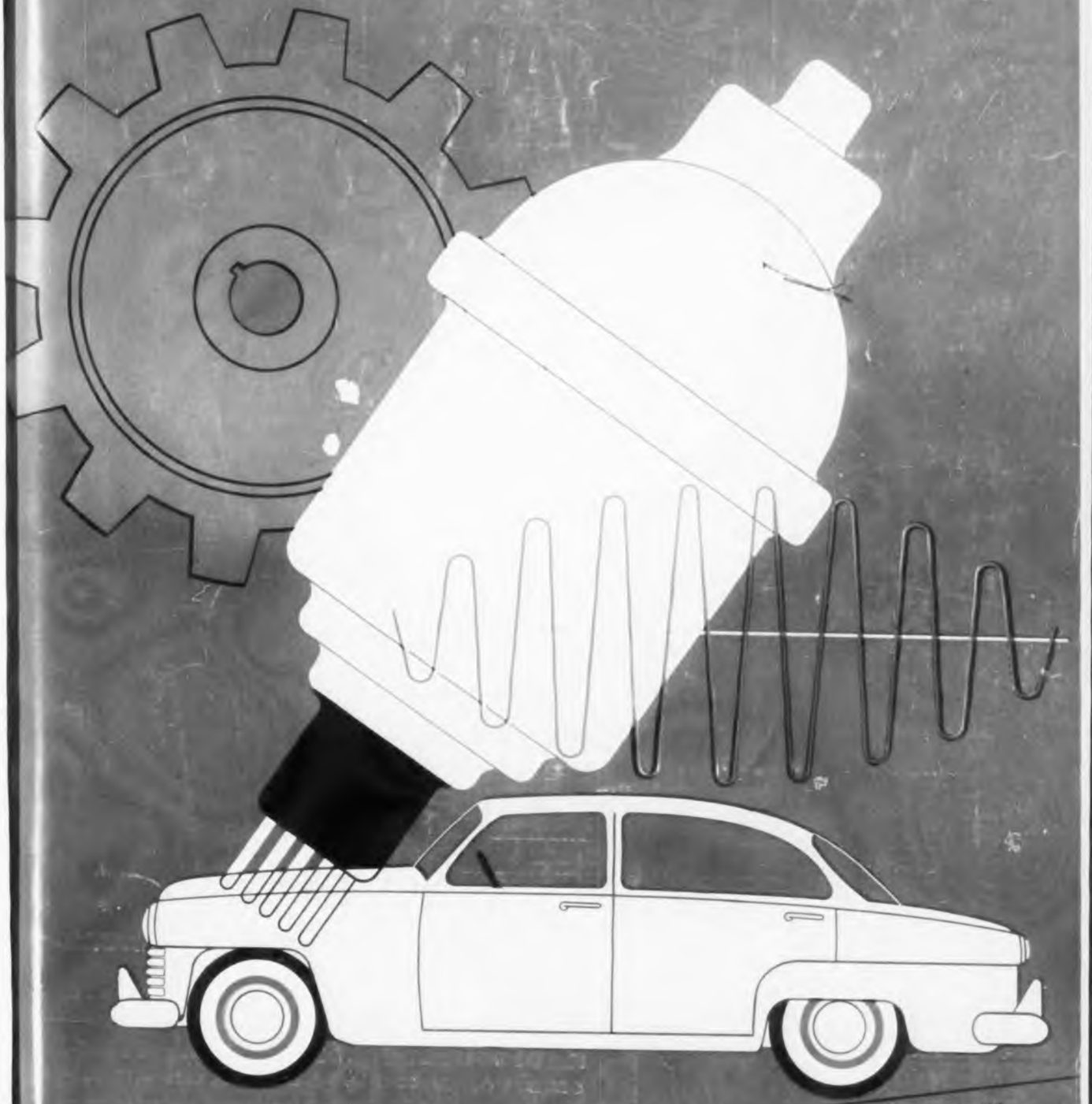
TELE-TECH

& Electronic Industries



ELECTRONIC-AUTOMOTIVE INDUSTRY STUDY

Magnetic Video Recording
Electronic Industry Statistics
Leningrad T-2—Modern Russian TV Receiver

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1954

Designed to Replace Paper Capacitors

RMC DISCAPS®

For Dependability and Longer Life

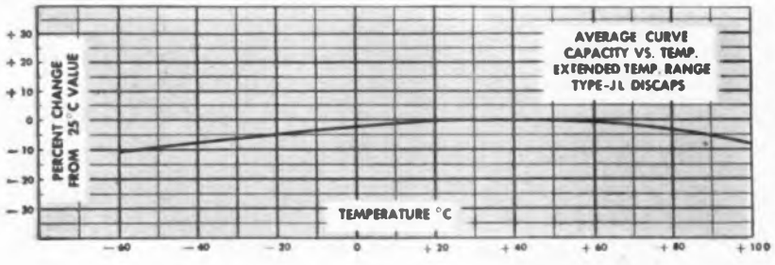
Type JL DISCAPS, another first from the RMC Technical Ceramic Laboratories, are especially engineered to replace paper capacitors up to .005 MFD in coupling applications or wherever a stable capacity is required. The maximum capacity change between + 25° C and + 100° C is only ± 7.5% of capacity at 25° C. Type JL DISCAPS are available in tolerances of ± 10% or ± 20%.

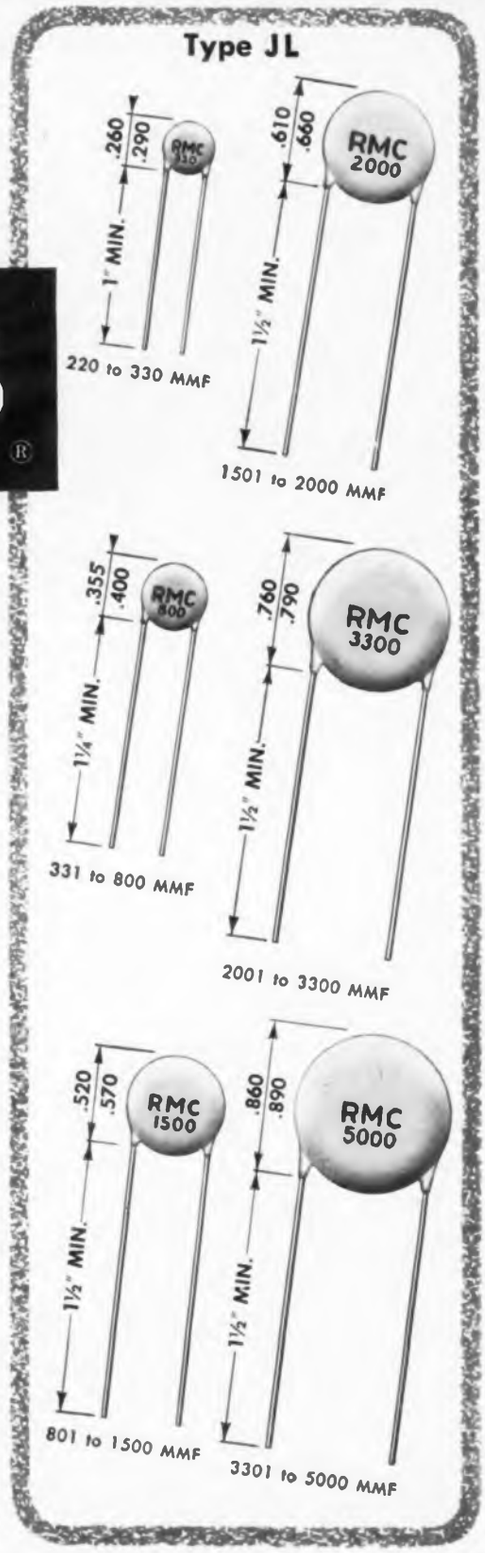
For by-pass applications requiring capacities up to .01 MFD you can take advantage of the longer life and dependability of ceramic capacitors by specifying RMC Type B DISCAPS.

Because RMC DISCAPS are of smaller size and are easier to wire into circuits they provide additional economies in assembly operations.

SPECIFICATIONS

POWER FACTOR: 1% max. @ 1 K C (initial)
POWER FACTOR: 2.5% max @ 1 K C, after humidity
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
LEADS: No. 22 tinned copper (.026 dia.)
INSULATION: Durez phenolic—vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms
CAPACITY TOLERANCE: ±10% ±20% at 25° C





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RMC

RADIO MATERIALS CORPORATION
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TELE-TECH
& Electronic Industries

JANUARY, 1954

FRONT COVER: ELECTRONIC-AUTOMOTIVE INDUSTRY STUDY—This symbolical cover introduces, after six months of intensive editorial investigations, the most comprehensive report to date showing how the automotive industry is using electronic equipment to both speed up and to guarantee precision in the production of its end product. Covering all phases of research and production, the analysis is based upon direct observations during on-the-spot inspections and contact with several hundred engineers, executives, and operating personnel. Included is an overall industry survey from a management organizational point of view. Starts on page 62.

DEPARTMENTS

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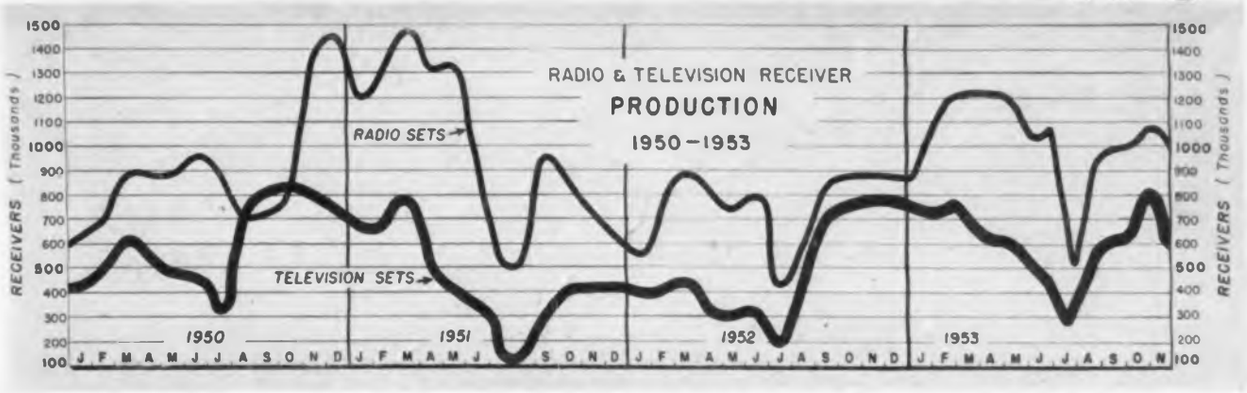
Facts and Figures Round-Up
January, 1954

ELECTRONIC INDUSTRIES TOTALS



Broadcast Stations in U.S.

	AM	FM	TV
Stations on Air	2437	551	220 VHF 117 UHF
Under Construction (CPs)	135	63	74 VHF 148 UHF
Applications Pending	234	8	325 VHF 99 UHF

Radio and TV Receiver Production

	TV	Radio	
November, 1953		Home	410,000
		Battery	110,000
		Auto	260,000
		Clock	220,000
Total	600,000		1,000,000
Eleven months, 1953 Jan.-Nov. inclusive		Home	4,010,000
		Battery	1,710,000
		Auto	4,760,000
		Clock	2,020,000
Total	6,900,000		12,500,000

More Millions for Electronic Defense in '54

The Department of Defense will have more money available for the procurement of electronic equipment in the fiscal year 1954, than it had in new obligational authority during fiscal year 1953, according to RETMA.

Although the new obligational authority for electronic procurement has been cut about $500 million from last year, a carry-over of almost $1 billion remains from fiscal year 1953 and most of it is expected to be retained.

As now allocated, $1.652 billion in new obligational authority has been made available by the Department of Defense for the procurement of electronic equipment during the current fiscal year. In addition, $931 million in carry-over funds remain unobligated from fiscal year 1953 and previous periods. Probably all of this money will be authorized for use, making a total of $2.583 billion.

Nearly $10 Billions in Three Years

Of the $1.652 billion in new fiscal year 1954 obligational authority for electronics, the Army is expected to be allocated $488 million; Navy, $466 million; Air Force, $419 million, and $279 million will be used for the Mutual Defense Assistance Program (MDAP). Of the carryover funds of $931 million, the Army has $67 million; the Navy, $151 million; the Air Force, $561 million, and $152 million remains unobligated by MDAP.

During fiscal years 1951-53, the three years following the start of the Korean war, new military obligational authority for the procurement of electronics equipment totaled $9.662 billion. This started at a high of $4.194 billion in fiscal year 1951, moving down to $3.350 billion in 1952 and $2.118 billion in fiscal year 1953.

The bulk of the 1951 electronics funds, $1.705 billion, was allocated to the Army. In that year the Navy had $1.316 billion in new obligational authority for electronics and the Air Force had $1.173 billion.

In fiscal year 1952 the Army's share dropped to $954 million. New obligational authority for Navy electronics was $1.233 billion while the Air Force received $1.163 billion.

1953-1954 Electronic Industries
STATISTICS
Start on page 78

RETMA Estimates on TV in '54

During the radio-TV manufacturers' convention at Chicago, several groups compiled expectations for 1954 TV output and revealed wide disparity in their estimates of what the industry will do in 1954. This year's "guess estimates" for the first time included color TV.

The Radio-Television Industry Committee: Black and white television set production, 4,860,000. Black and white sales, 4,900,000. Color television set production, 192,600. (The estimates on color television production in the RTIC ranged from a low of 50,000 to a high of 650,000.) Radio set production, 10,390,000.

The Tube Division: Black and white television set production, 5.1 million. (These "guess estimates" ranged from a low of 4 million to a high of 10 million sets.) Color television set production, 171,000. (The estimates ranged from a low of 30,000 to a high of 400,000.)

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in November 1953

Accelerometers	$27,326	Generators	979,627	Switches	167,500
Actuators	128,897	Harness, electronic	29,428	Switch Boxes	27,911
Amplifier Assys	35,086	Indicators	373,114	Target, radar reflecting	135,182
Antenna	45,684	Inverters	35,268	Telereader	39,945
Batteries, dry	969,790	Junction Boxes	159,681	Teletypewriters	125,394
Cable	795,928	Kits, detector	44,998	Testers	608,597
Coils	26,242	Kits, teletypewriter modification, transmitter	26,432	Thermostats	60,707
Compass Adapters	418,611	Microphones	26,600	Timing System	214,266
Connectors	30,637	Motors	343,519	Transformers	445,263
Couplers, directional	47,231	Plugs	78,120	Transmitters, flowmeter	100,196
Drift Meters	1,009,107	Range Instrument	413,523	Transmitter, marker beacon	139,162
Exciters	468,930	Relay Assys	344,088	Tubes, electron	659,665
Filters, bandpass	35,930	Spare Parts, recorder	181,022	Voltage Regulators	56,613
Frequency Meters	38,060			Wire	182,326

NEW! FOR PRINTED C

COMPLETE LINE O

1 **FOR AUTOMATION: EXCLUSIVE NEW** Self-Supporting Snap-in Bracket Mounting. (See Type YGC-B45.)

2 **NEW** Twist-ear Mounting. (See Types XP45 and UPM45.)

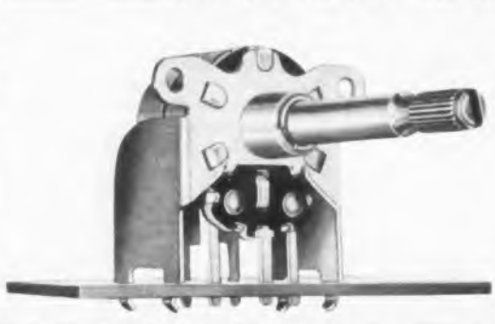
3 **PLUG-IN BLADE-TYPE TERMINALS** for vertical or horizontal mounting of control to printed circuit panel. (See all photos.)

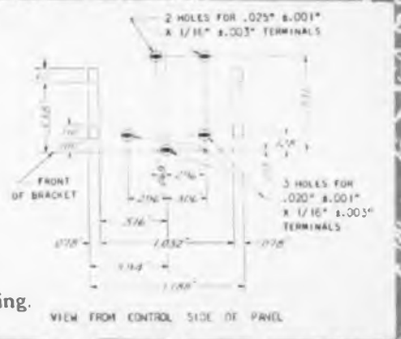
4 Threaded Bushing Mounting. (See Types XGC-45, GC-U45 and *miniaturized* U70.)

Consultation without obligation available on variable resistors for your printed circuit applications. Write today.

VERTICALLY MOUNTED to Printed Circuit Panel. Shaft above panel. (Types YGC-B45, XP45 and XGC-45.)

- NO shaft protection needed during soldering.
- PARALLEL terminals permit *small* round connecting holes instead of *large* elongated slots necessary for fan shaped terminals.
- Terminals available in 7/8" or 1-1/32" lengths from control's center.

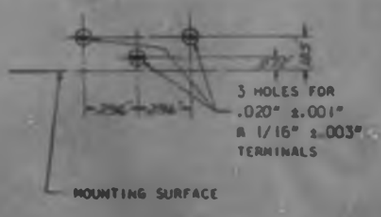




Suggested panel piercing.

Type YGC-B45 FOR AUTOMATION: *EXCLUSIVE NEW Self-Supporting Snap-in Bracket*

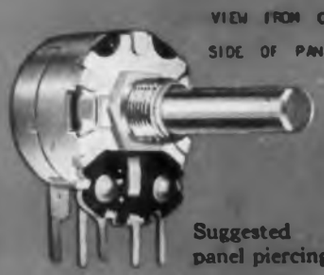
- Snaps instantly into place.
- Stays firmly put during soldering. Solder permanently anchors control to circuit panel.
- Terminal connections cannot loosen; bracket prevents mounting or operating strain on control or switch terminals.
- No mounting hardware, no separate supporting panel needed.
- No strain on printed circuit panel. Anchor tabs attach bracket to cabinet.
- Adequate clearance for circuit paths provided by ample spacing between terminals and by design of mounting lugs on bracket.

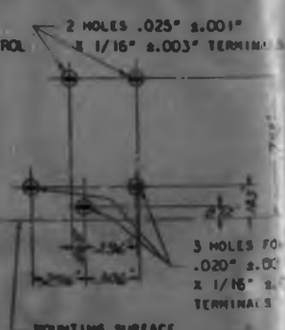


Suggested panel piercing.

Type XP45

For TV preset control applications using a mounting chassis to support printed circuit panel. Twisting 2 ears holds control rigidly to mounting chassis. Available in finger adjusted shaft lengths of 1/2", 5/8", 11/16", 7/8" and 1" from control's mounting surface. Also available with recessed screw driver slotted shaft





Suggested panel piercing.

Type XGC-45

For applications using a mounting chassis to support printed circuit panel. Threaded bushing mounting

All controls illustrated actual size.

CIRCUITS
OF VARIABLE RESISTORS

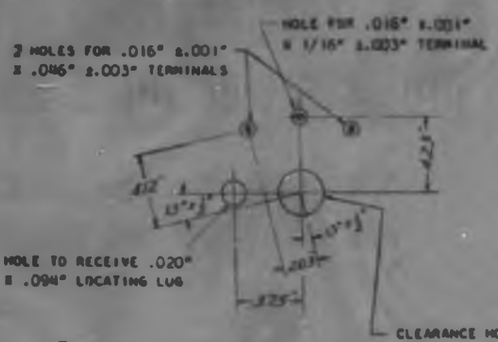
HORIZONTALLY MOUNTED

to Printed Circuit Panel. Shaft extends through panel. (Types U70, GC-U45 and UPM45.)

Type U70

(*Miniaturized*)

Threaded bushing mounting. Terminals extend perpendicularly 5/32" from control's mounting surface.



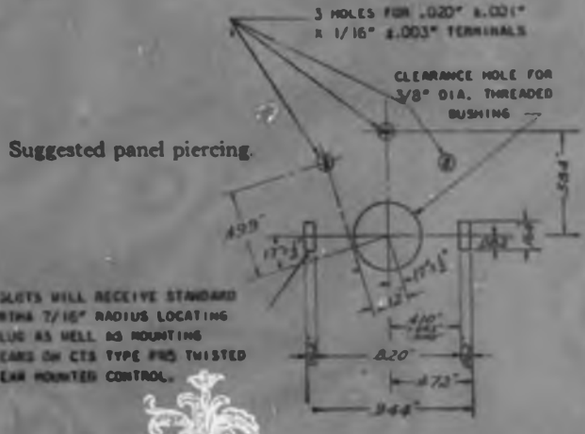
Suggested panel piercing.

Type GC-U45

Threaded bushing mounting. Terminals extend perpendicularly 7/32" from control's mounting surface. Available with or without associated switches.

Type UPM45

For TV preset control applications. Recessed screw-driver slotted shaft remains solder-free during panel dipping. Control may be held rigidly to panel before soldering by twisting 2 ears. If ears are left straight, the solder will permanently anchor control to circuit panel. Terminals extend perpendicularly 7/32" from control's mounting surface.



Suggested panel piercing.

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TELE-TECH® & ELECTRONIC INDUSTRIES is edited for top-level engineers and executives throughout the electronic industries. It gives the busy engineering executive authoritative information and interpretation of the latest developments and new products, with emphasis on subjects of engineering import and timeliness. Special attention is given to:

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—Electronic equipment, communications, broadcasting, microwave relay, instrumentation, telemetering, computing.
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—TV-FM-AM receivers, phonographs, recorders, reproducers.

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—Fixed, mobile and airborne communications in commercial, municipal, aviation and government services.
—Broadcasting, video and audio recording, records, audio and sound systems, motion picture production.
—Military, civilian and scientific electronic computing and control systems.

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Published annually as an integral section of TELE-TECH in June

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DEPENDABLE BORO-CARBON RESISTORS ...IN ½, 1, AND 2 WATT RATINGS

Now for the first time you can obtain a superior yet relatively low cost film-type resistor for military electronic gear—resistors that not only meet the severe performance requirements of Military Specification MIL-R-10509A, but are capable of full voltage dissipation at 70°C ambient!

Sprague Type 4E, 5E, and 6E Filmite B resistors are housed in a dense molded jacket which not only provides unexcelled physical protection for the film resistance element but serves as a barrier to moisture and vapor, the twin enemies of all film-type resistors.

Boro-carbon films are unusually sensitive to moisture. Protection against moisture in any form is a primary requirement for successful long term stability of resistance. The low-loss phenolic housings on molded Filmite resistors not only shed water but are vapor resistant and inert to the film material. There is minimum possibility of field failure through electrolytic action and penetration of moisture or vapor through the dense molded jacket.

Other features of molded Filmite B resistors are special low-contact-resistance, low noise end terminations held rigidly in place on special ceramic cores, extremely low temperature and voltage coefficients of resistance, and excellent load-life and high frequency characteristics.

For complete engineering data, write for Engineering Bulletin No. 130 to:

SPRAGUE ELECTRIC COMPANY
233 Marshall Street, North Adams, Mass.

SPRAGUE TYPE NO.	WATTAGE RATING	DIMENSIONS (INCHES) L	D	RESISTANCE (OHMS) Min.	Max.	VOLTAGE (Max.)
4E	½	¾	¼	100	1 Meg.	350
5E	1	1 1/16	3/8	100	2 Meg.	500
6E	2	2 3/16	3/8	200	10 Meg.	750

Standard Resistance Tolerances: 1 2 and 5%

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As We Go To Press...

Philco Develops "Surface-Barrier" Transistor

Development of a new type transistor currently in use for both military and civilian equipment, was recently announced by Philco Corp. The new "surface-barrier" transistor operates at high frequencies (up to 70 MC) and with low power consumption—requirements which have limited the use of transistors up to this time.

The production process consists of directing two tiny streams of liquid indium salt at opposite sides of a tiny slab of germanium. Electric current is passed through the streams so as to etch away the germanium. This process continues until the two streams almost drill through the slab. When the germanium has been etched down to a few ten thousandths of an inch in thickness, the current is suddenly reversed.

See page 87 for further details.

RCA Shows TV Recording on Tape

Color and black-and-white signals on magnetic tape herald coming era of "electronic photography"

Recording of TV pictures on magnetic tape in color and black-and-white was publicly demonstrated for the first time by RCA. The system is still in the developmental stage, but it is expected to become a commercial reality in two years. Video tape appears to be a low-cost solution to program recording for TV broadcasting, and also presents great possibilities for home movies, industry and military applications.

Among the advantages tape has over film are instant viewing, no chemical processing, rapid duplication and ability to be reused. The economic result is that black-and-white programs can be tape recorded for 20% of the cost of film, and original tape recordings of color TV programs for only 5% of the cost entailed in color film recording.

For further details, see page 81.

"Surface-barrier" transistor is produced by electro-chemical etching of small germanium slab. Tiny jets of indium salt etch germanium to thickness of 0.0002 in. When current is reversed, indium is electroplated to form electrodes. Technical details are given on page 87

FCC Tightens Ownership Rules

By a unanimous vote of the seven commissioners, the FCC has tightened its rules concerning multiple ownership of broadcasting stations. The decision limits the ownership of a licensee to five TV stations, seven AM and seven FM. Included in this count are stations in which the party has a minority interest. Under the old rules, only majority or definitely controlling interests were counted. The new ruling came as a surprise in some quarters where a more lenient decision was expected. CBS and J. Elroy McCaw are among the parties affected.

"Restricted" Classification Abolished

Defense Secretary Charles Wilson has signed a directive abolishing the security classification "restricted." The action is designed to provide a freer flow of information and to restrict the right of government agencies to classify printed material. It will also relieve industry of the burden of safeguarding a large volume of documents related to military contracts.

Annual Index

of all articles published in TELE-TECH & ELECTRONIC INDUSTRIES during 1953, classified according to subjects, may be obtained free of charge by writing to:

The Editors
TELE-TECH & ELECTRONIC INDUSTRIES
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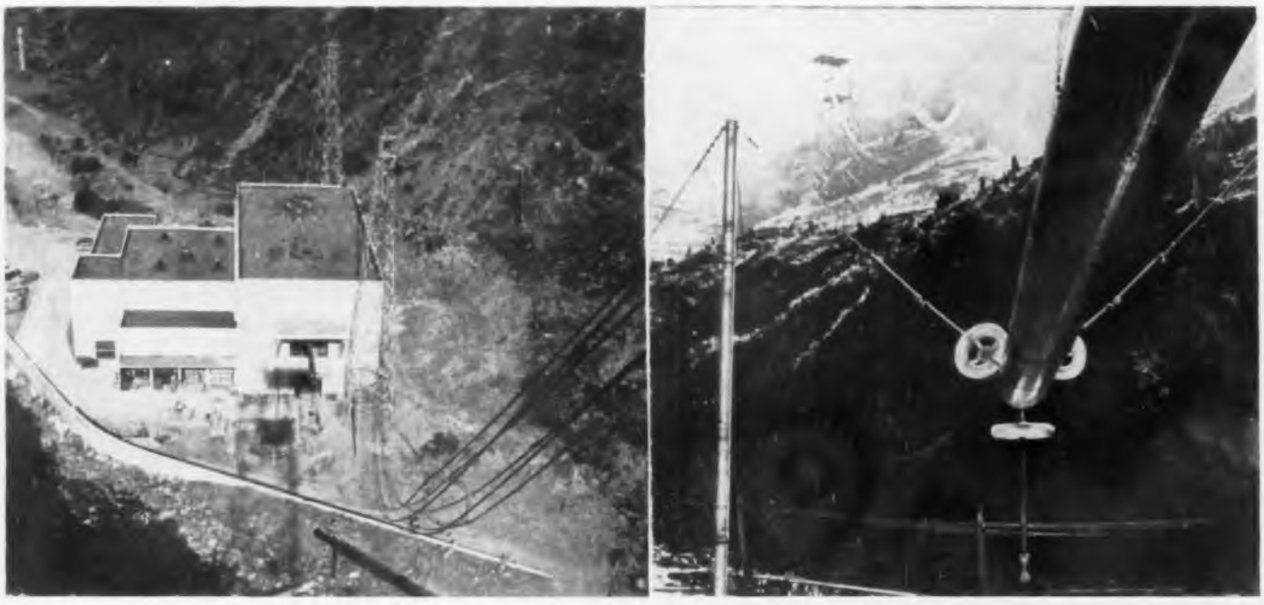
MORE NEWS on page 10

As We Go To Press . . . *(Continued)*

Navy Unveils World's Most Powerful Transmitter



View of Navy's Radio Jim Creek transmitter building (l) from 200-ft. tower on summit ridge. Cables from span plunge down to tower of busing system nestled in valley between 3000-ft. mountains. View (r) from building housing world's most powerful transmitter shows antenna lead-in trunk and 145-ft. bus tower halfway up mountain which has been cleared of trees. "Doughnut" shields guard trunk from corona discharge. Official U.S. Navy photographs

The Navy has unveiled its 1200-kw VLF transmitter, the world's most powerful, situated in Jim Creek Valley, Wash., 55 miles from Seattle. The transmitter, designed and constructed by RCA, will provide instantaneous CW communication to fleet units anywhere in the world. The $14,000,000 project was started in 1947.

The transmitter, covering the 14 to 35 KC band, is designed around the RCA 5831 power tube, a 500-kw triode. Each of the two power amplifiers employs three 5831's, two in push-pull with the third available as a spare. Tuning adjustments are confined to remote pushbutton controls of the antenna and power amplifier tuning. The loading inductances and variometers used to tune the antenna circuits are housed in two integral helix houses, each 75 ft. square and 60 ft. high.

The unique antenna system is suspended between two mountain ridges to eliminate the need for high towers. The antenna consists of ten spans, or catenaries, arranged in zig-zag fashion, each varying in length from 5640 to 8700 ft. To allow for ice and wind, the spans are permitted to sag as much as 1063 ft. at their center point. Twelve 200-ft. steel towers atop the 3000-ft. mountain crests support the spans. About 30 miles of Copperweld cable went into the antenna system, plus more than 220 miles of buried wires.

Compatible 3-D TV Now Available

An ingenious method of obtaining stereoscopic viewing of TV pictures without changing the studio pick-up or transmitting equipment has been developed by the Geneoscope Co. The 3-D effect is *not* accomplished by the anaglyph process of taking two separate pictures, and filtering only one to each eye. Instead, the camera is moved in a certain manner, and produces an ordinary or compatible picture on the receiver screen. However, when it is viewed through special glasses, the picture in the left eye is delayed, and the mind is conscious of two pictures: The near-instantaneous right eye view, and the delayed left eye view (which the right eye saw a moment before). Without glasses the observer sees a standard picture.

TV stations may obtain information and operating rights free of charge. Write to Geneoscope Co., 100 W. Olive St., Bloomington, Ill., for contract and literature. For technical details, see page 152.

"Univac" Enters Industry

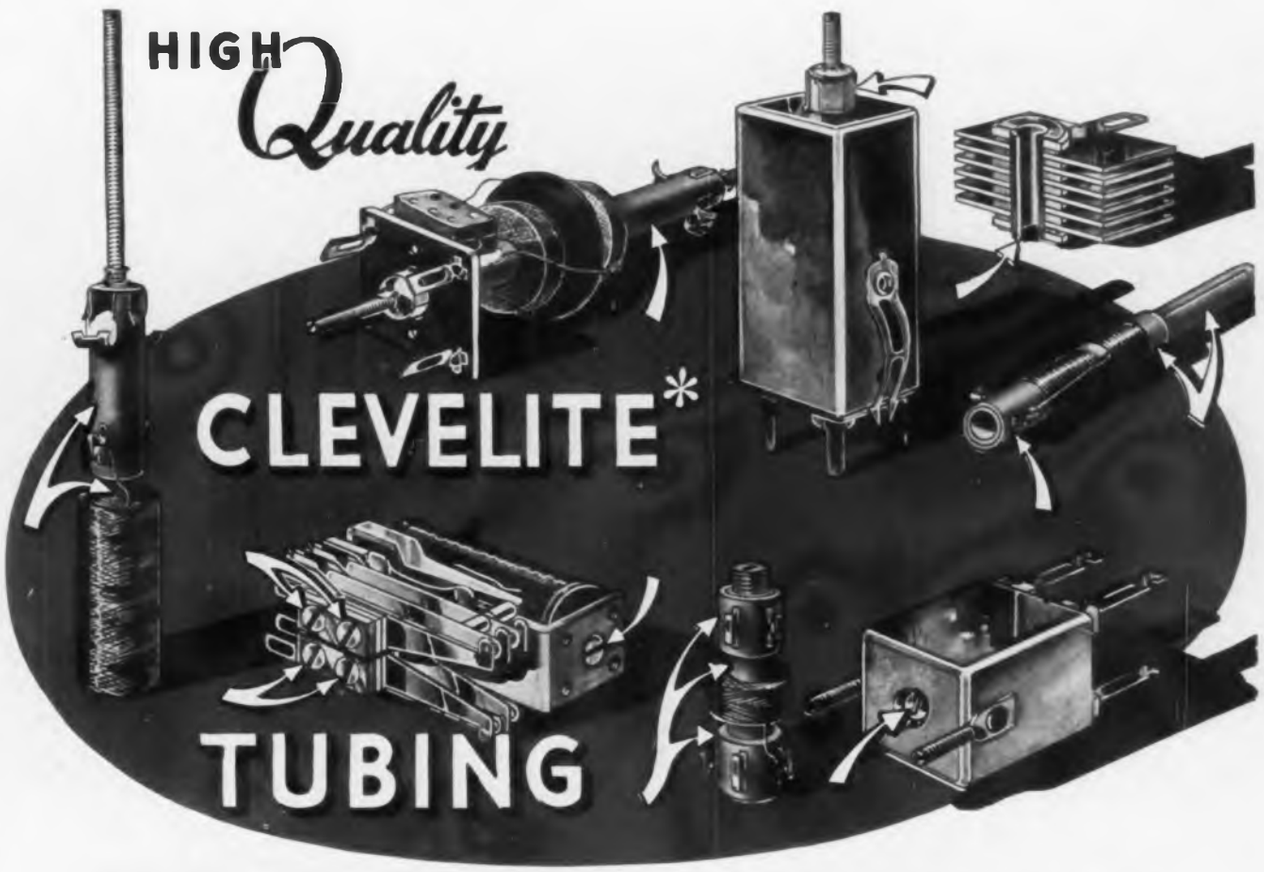
Remington Rand's Univac computer will be given its first industrial use by General Electric's Major Appliance Division. Several Univacs are now in government use. The unit at GE will be used to compile sales statistics, make market forecasts, prepare material schedules and process accounting data.

