf
4-5	220	+ 50 / − 50 %	mmf
5-6	.005	+ 75 / − 25 %	mf

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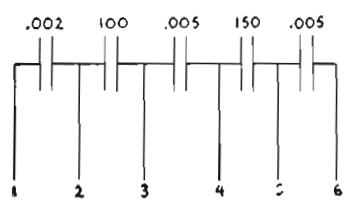
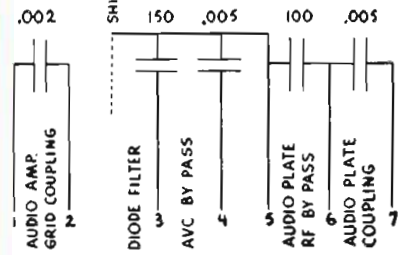


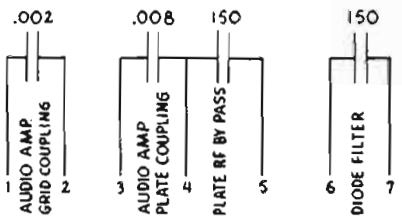
1-2	.002	+ 75 / − 25 %	mf
2-3	100	+ 50 / − 50 %	mmf
3-4	.005	+ 75 / − 25 %	mf
4-5	150	+ 50 / − 50 %	mmf
5-6	.005	+ 75 / − 25 %	mf

PC-102



1-2	.002	+ 75 / − 25 %	mf
3-5	150	+ 100 / − 0 %	mmf
4-5	.005	+ 100 / − 0 %	mf
5-6	100	+ 75 / − 25 %	mmf
6-7	.005	+ 75 / − 25 %	mf

PC-103



1-2	.002	+ 75 / − 25 %	mf
3-4	.008	Min %	mf
4-5	150	+ 50 / − 50 %	mmf
6-7	150	+ 50 / − 50 %	mmf

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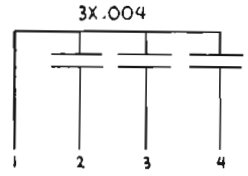

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PC-105

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1-3	.005	+ 75 / − 25 %	mf

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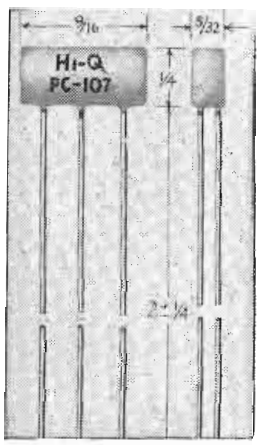

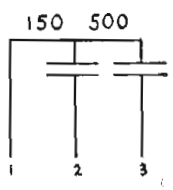

1-2	150	+ 75 / − 25 %	mmf
1-3	500	+ 75 / − 25 %	mmf

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The 17CP4 with its design-center maximum anode-voltage rating of 16 kilovolts, provides pictures having high brightness and good uniformity of focus over the whole picture area. It has a high-efficiency, white fluorescent screen on a relatively flat, high-quality faceplate made of frosted Filterglass to prevent reflection of bright objects in the room and to provide increased picture contrast.

Employing magnetic focus and magnetic deflection, the 17CP4 features an improved design of funnel-to-neck section which facilitates centering of the yoke on the neck and, in combination with better centering of the beam inside the neck, contributes to the good uniformity of focus over the entire picture area. The diagonal deflection angle is 70° and the horizontal deflection angle is 66°.

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RCA Application Engineers are ready to co-operate with you in applying the 17CP4 and associated components to your specific designs. For further information write RCA, Commercial Engineering, Section 57 AR, Harrison, N. J.

Another RCA-developed tube

Designed for Radiosonde Service, the RCA-5794 employs two resonators integral with the tube. The output resonator is tuned to 1680 Mc by means of an adjusting screw. Useful power output is 500 milliwatts.

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ELECTRON TUBES **HARRISON, N.J.**