25 KW Tetrode in Production

Production has begun on the GL-6251, General Electric's new VHF TV tetrode with a gain in excess of ten and a power output of 25 kw up to 220 MC. Only 5 kw are needed to drive a pair of the tubes.

When used as a Class B grounded-grid broadband TV amplifier the tube has a useful synchronizing peak-power output of 30 kw at 220 MC. In narrowband Class C service the output is 25 kw of continuous power as an amplifier or oscillator. Because of its ratings, the tube also is well adapted to use in dielectric heating equipment.

MORE NEWS on page 12



ENSURES BETTER PERFORMANCE AT LOWER PRODUCTION COSTS

ITS CHARACTERISTICS INCLUDE:

High Dielectric Strength . . .

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CLEVELITE is known for its dependability—uniformity—and ability to meet required tolerances, which are particularly important in coil forms, collars, bushings, spacers, tubes and many other products. Available in diameters, wall thicknesses and lengths as desired.

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As We Go To Press . . . (Continued)

Miniature Germanium Photocell Developed

A GE scientist, Dr. W. C. Dunlap, Jr., has designed a p-n junction germanium photocell which should find numerous industrial and military uses. It is only slightly thicker than a pencil lead, three-eights of an inch long, and is more sensitive

Dr. Dunlap examines new p-n junction germanium photocell developed at GE. Future applications include heat control and missile guidance

to light than vacuum photocells a hundred times larger. The unit's acute sensitivity to infrared radiation makes it ideally suited to the regulation and monitoring of various flames and heating devices. The device could be used in atomic radiation detectors and guided missile target controls. Its comparatively large power output makes it suitable for operating relays directly, to control many production processes. It consists of a metal cartridge housing a glass lens and a germanium wafer, in contact with a metallic button of indium. A whisker links the wafer to an outside lead.

How Much Would You Pay for a Color TV Set?

Curious as to how much people would be willing to pay for a color TV set, Sarkes Tarzian made a survey of personnel in its Rectifier Div. The participants were predominantly women with an average weekly pay of $60, in most cases supplementing the husband's wages. Most employees live in low-rent rural areas, and the nearest town (Bloomington, Ind., pop. 27,000) has a minimum of theatre activities. The questions and answers of replies are:

What would you pay for a color TV set?

$500	470
$750	62
$1000	10
Over $1000	3

Would you be satisfied to wait for two years for the price to reduce to $300?

Yes	500
No	45

Subscription TV Operating

International Telemeter Corp. has started operation of its wired subscription TV system in Palm Springs, Calif., with the showing of a current run movie. About 75 Telemeters were installed for opening night, and the company reports that almost all of the 500 set owners want the attachment.

Federal Exams for Engineers Announced

The U. S. Civil Service Commission has announced that new examinations will be given to fill positions paying from $3,410 to $10,800 a year. No written tests will be given. Examination information may be obtained from most post offices or from the U. S. Civil Service Commission, Washington 25, D.C.

COMING EVENTS

Jan.—Conference on Radio Astronomy, Carnegie Institute of Washington, California Institute of Technology and National Science Foundation, Washington, D.C.

Jan. 18-22—AIEE Winter General Meeting, Hotel Statler, New York N. Y.

Jan. 25-27—Plant Maintenance & Engineering Conference, Hotel Conrad Hilton, Chicago, Ill.

Jan. 25-28—Plant Maintenance & Engineering Show, International Amphitheatre, Chicago, Ill.

Jan. 26-27—AIEE Scintillation Counters Conference, Washington, D.C.

Jan. 27-29—Tenth Annual Technical Conference of the Society of Plastics Engineers, Royal York Hotel, Toronto, Can.

Feb. 4—ISA 9th Annual Regional Conference, Hotel Statler, New York, N.Y.

Feb. 4-6—6th Southwestern IRE Conference and Electronics Show, Hotel Tulsa, Tulsa, Okla.

Feb. 4-6—1954 Audio Engineering Society, Audio Fair, Alexandria Hotel, Los Angeles, Calif.

Feb. 11-12—AIEE-IRE-ACM West Coast Computer Conference, Ambassador Hotel, Los Angeles, Calif.

Feb. 18-19—AIEE-IRE Conference on Transistor Circuits, Philadelphia, Pa.

Mar. 15-19—NACE Tenth Annual Conference and Exhibition, Kansas City.

March 22-25—IRE National Convention, Waldorf-Astoria Hotel and Kingsbridge Armory, New York, N. Y.

April 22-23—AIEE Conference on Feedback Control, Claridge Hotel, Atlantic City, N.J.

April 24—Eight Annual Spring Technical Conference, IRE Cincinnati Section, Cincinnati, Ohio

April 26-30—Tenth Biennial ASTE Industrial Exposition, Philadelphia Convention Center, Phila., Pa.

April 27-29—AIEE Electronic Components Conference, Washington, D.C.

May 4-6—1954 Electronics Components Symposium, RETMA and others, U.S. Department of Interior Auditorium, Washington, D.C.

May 4-7—1954 AWS National Spring Technical Meeting, Hotel Statler, Buffalo, N.Y.

May 5-7—Third International Aviation Trade Show, 71st Regiment Armory, New York, N.Y.

May 5-7—AIEE Northeastern District Meeting, Schenectady, N.Y.

May 5-8—1954 Welding and Allied Industry Exposition, Memorial Auditorium, Buffalo, N.Y.

May 7-8—IRE North Atlantic Region, New England Radio Engineering Meeting, Sheraton Plaza Hotel, Boston, Mass.

May 7-9—AFCA National Convention, Shoreham Hotel, Washington, D.C.

May 17-20—Basic Materials Exposition, International Amphitheatre, Chicago, Ill.

May 17-20—1954 Electronic Parts Show Conrad Hilton Hotel, Chicago, Ill.

May 24-26—AIEE Conference on Telemetering, Morrison Hotel, Chicago, Ill.

May 25-27—NARTB Convention, Palmer House, Chicago, Ill.

June 15-17—RETMA Convention, Palmer House, Chicago, Ill.

June 21-25—AIEE Summer General and Pacific Meeting, Hotel Biltmore, Los Angeles, Calif.

July 8-12—Convention British Institution of Radio Engineers, Christ Church, Oxford, England.

July 13-15—Plant Maintenance Show, Pan Pacific Auditorium, Los Angeles, Calif.

Aug. 25-27—1954 WESCON Show, Pan Pacific Auditorium, Los Angeles, Calif.

Sept. 13-24—SESA First International Instrument Congress and Exposition, Convention Hall and Commercial Museum, Philadelphia, Pa.

Sept. 30-Oct. 2—High Fidelity Show, International Sight and Sound Exposition, Inc., Palmer House, Chicago, Ill.

ACM: Assoc. for Computing Machines.
AFCA: Armed Forces Communications Assoc.
AIEE: American Institute of Electrical Engineers.
ASTE: American Society of Tool Engineers.
AWS: American Welding Society.
IRE: Institute of Radio Engineers.
ISA: Instrument Society of America.
NACE: National Assoc. Corrosion Engineers.
NARTB: National Assoc. of Radio and TV Broadcasters.
RETMA: Radio-TV Manufacturing Association.
SESA: Society for Experimental Stress Analysis.
WESCON: Western Electronics Show & Convention.

MORE NEWS on page 24

Stable, Low-Noise Carbon Controls in ANY Combination You Want

You don't have to compromise with quality to get the carbon controls your application requires. For Mallory Controls are available in a complete range of constructions, including single, dual concentric and dual tandem types . . . with or without switch.

Their noise level is unusually low, resistance values are unusually stable, and humidity drift is held to 10% . . . thanks to carbon elements with a high degree of surface smoothness and unusual density. Switches are built for long, trouble-free service, with special silver contactors and heavy gauge terminals.

Mallory Controls are built with ample ruggedness to stand any production line handling. They incorporate such mechanical features as welded assembly, vibration-proof clinched terminals, and heavy gauge fastenings.

Write today for the new catalog that describes all Mallory fixed and variable resistors . . . including both carbon and wire-wound types.

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The control illustrated is typical of the many special types which Mallory manufactures. Designed for service adjustments in television receivers, it is a tab-mounted, bushingless model with a phenolic shaft . . . for especially economical mounting.

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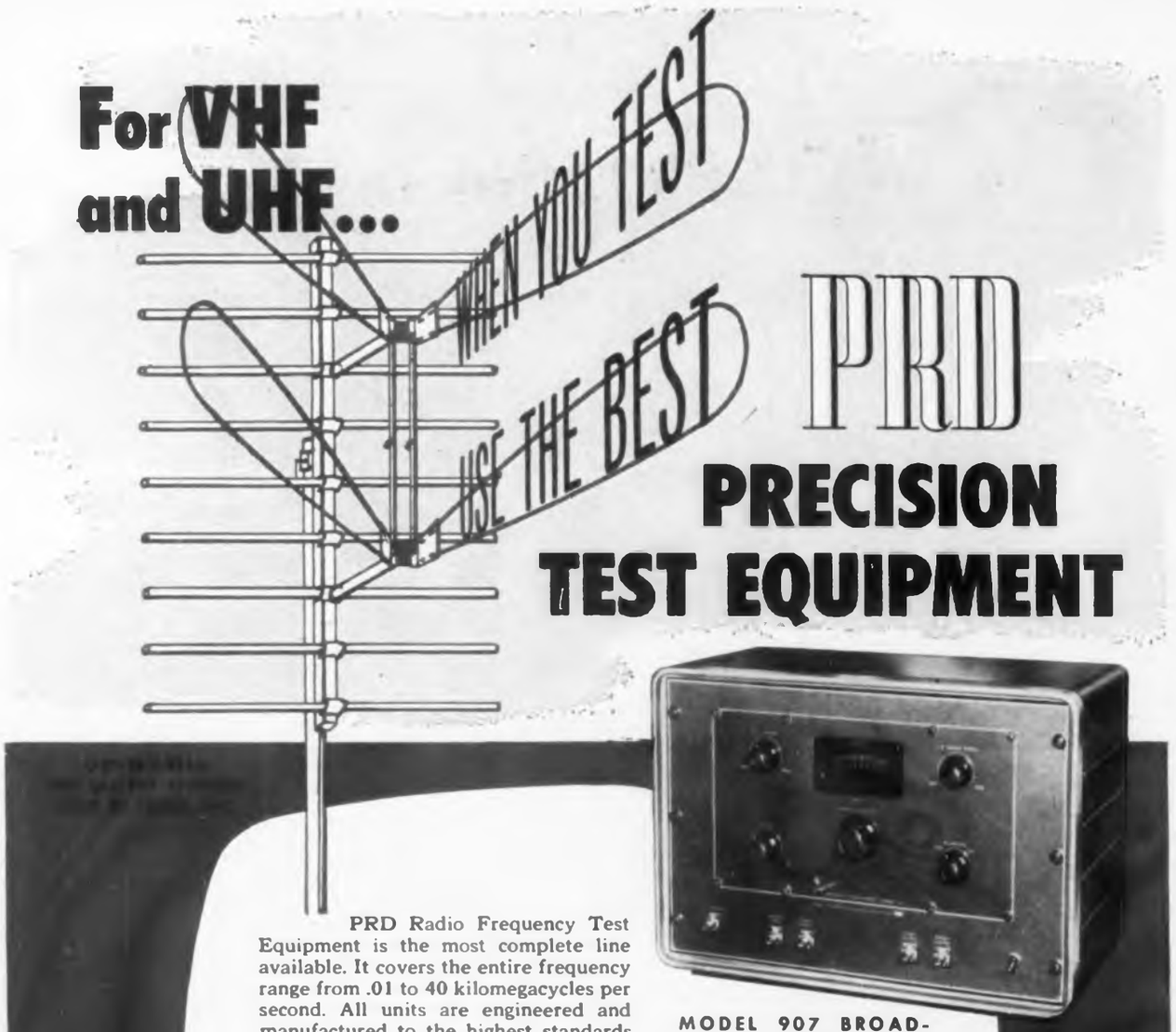

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MODEL 907 BROAD-BAND SWEEP FREQUENCY GENERATOR — A fundamental oscillator which can be swept over a band not less than 8 Mc/s for center frequency of 40 Mc/s. Sweep width not less than 40 Mc/s over the UHF band. Output continually variable over voltage range of 10 μv to ⅓ volt.

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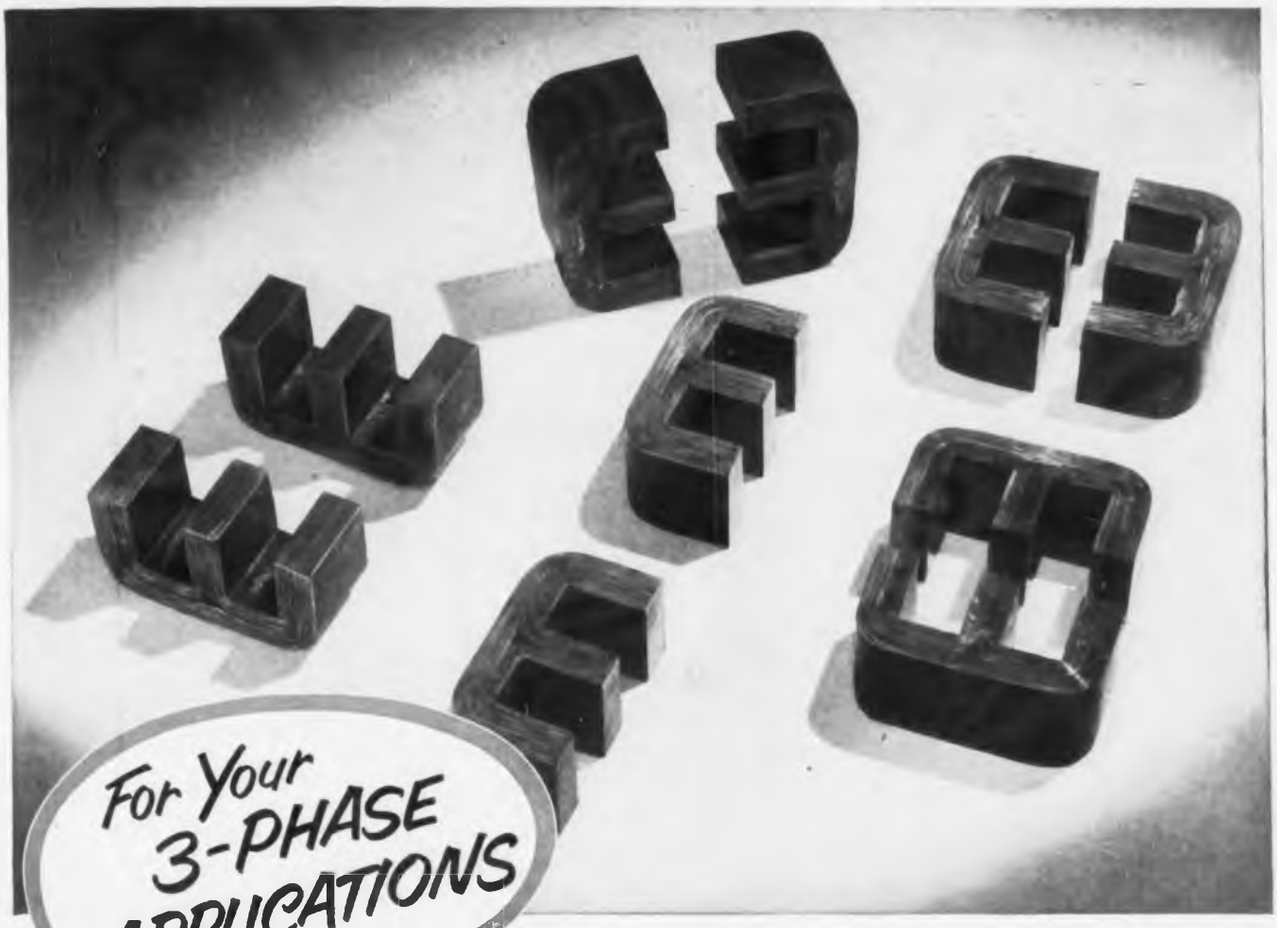

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made from SILECTRON strip
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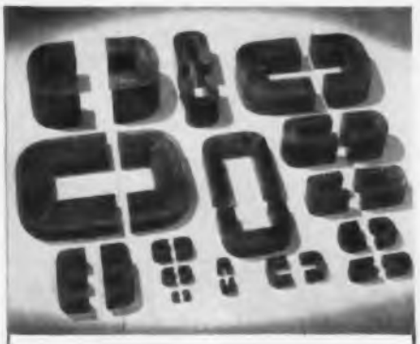

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WRITE FOR BULLETIN TC-105

WAD 4550

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The Model LSA Spectrum Analyzer is Polarad's answer to rising engineering costs when high performance and economy are essential.

This unique engineering tool helps get results faster with fewer personnel and in less space. Because of its ultra simplicity, tremendous frequency coverage and remarkable instrumentation the Model LSA can handle almost any problem in the radio spectrum (10 mc to 21,000 mc) with the greatest of ease, reliability and accuracy.

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FEATURES:

Frequency Range 10 mc-21,000 mc; 4 tuning heads
Accuracy Frequency Calibration—1%
Spectrum Display variable from 250 kc to 25 mc
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Broad Band R.F. Attenuators 10 mc-12,000 mc
Automatic Voltage selector for each tuning head
Single Dial Control
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Spectrum Displayed on 5" cathode ray tube

USES:

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Act as broad band receiver from 10 mc to 21,000 mc
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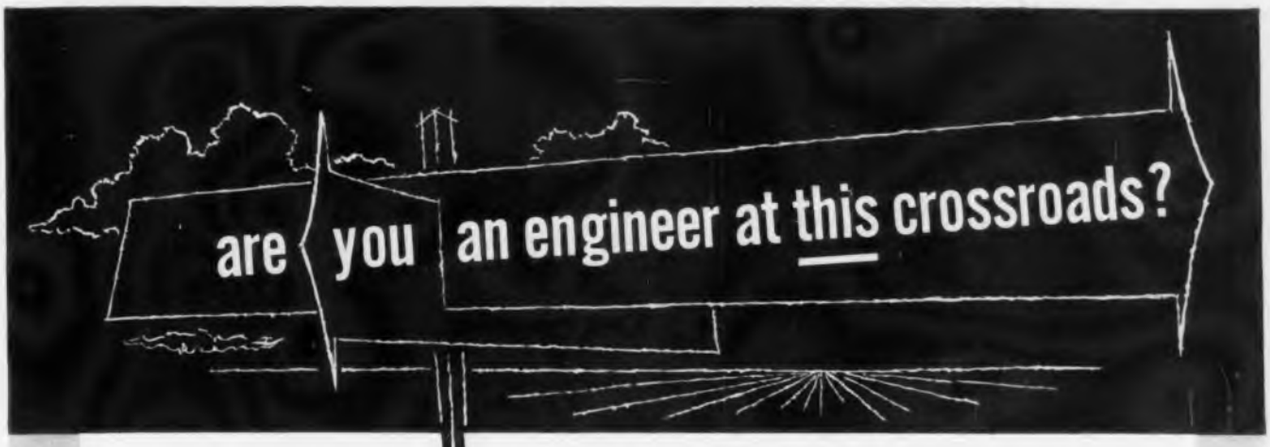

Never in the history of the electronics industry has it been more important for engineers to choose the right path for their careers to follow.

Everyone has done a lot of military work . . . but now the industry must find new markets in the industrial field!

As a leader in the production of industrial electronic equipment, Westinghouse has the necessary sales, distribution and field engineers organized to enter these new markets. We need research, design and development men to turn out the products. Now is the time to get into our organization, so that you'll be in on the ground floor as the industrial field expands!

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Duties: Design, development, and application of electronic circuitry including vacuum tubes and magnetic amplifiers as applied to the control of nuclear reactors.

Requirements: Three or more years experience and a B.S. degree in Electrical Engineering or in Physics.

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Duties: Applied research, development, and design of advanced radar, fire control and missile guidance equipment. Openings exist in the fields of local oscillators and associated circuitry, indicators, feed-back problems (closed-loop electronic circuits), pulsed circuits, video, simulators, i.f. strips, and in analysis of complex radar.

Requirements: Three or more years experience and a B. S. degree in Electrical Engineering or in Physics.

SENIOR COMMUNICATIONS ENGINEERS

Duties: Applied research, development, and design of advanced communications equipment and systems. Openings exist in the fields of automatic transmitters and communications circuitry.

Requirements: Three or more years experience and a B. S. degree in Electrical Engineering or in Physics.

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Duties: The applied research, development and design of audio transformers, modulation transformers and reactors, electric-wave filters, iron-core radio frequency transformers, radio frequency chokes, etc.

Requirements: Three or more years experience and a B. S. degree in Electrical Engineering or in Physics.

OR if you have experience in the fields of antennas, rf plumbing, magnetic amplifiers, technical writing, or in high frequency heating design and application, please apply.

To apply send resume of education and experience to
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Employment Supervisor, Dept. J-6
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Westinghouse
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BALTIMORE, MARYLAND

Another Sylvania Premium Subminiature Tube!
Type 6308 subminiature is a cold cathode, glow discharge diode . . .
especially designed by Sylvania for voltage reference applications.

Initial reports from engineers who have made comparative tests indicate that such critical performance factors as stability, drift, repeatability and voltage jump have been better attained with the 6308 than with other tube types of this classification.

This tube incorporates the excellent performance features of the Sylvania premium subminiature line and will provide dependable service under severe environmental conditions. Before selecting a voltage reference tube for your particular application, we urge you to check the ratings and controlled characteristics of the Sylvania 6308. For further information, call your Sylvania Sales Engineer or write Dept. 4R-4401 at the address below.

ELECTRICAL DATA

RATINGS—Absolute Values

Maximum Operating Current (dc)	3.5 ma
Minimum Operating Current (dc)	1.5 ma
Maximum Shunting Capacitance	0.02 uf
Maximum Starting Voltage (dc)	115 volts

CHARACTERISTICS

Operating Voltage[1] (dc)	87 volts
Voltage Regulation (max.)	3 volts
Drift[2]	200 mv
Stability[3]	5 mv
Repeatability[4]	150 mv
Voltage Jump[5]	50 mv

Maximum Average Temperature Coefficient of DC Operating Voltage:

−20 °C to +25 °C Ambient	−15 mv/°C
+25 °C to +60 °C Ambient	−5 mv/°C

Notes:

(1) *Anode voltage drop may range between 82 and 92 volts for any tube.*
(2) *Maximum operating voltage change during one hour of operation, at any specific value of current within operating range.*
(3) *Maximum operating voltage fluctuation having a frequency of 10 cps or greater, at any specific value of current within the operating range.*
(4) *Maximum shift in operating voltage between successive firings of tube.*
(5) *Maximum sudden jump in operating voltage when operating current is varied slowly over specified range.*

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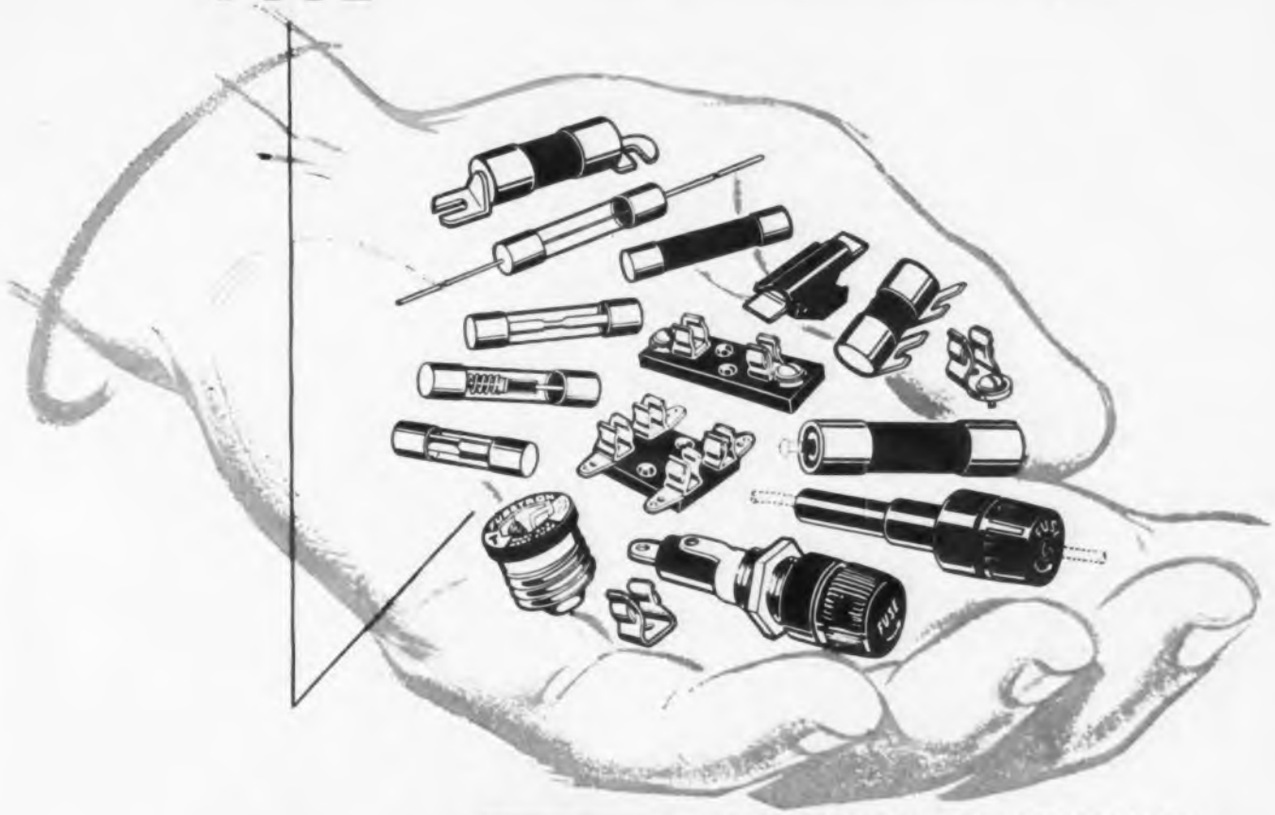
That's why manufacturers and service organizations for over 38 years have turned to BUSS for their fuse needs — no matter how exacting.

Should you have a special problem in electrical protection, BUSS places at your service the world's largest fuse research laboratory and its engineers.



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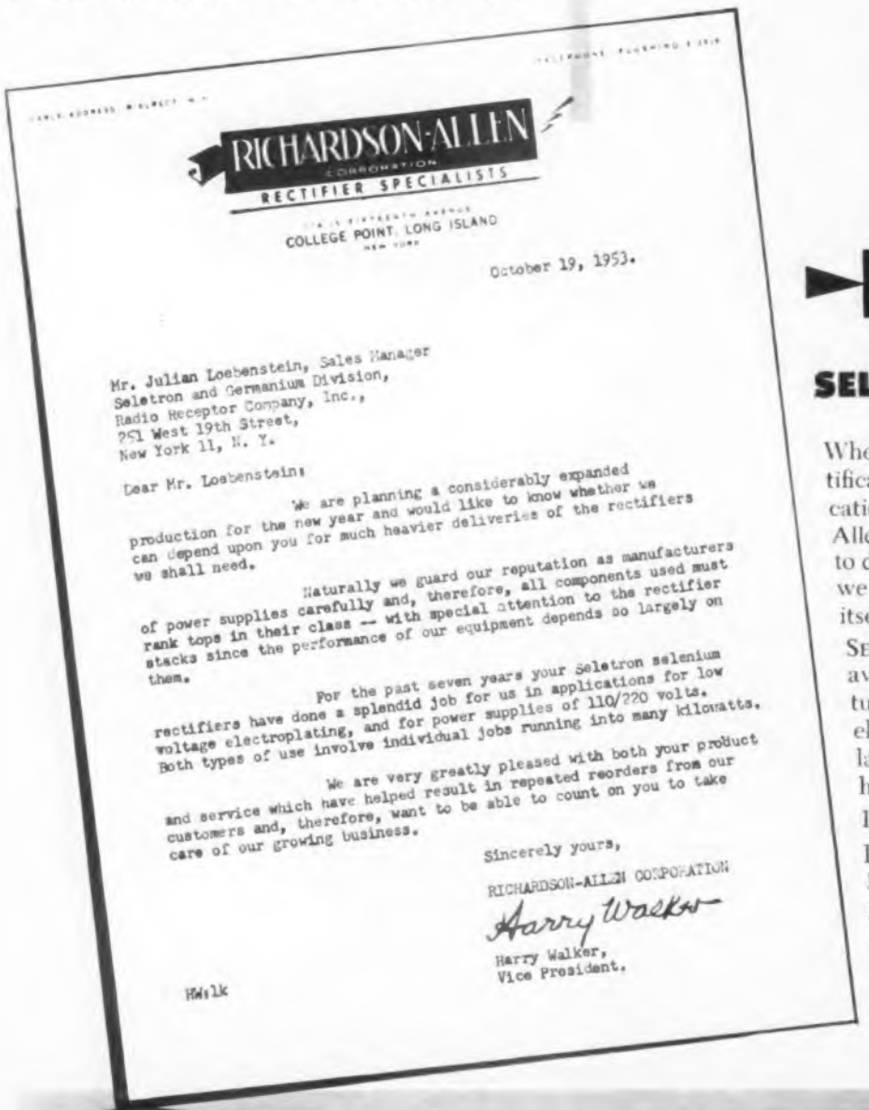

RICHARDSON-ALLEN CORPORATION
RECTIFIER SPECIALISTS

COLLEGE POINT, LONG ISLAND

October 19, 1953.

Mr. Julian Loebenstein, Sales Manager
Seletron and Germanium Division,
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251 West 19th Street,
New York 11, N. Y.

Dear Mr. Loebenstein:

We are planning a considerably expanded production for the new year and would like to know whether we can depend upon you for much heavier deliveries of the rectifiers we shall need.

Naturally we guard our reputation as manufacturers of power supplies carefully and, therefore, all components used must rank tops in their class -- with special attention to the rectifier stacks since the performance of our equipment depends so largely on them.

For the past seven years your Seletron selenium rectifiers have done a splendid job for us in applications for low voltage electroplating, and for power supplies of 110/220 volts. Both types of use involve individual jobs running into many kilowatts.

We are very greatly pleased with both your product and service which have helped result in repeated reorders from our customers and, therefore, want to be able to count on you to take care of our growing business.

Sincerely yours,

RICHARDSON-ALLEN CORPORATION

Harry Walker

Harry Walker,
Vice President.

HWilk

Seletron

SELENIUM RECTIFIERS

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Power Supply, 230 V. 225 KW.

Electroplating, 4000 amp., 9 volts

4 circuit Battery Charger. Each circuit 120 volts, 180 amps.

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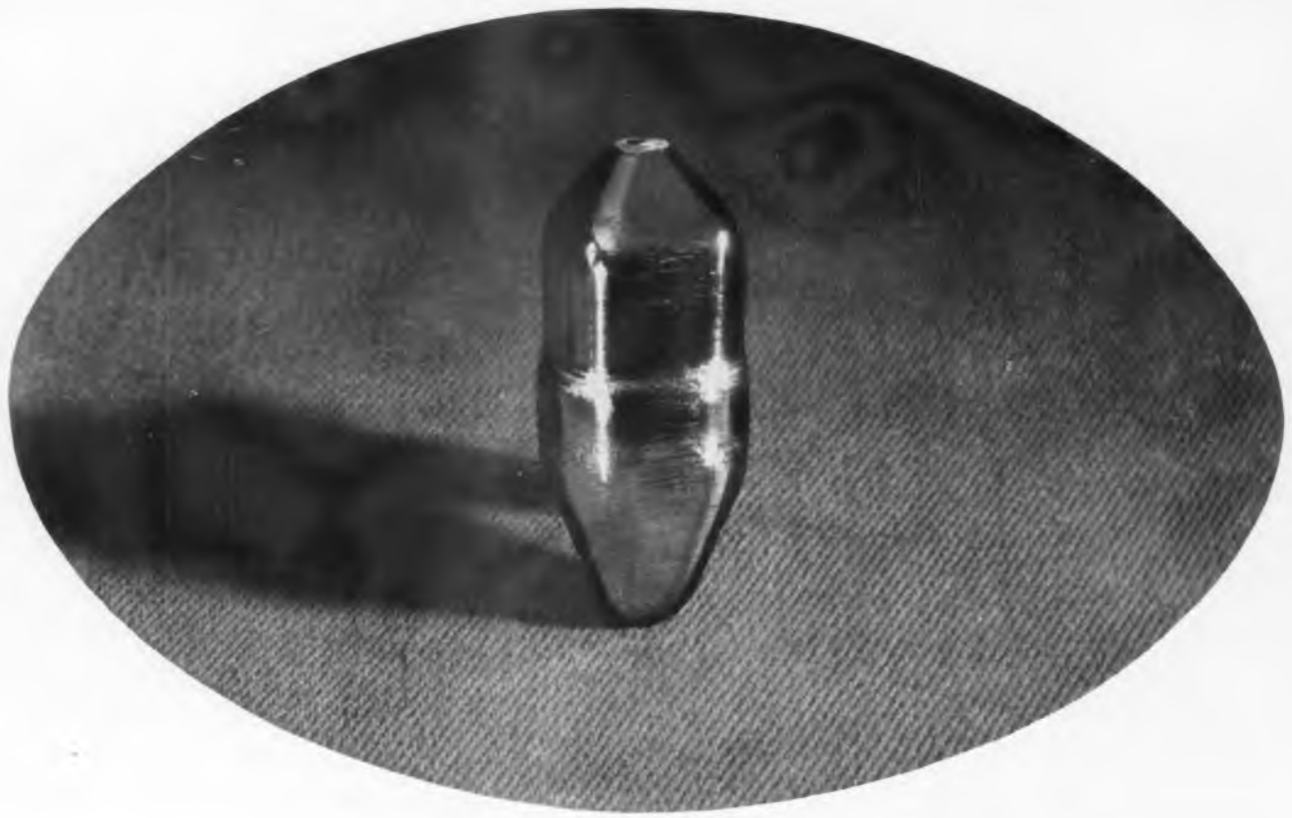

Germanium crystal grown at Bell Telephone Laboratories (life size). It is sliced into hundreds of minute pieces to make *Transistors*. Transistor action depends on the flow of positive current-carriers as well as electrons, which are negative. Arsenic —a few parts per 100,000,000—added to germanium produces prescribed excess of electrons. With gallium added, positive carriers predominate. Latest junction type *Transistor* uses both kinds of germanium in the form of a sandwich.

THEY GREW IT FOR TRANSISTORS

Heart of a ***Transistor*** – Bell Telephone Laboratories' new pea-size amplifier—is a tiny piece of germanium. If ***Transistors*** are to do their many jobs well, this germanium must be of virtually perfect crystalline structure and uniform chemical composition. But it doesn't come that way in nature.

So—Bell scientists devised a new way to *grow* the kind of crystals they need, from a melt made of the natural product. By adding tiny amounts of special alloying substances to the melt, they produce germanium that is precisely tailored for specific uses in the telephone system.

This original technique is another example of the way Bell Laboratories makes basic discoveries—in this case the ***Transistor*** itself—and then follows up with practical ways to make them work for better telephone service.

Section of natural germanium, left, shows varying crystal structure. At right is sectioned single crystal grown at Bell Laboratories.

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VHF or UHF

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NEW comprehensive 28-page brochure on RCA UHF Transmission Lines and Fittings. Includes detailed charts, drawings, curves, installations, etc. Ask your RCA Broadcast Sales Representative for a copy.

USE THIS HANDY CHECK LIST OF MAJOR COMPONENTS

1. 1 KW UHF Transmitter (Type TTU-1B)
2. 3⅛" 90° Mitre Elbow (Special Single Bullet Type)
3. Solder Type Flange Adapter
4. 3⅛" Transmission Line (Special Section Less Anchor Insulator)
5. 3⅛" 90° Mitre Elbow
6. UHF Filterplexer
7. Directional Coupler and Housing
8. Filterplexer Gassing Equipment
9. Line Gassing Equipment
10. Gas Stop
11. Reducer Transformer—6⅛" to 3⅛"
12. Horizontal Anchor Assembly
13. 6⅛" Transmission Line
14. Roller Assembly Support
15. 6⅛" Transmission Line (Special Section Less Anchor Insulator)
16. Lateral Braces
17. Two 6⅛" 90° Mitre Elbows in Series (Combined as One Unit)
18. Spring Expansion Hanger
19. Fixed Hanger—6⅛" Line
20. Two 3⅛" 90° Mitre Elbows in Series (Combined as One Unit)
21. Fixed Hanger—3⅛" Line
22. UHF Pylon Antenna
23. Beacon Assembly
24. Lightning Protector

RCA

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT — CAMDEN, N.J.

Armstrong Initiates Legal-Scientific Study

The complex problem of rendering correct legal decisions on intricate scientific problems beyond the comprehension of well-educated jurists is the subject of a study initiated by the pioneer inventor Major Edwin H. Armstrong. Under the terms of a $50,000 grant made by Major Armstrong, the investigation will be directed by the dean of the Columbia Univ. School of Law, William C. Warren. Serving as directors are Dr. Karl T. Compton, Bethuel M. Webster, and Prof. Young B. Smith.

"Selevision" Markets Perishable Foods

A new type of cross-country wholesale auction is going into effect to market perishable foods. It's an electronic - communications system called "Selevision"—no relation to television. Through the cooperation of IBM, AT&T Long Lines, and Selevision, specially adapted equipment permits instantaneous intercommunication between auction rooms in ten distant cities.

Selevision's "automatic auctioneer" counts time after bid is made in distant city

Early in January, after advance descriptions of certified carloads of citrus fruits have been transmitted from Lakeland, Fla., to accredited buyers, the first Selevision auction will start. In each of the ten auction rooms across the country, when a bell rings and a lamp lights, the first lot number will simultaneously be flashed on a screen. When a bid is made in one city, it is flashed immediately on the screens in all ten cities. A large visible time clock ticks off the seconds, and if after nine seconds no other bid is registered, a buzzer operates, Selevision flashes "Sold," and the next offer is brought up. The definite sale at a definite price is expected to speed shipments and eliminate rerouting charges.

TELE-TIPS

Begin on Page 44

RAYTHEON

MICROWAVE SPECIALISTS FOR TELEVISION

Studio-Transmitter Links
Remotes • Interconnection

TRPM Special casting assures rigidity of parabola in all applications.

now *meets full FCC specifications for STL*

— 15,000 cycles audio frequency response
— better than 55 db signal to noise ratio

KTR-100 provides in almost unbelievably light and compact form complete equipment for multiplex wide band video and high quality audio transmission and reception.

Highly portable yet ideally adapted for permanent installation, it is extremely easy to set up and operate in any location — with installation, control and servicing features never before available.

From unit packaging to IF strips, RF plumbing and audio circuits, the Raytheon KTR-100 is entirely new. Introduced only after long research and development, it combines the best efforts of Raytheon specialists in every phase of electronics with the advice of television engineers, industry professionals and consulting engineers.

Before you buy equipment for remote pick-up, STL or network interconnection, look into the Raytheon high and low power microwave—DESIGNED FOR TELEVISION. Write for complete information. Inquiries invited concerning special government or industrial applications.

RRPM Change parabola or feed from rear in one minute.

Recent Shipments Cover the Country

Stations from coast to coast will tell you that Raytheon KTR-100 is tops for simplicity, dependability, operating convenience and economy. Shipments are now being made on schedule.

KDUB-TV — Lubbock, Texas	**WCIA** — Champaign, Ill.	**WAYS-TV** — Charlotte, N. C.
WTTG — Washington, D. C.	**KNUZ-TV** — Houston, Texas	**KLPR** — Oklahoma City, Okla.
KVOS-TV — Bellingham, Wash.	**KOAT-TV** — Albuquerque, N.M.	**KFBC-TV** — Cheyenne, Wyo.
WHYN-TV — Holyoke, Mass.	**WTAP** — Parkersburg, W. Va.	**WCHA** — Chambersburg, Pa.
WTVE — Elmira, N. Y.	**KIEM-TV** — Eureka, Calif.	**KBOI** — Boise, Idaho
KCCC — Sacramento, Calif.	**WTAD** — Quincy, Ill.	**CBC** — Vancouver, Canada
KOMU — Columbia, Mo.	**KETX-TV** — Tyler, Texas	**KACY** — St. Louis, Mo.

RCU Circuit design and packaging by specialists.

RAYTHEON
Excellence in Electronics

RAYTHEON MANUFACTURING CO.

Equipment Sales Division

Dept. 6270 TL WALTHAM 54, MASSACHUSETTS

TCU Light and convenient with standardized connections at end of case.

INTERNATIONALLY SPEAKING

Two Gates 10,000 watt transmitters installed at Press Wireless, Inc., Hicksville, L. I., N. Y., one of the world's foremost companies in international communications.

When it comes to handling reams of press copy, commercial messages and facsimile on an around the clock basis—more and more, engineers are agreed that the rugged, straightforward, easy to service and dependable Gates high powered transmitters are the answer.

Date line—Bangkok, Thailand, Egypt, Norway, Dakar, Alaska, San Salvador, Korea, New York, or you name it — the best guess is — copy via Gates-made international short wave transmitters. Any Gates office will gladly participate in your planning. Overseas customers will also find a Gates representative close at hand.

GATES

GATES RADIO COMPANY

Manufacturing Engineers Since 1922

QUINCY, ILLINOIS - - - U.S.A.

INTERNATIONAL—13 East 40th St., New York City
(Cable - - - ARLAB)

DOMESTIC

51 East 42nd St.
New York City

7501 Sunset Blvd.
Los Angeles, Calif.

Warner Bldg.
Washington, D. C.

13th & Spring Sts.
Atlanta, Georgia

2700 Polk Avenue
Houston, Texas

Canadian Marconi Co.
Montreal, Canada

THIS IS WHAT RUST MEANS BY A COMPLETE REMOTE CONTROL SYSTEM

Illustrated on this page are what *we* consider to be the basic elements of a remote control system for the RCA 250 K or L transmitter. For other transmitters, different groups of elements will apply. Note that Rust not only supplies standard transmitter, control and pre-amplifier units (right) but also units for each of the functions in the table below. These units are especially designed for *your* transmitter. Each Rust system includes a complete interconnection diagram tailored to *your equipment* and *your requirements*. When you buy *Rust* you have everything you need . . . nothing else to buy; no units to fabricate.

What will you get for your money?

Don't be fooled by talk of "low price" remote control systems. Check and compare before you buy any system. Find out how much a *complete* installation will cost . . . what additional parts you will have to buy or make. Does it fulfill all your requirements?

Rust considers the system illustrated on this page to be the *minimum* to do a satisfactory job. It will provide the following control and metering functions:

CONTROL	METERING
Tower Lights	Lighting Current
Filament "on-off." Reset filament, line and modulator overload breakers.	Filament Line Volts
Plate "on-off." Reset plate and P.A. overload breakers.	Plate Voltage
P.A. Tuning	Plate Current
Power Output	Antenna Current

. . . and provides for addition of other control and metering functions when and if desired.

Of special interest is the especially designed RCA Actuator (A) which "hooks up" directly with the RCA 250 K or L front panel controls. Like other Rust Systems, it provides for resetting of manual overload breakers (so that you need not send a man to the transmitter location in the event of overload).

Let *Rust* quote you on a *complete* remote control system designed for *your* transmitter. You'll find an unbeatable value. Write, wire or phone.

rust INDUSTRIAL CO.

the rust industrial company, inc.

608 WILLOW STREET MANCHESTER, N. H.

TESTS PROVE EFFICIENT OPERATION —BELOW ZERO AND AT 100° C!

ACTUAL SIZE

VACUUM JUNCTION TRANSISTORS

WELL deserved recognition has been given General Electric's new vacuum sealed junction transistors throughout the entire engineering world. For here is a product with performance characteristics *second to none*. Designed for mass production at *low cost*, new G-E transistors ideally answer the needs of multiple commercial and military applications. Include this *tested and proved superior* product in your design plans now!

For complete specifications and additional information write today! *General Electric Company, Section 4814, Electronics Park, Syracuse, New York.*

● To demonstrate positive elimination of temperature and humidity restrictions this transistor was operated as the heart of a miniature radio transmitter while frozen in a cake of ice which was then melted and converted into boiling water. Above J. H. Sweeney, Manager of Marketing, G-E Germanium Products, demonstrates the unique system.

DESIGN FEATURES:

VACUUM SEALED JUNCTION... contaminating gases permanently eliminated!

WELDED SEAM CONSTRUCTION... free from solder-flux contamination.

HIGH POWER OUTPUT... case design makes possible a collector dissipation of 150 MW.

HIGH FREQUENCY PERFORMANCE... specifications cover operation at audio and supersonic frequencies.

HERMETIC SEAL... unaffected by moisture.

HIGH TEMPERATURE OPERATION... rated for a maximum junction temperature of 100°C.

LONG LIFE... stable performance throughout the life of your equipment.

SMALL SIZE... extremely compact design provides added flexibility for all applications.

NEWS FROM OUR ADVANCED DEVELOPMENT LABORATORIES

● Silicon junction rectifiers are capable of operating at relatively high temperatures. Heretofore, this advantage has been offset by high forward resistance compared to germanium. General Electric laboratories have recently succeeded in making 1 mm² silicon junctions having a forward resistance of only 1 ohm at 1.5 amperes.

GENERAL ELECTRIC

The *Pan Cinor* Zoom-type lens with a Bolex 16 mm camera ...what a terrific buy!

You can assure your viewers of a front row seat to every sports and news event in your TV area when you zoom in for a take with this precision equipment.

Think of it . . . this Pan Cinor-Bolex combination gives you a camera and zoom-type lens for less than one-half the price of other 16mm zoom-type lenses alone.

Here is a lens that can vary its focal length from wide angle (20mm) to telephoto (60mm), focusing from 5′ to infinity. It has its own parallax corrected variable field finder. Its maximum aperture is f/2.8. All lens elements are coated.

For TV filming, Bolex has proven itself a natural. Fast supplanting all other 16mm cameras used by TV stations today, its many exclusive features offer so much engineered value – unlimited forward and reverse hand winding . . . automatic film threading . . . time exposure and single frame setting.

Ask your Bolex Franchised Dealer for a demonstration, or write for literature. Pan Cinor lens and Bolex camera as shown in above photo . . . price $675.00.

Take title to a *Titler*

Still in limited supply, we again offer the Bolex Titler for 16mm filming. No other equipment has the same ruggedness and versatility that is so essential to movie makers. Its rock-steady track and massive camera cradle (with rack-over for perfect focusing and centering even down to 4″ x 5″) accepts all Bolex, Bell & Howell, and Kodak Cine-Special models.

With this Titler and its accessories, cartoons, animations, flip-flops, zooms, three-planes and a broad range of other tricks are made possible. Price of Titler and accessories, including FET, $295.50.

Ask your Franchised Dealer or write for Titler booklet.

Paillard Products, Inc., 100 Sixth Avenue, New York 13, N. Y.

Bolex®

a "Natural" for television filming

YOU CAN AFFORD to use Hermetic Seals

COSTS IN THE PAST 3 YEARS HAVE BEEN CUT AS MUCH AS 50% BY THE WORLD'S LARGEST PRODUCER OF GLASS-METAL HEADERS

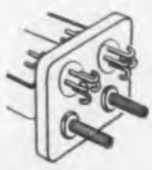
For many years most hermetic seals were channeled into special purpose applications for components used under extremes of climatic conditions. Because they have increased the working life of so many controls no matter what the operating difficulties were, their use has grown apace.

HERMETIC SEAL PRODUCTS CO. has always been the pioneer in this greatly expanding new activity. They have had a substantial head start in developing new mass- production methods and techniques and now can offer glass-metal seals for applications that were never before possible. Particularly, since costs have been dropped as much as 50% in the past 3 years. That's why we urge all manufacturers to discover for themselves the real economies now available in the application of hermetic seals to their production of rectifiers; relays; communication components; geological equipment; aircraft and airport instruments; frequency control devices; hearing aids; switches; resistors; transistors; germanium products; coils; radio and TV parts; transformers; and other related parts.

In addition to the present lower cost of hermetic seals, there are also many other advantages that will be derived from their use. Less expensive parts that will still perform with maximum efficiency may be used in enclosures because entire units can be completely protected . . . sealed in by glass-metal headers.

Going a step further, HERMETIC's new VAC-TITE* Compression Seals require fewer components for hermetic sealing. The complete header can be soldered right into the can, effecting additional savings in handling and assembly operations. Servicing is simplified. You merely remove the part to be replaced and insert a complete new hermetically sealed unit.

Because hermetic sealing brings so many advantages in price and ease of production to manufacturers of commercial components, write today detailing your requirements so that our design engineers may provide you with suggestions and seals for the parts you are making . . . in small or large quantities.



*VAC-TITE is HERMETIC's new vacuum proof compression-construction, glass to metal seal. In addition to special shapes, many standard sizes such as .800 O.D. and .900 O.D. multi-terminal headers and a large variety of individual terminals are available in VAC-TITE Compression Seals.

FIRST AND FOREMOST IN MINIATURIZATION

HERMETIC SEAL PRODUCTS CO. 33 South Sixth Street, Newark 7, New Jersey

Power Gain of 1000 at UHF

EIMAC 3K50,000LF
Length 49 inches
Weight 48 pounds

Eimac 3K50,000L Klystrons in typical CW operation give 10KW power output with only 10 watts drive

High power, high efficiency, ultra-high frequency Eimac type 3K50,000L klystrons, widely heralded for UHF-TV, are proving outstanding for CW. Typical CW operation of these versatile klystrons shows 40% efficiency while delivering 10 kw output with only 10 watts drive—a power gain of 30 db., or 1000 times. Furthermore service at frequencies above and below the UHF-TV band is being obtained through flexibility provided by the externally tuned cavities of Eimac klystrons.

● ***For information about Eimac type 3K50,000L klystrons contact our Application Engineering department.***

TYPICAL OPERATION
3K50,000L Klystrons

	CW	TV
D-C Beam Current	1.65	2.15 amps
D-C Beam Voltage	15	17.2 kv
Driving Power	10	55* watts
Power Output	10	12* kw
Efficiency	40%	32%*

*Peak synchronizing level (80% of saturation power)

3K50,000L KLYSTRONS FOR UHF-TV

TYPE	FREQUENCIES
3K50,000LA	470-580 mc
3K50,000LF	580-720 mc
3K50,000LK	720-890 mc

Eimac

EITEL-McCULLOUGH, INC
SAN BRUNO • CALIFORNIA

AlSiMag®

ULTRA LOW LOSS

COIL FORMS

AlSiMag coil forms are accurately made to your design and specifications. The range of sizes and designs is almost unlimited. Minimum tooling charges. Take advantage of our very broad experience on coil forms. Send blue prints and outline operating conditions for recommendations. No cost or obligation.

52ND YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

A Subsidiary of Minnesota Mining and Manufacturing Company

CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-8159 SYRACUSE, N. Y.: 330 Arlington Ave., Phone 76-5068 • CLEVELAND: 5012 Euclid Ave., Room 2007, Express 1-6685 • NEW ENGLAND: 1374 Mass. Ave., Cambridge, Mass., Kirkland 7-4498 • PHILADELPHIA: 1649 N. Broad St., Stevenson 4-2823 • ST. LOUIS: 1123 Washington Ave., Garfield 4959 • CHICAGO: 228 N. LaSalle St., Central 6-1721 • SOUTHWEST: John A. Green Co., 6815 Oriole Dr., Dallas 9, Dixon 9918 • LOS ANGELES: 5603 N. Huntington Dr., Capital 1-9114

1954

GA
fixed composition
CAPACITORS

22 new values
FOR THE ULTRA HIGHS

Stackpole GA fixed composition capacitors represent the simplest, most inexpensive capacitor design ever produced—and their operating stability is more than ample for the great majority of applications.

Pioneered by Stackpole, these sturdy little units are now available in an expanded range of values from 0.10 to 10.0 mmf. Insulated bodies, dielectrics and electrodes are integrally molded for maximum stability and durability. Leads are securely anchored and treated for easy soldering.

Although Stackpole GA capacitor bodies range only from 0.330" to 0.170" in length, they can now be supplied with as many as four easily distinguished color bands.

Up to 4 Color bands

STACKPOLE
TYPE GA
FIXED COMPOSITION
CAPACITORS
RTMA PREFERRED VALUES in mmf

	20%	10%	5%
New	.10	.10	
		.12	
	.15	.15	
		.18	
			.20
	.22	.22	.22
			.24
		.27	.27
			.30
	.33	.33	.33
			.36
		.39	.39
			.43
	.47	.47	.47
			.51
		.56	.56
			.62
	.68	.68	.68
			.75
		.82	.82
			.91
	1.0	1.0	1.0
			1.1
		1.2	1.2
			1.3
	1.5	1.5	1.5
			1.6
		1.8	1.8
			2.0
	2.2	2.2	2.2
			2.4
		2.7	2.7
			3.0
	3.3	3.3	3.3
			3.6
		3.9	3.9
			4.3
	4.7	4.7	4.7
			5.1
New		5.6	5.6
			6.2
	6.8	6.8	6.8
			7.5
		8.2	8.2
			9.1
	10.0	10.0	10.0

Electronic Components Division **STACKPOLE CARBON COMPANY, St. Marys, Pa.**

STACKPOLE

there are 4 points to a triangle...

THE POINT OF APPLICATION

determines the type of loudspeaker best capable of providing optimum performance at lowest possible cost. There are over 50 different University models to choose from... each designed to serve most efficiently and economically in its intended application.

- Radial type projectors and paging speakers with 360° dispersion for maximum coverage at lowest cost and ease of installation.
- Reflex trumpets in various sizes for incomparable efficiency, distance, and noise penetration.
- Wide-angle and bi-directional types, marine and submergence models for heavy industry.
- Paging and "talk-back" speakers in numerous sizes, power and frequency characteristics and mounting arrangements.
- "Explosion-proof", blastproof, and even superpower types from 100 to 720 watts capacity.
- High fidelity, full-frequency response types for indoor and outdoor use.

University Loudspeakers are application-engineered to assure customer satisfaction, avoid waste of amplifier power and speaker capacity and reduce initial equipment and installation costs. University helps you to sell more sound jobs... make more profit you can pocket. ***Why spend more for more than you need—CHECK UNIVERSITY FIRST!***

FREE—new 1953 copy of the University Technilog • Complete up-to-date manual of sound theory, application and installation requirements • SEND for your copy today.

University

UNIVERSITY LOUDSPEAKERS • INC.
80 SOUTH KENSICO AVENUE, WHITE PLAINS, N. Y.

THESE *miniature* HERMETICALLY SEALED PRECISION RESISTORS *won't fail you!*

Submersion in boiling salt water, ice cold salt water; temperature or humidity cycling; sudden altitude changes; will not affect the performance of these resistors. They are specifically designed and engineered for the utmost in permanence and stability under severely adverse conditions.

RPC's miniature Hermetically Sealed Resistors are solder sealed, insuring a true, permanent seal. All parts are metal or steatite, eliminating shrinkage or deterioration. Not affected by time or unusual conditions. 100% vacuum tested under water.

Requirements of JAN-R-93 and proposed addition to MIL-R-93A are fully met. Available in resistance tolerances to 0.1%.

RPC makes a complete line of precision wire wound resistors. Test equipment and standards are on a level matched by only the outstanding laboratories. Advanced methods of production enable RPC to fill large or small orders promptly and at moderate cost.

Write for complete catalog.

ENGINEERING DATA

RPC TYPE	Govt. Spec.		Dimensions Inches		Resistance (Ohms)			Watts	
	JAN-R-93	MIL-R-93A	LENGTH	DIAM.	MIN.	MAX. with low T.C. Alloy .0015 DIA.	MAX. with low T.C. Alloy .001 DIA.	JAN or MIL	COMM.
SCB	----	----	9/16	11/32	2.0	20.000	0.15 Meg.	----	.25
SCF	RB51A	RB52A*	13/16	11/32	1.0	50.000	0.40 Meg.	.25	.5
SED	RB51A	RB52A*	13/16	15/32	0.5	.125 Meg	1.0 Meg	.25	.5

* Proposed

RESISTANCE PRODUCTS CO.

714 RACE ST. HARRISBURG, PENNA.

SPECIALIZING IN THE MANUFACTURE OF QUALITY RESISTORS IN ANY AMOUNT

HIGH MEGOHM, HIGH VOLTAGE, HIGH FREQUENCY, WIRE WOUND PRECISION

PHOTOGRAPH COURTESY DU MONT TV NETWORK

Better Screen Images with *Wollensak* TV RAPTARS

Wollensak TV Raptar Lenses are specially designed for the television industry . . . built for tomorrow's advancements as well as today's requirements. TV Raptars will resolve 2½ times today's TV requirements . . . are made complete with camera adapters an integral part of the lens. These adapters are not added afterward by some other supplier. Wollensak TV lenses are designed specifically for TV cameras . . . won't be outmoded by new techniques and improvements in telecasting. Get the most from your efforts and use the highest quality lenses . . . TV Raptar Lenses by Wollensak.

TV Raptars are available in a wide range of focal lengths—14 lenses in focal lengths from 2" to 24".

WRITE *for new literature . . .*

Raptar . . . the MASTERPIECE of Lenses

Wollensak OPTICAL COMPANY, ROCHESTER 21, N. Y.

SPEED Production Testing

of Resistors — Inductors Capacitors — Impedances

The G-R Type 1604-B Comparison Bridge

is a direct-reading instrument which makes possible the rapid measurement of impedance and dissipation factor of R-L-C components, rheostats, capacitance trimmers and other impedances. Basic measurement accuracy is *one-tenth of one percent* . . . more than required for most measurements.

Checking tracking of condensers and potentiometers to very close tolerances — locating the position at which windings are to be center-tapped — measuring small capacitors in the 1 $\mu\mu$f range — adjusting one component to the value of another, rapidly and reliably

In any laboratory or shop, the Comparison Bridge will prove invaluable for checking, selecting and pairing components within given tolerances – the approach to balance is continuously and instantly indicated.

FEATURES

- Instrument is completely self-contained and ready for operation — includes internal oscillator, bridge circuit and high-gain non-linear amplifier terminated in a cathode-ray-tube detector.
- Three Measuring Frequencies — 400 c, 1 kc or 5 kc, selected by panel switch.
- Two IMPEDANCE DIFFERENCE Dial Ranges — 0 to ±5% range for accurate measurements; 0 to ±20% for determining whether components are within the common 20% tolerances.
- Accuracy and Range of Impedance Measurements

The range over which the basic ± 01% accuracy applies for resistors, inductors and capacitors is given below. At the more extreme values of impedance, measurements are less accurate.

Frequency	Resistance	Inductance	Capacitance
400 c	2Ω to 20 MΩ	2 mh to 1500 h	100 μf to 50 $\mu\mu$f
1 kc	2Ω to 20 MΩ	1 mh to 250 h	30 μf to 50 $\mu\mu$f
5 kc	4Ω to 2 MΩ	200 μh to 10 h	2 μf to 50 $\mu\mu$f

On the 20% deviation range, accuracy is ±0.5% over the same impedance range

- DISSIPATION FACTOR RANGE and Accuracy

Frequency	Range	Accuracy
400 c	± .006	±(0.0002 + 2% impedance diff.)
1 kc	± .015	±(0.0005 + 2% impedance diff.)
5 kc	± .075	±(0.0025 + 2% impedance diff.)

- CRO visual Detector — horizontal band of light is used as the indicator — highly non-linear detector amplifier keeps indication on scope over wide ranges of unbalance — continual resetting of gain control is eliminated.
- Zero Adjustment — adjustable index mark on scope can be offset and locked to compensate for deviation of the standard from the desired nominal value — permits use of any component as a standard of comparison.
- Anyone can be taught to operate the instrument in a very short time.
- Measurements can be made with unknown grounded or ungrounded, as desired.
- Dimensions—12" x 14¼" x 10"; Net Weight is 22½ lbs.

1604-B Comparison Bridge $390.00

HIGH-SPEED SORTING with the COMPARISON BRIDGE

Both dials are set to zero, and the cathode-ray-tube adjustable indicator is offset to the desired tolerance to give a visual "go, no-go" indication. As rapidly as each component is plugged into the unknown terminals . . . a few seconds at most . . . the detector indicates whether the unit is acceptable.

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.

Since 1915

Manufacturers of Electronic Apparatus for Science and Industry

Admittance Meters ☆ Coaxial Elements ☆ Decade Capacitors ☆ Decade Inductors ☆ Decade Resistors ☆ Distortion Meters ☆ Frequency Meters ☆ Frequency Standards ☆ Impedance Bridges ☆ Modulation Meters ☆ Oscillators Variacs ☆ Light Meters ☆ Megohmmeters ☆ Motor Controls Noise Meters ☆ Null Detectors ☆ Precision Capacitors Pulse Generators ☆ Signal Generators ☆ Vibration Meters ☆ Stroboscopes ☆ Wave Filters U-H-F Measuring Equipment ☆ V-T Voltmeters ☆ Wave Analyzers ☆ Polariscopes

TELE-TIPS

ALL-CHANNEL TV SETS are demanded of receiver manufacturers by the new UHF Television Association. In a letter from the Association's general counsel, William A. Roberts, to a number of manufacturers and station operators, praise was given the progress already achieved by both manufacturers and networks. Both branches of the industry, however, were advised that UHF offers them the "eventual market" for transmitting and receiving equipment as well as network programming, and that "genuine all channel" television receivers in all price ranges are one of the most important needs of the industry.

MILITARY SURPLUS now being disposed of, totals about $150 millions per month, reports RETMA. Less than 10% of this is electronic equipment. The $150 million represents initial cost, not the present return to the government. Through the end of September, RETMA learned that the Navy has released as surplus $27 million in electronic equipment. At that time the Signal Corps was releasing material at the rate of about $3 million per month and the Air Force monthly rate was running between $100,000 and $200,000.

BRITISH are making more TVs than radios. Production of television receivers during the month of September exceeded 100,000 for the first time. The total output of 103,000 sets compared with 69,000 in September, 1952. During the first nine months of 1953, 728,000 sets were produced in Britain. Responding to renewed public demand for radio receivers, the industry stepped up output and in September produced 106,000 sets. This brought production for the first nine months up to 706,000 sets.

FUNDAMENTAL RESEARCH — Ralph J. Cordiner, president of General Electric Co., Schenectady, N. Y., says industry now has store of knowledge that offers tremendous opportunity for growth in immediate future. Problem, he says, is to maintain this store by looking ahead far enough to be sure plans for future emphasize both fundamental and applied research.

(*Continued on page* 48)

Capacitors shown 2½ times actual size

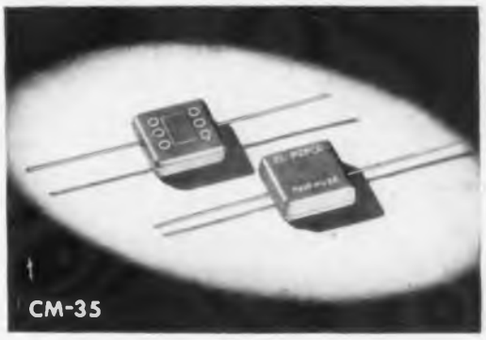
CM-15 EL-MENCO CAPACITORS

are only 9/32"x1/2"x3/16"... but they give

DOUBLE VALUE PER DOLLAR

ALL fixed mica El-Menco capacitors are *factory-tested at double their working voltage.* Couldn't that mean that they'll last twice as long as other capacitors which cost no less? They also meet all significant requirements of JAN-C-5. So, you can depend on them to perform perfectly on all military and civilian electronic applications. Our tiny CM-15 silvered mica capacitors come in capacities from 2 to 420 mmf. at 500vDCw — 2 to 500 mmf. at 300vDCw. Our other types run all the way up to 10,000 mmf. It will pay you to compare El-Menco capacitors with all others — performance-wise, price-wise. *The Electro Motive Manufacturing Co., Inc., Willimantic, Conn.*

Electro Motive is now supplying special silvered mica films for the electronic and communication industries in any quantity — just send us your specifications.



WRITE FOR FREE SAMPLES AND CATALOG ON YOUR FIRM'S LETTERHEAD

Jobbers and distributors are requested to write for information to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y. — large stocks on hand — spot shipments for immediate delivery. Sole Agent for Jobbers and Distributors in U. S. and Canada.

MOLDED MICA **El-Menco** **MICA TRIMMER**
CAPACITORS

Foreign and Electronic Manufacturers Get Information Direct from our Export Dept. at Willimantic, Conn.

THE ELECTRO MOTIVE MFG. CO., INC. **WILLIMANTIC, CONNECTICUT**

NEW

truly functional

TUBECHECKER

by

WESTON

with new features for greater accuracy and time-saving facility in all testing

- Provides accurate meter measurement of leakage resistance as high as 5 megohms between tube elements.
- Permits high transconductance measurements, with ranges 3000/6000/12000/24000 micromhos.
- Multiple switching protects against early obsolescence, allows making any combination of tube connections.
- Element switching permits checking and comparing individual sections of twin-section tubes without changing selector switch.
- Only *one* socket for each type tube base eliminates plugging tubes into wrong sockets.
- Sockets for all type bases . . . including acorn and 7 and 8 pin subminiatures.
- 19 filament voltage settings—.65 to 115 volts. 5 plate voltages — 20 to 177 volts. A 45-volt source for testing subminiature types.
- Grid bias, plate voltage and meter sensitivity adjustable.
- Large, readable fan-shaped meter . . . new roll chart with complete, up-to-date data on all tubes.

Complete data on the new Model 981 Type 2 available in bulletin form. Write . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

5539

Available through leading distributors

WESTON
Model 981 Type 2

WESTON *Instruments*

TELE-TIPS

(*Continued from page 44*)

MOBILE radiotelephone equipment has been installed on German buses. This enables passengers to be called by telephone subscribers while in transit. As far as we are aware, this is the first mobile telephone service to be offered by public transportation systems anywhere in the world.

FOR DESIGN ENGINEERS—"Techniques For Application of Electron Tubes in Military Equipment," recently issued by Wright Air Development Center, U. S. Air Force, Dayton, Ohio, is drawing many letters of praise from companies in the electronic field and rightly so. The purpose of this loose-leaf book is to increase the reliability of military electronic equipment by guiding the equipment design engineer in the use of tubes. In a sense it is a book of rules—but it is more than this because it is a pioneer effort to collect data, facts and advice not found elsewhere in consolidated form. For further information write to Harold V. Noble, Plans & Operations Office (WCEO), at the above address.

VELVET TOUCH—Or rather the mica touch is the one with the delicate feel. The Mica Fabricators Association reports that highly skilled operators, by the use of hand feeling, can judge the thickness of mica to within 0.001 in.

YOU CAN SAY that again as 1954 dawns, Mr. K.! To-wit: "We are at the opening verse, of the opening page, of the Chapter of Endless Opportunities."—Rudyard Kipling.

RESEARCH is a high-hat word that scares a lot of people. It needn't. It is rather simple. Essentially, it is nothing but a state of mind—a friendly, welcoming attitude toward change. Going out to look for a change instead of waiting for it to come. Research, for practical men, is an effort to do things better and not to be caught asleep at the switch. The research state of mind can apply to anything: personal affairs or any kind of business, big or little. It is the "problem-solving" mind as contrasted with the "let-well-enough-alone" mind. It is the "composer" mind instead of the "fiddler" mind. It is the "tomorrow" mind instead of the "yesterday" mind.—Charles F. Kettering, formerly vice-president and director, General Motors Corp.

CAREFUL, MAESTRO,

DON'T FIDDLE AWAY

YOUR REPUTATION!

Yes, you can make one false note and be all washed up . . . with the name you've spent years building, quickly consigned to oblivion. We at Kester know the importance of consistency . . . make sure that the solder alloy and especially the flux formula never varies, never changes. Kester never experiments at the expense of the solder user!

For best results in efficient, economical soldering, remember this Solder Trio: "44" Resin, "Resin-Five" and Plastic Rosin—all made by KESTER . . . Key Name in Flux-Core Solder for More Than 50 Years.

KESTER

SOLDER COMPANY

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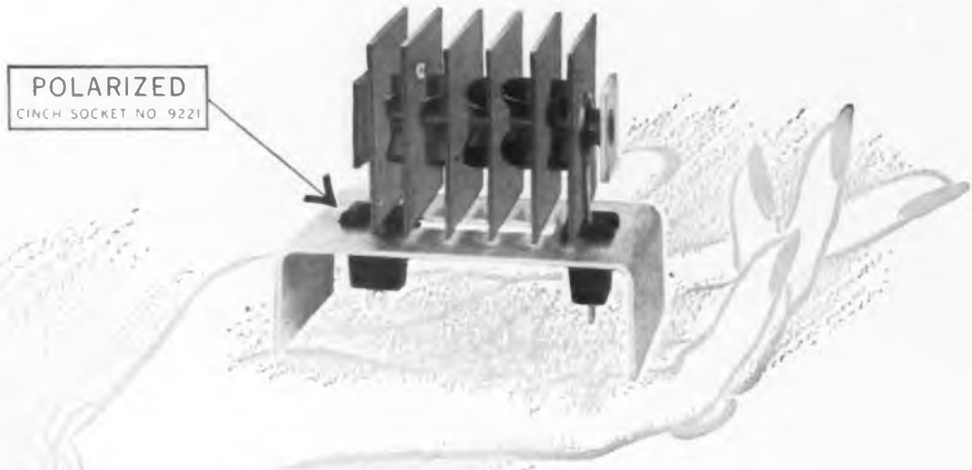
NEWARK 5, NEW JERSEY • BRANTFORD, CANADA

Now It's

Plug-In

Selenium Rectifiers



1 **Plugged In for Easy Replacement**

2 **Polarized for Correct Positioning**

3 **Still Can Be Soldered In The Set**

Available In All Sizes.

Write for Further Information.

Sarkes Tarzian, INC.

RECTIFIER DIVISION

415 N. College Ave., Dept. T-1, Bloomington, Indiana

In Canada – 50 St. Clair Ave., N. W., Toronto

WSM-TV enthusiastically endorses

Styroflex COAXIAL CABLE

in mobile microwave for remote pickups!

Left to right, William A. Hill, Jr., television supervisor and Aaron Shelton, chief engineer of WSM-TV, installing Styroflex cable in 2000-MC microwave receiver.

WSM-TV recently installed 7/8" Styroflex coaxial cable feeding 2000-MC microwave receiver in local remote TV pickups. Chief engineer Aaron Shelton says, "We were able to gain better than 3 db, which we feel is the easiest and fastest and cheapest 3 db that we could possibly get!"

Styroflex's unique qualities can help reduce operating costs — provide the same efficient, dependable service for every industry using or contemplating the use of microwave communication. Our engineering, production and application experiences are at your service.

PHELPS DODGE COPPER PRODUCTS CORPORATION

40 WALL STREET, NEW YORK 5, N.Y.

LETTERS...

Different Nomenclatures for Printed Circuits

Editors, TELE-TECH:

As manufacturers of Etched Circuits, we at the Manz Corp. feel that the use of the words *printed circuits* as a sort of all-inclusive term to cover the use of both printed circuits (silk screen, offset, etc.) *and* etched circuits is not good nomenclature. The etched circuit is a product of photoengraving and is not printing in the precise sense of that word.

Secondarily, they ought not to be bracketed because the etched circuit is capable of being held to closer tolerances than are presently held by any of the printed circuit methods.

Cannot a word or phrase be coined which would be more descriptive? The use of *graphic circuit*, for example, could be employed to describe both etched and printed circuits. This would be an unfamiliar, and therefore awkward word in the beginning; but would, with the passage of time, gradually become accepted as the norm.

EUGENE P. PATTBERG

Manz Corp.
3043 Ravenswood Ave.,
Chicago 13, Ill.

(Readers' reactions and suggestions are invited.—Ed.)

Annual Index

of all articles published in TELE-TECH & ELECTRONIC INDUSTRIES during 1953, classified according to subjects, may be obtained free of charge by writing to:

The Editors
TELE-TECH & ELECTRONIC INDUSTRIES
480 Lexington Ave., New York 17, N. Y.

FM's Growing Total Power

It is interesting to note that, in terms of service to listeners, FM Broadcasting has improved steadily over the last few years because of increased powers and through the removal of certain operating restrictions. At the present time, the majority of the FM stations are operating at full power under regular license conditions. The FM service to the public, therefore, even with a somewhat smaller number of stations, is now far better since the listener hears many more signals in his territory than ever before. The details of the situation are given in the table below:

Number of FM Stations on Air

	Commercial	Educational	Total
Maximum, October, 1949	744	40	784
December 1, 1952	626	96	722
December 1, 1953	551	108	659

NET LOSS: 125 stations—15.8%

RAYTHEON

presents the

FIRST ANNUAL REPORT on transistors

Hundreds of thousands of RAYTHEON *Junction Transistors are now in actual commercial use . . . several times more than all other makes combined! Furthermore, one year's field experience has demonstrated that the moisture resistance of Raytheon's specially developed glass-plastic package is completely satisfactory!*

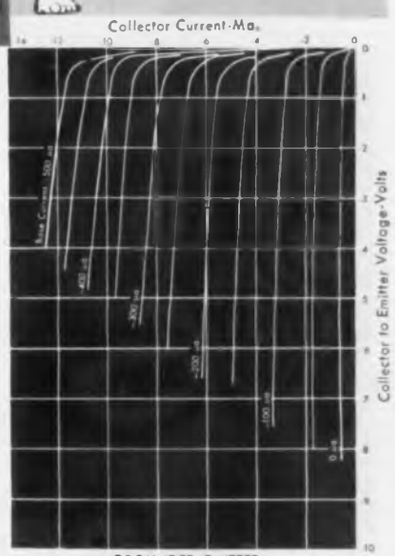
For critical applications, the new CK727 Raytheon junction transistor offers the low average noise factor of only 15 db. plus all the desirable performance characteristics of the popular and highly successful CK721.

For complete characteristics on CK727, get in touch with our nearest office.

AVERAGE CHARACTERISTICS AT 30°C

	CK721	CK722	CK723	CK727
Collector Voltage (volts)	−6	−6	−6	−1.5
Collector Current (ma.)	−2	−2	−2	−0.5
Alpha	.975	.90	.90	.975
Cut-off Current (approx.) (μa)	10	25	10	5
Noise Factor (Max.) (db.)*	30	—	30	18
Collector Resistance (meg.)	0.7	0.5	0.5	1.0
Base Resistance (ohms)	350	150	150	800

*Common emitter circuit with R_{in} = 1000 ohms, R_{out} = 20000 ohms.

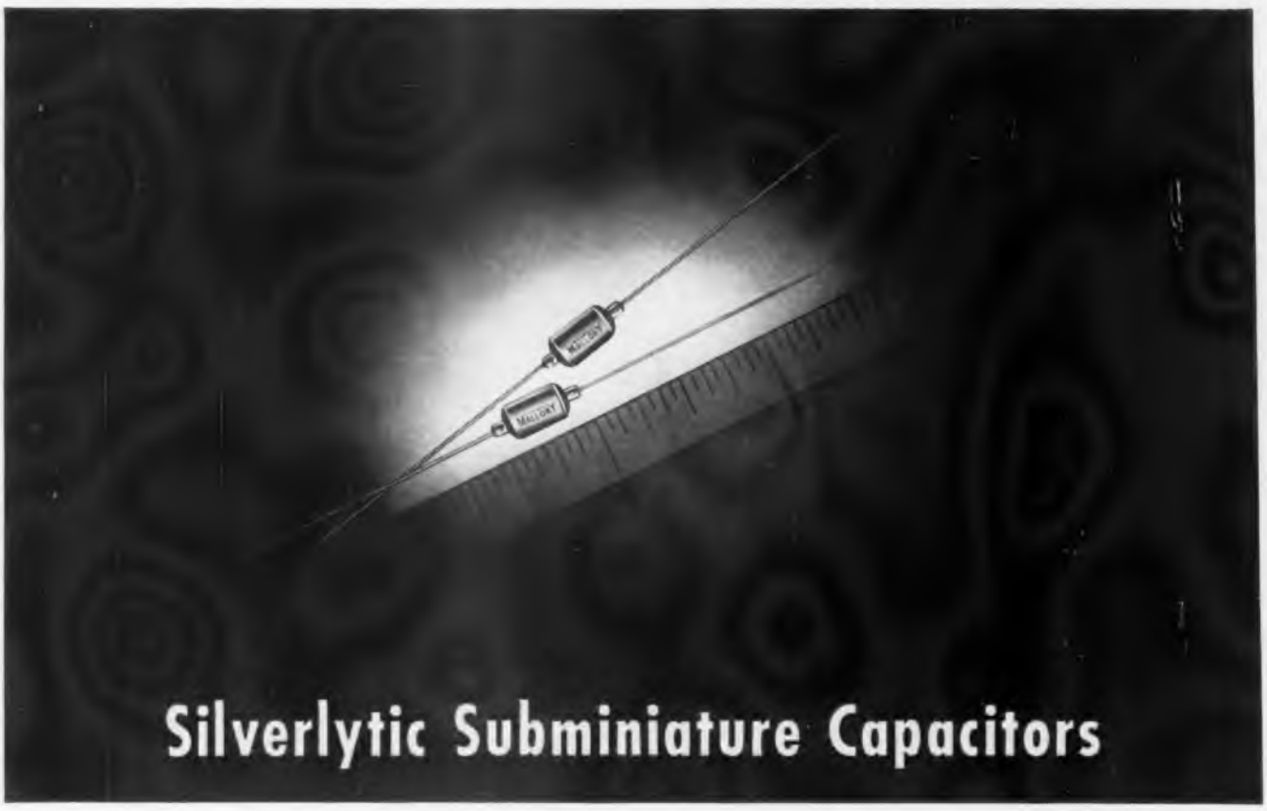


GROUNDED EMITTER
Typical Collector Characteristics

RAYTHEON

RAYTHEON MANUFACTURING COMPANY

RAYTHEON MAKES ALL THESE



Save Space in Transistor Circuits

Specifications for Silverlytic Capacitors

Available ratings:

4 mfd.	4 volts DC Max.
2 mfd.	5 volts DC Max.
1 mfd.	10 volts DC Max.
.5 mfd.	10 volts DC Max.
.3 mfd.	10 volts DC Max.
.2 mfd.	10 volts DC Max.
.1 mfd.	10 volts DC Max.

Temperature range: —30° C to +65° C

Capacity tolerance: —10% to + infinity

Max. leakage current: 2 microamps, after 5 min. at rated voltage

In a case smaller than the eraser on a lead pencil, Mallory Silverlytics provide a capacity of up to four microfarads. They're the ideal answer to capacitor problems in transistor circuits and other miniaturized low-voltage applications.

The case is only 7/32 inch in diameter and 3/8 inch long. Axial leads of No. 26 bare tinned wire are furnished for self-supported mounting.

Despite their tiny size, Silverlytics actually exceed the characteristics of their larger predecessors. They embody the years of research and production experience which have made Mallory electrolytic capacitors the leading choice of manufacturers of electronic equipment. Write to Mallory today for complete technical information.

Expect more . . . Get more from **MALLORY**

Parts distributors in all major cities stock Mallory standard components for your convenience.

P. R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

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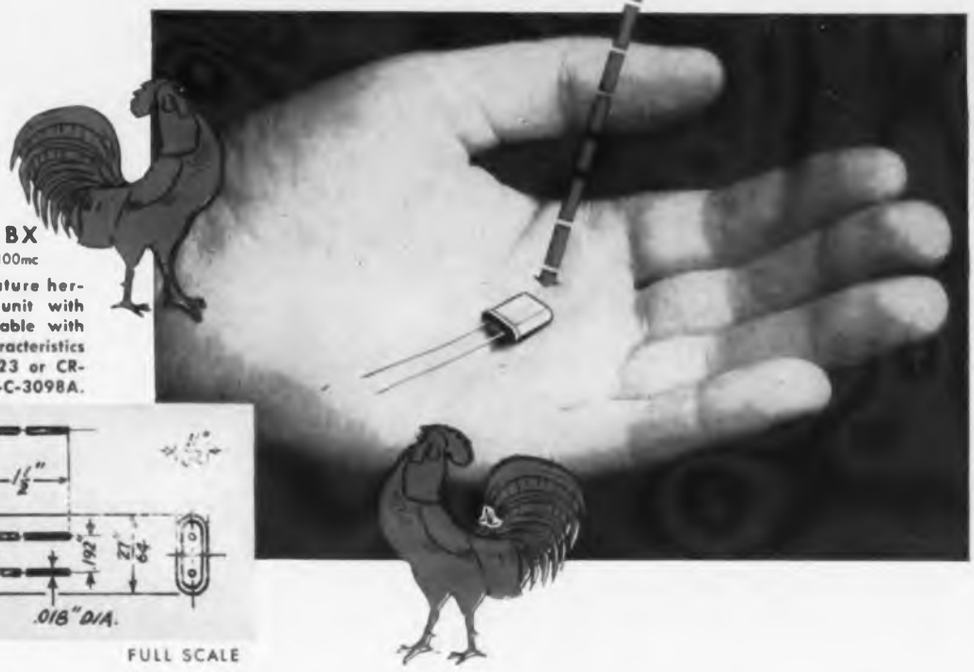
Electromechanical — Resistors • Switches • Television Tuners • Vibrators
Electrochemical — Capacitors • Rectifiers • Mercury Batteries
Metallurgical — Contacts • Special Metals and Ceramics • Welding Materials

NEW... The Bliley BANTAM Crystal

TYPE BX

Precision Performance In Sub-Miniature



BLILEY TYPE BX

FREQ. RANGE: 15mc-100mc

A sub-miniature hermetically sealed unit with wire leads. Available with performance characteristics as MIL types CR-23 or CR-32 per MIL-C-3098A.

FULL SCALE

The **Bliley** BANTAM presents new possibilities for compact multi-channel design in the communications and frequency control field. The **BANTAM** may be wired into a miniature selector switch assembly or plugged into a sub-miniature tube socket.

Design engineers are invited to request quotations for prototype purposes

Bliley CRYSTALS

BLILEY ELECTRIC COMPANY

UNION STATION BUILDING • ERIE, PENNSYLVANIA

for all continuous-motion or single-frame OSCILLOGRAPH RECORDING

the TYPE 321

OSCILLOGRAPH-RECORD CAMERA

• Continuous motion recording over the entire range of laboratory applications, including the most highly specialized investigations • Film speeds from 1 to 10,800 inches per minute. Film motion either horizontal or vertical • Overall accuracy of film speed guaranteed within 2% at proper line frequency • Friction film drive for simple loading. Permits use of perforated or unperforated film or paper • Single-frame recording of any phenomenon, including high-speed, single transients. Coated f/1.5 lens enables recording of spot-writing rates up to 35 inches/μsec from cathode-ray tube operated at 12,000 volts • Built-in timing lamp • Built-in illuminated data card • Simultaneous viewing and recording • Mounts quickly and easily on any standard 5-inch cathode-ray oscillograph • Delivery FROM STOCK.

(For 60-cycle power) PRICE $875

SPECIFICATIONS

Optical System: Wollensak f/1.5 coated Raptar lens. Image reduction ratio 4.5.

Shutter: Permits "Time" and "Bulb." Provision for remote operation.

Writing-rate Capability: 35 in./μsec with Type P11 screen at 12,000 volts.

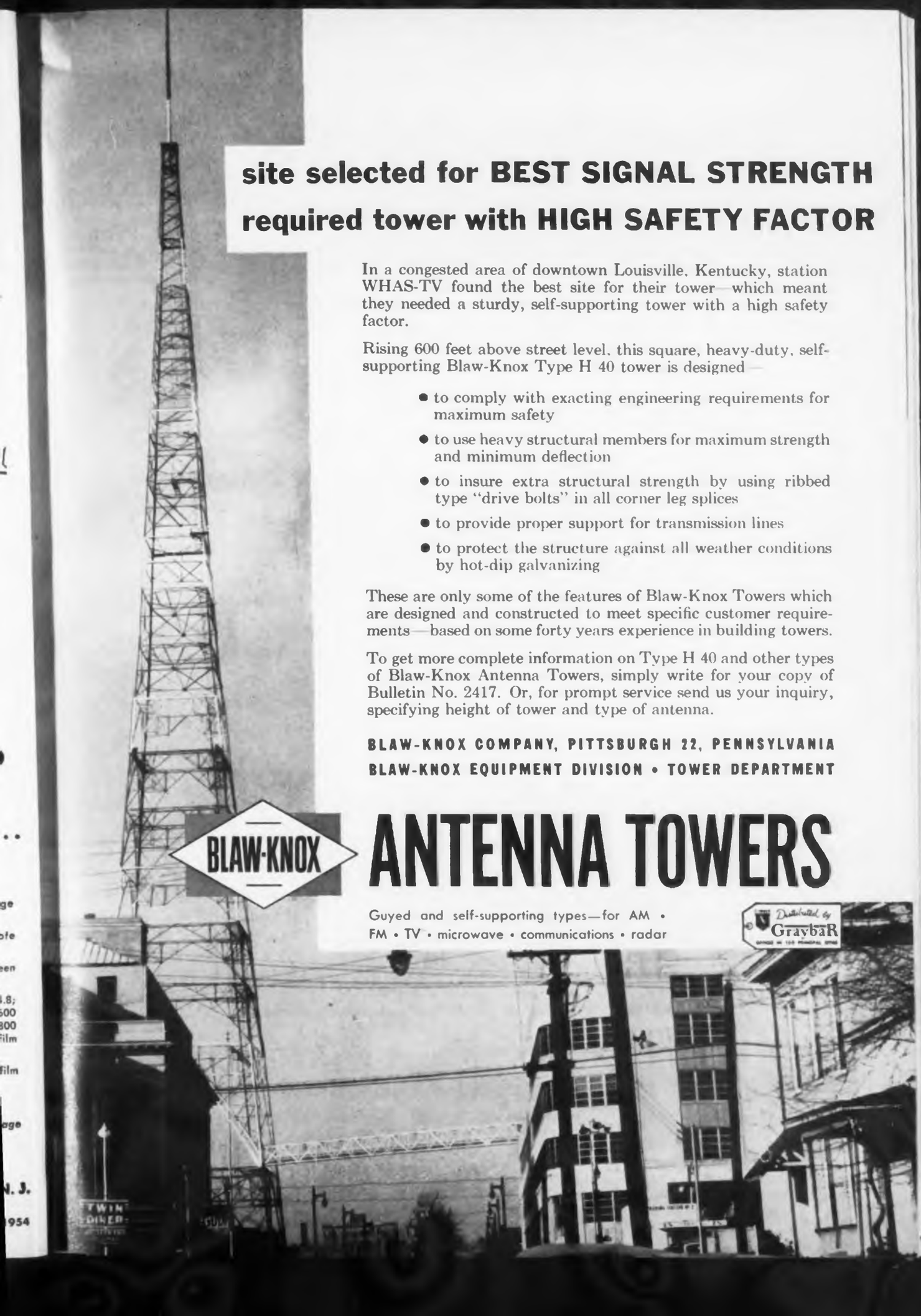
Film Speed: Variable in steps of: 0.8; 1.6; 2.5; 4.9; 7.4; 14.8; 22.2; 44.4; 66.6; 133.3; 200; 400; 600; 1200; 1800; and 3600 in/min with rolls up to 400 feet in length. Also 5400 and 10,800 in/min wth film strips up to 10 feet in length. Accuracy of film speed within 2% at proper Line frequency.

Recording Material: Perforated or unperforated 35 mm film or recording paper in lengths up to 400 ft.

WRITE *for "Techniques of Photo-Recording," a 36-page handbook on cathode-ray photography.*

DU MONT

ALLEN B. DU MONT LABORATORIES, INC., INSTRUMENT DIVISION, 760 BLOOMFIELD AVE., CLIFTON, N. J.



site selected for BEST SIGNAL STRENGTH required tower with HIGH SAFETY FACTOR

In a congested area of downtown Louisville, Kentucky, station WHAS-TV found the best site for their tower—which meant they needed a sturdy, self-supporting tower with a high safety factor.

Rising 600 feet above street level, this square, heavy-duty, self-supporting Blaw-Knox Type H 40 tower is designed—

- to comply with exacting engineering requirements for maximum safety
- to use heavy structural members for maximum strength and minimum deflection
- to insure extra structural strength by using ribbed type "drive bolts" in all corner leg splices
- to provide proper support for transmission lines
- to protect the structure against all weather conditions by hot-dip galvanizing

These are only some of the features of Blaw-Knox Towers which are designed and constructed to meet specific customer requirements—based on some forty years experience in building towers.

To get more complete information on Type H 40 and other types of Blaw-Knox Antenna Towers, simply write for your copy of Bulletin No. 2417. Or, for prompt service send us your inquiry, specifying height of tower and type of antenna.

BLAW-KNOX COMPANY, PITTSBURGH 22, PENNSYLVANIA
BLAW-KNOX EQUIPMENT DIVISION • TOWER DEPARTMENT

BLAW-KNOX

ANTENNA TOWERS

Guyed and self-supporting types—for AM • FM • TV • microwave • communications • radar

Distributed by GraybaR

Come Again

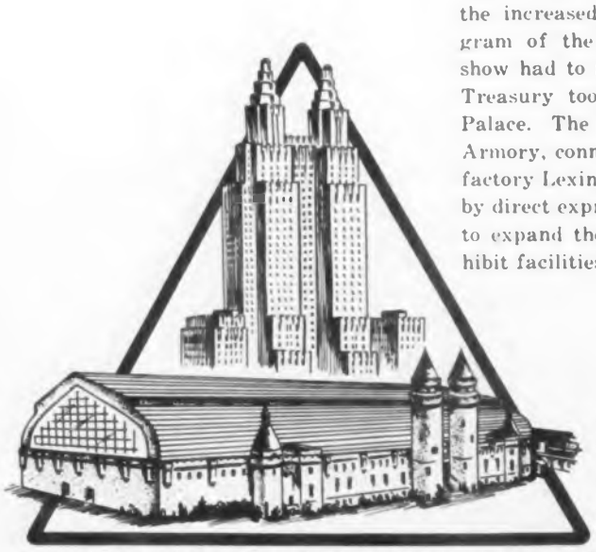
Radio-Electronic Men!

Just as you have been coming since 1945 to the IRE National Convention and Radio Engineering Show — coming by the thousands, 35,642 in '53 — so come again to see and hear all that is new in the engineering advances of your industry.

▲ Fifty-four in '54! — 243 scientific and engineering papers will be presented, skillfully grouped by related interests into 54 technical sessions. More than half these sessions are organized by IRE Professional Groups, thus making the IRE National a federation of 21 conferences in one. The whole provides a practical summary of radio-electronic progress.

▲ 600 Exhibitors "spotlight the new!" — A mile and a half of exhibits line the avenues of this show, intriguingly named for the elements of radio — such as "Instruments," "Components," "Airborne," "Radar," "Transistor," "Audio," "Microwave," etc., filling the four acres of the great Kingsbridge Armory to capacity. An expanding radio industry shows why it is growing by proving how engineering research pays out in new products. The exhibits themselves are an education, condensed to one place — reviewed in four days.

▲ Kingsbridge is the solution! Only the combined facilities of the Waldorf-Astoria Hotel, plus the three great halls in the Kingsbridge Armory, seating 906, 720, and 500 respectively, are able to keep pace with the increased technical papers program of the IRE Convention. The show had to move because the U. S. Treasury took over Grand Central Palace. The immense Kingsbridge Armory, connected to the very satisfactory Lexington Avenue Hotel area by direct express subway, serves well to expand the already outgrown exhibit facilities of the Palace and provide space for 200 new firms to exhibit, as well as seat greater audiences at the high-interest sessions. In addition to the subways, free busses leave the Waldorf every ten minutes in which you may travel in the congenial company of fellow engineers, direct to Kingsbridge.



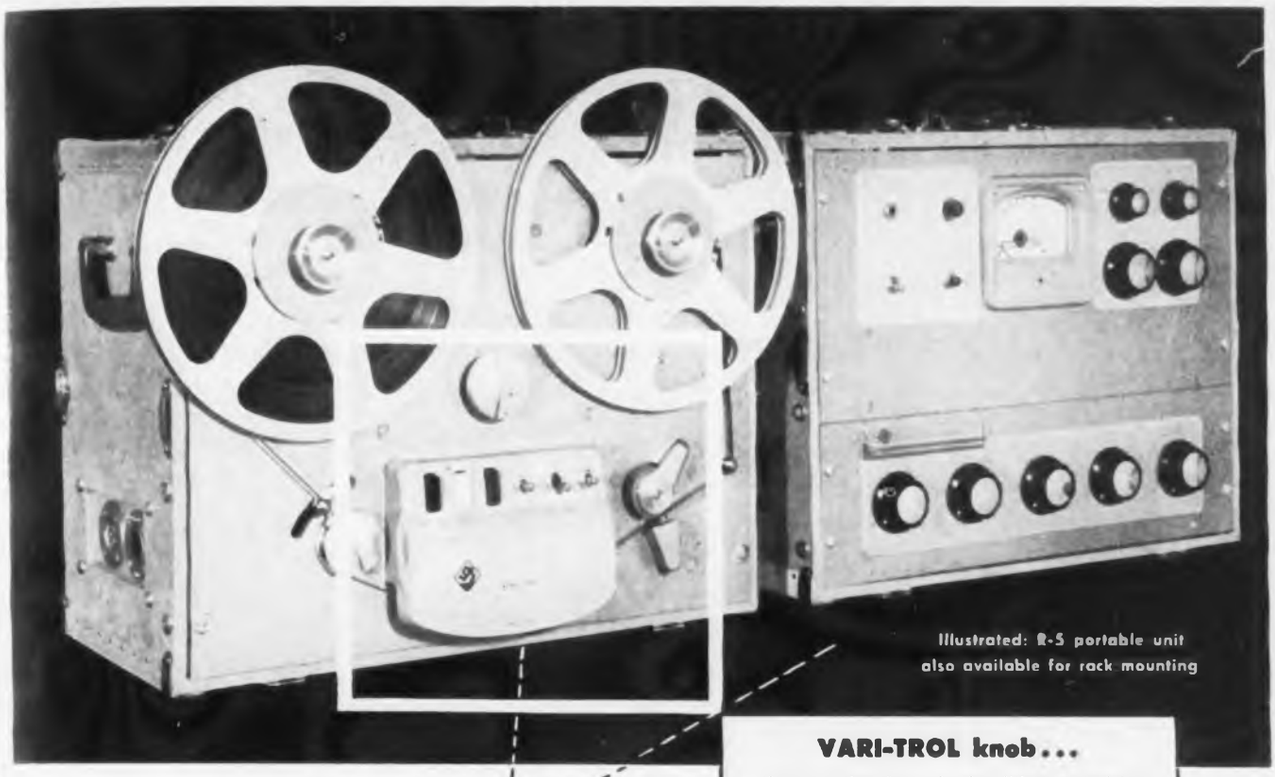
Waldorf-Astoria and Kingsbridge Armory

▲ Admission by registration only! Registration serves for the four day period. It is $1. for IRE members $3. for non-members, covering sessions and exhibits. Social events priced separately.

March 22-25, 1954

The IRE National Convention
and
Radio Engineering Show

THE INSTITUTE OF RADIO ENGINEERS
1 East 79th Street, New York City



Illustrated: R-5 portable unit
also available for rack mounting

EDITING IS EASIER WITH THE NEW R-5

Stancil-Hoffman R-5 recorder is greatest functional and technical achievement in years!

VARI-TROL knob...

the sensational one knob editing control to wind or re-wind tape at continuous or variable speeds... moves the tape in either direction at full or playing speeds, or stops tape instantly. An exclusive feature found only in the Stancil-Hoffman R-5.

PIANO KEY controls...

the new electrically interlocked, centralized control panel with forward, rewind and stop keys for quick, one hand editing. An exclusive feature found only in the Stancil-Hoffman R-5.

The most advanced professional tape recorder ever engineered... designed and developed for the Armed Forces by Stancil-Hoffman... now used the world over... tested and proven superior to any other tape recorder, regardless of cost! Now available for commercial use.

Write for prices and complete specifications

REPRESENTATIVES:

New York: H. J. Geist & Associates
60 East 42nd Street
New York 17, N.Y.

Canada: S. W. Caldwell, Ltd.
150 Simcoe Street
Toronto 1, Canada

Chicago: W. Cozzens
220 Kedzie Street
Evanston, Ill.

Hawaii: S.O.S. Recording
1545 South Beretania
Honolulu, Hawaii

STANCIL-HOFFMAN

921 North Highland Avenue
Cable Address: STANHOFF

Hollywood 38, California
Phone: HOllywood 4-7461

OTHER FEATURES

- Automatic tape lift protects heads from wear... insures tape position for recording.
- Three motor units... two reel torque-sensitive motors and one drive system... direct drive capstan gives positive timing.
- Two speed motor control for 7½ and 15 ips... automatic "pre" and "post" equalization.
- Ideal for instrumentation too.

SPECIFICATIONS

- Operates vertically on racks, horizontally, in consoles and in motion... for both fixed and portable operation.
- Complete recording and play back system in two convenient carrying cases, only 20" wide, 14" tall. Three wide range, low noise microphone inputs, monitor amplifier and speaker output.
- Designed for full remote control.
- Maximum total distortion less than 1.5%.
- Flutter less than 0.1% RMS at 15 ips.
- Signal-to-noise exceeds 60 db.

HERMETICALLY SEALED METAL-ENCASED

PRECISION CERAMIC CAPACITORS

with HIGH STABILITY

for critical circuits

Sprague, on request, will provide you with complete application engineering service and assistance for optimum results in the use of precision ceramic capacitors.

IF YOUR problem is one of circuit stability in precision oscillators or of close capacitance tolerances in electronic instrumentation, have you investigated the advantages of Sprague-Herlec Precision Ceramic Capacitors?

These unique capacitors offer not only top capacitance and temperature stability but stability with applied voltage, uniform retrace characteristics, and high "Q". They are available in capacitance tolerances as close as ±1% and temperature coefficient tolerances as close as ±10 ppm/°C in regular production quantities.

Mechanically, they are small in size, sealed against atmospheric humidity, and resistant to vibration and shock. Standard operating temperature range is from −55°C to +85°C.

Sprague-Herlec Precision Ceramics are available in all standard temperature coefficients from P100 to N750, and can also be manufactured to any exact intermediate coefficient required for balancing other circuit constants. When used in combination with Sprague Durameg® Accurate Wire-Wound Resistors, it is possible to achieve stability heretofore impracticable in mass-produced electronic equipment. Sprague can furnish you either these R-C network components or complete network subassemblies to meet your tolerance requirements.

For complete details on Sprague-Herlec Precision Ceramic Capacitors, write for Engineering Bulletins 603-B and 607-A to Sprague Electric Co., 233 Marshall Street, North Adams, Mass. or Herlec* Corporation, Grafton, Wisconsin.

*THE HERLEC CORP. IS A WHOLLY-OWNED SUBSIDIARY OF THE SPRAGUE ELECTRIC CO.

SPRAGUE

WORLD'S LARGEST CAPACITOR MANUFACTURER

EXPORT FOR THE AMERICAS: SPRAGUE ELECTRIC INTERNATIONAL LTD., NORTH ADAMS, MASS. CABLE: SPREXINT

TELE-TECH
& Electronic Industries

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

WHAT'S AHEAD for '54

COLOR TV

HISTORY-MAKING YEAR is in the offing with the first color TV Receivers available to the public during the spring of 1954. Production is not expected to pick up momentum until the fall, and present estimates are that only about 100,000 sets will be made by year's end. There is reason to suspect that favorable public reaction could double or triple this figure. First sets will use tubes with 15-in. envelope providing approximately 12-in. screens and will sell at $750 to $1,000. Late in 1954 some 21-in. screens should make their appearance. Engineering attention will focus on overcoming the big bottleneck—the picture tube—and several innovations will be announced. Networks will push hard for early introduction of medium by stations. About 80 stations have already placed orders for color-TV transmitter modification equipment.

TRANSISTORS

FURTHER IMPROVEMENTS in production techniques will lower cost and increase performance of these units. Better high-frequency characteristics will foster use in military and special commercial communications equipment. Computer manufacturers will make use of transistor's low power consumption. A few radical developments will come about, including the use of material other than germanium—possibly silicon—which will give superior performance. Watch for further development and application news about "power" transistors.

AUTOMATION

ELECTRONIC MANUFACTURERS will incorporate a few new automatic production techniques, but for the most part systems will remain the same as 1953. Most of the companies will be cautious about jumping into methods which will obsolete existing investments. Improved electronic controls for automation systems used in other industries should receive increasing acceptance.

GOVERNMENT PROCUREMENT

ECONOMY-MINDED congress will spark sizable setbacks which will pinch a number of electronic suppliers to the military. However, on-hand appropriations of over $2.5 billion for fiscal 1954 will keep the ball rolling. Continued unrest in Asia and a stymied European defense alliance during calendar year 1954 are expected to keep armament—and military electronic gear—from falling too far below 1953's $3.5 billion. Large number of "war baby" companies will be forced to find commercial markets or else.

PRINTED CIRCUITS

MORE MASS PRODUCED equipment for military and civilian applications will employ printed circuits, though most of these will be for certain subassemblies only. At least two TV makers now toying with the idea may take the plunge and use printed circuits extensively throughout their sets. About 1,000,000 of the radios made in 1954 will fully utilize printed circuit techniques.

VIDEO RECORDING on MAGNETIC TAPE

Brig. Gen. David Sarnoff, Chairman of the Board of RCA, holds length of half-inch magnetic tape used to record color as well as black-and-white TV programs in recent demonstration. This development opens limitless opportunities for an era of electronic photography. Although commercial units are not expected for two years, prototype will be made toward the end of 1954. See page 81 for details

INDUSTRIAL APPLICATIONS of Electronic Equipment

A TELE-TECH INDUSTRY STUDY

The following 16-page report is the result of an intensive six-month study, and is the most complete analysis of its kind ever made. In 21 sections, it reveals how and why electronic devices are used in research and production

By ALBERT J. FORMAN, Associate Editor
TELE-TECH & ELECTRONIC INDUSTRIES

THE fabulous automotive industry is opening new horizons for electronic engineers and manufacturers. To the engineer it offers the challenge to develop new equipment for use in mammoth laboratories and production plants. In addition, the fact that too few auto people really understand the very electronic equipment they are using indicates increasing employment opportunities. To the electronic manufacturer it means a vast growing market for his products—a market that is to a great extent still unexploited.

Auto firms are constantly learning how electronic devices can improve their operations. Slowly but surely they are taking advantage of this knowledge. So far auto manufacturers have invested over $25,000,000 in electronic equipment for their plant facilities, most of this during the past few years. The value of apparatus directly related to electronic devices is about $50,000,000. Coupled with this are huge purchases of auto radios. During the past year some 4,800,000 broadcast receivers with a retail value of $250,000,000 were purchased. Add to this a sizable amount of two-way radio communication equipment. Also, an examination of over 400 important suppliers to the auto makers has shown that nearly 100% utilize electronic devices in their own plants, amounting to a very sizable investment.

Of vital interest to electronic industries management is the fact that a segment of the auto industry is presently engaged in electronic production. This extension is in line with the trend toward product diversification in all industries to provide a more stable operating level. Although penetration is not presently extensive, it is at least a straw in the wind—and probably more. For example, General Motors' Delco Radio Div. is a major producer of auto radios, and Kaiser and Willys Motors are in the business of making low-power TV transmitters. Concerning defense production, the effect of big auto facilities and know-how is still more noticeable. Among GM's defense products are navigational computers, fire controls, instruments, gyros, and two-way communications. Kaiser's output includes electronic components and development work.

BEFORE describing the applications of electronic equipment, it will be of interest to examine the industry as a whole, and to learn how its far-reaching effects enter the lives of all of us.

The remarkable history of the sleek and powerful vehicles we know today had its start in Springfield, Mass., where the Durea brothers made their first successful tests of a one-cylinder gasoline engine mounted on a buggy chassis. The year was 1893. Though scoffed at by most people, its impact on the community was immediately recognized—in 1895 Chicago banned the "horseless carriage." Odd and assorted uses were found—in 1913 the Model T proved to be a wonderful anti-tiger weapon in Korea.

From this somewhat disjointed beginning, the industry grew to the keystone position it occupies in our society today. In 1900, 4192 autos were produced. In 1953, about 6,200,000 passenger vehicles and 1,300,000 trucks and buses were made. In the peak year of 1950 these figures were 6,665,863 and 1,337,193, respectively. More than 900,000 people are employed in ve-

in the Automotive Industry

hicle and parts manufacturing, over one-half of these being in the vehicle plants. Sales and service account for an additional 1,900,000 people. Its industrial and economic leadership has few rivals.

Considering how the automobile has changed our way of living, it is no wonder that Americans are car-conscious. Our annual cost of buying and operating cars amounts to $38 billion, which is over 15% of the $250 billion consumer market. About $16 billion of this is spent buying cars. By the end of 1953, there were 45,000,000 passenger vehicles operating, 250,000 buses and 9,460,000 trucks. Of the nation's 48,500,000 families, 31,500,000 own automobiles. Motor vehicle traffic in the U. S. covers more than one-half trillion miles annually. Add such outgrowths as auto vacationing ($9 billion per year), drive-in theaters and restaurants, and many others, and the real impact of the "horseless carriage" becomes apparent.

Auto Industry Organization

There are 10 major passenger car companies which produce 20 different makes through a divisional arrangement. Similarly, over 30 major truck manufacturers are the source of more than 35 truck makes. Over 13,000 suppliers furnish their products to the auto industry. The leading trade group representing the auto makers is the Automobile Manufacturers Association, 320 New Center Building, Detroit 2, Mich., which acts as advisory center and information clearing house.

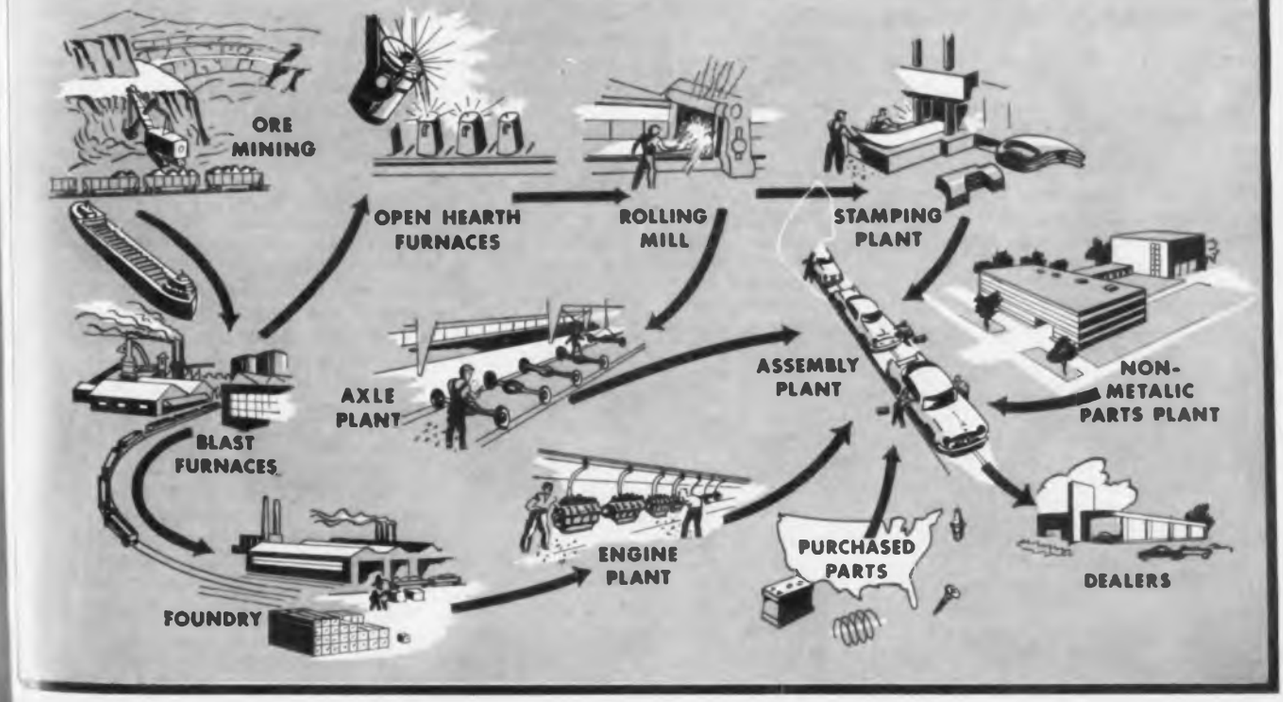
The industry is dominated by the Big Three—General Motors, Ford, and Chrysler—which accounted for over 90% of the nation's passenger car output during the first nine months of 1953. Toward the end of the year, the "independents" had only 4.1% of the production. Although its heaviest concentration is in the Detroit area, a large number of the industry's several hundred plants are located in cities across the nation and in foreign countries.

General Motors Corp., which includes Buick, Cadillac, Chevrolet, Oldsmobile and Pontiac, made over 47% of the cars turned out during 1953. GM's payroll reached 576,000, and its stockholders numbered 493,258 during 1953. It comprises 116 plants in 57 U. S. cities, six in Canada, and facilities in 19 other countries. Almost all of the 39 GM divisions are in defense production—$1.7 billion during 1953. The accent is on vehicular and aircraft equip-

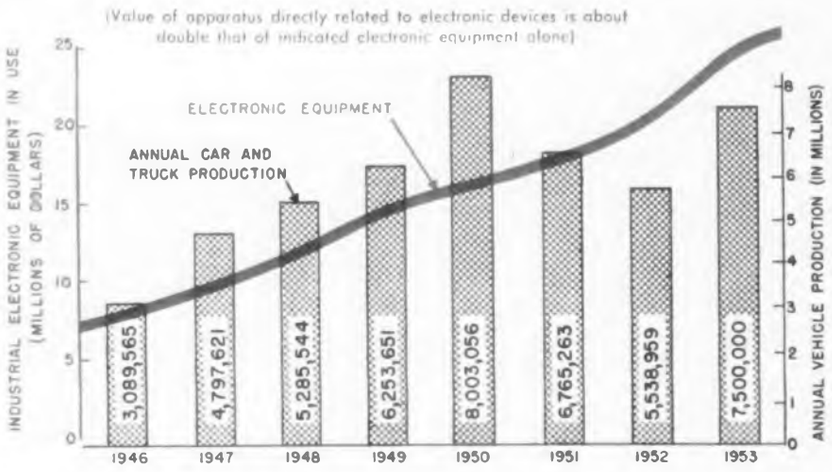
AUTOMOTIVE HIGHLIGHTS

- 45,000,000 passenger cars operating in U.S.
- Annual cost of buying and operating cars is $38 billion
- Annual sale of auto radios totals $250,000,000
- Over 29,000,000 cars now radio equipped
- About 6,200,000 passenger cars produced in 1953
- Over 900,000 people employed in auto manufacturing
- 20% of steel produced goes into autos
- There are 78,000,000 vehicles in world
- Over $1 billion of vehicles and parts exported yearly
- U.S. annual vehicle traffic is one-half trillion miles
- 17% of nation's 4,000,000 businesses related to autos
- 31,500,000 U.S. families own cars

How a car is made . . . the flow of materials from the mines and blast furnaces through the metal-working and assembly plants. Parallel with this flow is an intensive program of research, engineering and quality control. In the laboratory and factory, electronic equipment speeds automotive progress



Growth of Electronic Equipment Use and Vehicle Production in Auto Industry



ment. Total sales volume was over $10 billion. Expanded engineering facilities will be provided in the Technical Center now being completed on an 813-acre site.

Ford Motor Co., which includes Ford, Lincoln and Mercury, produced about 22.5% of 1953 passenger cars during the first nine months, made 34.5% during October. It is a family-owned corporation with assets listed at $1.76 billion. It has 186,000 employees and holds $1.5 in defense contracts. The $900,000,000 spent since 1946, part of Ford's $1.4 billion post-war expansion program, has added 26,000,000 sq. ft. of facilities. Its new $90,000,000 research and engineering center will be completed on a 750-acre tract by 1958.

Chrysler Corp., which includes Chrysler, De Soto, Dodge, and Plymouth, manufactured about 20.5% of 1953 autos, being hampered by a strike stoppage. Last year it had 133,000 employees in 35 plants having a net worth of over $547,500,000. Chrysler is adding 1,000,000 sq. ft. to its 30,000,000 sq. ft. of floor space. The company operates 28,000 machine tools. It is producing vehicles and aircraft equipment for defense, and is also engaged in a guided missile program.

The awesome complexity involved in producing an automobile can be summed up in the words of one of the industry's top plant managers: "After 30 years in this business, I still wonder how an automobile ever gets made." Such a near overwhelmed attitude from a prominent authority is understandable when we consider that a car consists of 5000 parts made up of 15,000 separate items. Furthermore, these components are made of 260 different chemical ingredients, including more than 150 metals and alloys.

For example, take just one major element, the engine. Around 10,000 operations are required to fabricate parts and assemble one engine. Quality control plays an extremely important role in monitoring almost all operations along the way. To accomplish this, 1400 different kinds of gages are employed.

Extensive research is being carried out to develop new materials and improved designs. The significance of this effort is illustrated by the fact that the future increase in engine efficiency by 30% by raising the compression ratio to 12:1 will save 10.5 billion gallons of gasoline each year. Radical innovations are also in the offing. Researchers are working on gas turbines as a possible substitute for the internal com-

DIRECTORY of AUTOMOTIVE MANUFACTURERS

Passenger Car Manufacturers

Buick	Buick Motor Div.[3]	Flint 2, Mich.
Cadillac	Cadillac Motor Car Div.[3]	Detroit 32, Mich.
Checker	Checker Cab Mfg. Corp.	Kalamazoo 13F, Mich.
Chevrolet	Chevrolet Motor Div.[3]	Detroit 2, Mich.
Chrysler	Chrysler Div.[1]	Detroit 31, Mich.
DeSoto	De Soto Div.[1]	Detroit 31, Mich.
Dodge	Dodge Div.[1]	Detroit 31, Mich.
Ford	Ford Motor Co.[2]	Dearborn, Mich.
Henry J	Kaiser Motors Corp.[4]	Toledo 1, Ohio
Hudson	Hudson Motor Car Co.	Detroit 15, Mich.
Kaiser	Kaiser Motors Corp.[4]	Toledo 1, Ohio
Lincoln	Lincoln-Mercury Div.[2]	Dearborn, Mich.
Mercury	Lincoln-Mercury Div.[2]	Dearborn, Mich.
Nash	Nash-Kelvinator Corp.	Detroit 32, Mich.
Oldsmobile	Oldsmobile Div.[3]	Lansing 21, Mich.
Packard	Packard Motor Car Co.	Detroit 32, Mich.
Plymouth	Plymouth Div.[1]	Detroit 31, Mich.
Pontiac	Pontiac Motor Div.[3]	Pontiac 11, Mich.
Studebaker	Studebaker Corp.	South Bend 27, Ind.
Willys	Willys Motors, Inc.[1]	Toledo 1, Ohio

Motor Truck Manufacturers

Autocar	Autocar Div.[5]	Ardmore, Pa.
Chevrolet	Chevrolet Motor Div.[3]	Detroit 2, Mich.
Coleman	Coleman Motors Corp.	Littleton, Colo.
Cook	Cook Bros. Equipment Co.	Los Angeles, Calif.
Corbitt	Corbitt Co.	Henderson, N. C.
Dart	Dart Truck Co.	Kansas City, Mo.
Diamond T	Diamond T Motor Car Co.	Chicago 23, Ill.
Divco	Divco Corp.	Detroit 5, Mich.
Dodge	Dodge Div.[1]	Detroit 31, Mich.
Duplex	Duplex Truck Co.	Lansing 4, Mich.
Eageol	Twin Coach Co.	Kent, Ohio
Federal	Federal Fawick Corp.	Detroit 9, Mich.
Ford	Ford Motor Co.	Dearborn, Mich.
F.W.D.	Four Wheel Drive Auto Co.	Clintonville, Wis.
G.M.C.	G.M.C. Truck and Coach Div.[3]	Pontiac 11, Mich.
Hendrickson	Hendrickson Motor Truck Co.	Lyons, Ill.
International	International Harvester Co.	Chicago 1, Ill.
Kenworth	Kenworth Motor Truck Corp.	Seattle 8, Wash.
Linn	Linn Coach & Truck Co.	Oneonta, N. Y.
Mack	Mack Manufacturing Corp.	New York 1, N. Y.
Mormon-Herrington	Mormon-Herrington Co.	Indianapolis 7, Ind.
Nash	Nash-Kelvinator Corp.	Detroit 32, Mich.
Oshkosh	Oshkosh Motor Truck Corp.	Oshkosh, Wis.
Peterbilt	Peterbilt Motors Co.	Oakland 5, Calif.
Pontiac	Pontiac Motor Div.[3]	Pontiac 11, Mich.
Reo	Reo Motors, Inc.	Lansing 20, Mich.
Sterling White	Sterling Div.[5]	Milwaukee 1, Wis.
Studebaker	Studebaker Corp.	South Bend 27, Ind.
Walter	Walter Motor Truck Co.	Ridgewood 27, N. Y.
Ward-LaFrance	Ward-LaFrance Truck Corp.	Bronx, N. Y.
White	White Motor Co.	Cleveland 1, Ohio
Willys	Willys Motors, Inc.[4]	Toledo 1, Ohio

[1] Chrysler Corp. [2] Ford Motor Co. [3] General Motors Corp. [4] Kaiser Motors Corp. [5] White Motor Co.

A TELE-TECH INDUSTRY STUDY

bustion engine. In the laboratory, as on the production line, electronic equipment is playing an increasingly vital role.

Fundamental studies play a prime role in the research activities of the automotive laboratories. These investigations cover the analysis of new materials adaptable to high-speed, high-temperature and high-pressure propulsion systems; efficient fuel conversion into energy in gas turbines; development of new high-speed electronic sensing devices; radioactive materials; future use of atomic energy; and conversion of waste byproducts into usable materials. These efforts, and many others, require well-equipped labs with a large number of electronic instruments.

Nature of magnetism is studied within framework which supports Helholtz coils. Current in coils sets up magnetic field to counteract that of earth. Extremely sensitive current control is effected by amplifier which incorporates two phototubes as error detection elements

2 Basic Magnetic Studies

A GOOD example of basic research is the probing investigation of magnetism in the General Motors Labs. This long range project is devoted to enlarging the boundaries of science, rather than the cruising range of automobiles.

The present emphasis of the program is on gyromagnetics. This is a concept that can best be explained as follows: a ferromagnetic material consists of a large number of atomic systems, each one of which contains rapidly spinning electrons. The motion of these electronic charges is now believed to be the cause of magnetism. The motion of the electron mass, on the other hand, produces ordinary mechanical inertia effects. When the material is magnetized, these spinning electron systems, normally oriented randomly, tend to line up their magnetic axes in the direction of the applied field. This results in a net circulation of electricity about the axis of magnetization. Of course, this reorientation of the magnetic axes of the electrons is accompanied by a reorientation of the electron mass as well. Thus, two quantities are involved in the magnetization process: a magnetic moment and an angular momentum. The ratio of the angular momentum to the magnetic moment is known as the gyromagnetic ratio for the material.

Two separate measurements have to be made to determine gyromagnetic ratio. The first is to measure the angular momentum of a cylindrical rod of the material. The rod is suspended vertically in a neutralized field, and magnetized. The sudden resultant lining up of the electron systems imparts a rotary kick or impulse to the rod about the axis of magnetization. The amount of this impulse is a measure of the angular momentum of the rod.

Now the rod is suspended horizontally, in a known field established by Helmholtz coils. An angular deflection, or magnetic moment results. This is measured by hanging a body with a known magnetic moment from the same suspension, and varying the field until the same deflection is attained.

3 Spectroscopy

SINCE all materials emit or absorb a characteristic pattern of radiation under proper conditions, metals, fuels, and other materials may be analyzed by measuring this radiation. For this purpose, electronic-optical equipment, such as spectrometers and infra-red spectrophotometers, have been developed.

In the Baird Associates direct-reading spectrometer, a metal may be analyzed in less than five minutes. This unit is similar to the emission spectrograph, except that photomultiplier tubes are substituted for the photographic plate. The sample is placed in an electrode

GM's infra-red spectrophotometer expedites analysis of hydrocarbon fuels. Use of dc breaker amplifier achieves sensitivity without attendant vibration problems encountered with galvanometers

Research engineer makes a quantitive gas analysis on mass spectrometer at Ford Laboratory

holder, and a high-voltage spark excites the sample causing it to emit light. This light enters the optical system of the instrument, and is dispersed into a spectrum by a diffraction grating. Some of the spectrum lines produced are particularly concentration-sensitive, and their brightness can be used to determine the concentrations of the various elements in the sample. These lines are allowed to pass through slits; all other lines are rejected. These lines, one for each element to be analyzed, and one for the matrix element (e.g.: Fe in steel), fall on photomultiplier tubes, one tube per line. During the exposure period while the spark is operating, the photomultiplier tubes produce a current which is proportional to the brightness of the lines falling on them. The current from each tube is used to charge capacitors, one capacitor for each tube. By combining capacitor output with a triggering circuit, clocks are controlled to give direct readings of material concentration.

The spectra of liquids and gases may be examined with an infra-red spectrophotometer of the type developed by GM. Through an arrangement of slits, mirrors and prisms, light from a source is passed through an absorption cell for liquid or gas, and directed to a detector. The source of radiation is a Nernst glower, the dispersing unit a 10 x 15 cm sodium chloride prism, and the detector is a compensated thermopile. The output of the thermopile is amplified with a contact-modulated amplifier. The installation is comparatively insensitive to mechanical vibration and fast temperature changes. The instrument is enclosed in a vacuum tank to prevent interference from absorption by gases.

4 Electron Microscope

AN invaluable tool in metallographic studies is the electron microscope. It has also made valuable contributions in automotive studies of paint pigments, atmospheric pollution, ceramics, and dispersion of solids in fuels and lubricants.

Any microscope's ability to detect objects is limited by the wavelength of the illumination, the enlargements of light micrographs beyond about 2000 times show no new detail but merely make the pictures larger. However, since electrons have wavelengths about 1/100,000 that of visible light, it is easy to obtain direct magnifications of 20,000X, resolutions better than 30 Angstrom units (1 Angstrom = 0.1 milimicron), and photographic enlargements up to 100,000X.

In operation, a typical electron microscope will have a 50,000-volt electron gun emit electrons which are directed through a condenser aperture to strike the specimen. Depending on the composition, some electrons pass through the specimen, while others are deflected. Those passing through are focused by an objective lens, enlarged, and further magnified by a projector lens. The electron beam strikes a fluorescent viewing screen or photographic plate.

A TELE-TECH INDUSTRY STUDY

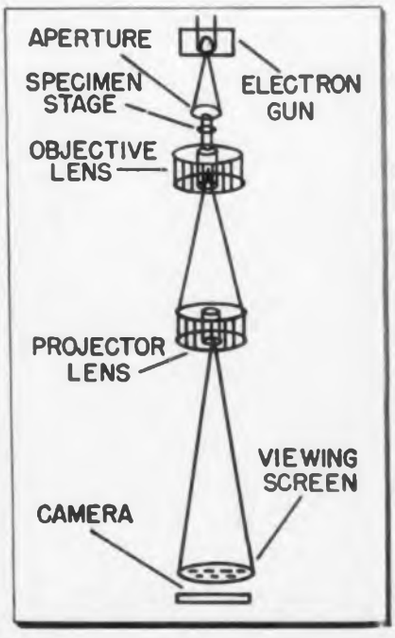
5 X-Ray and Electron Diffraction

DIFFRACTION equipment permits scientists to identify different materials by the patterns that result from subjecting substances to X-ray and electron beams. The reflection and transmission diffraction patterns of thousands of compounds have been thus catalogued.

One X-ray diffraction system application in the auto field is the determination of the per cent of austenite in a sample of steel. A film record containing areas of varying darkness is scanned in a microphotometer, which passes a thin slit of light through the film. This beam is picked up on a phototube, and after suitable amplification the resulting signal is displayed on a strip chart.

Electron diffraction is useful to the metallurgist in studying corrosion and surface phenomena, and to the chemist trying to identify the different crystalline phases of chemically similar materials.

RCA electron microscope in GM lab (left) is vital tool in metallographic studies. Unit can magnify directly to 20,000X. Inset shows vapor blasted surface of engine part operated at high temperature. (Right) Electron optics of electron microscope



X-ray diffraction film record (left) is scanned in microphotometer in GM lab. Beam is picked up on phototube, whose output is then amplified. Resulting signal is displayed on strip chart. In photo (right above) Engineer at left checks angular position on recorder of GE X-ray spectrogoniometer in Ford Scientific Laboratory. Researcher at right adjusts specimen position on X-ray diffraction camera

6 Chemical and Electrometric Analysis

INTEGRATED with the program of spectral and diffraction analysis of materials is the chemical and electrometric determination of substances. These latter techniques are widely used in production as well as research, and electronic amplifiers and controls are intrinsic elements of many of these systems.

For example, pH measurement and control (relative acidity and alkalinity) of various treating baths and lubricants can be determined electrometrically by inserting two special electrodes in a liquid. One develops a constant reference potential, but the other undergoes a change in potential with a change in solution pH.

By measuring the conductivity of a solution, ion concentrations of contaminants are readily determined. A method of measuring electrolytic conductivity is an ac Wheatstone bridge arrangement with an immersed conductivity cell in one arm. Another arm has a temperature-compensating resistor in the solution. Bridge unbalance is amplified and fed to a motor which records the new conductivity and resets the balance.

Economically, the importance of electronically controlled chemical measurements cannot be underestimated. For instance, one plant in Flint, Mich., used to throw out an abundance of cutting oil, hydraulic leakage, press forming lubricant, honing compound and rust preservative. Chemical treatment now salvages 50,000 gallons per month from the waste water. The salvaged oil is shipped to a forge plant for fuel.

7 Electronic Instruments and Recorders

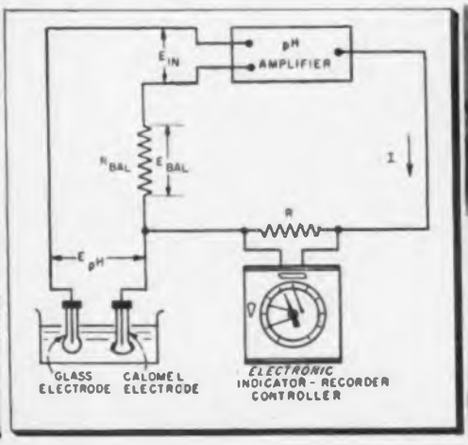
THE automotive industry is a big user of electronic measuring instruments and recorders. Nearly all such devices found in an electronic laboratory are utilized in the automotive counterpart, plus a goodly number employed only in heavy industry. One particular laboratory is stocked with secondary standards and measuring devices capable of handling anything from 0.01 cps to 600 mc, and from 0.1μv to 500 kv. Add to this a host of analyzers, amplifiers, counters, detectors, generators, meters, and oscilloscopes and we gain an inkling of the magnitude of the operation. Rather than list all the different types of instruments and recorders, these units are described in other sections of this report according to the functions they perform.

It is worth noting that a large number of electronic instruments are sold to service stations for analyzing engine performance, checking ignition systems, charging batteries, and testing ignition components.

8 Radioactive Techniques

BEHIND lead-shielded doors in research laboratories, Geiger counters play a staccato tune to the accompaniment of automotive progress. Radiation detectors, function generators, decimal scalers and oscilloscopes are some of the electronic devices employed to harness

Ford research engineer (left) adjusts pressure control on semi-automatic distillate analyzer. Minneapolis-Honeywell system (center) for recording pH employs special electrode and amplifier. (Right) Radioactive piston rings used in engine wear test are handled behind lead bricks at Ford laboratory.



Radiation detector shows cylinder head leakage of isotope-tagged coolant on Tracerlab monitor

the atom to the wheels of industry.

In a broad sense, radioactive isotopes are called upon to do the jobs that cannot be done elsewhere. In a typical wear test, a piston ring is irradiated at Oak Ridge, and given a short run in a stock car engine. The motor oil is then drained and tested for radioactivity, which is proportional to the amount of ring wear. This method is more accurate and less time consuming than the old method of before-and-after weighing of parts.

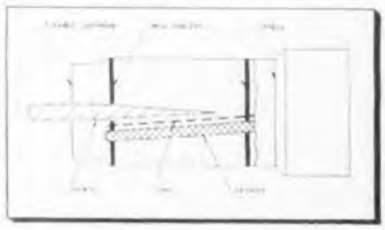
Use of electronic smoke detecting system made by C-O Two Fire Equipment Co. is a big help in eliminating hazards in Nash paint booths

The ionization anemometer is an embodiment useful for measuring air flow. The air passes between two ionization plates, carrying charged particles to a collector. The collected ions are a measure of the air flow. Other applications include tracing engine coolant, studying metal ores, testing oil breakdown, measuring material thickness, and taking radiographs of castings.

9 Surface Measurements

THE great importance of accurate surface finishing in automotive parts provided the impetus for the development of a relatively inexpensive, portable, direct-reading instrument for measuring surface roughness. One such device developed by General Motors, the Surfagage, has laboratory precision and production plant ruggedness.

A diamond stylus with tip radius of 0.0005 in. is mounted in a pickup rider and used as the feeler along the surface contour. The stylus is connected to an RCA 5734 transducer triode through a viscous coupler. By the movement of the plate inside the transducer tube, which causes the tube resistance to vary, a dc output is produced, effectively converting the minute mechanical displacements of the stylus into electrical signals. These signals are fed through a two-stage amplifier followed by a balanced output stage which provides a current that is rectified and indicated on a meter. The indicating circuit is essentially a good ac vacuum tube voltmeter with flat frequency response to below 5 CPS. Power is supplied by any 115-volt ac line.



Transducer triode converts mechanical displacements into electrical signals in Surfagage. Movement of plate varies the tube resistance

Closely allied to roughness is waviness, which is found on practically all surfaces of rotation. Contrasted to roughness, the irregularities are relatively widely spaced, but cause their share of wear and vibration with gremlin-like efficiency.

A unit for measuring waviness is the Wavometer made by Micrometrical Mfg. Co. It gives meter readings of the rms average height of the waves directly in microinches and shows on an oscilloscope the general shape and spacing of the waves. It also has a loudspeaker that enables the operator to detect deviations in quality by ear. Mechanical deviations are converted to electrical signals by a felt feeler tip which moves a coil in a magnetic field. The resulting signals are amplified in a four-channel electronic amplifier and delivered to the meters, oscilloscope and speaker.

Machined metal surfaces of automotive parts are measured and specified for roughness with the Surfagage, which employs diamond stylus, transducer triode and electronic amplifier

10 Dimensional Gaging for Quality Control

MEASURING the size of the thousands of parts composing an automobile is an exacting process which is carried out automatically in most production operations. Quality control gages check the dimensions beforehand to prevent this. Many of these functions are accomplished by air gages (size of work controls air

Wire feelers chart gear profile on Ford's Industrial Scientific Co. probograph. Instrument has photoelectrically scanned master drum

A TELE-TECH INDUSTRY STUDY

flow from nozzle) as they have been for many years. However, the speed, accuracy and compactness of electronic and magnetic gages have found very wide applications during recent years.

The operating principle of the electronic gage is that a pick-up probe causes a coil to move, producing a proportional signal which is amplified and either read on a meter or used to control a reject relay. A device of this type for inspecting and sorting piston pins has a continuous feed which moves the pins along several gaging stations. At one station a surface comparator checks the finish by light reflection. The various pin dimensions are measured with the probe-and-coil arrangement described. If the size is within tolerance limits, the pin is guided into the accept chute. If oversize or undersize, corresponding reject relays are actuated, guiding the pins into their respective chutes.

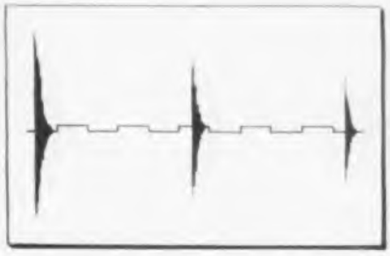
The Cox magnetic thickness gage consists of an ac electromagnet having secondary magnets around each of its two poles. In use, both poles are in contact with the cylinder wall, for example, through which magnetic flux passes. The thickness of the wall at one of the poles determines the magnitude of the current induced in the secondary coil at that pole. The induced current is read on a meter. Thus by placing the unit in contact with one side of the part, changes in thickness as small as 0.005 in. may be detected.

Automatic piston pin inspection and sorting at Ford is accomplished by pick-up probe which moves coil according to pin diameter. Resulting signal is amplified and actuates reject relays

Ultrasonic oscillator resonance rapidly checks volume of cylinder head cavities within 0.2 cc accuracy on Ford production line. Previous method required that each cavity be hand-filled with oil

ULTRASONIC devices have turned out to be one of the most important tools used in the auto industry. The scope of application encompasses a great many vital activities, from breaking down liquids in the laboratory to inspecting castings for internal flaws and external construction.

Thickness from 0.005 in. to about 1 in., as well as bonding flaws and internal cracks, can easily be measured within 2% error with the automatic Sonigage developed by GM. This ultrasonic instrument makes possible rapid non-destructive tests of metal and plastic parts. Only one surface is needed for testing. In operation, the resonant frequency of an electronic oscillator (about 1.5 to 3 MC) indicates the thickness and soundness of a part



Reflectoscope screen shows (l) ultrasonic pulse transmitted into material; (c) portion of pulse reflected back from defect; (r) first back reflection from opposite side of part. Horizontal position indicates depth in work

As a small electric motor rotates the tuning capacitor, the operator observes the trace on an oscilloscope. The horizontal position of sharp

Automatic transmission shafts are inspected for internal flaws with reflectoscope made by Sperry Products. If flaws are present, they will reflect ultrasonic waves introduced by crystal

GM-developed Sonigage utilizes ultrasonic resonance to measure thickness and detect intern l flaws. Inset shows vertical trace deflection on CRT for measuring 0.07 in. steel

vertical trace deflections indicates thickness on a superimposed calibration scale. This is done by synchronizing cathode-ray spot sweep with the variable oscillator. The vertical deflection is caused by the momentary increase in energy supplied to the crystal (which is pressed against the measured piece) when the resonant frequency of the tested part is tuned.

Another ultrasonic thickness-and-soundness measuring device is the Reflectoscope manufactured by Sperry Products. Unlike the Sonigage which operates on a resonant frequency principle, this device employs the radar technique of measuring the time interval between the transmission of the ultrasonic pulse and reception of the echo. This period is a measure of the distance from the surface to the discontinuity. It is used with pieces from under 1 in. to 30 ft. thick, and accuracy is within 2%. Testing ranges cover 0.2 to 25 Mc, depending on the nature of the test requirements. The vibrations are introduced into the work by a quartz crystal. At the same time, the pulse is displayed on an oscilloscope. After a very short time, if a defect exists, a pulse is reflected from the discontinuity and displayed. Then the first back reflection from the opposite side of the part is reflected. The horizontal position on the oscilloscope, determined by the time taken to enter and be reflected, is a measure of the distance to the discontinuity.

Ford research engineer conducts laboratory test with Massa Labs ultrasonic generator

An excellent example of how ultrasonics has stepped up production efficiency is the Poole Cavitometer. The old method of measuring the volume of a cylinder head was the slow and messy process of filling the cavity up with oil by hand. Now, in 12 to 20 seconds the volume is tested to within 0.2 cc accuracy by the $22,000 Cavitometer. The head is fed into the machine, a sweep oscillator automatically determines the resonant frequency (and thereby the volume) for each cylinder cavity, showing the operator whether it is within tolerance limits.

(12) Induction and Dielectric Heating

RADIO-frequency oscillations are put to work in a large variety of heating applications. The two methods of harnessing this energy are induction and dielectric heating, with induction heating being a very widely used technique. In induction heating, the part is in the field of a coil connected to a source of high-frequency power. Induced hysteresis and eddy currents in the metal generate the heat to anneal or harden the part. Although more expensive than gas heating, this method has replaced gas in many operations because it is cleaner, faster and provides better area and depth control.

Dielectric heating is applied by placing the material between two electrodes connected to a high-frequency source. The resulting electrostatic field produces dielectric losses which generate heat throughout the work. It is useful for bonding brake linings, gluing wood parts, softening plastic preforms, curing resins and similar applications.

A production plant hardens shafts at 10 Kc, and valve tips at 400 Kc. In another plant the hole area in a shackle bolt is softened

GE automatic induction heat and quench at Chrysler. Hardening depth is controled to 0.015 in. Type 880 triode is used in oscillator

in 2.5 seconds with 20 kw at 0.5 Mc, and 3200 push rod ends (used to push open engine valves) are hardened every hour. When very high powers are necessary, such as 200 kw for treating crankshafts, a non-electronic motor-generator set may provide the 3 Kc power.

Typical of production line induction equipment is the General Electric automatic induction heat and quench device at Chrysler. A torque converter impeller for the automatic transmission is placed on a mount which lifts it up to the coil. A 880 triode oscillator in a Colpitts circuit with 15 kv on the plate provides 20 kw at the work. In timed sequence, the r-f is automatically turned off, the mount lowered, and water sprayed on the part for quenching. The hardening depth can be controlled to within 0.015 in.

Induction heating hardens end of push rods at Chrysler at rate of 3200 per hour. Continuously fed rods on rotating wheel are moved past coil and quenched in oil before ending up in hopper

A TELE-TECH INDUSTRY STUDY

13 Welding and Temperature Controls

Ring gears are welded to cover with Weltronic welder at Chrysler. At completion of operation, parts are passed along roller track (l) to next station. Welder's electronic controls (r) include sequence timer and phase shift circuit (upper) to control firing of Westinghouse ignitrons (lower)

ELECTRONIC controls are much more than adjuncts to welding installations. Rather they are integral units which determine the welding sequence and current. In the Weltronic unit, an electronic sequence timer alternately fires each of two sets of "D" ignitrons which control 300 kv transformers. The amount of current drawn (and consequently the heat generated) is controlled by an electronic phase

Leeds & Northrup electronic heat control and recording for ring gears at Nash Motors plant

shift which delays the ignitron starting point.

Measuring and controlling the temperatures of heated materials is sometimes accomplished by relatively simple thermometer or thermocouple readings. More often, the temperature of automotive parts in furnaces, kilns, treating baths, and induction heaters can be more closely controlled when a pyrometer is used in conjunction with a recorder-controller or balancing system.

The Brown radiation pyrometer converts the radiant energy emitted by the heated part into electrical energy, and feeds this output to a potentiometer-type instrument. Units are available covering from ambient temperature to 7000°F. The typical pyrometer consists of a lens, slighted on the work, which focuses the radiant energy on a thermopile, producing an emf which increases exponentially as a power of the heated part's temperature. The thermopile comprises a radial assembly of series-wired thermocouples mounted on a mica plate. A shunt coil or temperature-sensitive resistance winding is included in the thermopile circuit to provide automatic compensation for ambient temperatures up to 250° F.

Another approach to temperature control is the use of an electronic oscillator controlled by a thermocouple. One way this is done is to feed the small thermocouple voltage to a vane located next to the oscillator circuit coil. Movement of the vane throws the circuit off resonance, causing a current surge sufficient to actuate a temperature indicator and control relay.

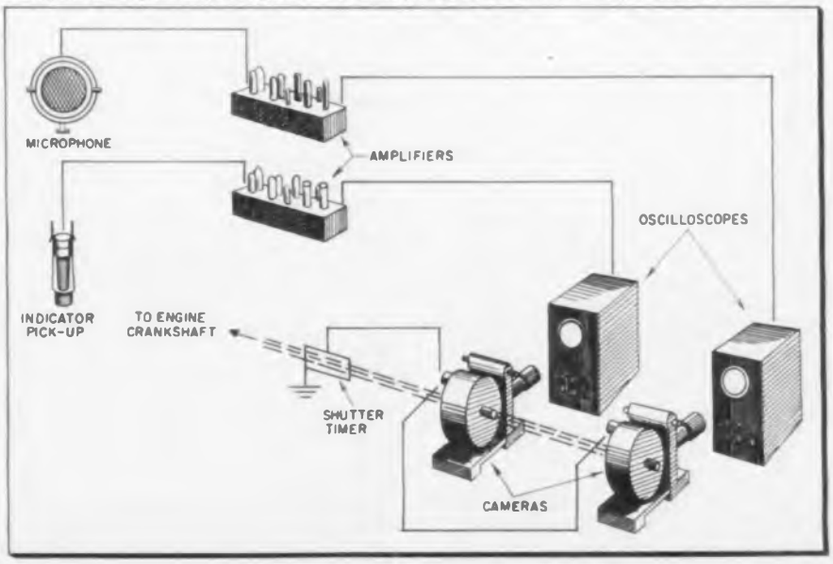
14 Sound, Pressure and Detonation

WHEN the engine's spark plugs ignite the fuel-air mixture in the cylinders, a complex pattern of combustion pressure, shock waves and audible sounds result. The characteristics of these functions are a measure of engine and fuel performance.

A variety of indicator pick-ups are available to convert combustion pressure into usable signal indications. These include piezoelectric, resistance, magnetic, capacitive, and magnetostrictive types, each having their respective advantages and disadvantages. The piezoelectric type consists of two quartz crystals mounted in a steel casing which is introduced in the combustion chamber by replacing a spark plug. The high-potential electrode is inserted

Cox indicator pick-up for measuring detonation pressure in cylinder has quartz crystal which converts gas pressure into electrical signal. Unit replaces spark plug in combustion engine

Test set-up for correlating external sounds and internal engine pressure amplifies signals from microphone and pressure pick-up, and records scope traces with cameras in sync with engine



Chrysler engine on mount produces sounds which are picked up by mike and taped on Magnecorder. Subjective sound tests aid designers

Chrysler engineer adjusts Hewlett-Packard audio oscillator to analyze frequency patterns on DuMont scope. Ampex recorder plays back sounds taped earlier in vehicle test runs

between the two crystals, and the output during detonation is calibrated, say, 0.003 volts per 100 lbs. pressure. The igniting spark can be introduced through the indicator pick-up itself.

The crystal output is amplified in an electronic amplifier and applied to an oscilloscope. If, for example, it was desired to correlate the pressure patterns with audible sounds, a microphone would be connected to another oscilloscope, and the traces of both photographed by two cameras in synchronism with engine crankshaft rotation. Such studies have provided enlightening data for future developments.

15 Static and Dynamic Balancing

A TELE-TECH INDUSTRY STUDY

IN the popular mind the expressions "power roar" and "throb of the engine" convey a feeling of great mechanical force and reliability. To the automotive engineer these terms mean unbalance, high bearing loads and undesirable vibration. They come about because rotating parts do not have mass and rotational axes which perfectly coincide. The result is a sort of wobble, like a spinning top with an added weight on one side. With the advent of high-speed combustion engines running at 2000 to 8000 rpm—and some rotating parts whirling at 20,000 rpm—unbalanced centrifugal forces present a problem.

The two types of unbalance are static and dynamic. Static unbalance may be illustrated by a disc suspended on a shaft passing through its center, which is free to rotate. If one side of the disc is heavier than the other, that side will always come to rest on the bottom. Use of static balancing is limited because it is slow and extremely difficult to apply to more complex shapes such as crankshafts. Besides, a body can be statically balanced and still be dynamically unbalanced, but not vice versa.

For those parts that lend themselves to static balancing, an electronic weighing unit is used. A part such as the connecting rod and cap assembly is placed on the electronic weighing unit so that each end is weighed. Any overweight causes the cutters on an adjacent milling machine to be automatically set.

To illustrate dynamic unbalance consider the shaft with several discs along its length. Even if the system is statically balanced, the distribution of weights can be such that when the shaft is rotated centrifugal forces acting in opposite directions will rotate the whole assembly about some point on the rotational axis, and the shaft ends will tend to describe a circle.

Dynamic balancing machines are available for almost all parts. Using capacitive pick-ups and oscilloscopes to measure and locate the unbalance, automotive propeller shafts can be tested with a sensitivity of better than 0.25 in.-oz., at a rate of 50 per hour.

One balancer operates as follows The part under test is rotated on a floating spring suspension. If the part moves off center, a permanent magnet and coil arrangement generates a pulse which is compared to a ref-

GM-developed propeller shaft balancing machine utilizes capacitive pick-ups and oscilloscopes to measure how much the shaft is out of dynamic balance and where unbalance is located

mpulses produced by rotating Ford crankshafts re stored in electronic memory. With crankhaft stationary, drills automatically remove etal to bring part to 0.5 oz.-in. perfect dyamic balance

rence pulse made by a cam device. The difference output of the two ulses locates the place and amount f unbalance. The part is then taken ff the balancing machine and eights are welded on to make up he difference.

Machining operations are comined with balancing in recent modls. The location and magnitude of out-of-balance is fed to an electronic memory which retains all information transmitted to it while the part was revolved previously. Then, with the part held stationary, the machine sets drills in action to remove metal to restore dynamic balance.

Electronic weighing machine automatically sets milling machine if Ford connecting rod and cap assembly are not in static balance. Cutters then remove metal to achieve balance within 2 grams

iven part of torque converter turbine is nomically balanced on Chrysler's Tinius-Olsen achine which compares off-center pulse with reference pulse to locate unbalance

16 Communications

THE vast scale of automotive operations and the complex interrelations of man and machine functions demand efficient communications. The lion's share of communication traffic is carried by standard telephones but a large number of specific operations utilize radio, teletypewriter and wired audio systems to handle messages.

Dispatching vehicles for handling materials lends itself well to radio communications. The Electric Storage Battery Co., for example, has 98 materials handling trucks. Of these, 28 are heavier trucks, with 10 radio equipped. The remaining 18 will have two-way radios installed within a short time. In operation, a dispatcher at the central 120-watt transmitter receives telephone calls on pick-ups to be made. He examines the schematic of the 19-acre plant in front of him, which shows magnetic markers representing the locations of the various trucks. He calls the fork lift truck nearest the pick-up point and gives the driver instructions. Likewise, the driver reports the completion of a haulage job. As a measure of the savings exacted by the radio system, more than 30 trucks have been obsoleted during the past year, and none have had to be replaced.

In assembling the automobile, a large number of different parts must funnel toward the assembly line in just the right sequence. Since different models and colors move along the same conveyor, the correct part must feed into the line at the moment that the car for which it is intended is passing a particular point. This task is accomplished by teletypewriters from a central planning office which notify the various departments on how parts must be scheduled.

In some factories, loudspeakers are useful for intra-plant one-way communications. However, the din of production noise restricts the location of such systems. One way this obstacle is overcome is by wiring a large section of a plant for audio contact to a central office. Production line trouble shooters walk around wearing headset phones. As soon as trouble is spotted, they plug the unit into a nearby jack which allows them to talk to the central office immediately.

After receiving telephoned information on material haulage job, dispatcher at Electric Storage Battery Co. uses two-way GE radio to call pick-up truck most conveniently located on plant map

From 300 feet inside Ford stamping plant, operator uses TV screen to observe loading of steel trimming bales into waiting freight cars

17 Industrial TV

CLOSED circuit TV for monitoring and controlling industrial operations remotely has made its entry into the automotive field. Its application has been restricted mostly to baling metal and loading the bales into freight cars. In this

TV camera at Cadillac plant is focused on railroad car being loaded by conveyor. Operator in building observes operation on TV screen (inset) and has car moved to prevent overflow of metal

Analog computer recently added to Ford facilities is Goodyear L-3 Electronic differential analyzer

operation, scrap metal is fed to a sheet metal press which packs the metal into bales. The operator controlling this press is able to load the bales into waiting freight cars via conveyors by observing a TV monitor. Although the operator is inside a building hundreds of feet from the outdoor freight cars, the operation is made safe by a TV camera focused on the loading cars. When one is full, the operator sees this on the TV screen, and he has an empty car shuttled into position.

Other related applications of industrial TV are in steel production, where the TV screen enables the fiery red metal to be viewed at a safe distance.

18 Electronic Computers

ELECTRONIC computers have proven themselves to be valuable assets to industry—and the automotive industry has been no exception. One of most important applications has been for data reduction, and not only have many manhours been saved, but problems that had previously been beyond reach have become amenable to solution. For example, a large number of runs on gas turbines produced a huge volume of information, which was made usable by reduction in a card programmed calculator. One company made an extensive and time-consuming survey to rate the paint and plating finishes of their competitors' cars as well as their own. To correlate and print the 32,000 pieces of data gathered in this survey would have taken many weeks of manual work.

IBM card programmed electronic calculator at GM is used for engineering data reduction, survey correlation and gear design computation

In the factory, computers keep track of capital equipment and inventory, and make up payrolls. For the automobile assembly line, if there are say 10,000 orders for cars, cards for each are run through the computer to sum up how many yards of blue upholstery material will be needed, how many whitewall tires, etc.

An interesting specialized design is the simulator-type analog developed at Ford. It consists mostly of passive networks which represent the design measurements of such parts as crankshafts, cams and valves taken from the drawing board. In about one-half hour, the computer can define the relative merits of the proposed design. For example, to simulate a crankshaft to measure torsional vibration, an LC pi network is set up with decade adjustments. Capacitance represents lumped inertia, and inductance the shaft flexibility. When an oscillator signal is applied to the network, the resulting output can be interpreted in terms of torsional amplitude over a range of rotational speeds.

The future holds the promise of increasing use of analog and digital computers, not only for the applications just described, but for the automatic control of factory machines. On an experimental basis this has already been accomplished, and the laboratories of automotive manufacturers and a few of their suppliers are actively engaged in developing the machine regulation techniques which should find commercial acceptance within the next five years

19 Photoelectric Controls

PHOTOELECTRIC devices have found their way into the laboratories, into the production plants, and even into the finished car. Some of these units have been described in preceding sections in relation to such functions as temperature control, spectrographic analysis and parts inspection. Other automotive applications include timing parts movement, taking pictures by setting off high-speed flash bulbs, and as safety guards on heavy punch presses and similar machinery.

Measuring the twist or strain of crankshafts is accomplished with a high degree of accuracy by a photoelectric arrangement. The twist sets

Photoelectric safety guard made by Electronic Control Corp. prevents machinery accidents

up a vibrational pattern which disturbs the speed of a special fanbelt pulley. This pulley has 240 chrome-plated-gear teeth which act as mirrors to reflect light to the photocell. An oscilloscope counts the pulses produced by the rotating pulley, and it notes when the speed is changed by the crankshaft vibration. The device is another tool to help engineers develop tougher crankshafts.

Photoelectric equipment contributes a good deal to factory materials handling. A typical use is to make sure that a hopper being fed small parts or scrap from a chute does not overflow.

At the end of an automobile assembly line, one of the last things to be checked is the headlight focusing. A quick way of doing this (and one

which eliminates any oversights) is to have a railroad-crossing type of barrier with a photoelectric bulls-eye mounted on each arm. The bulls-eye consists of four photo-sensitive cells which the headlight beam must be adjusted to focus on. When the focus is correct the letters "OK" light up and the barrier can be raised to let the car through; if all four cells are not covered by the headlight, the barrier will remain down.

Motorists become gentlemen of the night highways with the Autronic-Eye, an automatic photoelectric headlight dimmer developed by General Motors, and available as a car accessory. The basic idea is that oncoming bright headlights cause a sensitive multiplier phototube to pass a current through a load resistance which develops a negative bias on the amplifier tube control grid. This causes the tube to reduce the current through a sensitive relay. The relay opens, operating a power relay which switches the lights to low beam. To retain the low beam when the approaching driver dims, the sensitive relay switches a much larger load resistance into the phototube circuit. This causes the device to be about 10 times as sensitive in low beam as it is in high beam position.

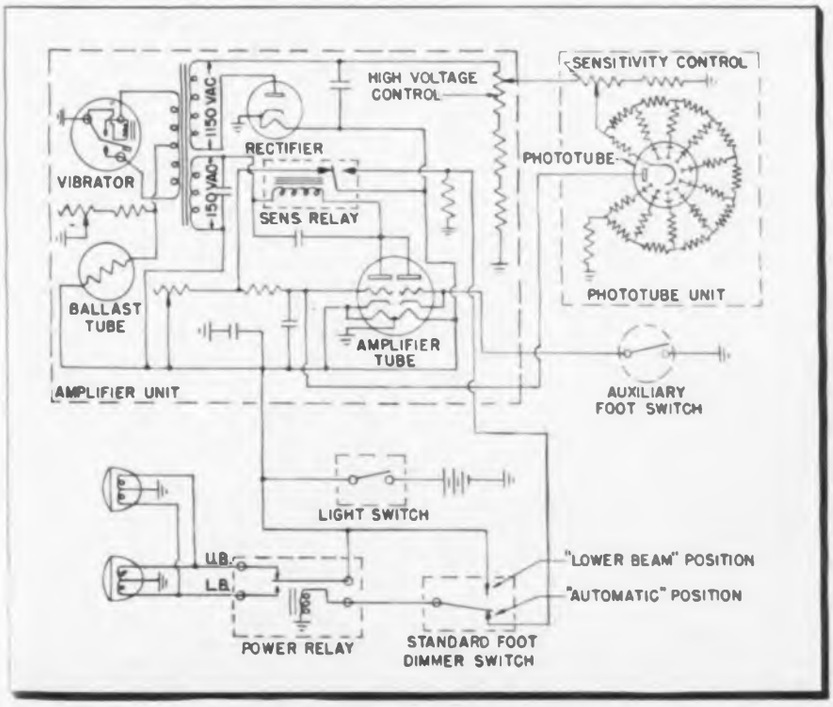
Photoelectric system keeps watchful eye over automobile delivery conveyor at Nash

THE automotive industry has been the pioneer in automation —the automatic handling of parts being processed. The notion has arisen that a number of factories are completely automatic. Such is not the case. Plants in operation today are based on the automatic handling of parts in certain departments, and as experience is gained, an increasing amount of automatic operations are being placed in effect. Someday we may see the completely automatic vehicle factory, but not for many years to come.

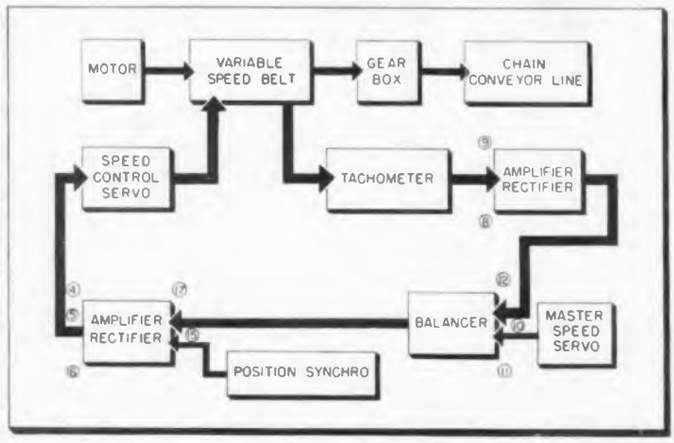
One of the fears that automation has given rise to is that people will be thrown out of work. The notable rise of employment concurrent with increasing automation testifies to the error of this idea. The reason for this seeming paradox is that the growing importance of vehicles in the nation's life has created an increased demand which more than compensates for the labor saving machinery. Also, consumers' demands for greater service from their cars has resulted in more devices being added to the millions of cars produced every year. Automation has caused a redistribution of manpower, rather than its elimination. By doing away with monotonous work in many cases, more skilled workers have been needed. The result has been higher output per man-hour, utilizing more brain power and less muscle power.

How far automation goes in a plant is dependent on engineering-economic factors governing cost and performance. The high cost of retooling and replacing machinery must be

Circuit of GM's Autronic-Eye which automatically switches headlights to lower beam when another automobile approaches. Sensitive phototube controls amplifier which operates switching relay



Photoelectric bulls-eye facilitates headlight adjustment at end of Ford assembly line. Four photocells are located on each arm of lowered barrier. When headlight beam is properly focused, striking all four cells, the letters OK light up and the barrier may be raised to allow the car to pass



De Soto central control board (left) permits operator to keep watchful eye on nine miles of automatic conveyor systems. Headset and mike provide rapid communications with personnel along the line. Automation control (right) at De Soto. Conveyor system employs servo to control line speed. Feedback loop feeds voltage difference between tachometer and master speed servo to servo controlling variable speed belt. Position synchro makes sure line is in proper space relation with other operations. Circled numbers refer to corresponding points on accompanying schematic circuit

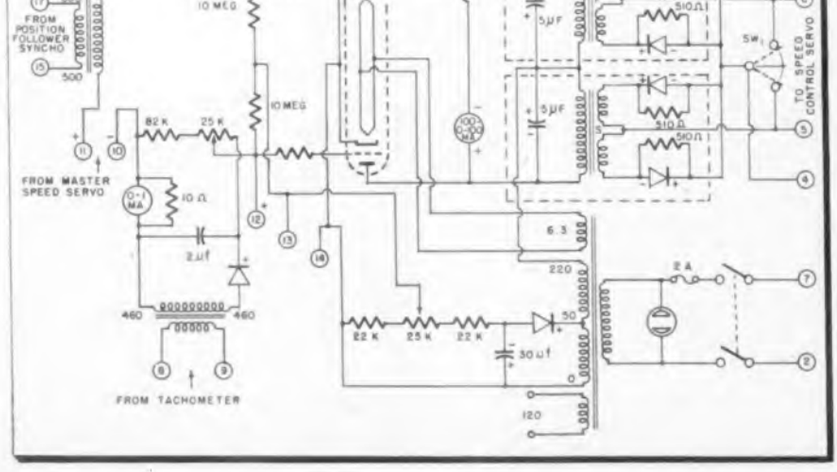
justified by greater savings from higher production rates, operating machines closer to designed capacity, fewer rejects, and reduced safety hazards. On the other hand, higher maintenance costs militate against automation. The breakdown of even the smallest element can shut down the entire line.

A finished piece of automation equipment is made up largely of standard elements such as conveyors and transfer devices controlled by mechanisms arranged to obtain proper movement. Most of the controls are either electrical, hydraulic or pneumatic. In recent years electronic controls have started to make headway, in spite of old-line auto management suspicion and lack of familiarity with the precocious electronic baby. Furthermore, too few qualified electronic personnel are available to maintain the equipment.

An excellent example of electronic and servomechanism control of automatic lines is the nine-mile conveyor line at De Soto. The motor which drives the chain conveyor is coupled to the driving gear box through a variable speed belt arrangement. This automatically adjustable belt is controlled by a servo, which is fed by an amplifier-rectifier circuit. For instance, suppose the line should run at 10 jobs/hr. At this speed, the ac output of a tachometer connected to the variable belt is stepped up and rectified to give 100 v. dc. This voltage is balanced against the voltage from the master speed servo. If the voltages are the same, they cancel out, producing no feedback, and the speed control servo does not change the speed ratio of the adjustable belt. If the voltages are not the same, that is, if the rectified tachometer output of 90 v. shows a reduced conveyor speed of 9 jobs/hr., the 10 v. difference will be amplified and rectified, and fed to the speed control servo to speed up the conveyor. At the same time, the output of a position follower synchro is combined with the speed control voltage difference to make sure that the conveyor position is in proper space relation to other lines.

An automation system called "power and free" is used by Ford to route engines along the conveyor line. Suppose examination of an engine block shows that a particular repair job needs to be done before it can be accepted for a succeeding operation. In order to route this one

Schematic of De Soto's electronic panel for automatically controlling conveyor assembly lines. Speed and position inputs are amplified and rectified, and fed to servo which controls a variable speed belt. Output, calibrated in jobs/hr., is indirectly fed back through tachometer output which is coupled to servo-controlled belt. At point (12) it is balanced against master speed servo (11). Voltage difference represents amount line should be speeded up or slowed



Nerve center of Ford automated lines is relay memory which receives information from electric switches along line. It compiles data and directs power to steel fingers and turntables which move parts between automatic machines

A TELE-TECH INDUSTRY STUDY

21

Road Testing

nit back into the bay or conveyor idetrack where such repair is per-rmed, the examiner sets an ad-stable lever arm on the conveyor unt holding that block. When the rticular block approaches the bays which it is intended, the ad-stable lever arm trips a switch a oment before or after a fixed lever

Electronic rectifier supplies dc to operate magnetic chucks in Nash production machinery. Electron tubes also control speed of motors

arm on the conveyor mount trips a econd switch. The time between tripping the first and second switches is noted by a relay memory circuit, which determines into which bay the engine should be sidetracked. If the bay is already full, it is routed to another. If all bays doing the desired job are temporarily full, the block will keep circling until it comes to an empty one.

Atmospheric pollution is prevented with Westinghouse Precipitron for filtering oil fumes from the air at Nash. Ionizer requires 13 kv

THE proof of the car is in the driving, and the acid test is how it endures the road test. Automobiles are battered and abused over miles of specially designed roads, made of dirt, gravel, mud, and chuckholes. They are driven through a 1000-foot bathtub, have their tires blown out with dynamite caps, and are overturned going up a ramp at 50 mph. This havoc is not wrought with maniacal glee; rather, each step is carefully thought out to analyze every important facet of performance.

To measure car pick-up or acceleration, test engineers use two sensitive instruments: The time-distance oscillograph and the fifth-wheel speedometer. The oscillograph is an electronic recording instrument which prints speed gain as a long sloping line on a paper tape. It shows time in hundredths of a second, and distance in feet. The fifth wheel fastened to the rear of the car looks

Automobile acceleration during GM road test is measured with the assistance of time-distance oscillograph made by Consolidated Engineering

like a bicycle wheel. It generates a voltage proportional to the speed, and sends the voltage to a voltmeter calibrated in mph. The oscillograph and voltmeter beside the driver provide all that is needed for precision measurement of pick-up.

Noise and vibration are ferreted out by magnetic tape recorders, oscilloscopes, microphones and vibration detectors. The noise being recorded may be monitored by ear during the test to provide on-the-spot information, and then be analyzed again in the lab by playing back the tape.

Since autos are also electrical power plants, they are bound to generate pulses which would produce interference to radio and TV if not properly shielded. Using electronic instruments for measuring r-f, ignition emission, antenna radiation and similar potential trouble spots are checked during road tests. •

Radiation from ignition system is checked to see if it will cause radio or TV interference on General Motors Proving Grounds

Magnecord tape recorder stores sounds picked up by microphones strategically located on moving car. Playback in laboratory will permit further analysis

Rear wheels of auto turn drums coupled to dynamometer measuring speed-torque characteristics. Westinghouse electronic controls simulate wind resistance and road grades

Final tests at Ford use dynamometer to check speed at which automatic transmission shifts, and pick-up roller to measure front wheel toe-in angle. Esterline-Angus recorder at right shows angle

1953-1954 Statistics of the

RADIO AND TV SETS IN U. S.; WORLD

	January 1, 1954 Radio	TV
United States homes* with:	48,000,000	26,500,000
Secondary sets in above homes	36,000,000	650,000
Sets in business places, institutions	7,500,000	850,000
Auto sets	29,000,000	——
Total	120,500,000	28,000,000
Total Radio-TV sets in U. S.	148,500,000	
Total radio sets in rest of world: North America, 10,000,000; South America, 10,500,000; Europe, 69,000,000; Asia, 16,000,000; Australia, 5,500,000; Africa, 3,000,000.	114,500,000	
TOTAL sets in world	263,000,000	

ANNUAL BILL OF U. S. FOR RADIO-TV

Sale of Time By Broadcasters	$ 900,000,000
Talent Costs	140,000,000
Electricity, Batteries, etc., to Operate 148,100,000 Radio & TV Receivers	550,000,000
13,400,000 Radio Sets, at Retail Value	536,000,000
7,300,000 Television Sets, at Retail Value	1,675,000,000
Phono Records, 200,000,000 at Retail Value	250,000,000
Radio-TV Servicing and Installation:	
85 Million Replacement Receiving Tubes	250,000,000
2½ Million Replacement TV Picture Tubes	100,000,000
Radio-TV Component Parts, Antennas, Accessories	350,000,000
Labor	600,000,000
TOTAL	$5,351,000,000

◀*Note: Caldwell-Clements' figure on "homes," includes every dwelling unit whether individual or family, and includes permanent residents in hotels, apartment-hotels and apartment houses.

PRODUCTION OF CIVILIAN RADIO SETS — 1922 TO 1953

	Total Civilian Radio Sets Manufactured		Total Receiving Tubes * Manufactured		Automobile Sets Manufactured		Auto Sets In Use	Homes with Radio Sets	Total Radio Sets in Use in U. S.	
	Number	Retail Value	Number	Retail Value	Number	Retail Value	Number	Number	Number	
1922	100,000	$ 5,000,000	1,000,000	$ 6,000,000	.....	.....	.....	260,000	400,000	1922
1923	550,000	30,000,000	4,500,000	12,000,000	.....	.....	.....	1,000,000	1,100,000	1923
1924	1,500,000	100,000,000	12,000,000	36,000,000	.....	.....	.....	2,500,000	3,000,000	1924
1925	2,000,000	165,000,000	20,000,000	48,000,000	.....	.....	.....	3,500,000	4,000,000	1925
1926	1,750,000	200,000,000	30,000,000	58,000,000	.....	.....	.....	5,000,000	5,700,000	1926
1927	1,350,000	168,000,000	41,200,000	67,300,000	.....	.....	.....	6,500,000	7,000,000	1927
1928	3,281,000	400,000,000	50,200,000	110,250,000	.....	.....	.....	7,500,000	8,500,000	1928
1929	4,428,000	600,000,000	69,000,000	172,500,000	.....	.....	.....	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	.....	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	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	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	500,000	20,402,369	22,000,000	1933
1934	4,084,000	214,500,000	58,000,000	36,600,000	780,000	28,000,000	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	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	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	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	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	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	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	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	9,000,000	30,800,000	59,340,000	1942
1943	.....	.....	17,000,000	19,000,000	.....	.....	8,000,000	32,000,000	58,000,000	1943
1944	.....	.....	22,000,000	25,000,000	.....	.....	7,000,000	33,000,000	57,000,000	1944
1945	500,000	20,000,000	30,000,000	35,000,000	.....	.....	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	7,000,000	35,000,000	65,000,000	1946
1947	17,000,000	800,000,000	220,000,000	260,000,000	2,500,000	150,000,000	9,000,000	37,000,000	74,000,000	1947
1948	16,000,000	700,000,000	200,000,000	230,000,000	2,800,000	200,000,000	11,000,000	40,000,000	82,000,000	1948
1949	10,000,000	500,000,000	200,000,000	350,000,000	3,500,000	240,000,000	14,000,000	42,000,000	89,000,000	1949
1950	14,600,000	721,000,000	383,000,000	644,000,000	4,760,000	248,000,000	17,000,000	45,000,000	98,000,000	1950
1951	13,000,000	605,000,000	430,000,000	640,000,000	4,800,000	255,000,000	20,000,000	45,850,000	107,000,000	1951
1952	10,000,000	500,000,000	330,000,000	740,000,000	2,750,000	148,000,000	25,000,000	46,000,000	114,500,000	1952
1953	13,400,000	536,000,000	410,000,000	920,000,000	4,800,000	250,000,000	29,000,000	48,000,000	120,500,000	1953

* Total tubes include those used in TV. Replacements accounted for about 23% in 1952.

WORLD INCOME—POPULATION DISTRIBUTION

Countries on distorted map are plotted on scale of their 1950 population. Density of dots (each represents $5 billion income in 1948) indicates a region's prosperity. U.S. has 40.7% of $548 billion world income. Per-person income is: U.S., $1525; Switzerland, $950; New Zealand, $933; Canada, $895; Australia, $812; Sweden, $805; Denmark, $781; United Kingdom, $777; Norway, $550; France, $418; Germany, $336; Italy, $225; U.S.S.R., $181. From five-year study, World Population and Production, by W. S. and E. S. Woytinsky, recently issued by Twentieth Century Fund

BILLIONS OF DOLLARS

V-Radio-Electronic Industries

VITAL TELEVISION STATISTICS 1946-1953

	Total TV Sets Manufactured		Receiving Tubes Used in New TV Sets and for Replacement		Total TV Picture Tubes Manufactured		Total Receiving Sets Manufactured AM-FM-TV	TV Stations on the Air	Total TV Sets in use in U. S.	At Close of
	Number	Retail Value	Number	Retail Value	Number	Retail Value				
1946	10,000	$ 5,000,000	350,000	$ 588,000	20,000	$ 100,000	14,010,000	5	8,000	1946
1947	250,000	100,000,000	8,500,000	15,000,000	300,000	150,000	17,250,000	20	250,000	1947
1948	1,000,000	350,000,000	32,200,000	53,000,000	1,500,000	75,000,000	17,000,000	44	1,000,000	1948
1949	3,000,000	950,000,000	87,000,000	146,000,000	3,500,000	210,000,000	13,000,000	100	4,000,000	1949
1950	7,500,000	2,700,000,000	225,000,000	378,000,000	8,000,000	400,000,000	22,100,000	107	10,500,000	1950
1951	5,600,000	2,100,000,000	161,000,000	270,000,000	6,000,000	300,000,000	19,100,000	108	15,750,000	1951
1952	6,300,000	2,360,000,000	168,000,000	380,000,000	6,500,000	260,000,000	16,300,000	123	22,000,000	1952
1953	7,300,000	1,675,000,000	210,000,000	400,000,000	9,000,000	36,000,000	20,700,000	350	28,000,000	1953

Electricity Generated in US

Total public supply in thousands of kilowatt-hours

1953	442,000,000
1952	398,924,000
1951	370,234,364
1950	329,141,343

Note: Cost of electric power consumed by home TV receivers in 1953 was $250,000,000.

TV Sets Produced By Tube Sizes 1947-1953

Tube Size	'47-'52	'53
7-8"	275,000	
10"	2,000,000	
12-14"	3,100,000	
15"		1,190
15-16-17"	13,225,000	
16-17-18"		2,000,000
19-20-21"	4,985,000	5,000,000
Over 21"	75,000	
22-25"		225,000
26" & over		44,600
Total	23,660,000	7,226,690

SOUND RECORDING—1953

4 billion feet of magnetic tape
Appr. cost $9 million
Tape markets:
1/3 radio, TV, movies, commercial recording
1/3 home recording
1/6 industrial (computers, instrumentation, etc.)
1/6 educational (schools, institutions)
3 million transcription discs (all types)
Appr. cost $7.5 million

1953 Production of Radio-TV Tubes and Accessories

TV PICTURE TUBES	
Total Units	9,000,000
Retail Value	$360,000,000
RADIO BATTERIES	
Total Units	22,000,000
Retail Value	$65,000,000
PHONOGRAPH RECORDS	
Total Units	200,000,000
Retail Value	$250,000,000
PHONOGRAPHS (Players, combinations)	
Units	3,600,000
Value	$162,000,000
HOME RECORDERS	
Units	300,000
Value	$54,000,000

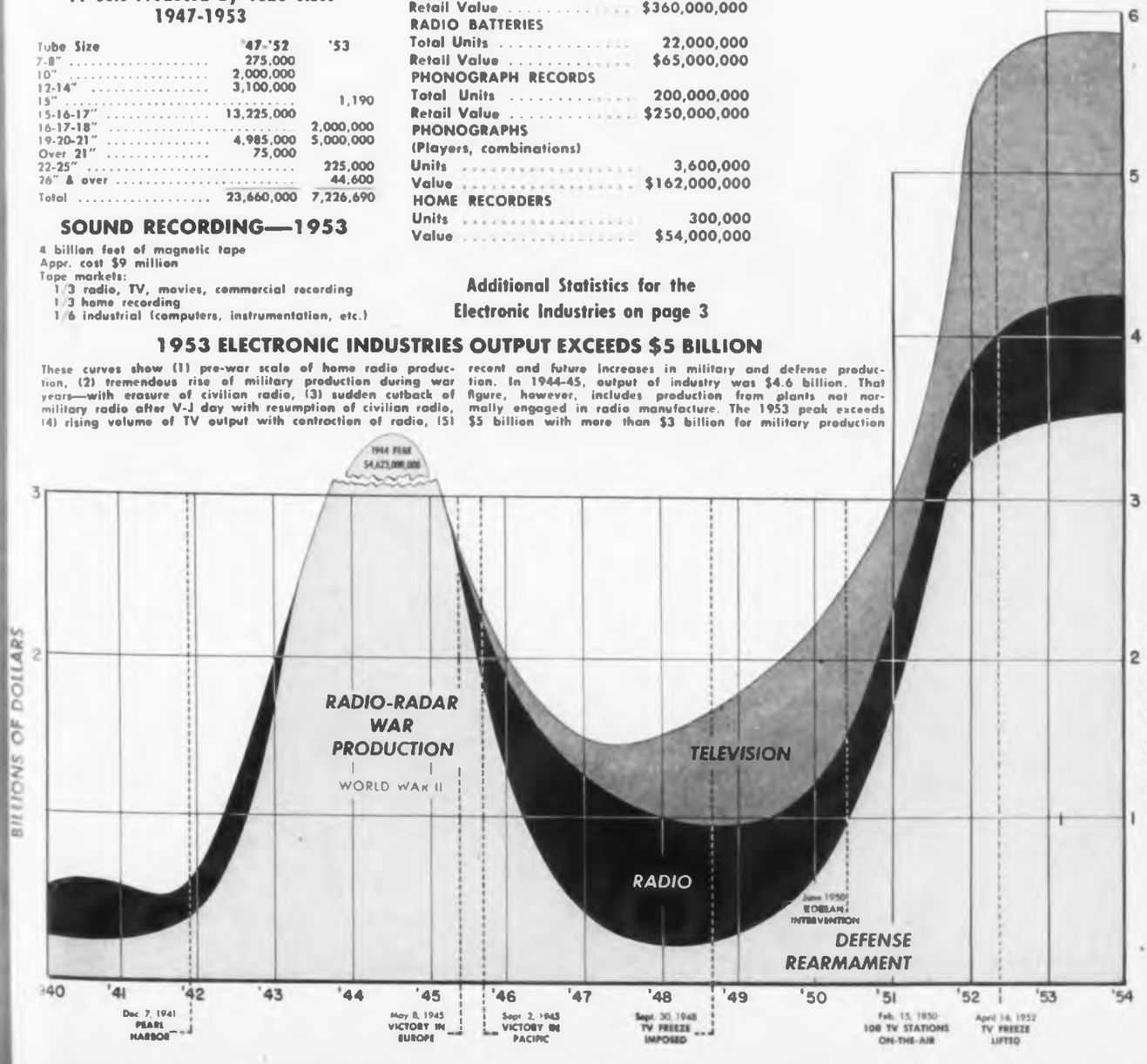
Germanium Diodes Used in 1953

New Equipment	15,720,000
Replacements	490,000
Government	450,000
Other	85,000
Total	16,745,000

Additional Statistics for the Electronic Industries on page 3

1953 ELECTRONIC INDUSTRIES OUTPUT EXCEEDS $5 BILLION

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. That figure, however, includes production from plants not normally engaged in radio manufacture. The 1953 peak exceeds $5 billion with more than $3 billion for military production



PRODUCTION OF PRINCIPAL COMPONENTS USED in RADIO-TV RECEIVERS

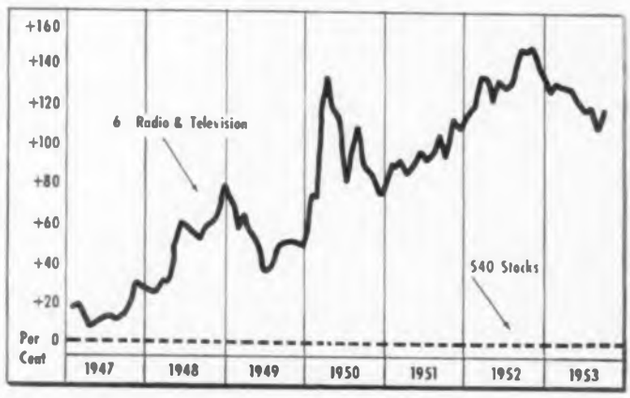
Year	Transformers	Coils	Capacitors, (Electrolytic)	Capacitors, (Mica)	Capacitors, (Ceramic)	Capacitors	Resistors, (Composition)	Resistors, (Wire Wound)	Loudspeakers	Year
1946	49	149	22	69	284	155	477	29	14	1946
1947	70	193	27	84	349	196	608	37	17	1947
1948	46	250	28	86	357	212	654	42	17	1948
1949	39	196	25	74	310	218	670	50	13	1949
1950	65	332	44	106	417	351	1090	70	22	1950
1951	47	288	38	90	394	284	862	59	19	1951
1952	56	305	42	100	433	312	948	67	17	1952
1953	63	323	43	103	455	325	900	69	21	1953

(Figures are in Millions of Units.)

What It Has Cost To Run The FCC—1942 To Date

1953	$6,408,460
1952	6,585,550
1951	6,600,000
1950	6,729,345
1949	6,717,000
1948	6,240,000
1947	6,236,900
1946	5,954,900
1945	6,312,343
1944	7,884,914
1943	7,777,135
1942	5,655,924

Chart shows how prices of six leading radio-TV manufacturing stocks have raced ahead of the general market level since 1947, culminating in a 1952 lead of 140%. The 1953 dip from the 1952 peak represents a 40% change. Compiled by Merrill Lynch, Pierce, Fenner & Beane.



GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies June through October 1953.

(See page 3 for November 1953 Totals)

Accelerometers	$ 993,794	Delay Lines, solid	58,205	Mounts, vibrator	255,081	Signal Tracers	26,524
Actuators	1,934,217	Demagnetizers	8,976	Multimeters	1,466,198	Simulators	1,475,135
Actuators, aircraft	137,833	Dials	48,785	Oscillators	1,127,479	Single Sideband, radio	1,031,350
Adapters	136,261	Diodes	85,000	Oscillographs	548,776	Solder	196,220
Altimeters, pressure	1,051,710	Dummy Loads	37,288	Oscilloscopes	190,640	Solenoids	62,787
Ammeters	29,011	Dynamotors	1,059,141	Panel Assys	80,875	Sonar Sets	148,154
Amplifiers	10,627,588	Electrocardiographs	60,000	Panels, Generator Control	774,597	Spare Parts, meters, crystals	5,339,136
Amplifier Assys, motor	130,454	Facsimile Sets	49,303	Panoramic Adapters	62,199	Spectrophotometers	20,225
Analyzers	780,082	Filters	129,933	Panoramic Indicators	59,633	Standards, frequency	67,461
Analyzers, servo type	138,965	Filter Controls	45,625	Platters, function	29,799	Summation Bridges	177,406
Anodes	228,066	Flight Simulators	1,095,824	Plotting Board, vertical	69,600	Switches	1,464,669
Antennas	1,731,917	Fluxmeters	189,253	Platters, reflection	100,286	Switch Boxes, Relay	62,745
Antenna Feeds	43,572	Generators	20,315,366	Plugs	28,940	Switchgear Assys	157,088
Auto Pilots	7,982,172	Gyros	142,345	Positioning Mechanisms	195,478	Switchboards	39,924
Auto Pilot Components	1,203,548	Gyro Indicators	565,062	Potentiometers	237,523	Switches, Control stick	85,253
Batteries	16,397,767	Gyro Motors	67,211	Power Supplies	670,114	Synchros	946,043
Battery Chargers	441,198	Headsets and Handsets	876,488	Preamplifier Strips	34,972	Synthetic Quartz	146,447
Bridges, impedance	76,133	Homing Groups	30,000	Public Address Sets	30,708	Telegraphs	125,689
Brush Assys	50,668	Indicators	24,940,060	Q Meters	54,543	Telegraph Monitors	118,740
Cabinets, electrical	153,547	Ignition Analyzer Assys	2,316,380	Racks	71,773	Telephone Central Sets	4,846,082
Cable	3,584,967	Inspection Units	82,735	Radar Attachments	632,414	Telemetering Equipment	104,062
Code Practice Equipment	140,320	Instrument Landing Systems	44,684	Radar Components	480,667	Telemetering Systems	64,216
Calibrators	56,709	Insulation Sheet	66,405	Radar, GCA	215,877	Teletypewriters	4,648,315
Capacitors	58,721	Insulation Tape	44,247	Radio Beacons	394,573	Temperature Controls	155,182
Capacitor-Resistors	131,251	Insulators	122,505	Radio Compasses	4,144,149	Tensionmeters	29,083
Cathodes, nickel	26,641	Intercommunication Stations	74,558	Radio Phonographs	26,164	Terminals	549,979
Cavities	171,995	Intervalometers	275,869	Radio Receivers	2,075,363	Testers, high voltage	31,317
Circuit Breakers	881,183	Inverters	3,808,168	Radio Sets	22,756,721	Test Equipment, Instruments	830,200
Circuit Demonstrators	95,031	Jack Box Assys	40,392	Radio Telephones	42,460	Test Sets	3,013,430
Coils	223,318	Jacks, telephone	55,250	Radome	322,706	Test Stands, generator	1,295,698
Coil Assys	46,826	Junction Boxes	62,400	Reactors	39,810	Theater TV	65,174
Coil Assys	279,470	Keyboxes	54,029	Receivers	356,140	Thermocouples	31,252
Communication Vans	1,624,163	Keyers	1,163,539	Receiver-Transmitters	4,995,498	Tower Section Sets	129,253
Computers	542,489	Light Assys	32,638	Receptacles	60,381	Tracking Systems, 3D	101,122
Connectors and Cords	1,847,984	Line Kits, transmission	45,597	Recorder Reproducers	1,115,487	Trainers, ground instruction	3,998,876
Consoles	329,390	Loran	36,000	Recorders, sound	78,000	Trainers, instrument flying	250,757
Contacts, female	37,050	Loudspeakers	75,325	Recording Units	300,967	Trainers, radio	1,927,079
Control Equipment	1,504,011	Magnetic Sound Recorders	32,324	Regulators	1,725,963	Transformers	2,928,598
Control Panels	951,166	Measuring Sets	37,193	Regulator Assys	28,242	Transmitters	7,603,272
Controls, radio set	1,244,466	Meters	3,058,142	RF Assys	2,535,396	Transmitter Elements	73,572
Converters	330,381	Microphones	97,247	Reflectors, radar	39,158	Transmitter Kits	40,828
Cores	37,170	Microlinks	17,900	Rheostats	135,023	Transmitter- Receivers	287,650
Core Mounts	35,264	Microphone Simulators Sets	75,178	Relays	952,348	Transistors	748,177
Countermeasures Receivers	98,640	Mixing Equipment	7,701	Relay Equipment	256,364	Tubes, electron	26,857,853
Countermeasures Transmitters	218,715	Modulators, video	363,460	Repeaters	380,709	Tuning Units	753,477
Couplers, transmission line	109,411	Motors	991,786	Reproducers, sound	121,121	Vibrators, power supply	151,328
Crystals	1,575,624	Motor Assys	47,543	Resistance Bridges	70,372	Wattmeters	65,051
Crystal Holders	112,395	Motor Generators	3,343,052	Room Screens	132,900	Waveguides	52,164
Crystal Kits	44,388	Mountings, circuit	79,432	Rotors, motor generator	37,008	Welders, electric	98,767
Cutting Equipment, ultrasonic	100,000			Rotary Assys	53,360	Wire	22,576
				Rotary Couplers	46,414		

Recording TV on Magnetic Tape

Demonstrations at RCA Princeton Labs. prove practicability of recording video in both black-and-white as well as in color on magnetic tape

By ***BERNARD F. OSBAHR***
Executive Editor

LAST month the Radio Corporation of America officially demonstrated its video magnetic-tape recording equipment for the first time. The highly successful tests, conducted at the David Sarnoff Research Center in Princeton, N. J., on Dec. 1, involved both black-and-white and color-TV signals. Brig. Gen. David Sarnoff, Chairman of the Board, heralded the achievement as the first major step into an era of electronic photography, where neither photographic development or processing techniques are necessary. The commercial cousins to this research prototype equipment are not expected to be available for about another two years, and then only for broadcast and for commercial re-

(*Continued on page* 124)

Laboratory equipment used for first video recording demonstration. Dr. Harry F. Olson, who headed 7-man research team (right), and W. D. Houghton are shown. In commercial installations only first three equipment racks would be required.

Heart of the new development lies in the design of the recording heads, as shown by J. Zenel. Present equipment permits recording 3 MC bands in two channels for b-w, five for color-TV.

Diagram contrasts video recording steps on magnetic tape against film. Video magnetic tape recording is expected to have wide application in motion picture, military, industry, education, and ultimately in home-movie fields.

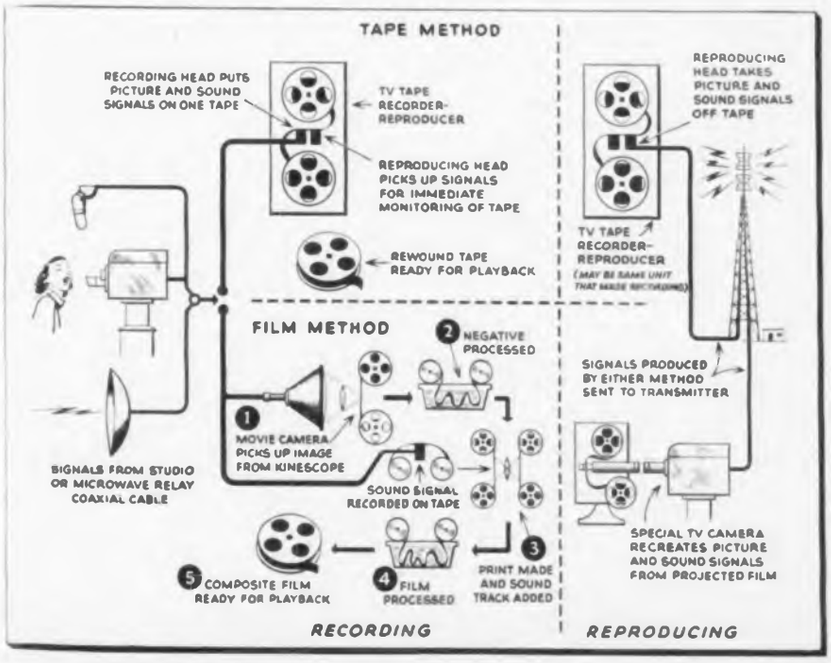


Fig. 2: High temperature delay line and pulse transformer are silicone resin impregnated

Computer Circuits for

Carefully selected components provide reliable Design and performance of circuits from simple

J. F. Koch G. C. Hand

By JOHN F. KOCH, JR. and GEORGE C. HAND, JR.
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SINCE the need was first determined, there have been two general approaches to high ambient temperature electronics. One is to provide external cooling means; in the case of very high ambient temperatures this usually involves bulky and expensive equipment. The other is to find components, circuits, and systems capable of operating in the desired temperature range. For our application small volume was desirable so that the latter course was taken.

These are the general specifications set up for the equipment:

Maximum operating temperature: 200°C.
Size: Minimum
Functions: Standard computer operations, subtraction, multiplication, and division
Input: Analog in nature
Speed: Medium

When considering what form the machine should take, a most inviting possibility, noting the analog input, is the analog computer. However, when one realizes that an analog machine carries its data as a signal amplitude and that this signal must be developed across components of many and varying temperature coefficients, our choice of a digital approach is made clear.

The speed requirements, being rather mild for a digital computer, allowed us to use a serial data transmission system, thus realizing the economy of vacuum tubes and components inherent in this system over the corresponding parallel type.

Once the primary decisions had been made, the proposed design crystallized as follows:

The machine was to be of the serial type, using binary notation. For the long time delay required in a serial register, we would use a solid acoustic delay line of fused quartz. The electronic circuitry, normally using vast numbers of crystal diodes, was modified to a combination of vacuum tube logical elements similar to those developed for EDVAC, and vacuum diode elements in the SEAC tradition, since no crystal diodes were, or are, available for operation at 200° C. We even went back to the granddaddy of them all, ENIAC, for some ideas. This was in June of 1951.

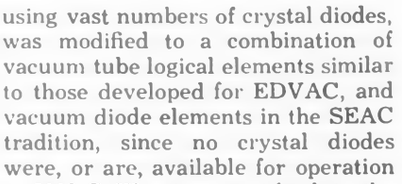


Fig. 1: Typical temperature characteristics for both resistor and capacitor components

Some comment must be made on the state of the art at that time. The magic number 200° C. was being whispered about in hushed rumors. Component manufacturers, having been hurt in the past by over-optimism, were holding fast to their conservative ratings. Some laboratories had made high temperature studies of materials and components with encouraging results. One Government laboratory told us, in no uncertain terms, that no capacitor, then manufactured or under development, would operate at 200° C. The situation, to put it mildly, was confused. Faced with a great lack of data, we began a program of testing the most promising commercial components. The object was to buy what we could and to develop what was not available.

Components

Components have been in a rapid state of development for the past decade. Initiated by the military, aided by the growth of TV, and stimulated by the computer industry, this development toward more reliable components at a reasonable cost has done much for the development engineer. Even as we worked on the computer, new components were continually appearing, some of which have made our job considerably easier.

Let us consider specifically the case of the resistor. In the beginning there was one manufacturer, Welwyn Electronic Components, Ltd., who was making a resistor rated for

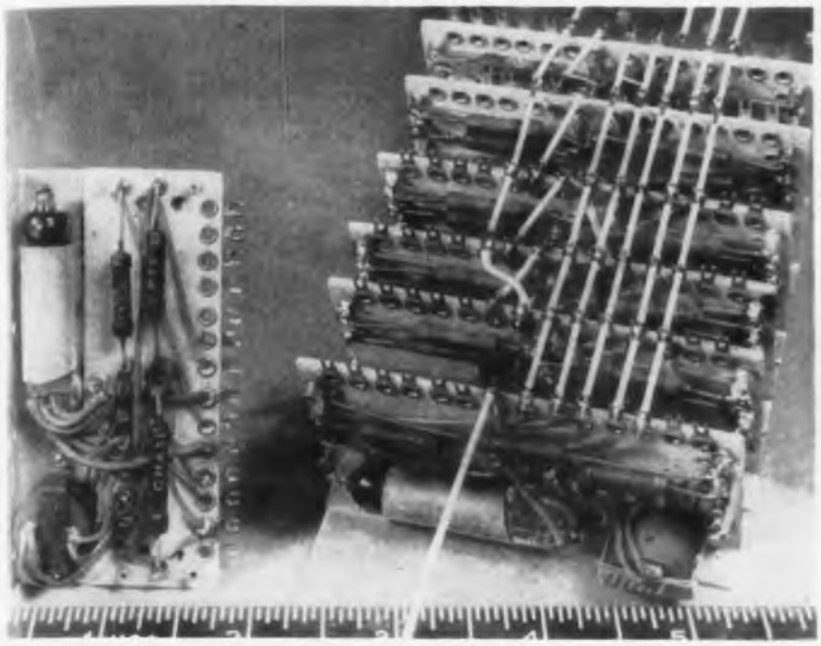


Fig. 3: Component mounting boards are riveted to "L" bracket to form sub-chassis. Note interwiring

High Temperatures

operation of serial digital computer at 200°C ambient. coincidence gates to complex acoustic delays discussed

operation at and above 200° C. This unit is a miniature wirewound resistor with a vitreous enamel insulation and is available in three-, six- and ten-watt sizes. The three-watt resistor has resistance values up to 2,000 ohms, and is about the size of a standard half-watt resistor. We have used the Welwyn resistors with excellent results wherever low resistance and/or higher power dissipation were required.

The Welwyn Co. was located in England and it was felt that a domestic source of components was necessary. Also, we require considerably higher values of resistance than were available in miniature wirewound types.

It was known that deposited carbon resistors had been run at extreme temperatures in a vacuum. We reasoned that an adequate impregnating varnish would enable this type to perform at 200° C. Samples of several different deposited carbon and deposited metal resistors were obtained and testing was begun. Samples of high temperature varnishes and a silicone resin were also procured with the thought of modifying the original components.

The early stages of the testing program met with limited success. One deposited carbon resistor operated with reasonable reliability at high temperatures, but failed at our low temperature limit due to cracking and peeling of the insulation. A hermetically sealed type did well until the solder seals softened near

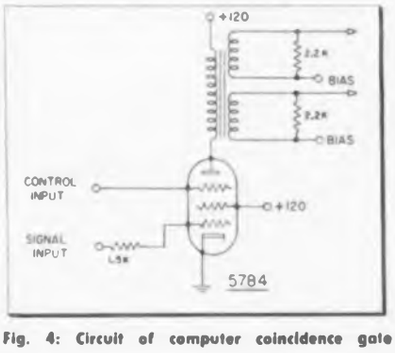


Fig. 4: Circuit of computer coincidence gate

200° C. A deposited metal resistor would perform reasonably over the temperature range, but exhibited a slight permanent change after each temperature cycle. This, the manufacturer claims, is due to the metal diffusing into the ceramic core at extreme temperatures.

We had gone so far as to obtain deposited carbon resistors without any insulation and to treat them with silicone resin, a combination which was satisfactory. About this time the International Resistance Co. introduced their type DCC half-watt deposited carbon resistor, soon followed by the BOC Borocarbon type. Both of these resistors passed our acceptance tests and have been used throughout the machine.

Test Conditions

In deference to the manufacturers' conservative specifications, it would be wise to state our test conditions and the general use to which resistors were put in the computer. In a typical test, four resistance values were tested to give coverage of the range of resistors used. Four resistors of each value were tested. The test consisted of five temperature cycles with data taken by a precision bridge at selected points in each cycle. During the tests, the resistors were under no load. In service in the machine, the resistors were well derated and the majority were used under pulse loading, thereby receiv-

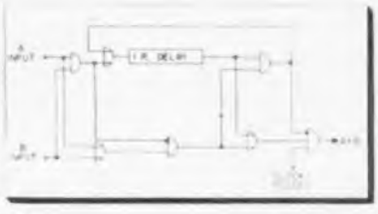


Fig. 5: Logical diagram of two-input adder

ing additional derating by the duty cycle factor. An average loading of ⅛ watt is fairly common.

Recently, several manufacturers have placed on the market resistors capable of operating to our specification. "Stablohms," produced by Chase Resistor Co. of Moorestown, N.J., and "Carbon Coat" resistors made by the Electra Manufacturing Co. of Kansas City, Mo., have been used to some extent in the machine.

Finding a high temperature capacitor was considerably easier. Two manufacturers, Corning Glass Works and Vitramon, Inc., advertised small fixed capacitors rated for 200° C. Both types have been used successfully, although we have found it advisable to use a voltage derating factor of four. Shorting at 200° C. is then practically non-existent. Larger capacitors, for general purpose bypassing, have been made by using teflon as a dielectric in a standard tubular type capacitor. These units were developed for a Government

agency and, subsequently, supplied to us.

While speaking of resistors and capacitors, it is well to examine their temperature coefficients. Fig. 1 shows a group of typical temperature coefficients of the components we used. Note that for normal pulse type computer circuits, variations such as are shown here are negligible, but in some special circuits, resistance-capacitance time constants are important. The curves indicate that there is a choice of temperature coefficients which enabled us to compensate, within a narrow range, our temperature sensitive circuits.

Fortunately, suitable vacuum tubes were available at the conception of the program. The special "reliable"

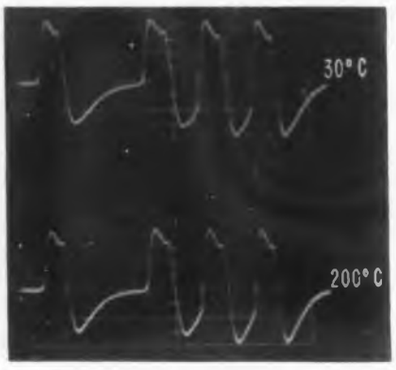


Fig. 6: Temperature effect on gate circuit output is practically same at 30° and 200° C

lines of subminiature vacuum tubes, made by both Raytheon and Sylvania, when used with good thermal conducting mounts, have proven very satisfactory. Both showed negligible operational failures throughout our work. New tube types recently introduced have made our job easier. We have the highest regard for these tube types. Out of approximately 400 tubes used, we have had about 5% failures, even after many hours of 200° C. operation. The bulk of these failures was mechanical breakage of the leads during assembly.

The search for high temperature electronic components must extend to the smallest details of wire, solder, and insulating materials. These elements again show the continuous improvement that the industry is making in new materials. For example, take the problem of hookup wire. In the beginning, we had some expensive teflon covered wire and some fiberglass sleeving loosely bound with silicone. Midway in the development, a silicone rubber impregnated fiberglass sleeving became available and has proven reliable and much easier to handle. Teflon covered wire in colors which will stand 200° C. is now available. If we had had this in time, the units could have been made more attractive and easier to service.

High Temperature Solder

A circuit is no more reliable than its connections, and a good high temperature solder was one of our most annoying problems. Time after time our tests were interrupted when, at a local hot spot, a soldered joint would fail. We were desperately considering welded wiring when Division Lead Co. made available their 285 flux-cored high-temperature solder. We have used 285 ever since, with no serious trouble. With repeated soldering, a joint does have a tendency to become crystallized, at which point it must be cleaned and new solder used.

For component mounting boards, we were fortunate to find a silicone fiberglass laminate which has proven satisfactory from the beginning.

We have had the good fortune to be able to use a large number of commercial components in this machine. There have been, however, a few items which had to be developed in our laboratory. One of these was the pulse transformer. It is relatively easy to specify the primary inductance and turns ratio for a

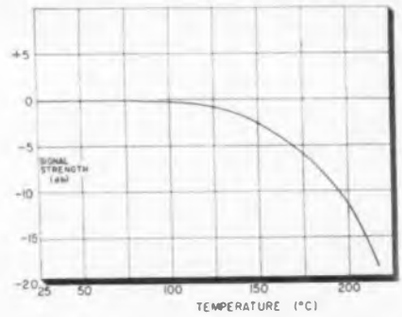


Fig. 7: Output characteristic of quartz delay line. High temperature softens bonding agent

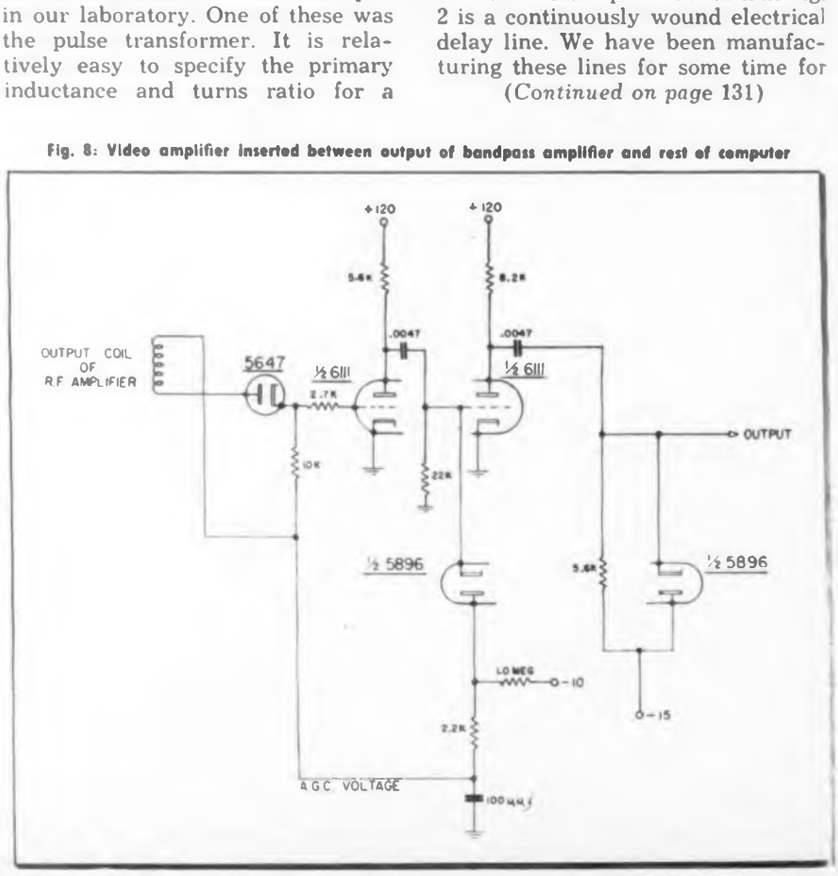
given transformer application. The job here was to construct the transformer of high-temperature materials.

A ferrite cup core was supplied to us by General Ceramics and Steatite Co., Keasby, N. J. The material, "Ferramic B," has a curie point high enough to assure no loss of magnetic properties at 200° C. We designed a three-slotted bobbin of teflon and wound the transformer with Ceroc "T," ceramic, and teflon-coated magnet wire made by Sprague Electric Co. The wound bobbins were impregnated with silicone resin and the transformer assembled as shown in Fig. 2. You will notice that the leads are protected by fiberglass sleeving, since this is the most fragile point of the completed assembly.

The other component shown in Fig. 2 is a continuously wound electrical delay line. We have been manufacturing these lines for some time for

(*Continued on page* 131)

Fig. 8: Video amplifier inserted between output of bandpass amplifier and rest of computer



FM/FM TELEMETERING

Building block" arrangement of standard subassemblies allows versatile use in different installations. High reliability built into measurement systems for rockets

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PART TWO OF TWO PARTS

PART One of this article, published in the December 1953 issue of TELE-TECH & ELECTRONIC INDUSTRIES, described the basic elements used in FM/FM telemetering. In this final part, equipment circuitry and system operation are analyzed.

Measurement of Temperature: Pickups to measure temperatures of surfaces, liquids, and compartments are viewed at positions (E), (D), and (C) on Fig. 3. All these have a maximum range of 500°-800° F. For higher temperatures, up to 2000° F, thermocouples, an example of which is shown at (L) on Fig. 4, are employed.

The former type of pickups are resistance thermometers whose resistance changes with temperature. These pickups are connected to very stable fixed resistors to form a four arm bridge, with one arm consisting of a series element of a pickup and a fixed resistor. The pickup may also be shunted by another resistor to adjust the sensitivity.

These bridges may be used in two distinct applications. In one the bridge output and the input is connected directly to a bridge-controlled oscillator as shown in two views at (L) on Fig. 1, and with the circuit on Fig. 12. This oscillator is a phase shift type with the bridge forming a part of the phase shifting network. The sensitivity is such that a change of ±0.5% in a bridge leg effective resistance produces a 7% shift in the oscillation frequency. The bridge is coupled to the oscillator by two sub-ouncer transformers seen on the right hand view.

The second method is useful when a number of bridges may be sampled in turn. The bridges are now excited with dc and their outputs sampled by a commutator-switch twice in succession before passing to the next bridge. The second time the bridge output is sampled with a reverse connection so that the resultant signal of the commutator is a series of square waves. These may be amplified in a special a.c. square wave amplifier, the circuit of which is shown in Fig. 13, and the unit at (F) on Fig. 1. This amplifier has a maximum gain of 100. It is always used with a special input transformer packaged as a separate unit and viewed at (1) in Fig. 2. The output of the amplifier may be used to modulate either type of voltage controlled subcarrier oscillator. This second method may be varied by exciting the bridges with a sinusoidal ac signal and eliminating the need for a reversing action in the switch.

Calibration of the channel is accomplished by inserting a standard series of bridges in place of the temperature bridge.

Thermocouple outputs may be telemetered by the bidirectional commutation system, with no excitation required, and the thermocouple output sampled in two directions. A more usual method, however, is to use a saturable reactor shown at (K) on Fig. 4, and its accompanying oscillator shown at (E). The saturable reactor is shown diagrammatically in Fig. 14. The two outer coils form the inductance of the plate and grid circuits of the oscillator. The middle leg carries the current coil from the thermocouple and a biasing coil. These two coils are wound on a brass sleeve

Fig. 12: Phase shift oscillator with bridge forming a part of the phase shifting network

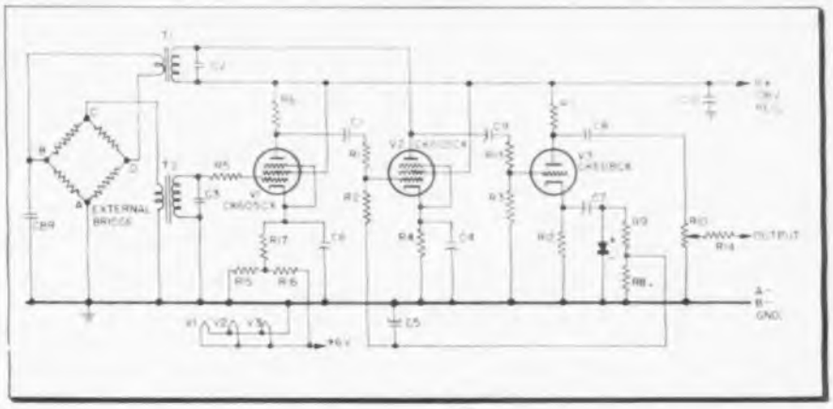
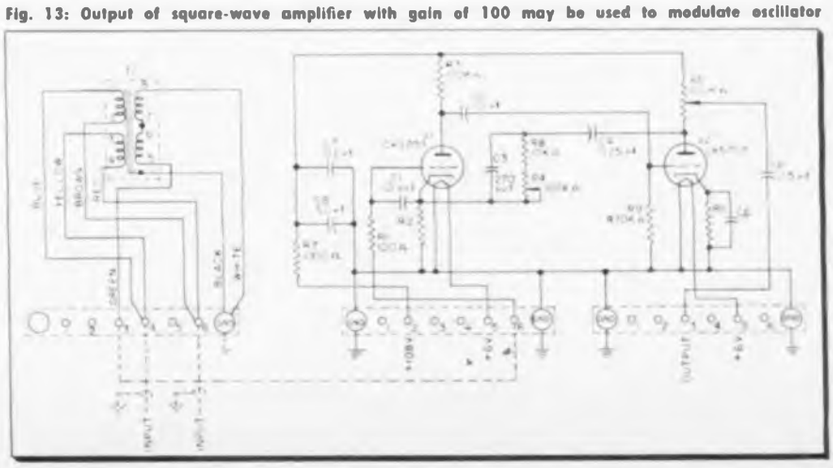


Fig. 13: Output of square-wave amplifier with gain of 100 may be used to modulate oscillator



FM/FM TELEMETERING (Continued)

which acts as a short-circuited turn and serves to alternate the flux from the plate and grid coils out of this leg. The subcarrier oscillator is of the Hartley type and its circuit is shown on Fig. 15.

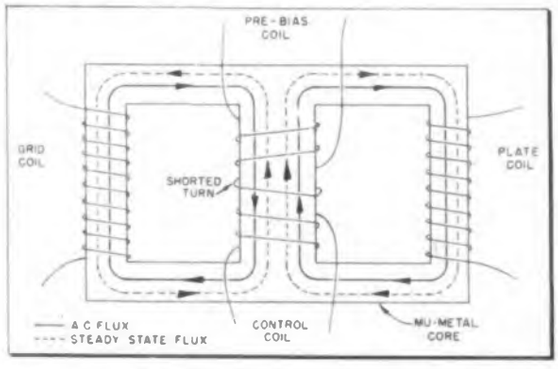
Measurement of Strain: Stresses and strains are measured by two methods. One involves the use of the bonded strain gage with a nominal resistance under no strain of 120 ohms. These gauges are built up into bridges in a similar technique to that used in applying the resistance thermometers. Both the bridge controlled oscillator and the bidirectional commutation with dc excitation and voltage oscillator are employed. The normal sensitivity for a single active arm bridge is $\triangle R/R = \pm 0.005$ and for four active arms $\triangle R/R = \pm 0.00125$ when used with the phase shift oscillator to obtain full bandwidth. As mentioned earlier, the bridge controlled oscillator is necessarily more complex than the inductance or voltage modulated types and occupies an extra section of the standard plug-in or jack strip.

The second method employed where a telemetering dynamometer may be built into a mechanical force system uses a pickup, two examples of which are shown at (O) and (P) on Fig. 3. These pickups, and other models designed for specific applications are of the variable inductance type and operate in conjunction with the Hartley inductance-modulated oscillator described under Pressure Measurement. In the dynamometers pictured, force is applied to the ring which is distorted. This distortion varies the air gap between the E coil and mu-metal pad mounted in opposition at two points 180° apart around the ring circumference.

Other Measurements: Many other types of measurand have been telemetered including: (a) By inductance pickups: angular acceleration, gyro position autosyn position and valve movements. (b) By voltage oscillators: cosmic ray pulses and magnetic data converted into dc signals. (c) By the optical-electronic pickup shown at (J) on Fig. 2: liquid flow. In this last measurement a light beam is interrupted by a small light-weight propellor turned by the liquid flow, and the energy experienced by an appropriately placed photo-cell converted into an ac signal which is in turn amplified ac signal which is amplified and used to modulate a multivibrator.

Commutator-Switches: Examples of the commutators are shown at (M) on Fig. 4 and at (F) and (G) on Fig. 2. Some commutators are manufactured with the number of pins double the number of contacts required for switching. Thus a dead pin or in some cases a grounded pin is interposed between each pair of live contacts. This aids in the problems of isolation although all switching is done at low impedance whenever possible. More usually a "make-before-break" operation of the revolving switch contact is preferred. The unit shown at (M) has two decks with 30 active contacts and 4 poles per deck. It is driven by a 27-volt motion for 5 rps operation, and this may be reduced to 21, 17, and 12 volts for 4, 3, and 2 rps respectively. Commutators besides switching channels are useful to provide "in-flight calibration" of voltage modulated oscillators.

Fig. 14: (l) Two outer coils of saturable reactor form plate and grid inductance of oscillator. Fig. 15: (r) Subcarrier Hartley-type oscillator



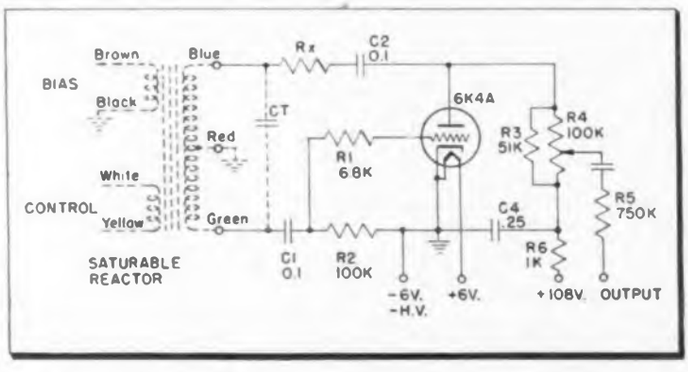
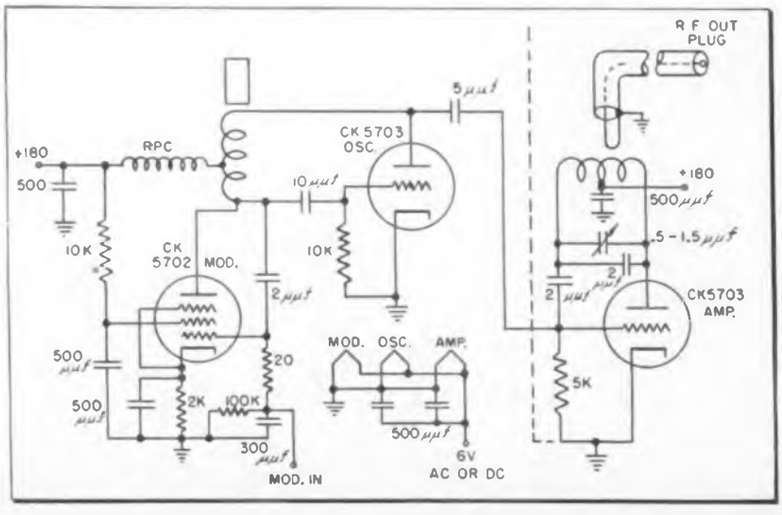
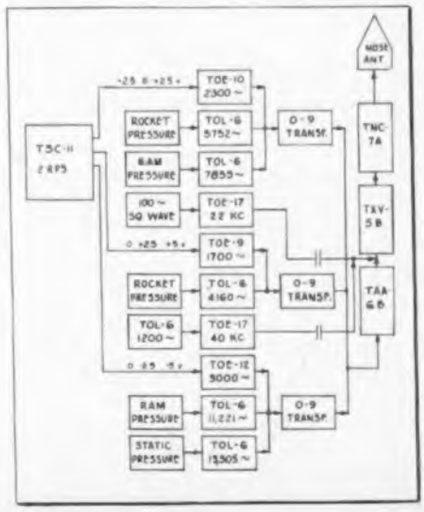


Fig. 16: (l) R-F transmitter contains pentode modulator, triode oscillator, and triode amplifier. Fig. 17: (r) Block diagram of test rocket





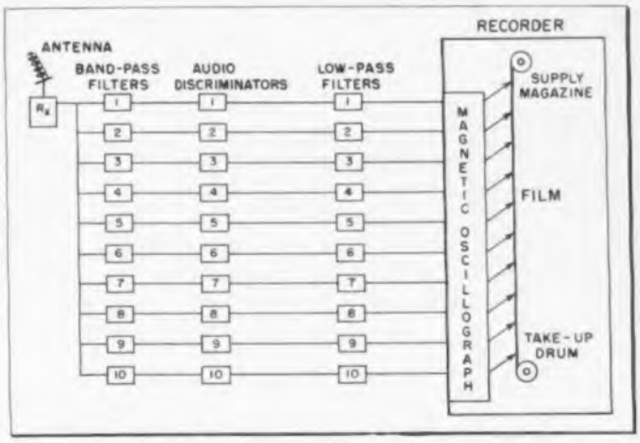


Fig. 18: (l) Block diagram of 10-band ground station telemetering equipment. Fig. 19: (r) Eight-turn helical antenna has 8 to 12 db gain

R-F Transmitters: The combined outputs of a group of subcarrier oscillators are used to modulate an r-f transmitter. An older model using miniature tubes is shown at (B) on Fig. 2, and a second type at (B) and (D) on Fig. 4. All these models have much the same characteristics except for size and shape as the one to be described shown at (A) on Fig. 2. This transmitter operates in the 200 MC band, and is tuneable over some 10 MC. It delivers 2 watts to the antenna system, and is deviated ±50 KC for each volt r.m.s. of modulation within the band 300 CPS to 100 KC. The maximum total distortion allowable under the specification is 2% for 2 volt input of 3 KC and at minimum power rating. General operating conditions are well below this figure. The unit operates

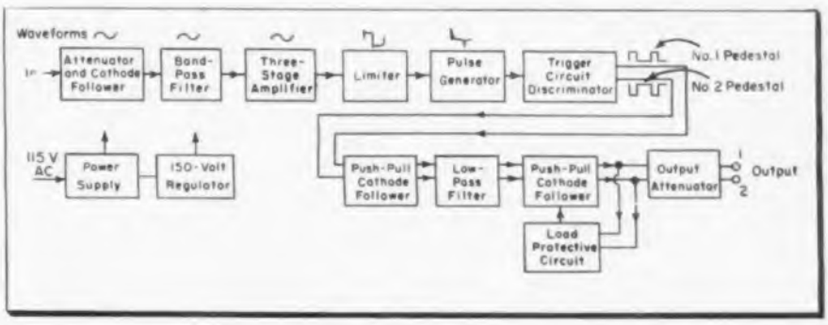


Fig. 20: Pulse-averaging discriminator are linear to 0.1% over the subcarrier bands

on 180 vdc at 55 MA and 6.0 v. at 600 MA. A diagram of the circuit is given in Fig. 16. The stages are a pentode reactance modulator, a triode oscillator, and a triode amplifier, and all employ commercially available subminiature tubes.

A version of this transmitter delivering 0.5 watt has been constructed to operate with 1½ filament volt hearing aid tubes.

Antenna System: Shown at (C) on Fig. 4 is a coupling device for

(*Continued on page* 138)

Philco Develops "Surface-Barrier" Transistor

BEFORE a joint meeting of the Franklin Institute and the Philadelphia section of the IRE, three Philco research engineers presented papers on what Philco called the "surface-barrier" transistor. The speakers were: W. E. Bradley, technical director of Research; W. H. Forster, research coordinator and J. B. Angell.

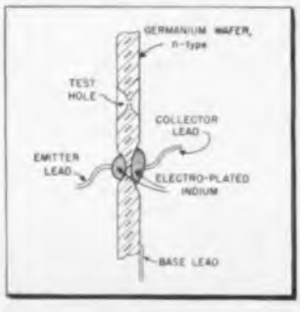
This was the first of what is hoped will be a series of releases on the progress in the Philco laboratories on transistors. The research in this new and important field which was initiated more than two years ago, was partially sponsored by the Bureau of Ships, Dept. of Navy.

At a press preview Leslie J. Woods, vice president-director of Research and Engineering addressed the group as did David B. Smith, vice president-Research, on the technical advance in the transistor art made possible by the new developments at Philco.

What is the "Surface-Barrier" Transistor? The word "transistor" first used by the Bell Labs., where the device was invented, means an electrical semiconductor which, in many electronic applications, is capable of performing the duties of the well known vacuum tube. Engineers are familiar with the point-contact type, the junction and the alloy type of transistor. The "surface-barrier" type, shown in Fig. 1, is said to enjoy the good points of the other types and be free from some of their disadvantages.

(*Continued on page* 112)

Fig. 1: (l) Cross-section of etched and plated wafer. Fig. 2: (r) Transistor with and without case



CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Hour Set System for Studio Clocks

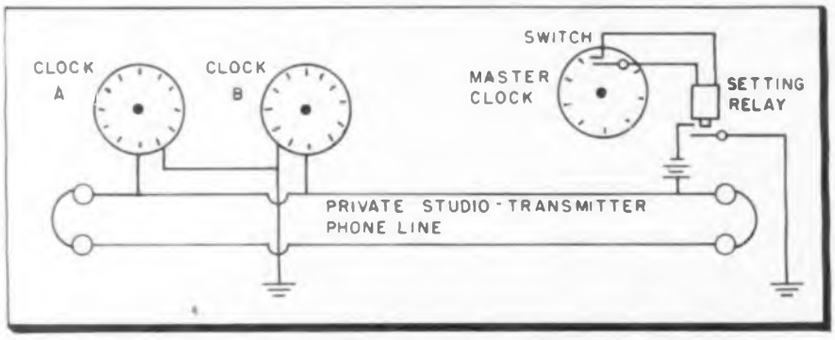
LARRY CRISSMAN, Western Electric Co., Winston-Salem, N.C.

A means is often desired whereby several studio clocks can be set hourly from a master clock at the transmitter. This system* utilizes the minute and second hands to close a switch which in turn operates a relay.

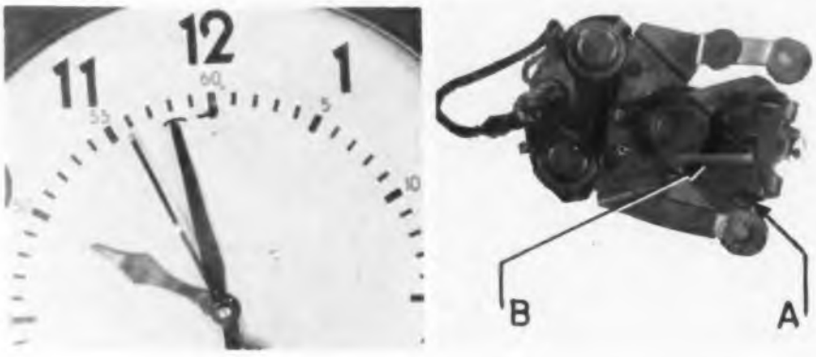
Just below the 12 mark on the clock face is a small switch lever. The tip of the second hand is bent back forming a flat "lifter." Normally the hand and "lifter" pass in front of, and over, the switch lever. On the hour the switch lever is lifted by the cam on the hour hand to a point where the second hand lifter will pass under the switch lever. The lever is lifted slightly as the second hand "lifter" passes under. This momentarily closes the contact points of the switch.

A discarded automotive type fuel gauge dash unit was modified to serve as a switch. When lever B is lifted sufficiently, contacts A close. Power to operate the setting relay is obtained from the master clock winding batteries. This type of clock is provided with a setting mechanism which is replaced by the relay contacts to be operated by pushbutton.

*Developed at KSAC, Manhattan, Kans.



Slave and master clock connections made using one side of private phone line



Close up of clock face showing switch lever and lifter. Right setting relays switch

Simplex Telephone Signaling System

ROBERT FLORY, Chief Engineer, WVBR, Ithaca, N.Y.

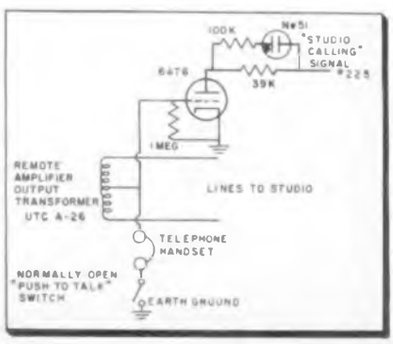
THE student radio station at Cornell University, WVBR, uses many remote lines for sporting events and other special broadcasts. Because of this, simplex telephone operation is frequently used. To make the use of simplex telephone more convenient, a signalling system has been devised which does not require the large ac currents necessary to operate a telephone bell. The diagrams show how the equipment for simplex operation is installed in a remote amplifier and studio console.

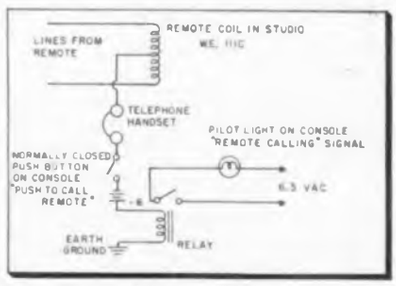
The telephone battery is normally connected to the line. The battery cuts off the 6AT6 except when the studio engineer pushes the "call remote" button. When this switch is pushed, the battery is no longer connected to the telephone circuit and the 6AT6 conducts. When the 6AT6 conducts, the voltage drop across the 39K plate resistor is sufficient to strike the neon lamp mounted on the remote amplifier panel. Thus the remote engineer is notified that the studio engineer wishes to speak to him on the simplex telephone.

If the remote engineer wants to call the studio engineer, he pushes the "push-to-talk" button on the simplex handset, completing the telephone circuit. The current flowing in the telephone circuit causes the normally open relay to close, lighting the "remote calling" light on the studio console. The relay must have an impedance which is low compared to the telephone handsets and must close on the telephone circuit "talking" current.

This system has operated successfully on telephone lines as long as five miles for more than a year.

Remote amplifier equipment for simplex





Simplex studio console equipment circuit

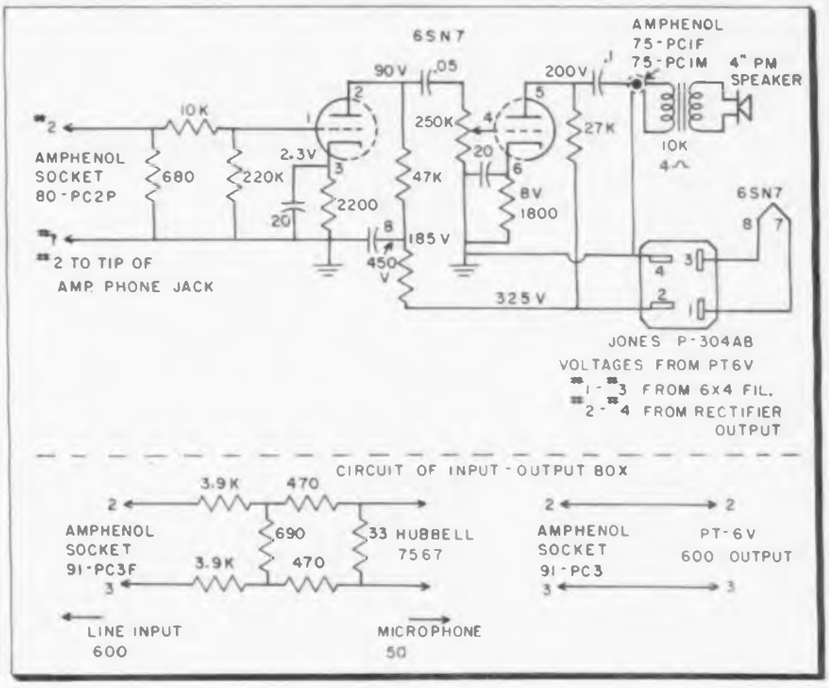
The only power consumed continuously is by the heater of the 6AT6. The plate current flows only when the remote engineer is being signalled. To conserve heater power, a junction transistor can be used to operate a plate relay.

Cue Circuits

J. N. LaFRENIERE, Technical Director, WPEP, Taunton, Mass.

A Gates SA-40 console with cue output from the three turntable channels provided by Daven ladder attenuators with "Q" control is used at WPEP. Since we operate only two turntables, our tape equipment has been connected to the third turntable input through a 20 db pad and an isolation transformer. This arrangement provides a handy means for cueing tapes before air-time.

Because the input impedance of our cue amplifier is high and impedance matching is unimportant in such a circuit, several other circuits may be connected to the cue system. The order phone outputs for the remote and network lines were tied to the cue amplifier input, providing an override type cue signal from any line whose key is in the "monitor-phone" position and obviating the switch of the regular monitor amplifier input for this purpose. Talkback to the remotes is accomplished in the usual manner by using the "audition" position of the control room mike key, and feeding the monitor amplifier output to the line.



Adding different input and output sockets and monitor speaker to Magnecord PT6-VA

Adding Monitor to Tape Recorder

EVERETT A. THOMPKINS, Chief Engineer, KTSW, Emporia, Kan.

AFTER some use of a Magnacorder PT6-VA, "Voyager," desired to add a speaker for monitoring purposes. There is very little room left in the case after the amplifier and mechanism are mounted, this caused us to spend some time measuring and planning the location of the amplifier and speaker. Also desirable was a different arrangement for input and output sockets, because much of our recording is done from lines.

First, we removed the 600 ohm output socket. In an aluminum box, 4x1½x1½, were mounted two Amphenol 91-PC3F sockets for output and input connections to the unit. In this box is mounted a bridging "o" pad with it's input connected to a Hubbell 7567 cable plug. This plug in turn connects to an adapter made of a Hubbell female cable type 7555, mounted as close to a XL-3-12 Cannon plug as possible. This adapter is used for the line pad input, or any of our microphones direct, as we use Hubbell plugs on all of our microphones.

The amplifier is mounted in a 4½x3½x1½ chassis directly above the recorder and microphone receptacles. All connections to this box plug in for future servicing of the units. We used an Amphenol Socket 80-PC2 for input, a Jones P-304AB for voltage supply from the Magnacorder, and an Amphenol 75-PC1M for output to the speaker transformer. The speaker was a 4" PM.

The three receptacles and volume control were mounted on the 1½" side of the chassis; with the volume control on the top for easy accessibility. The input and supply are on the opposite side, so the Recorder, Microphone and Bridge-In, can still be used. These have to be mounted as far apart, as possible. The output is on the inside, near the top corner, so the line output and input plugs can be removed.

The speaker and transformer were placed in a box 5x5x2½ and mounted to the side of the recorder case next to the motor. With care in measurements and constructional mounting, the newly constructed units can be mounted within the "Voyager" case and it can still be closed for moving to remote recording locations.

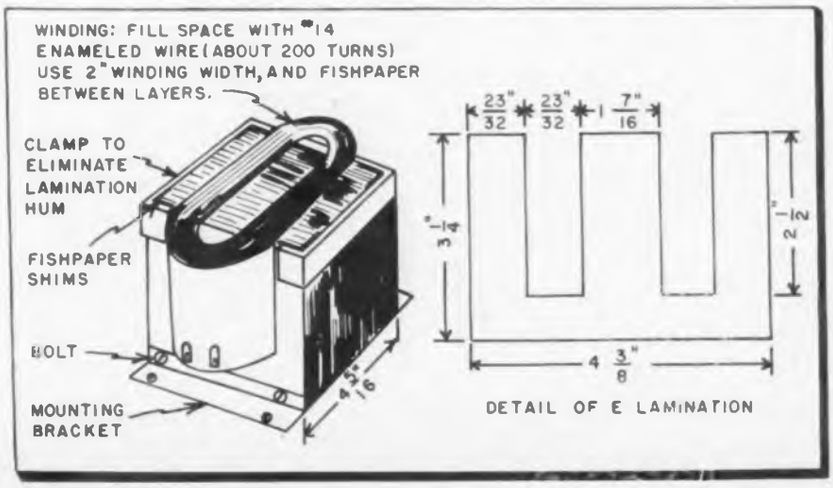
Bulk Eraser

B. J. HARRIS, Chief Engineer, KPFA, Berkeley, Calif.

WE built the illustrated bulk eraser to insure recording on clean tapes. The flux generator was

(*Continued on page 110*)

Transformer laminations suitably mounted and wound make highly efficient eraser

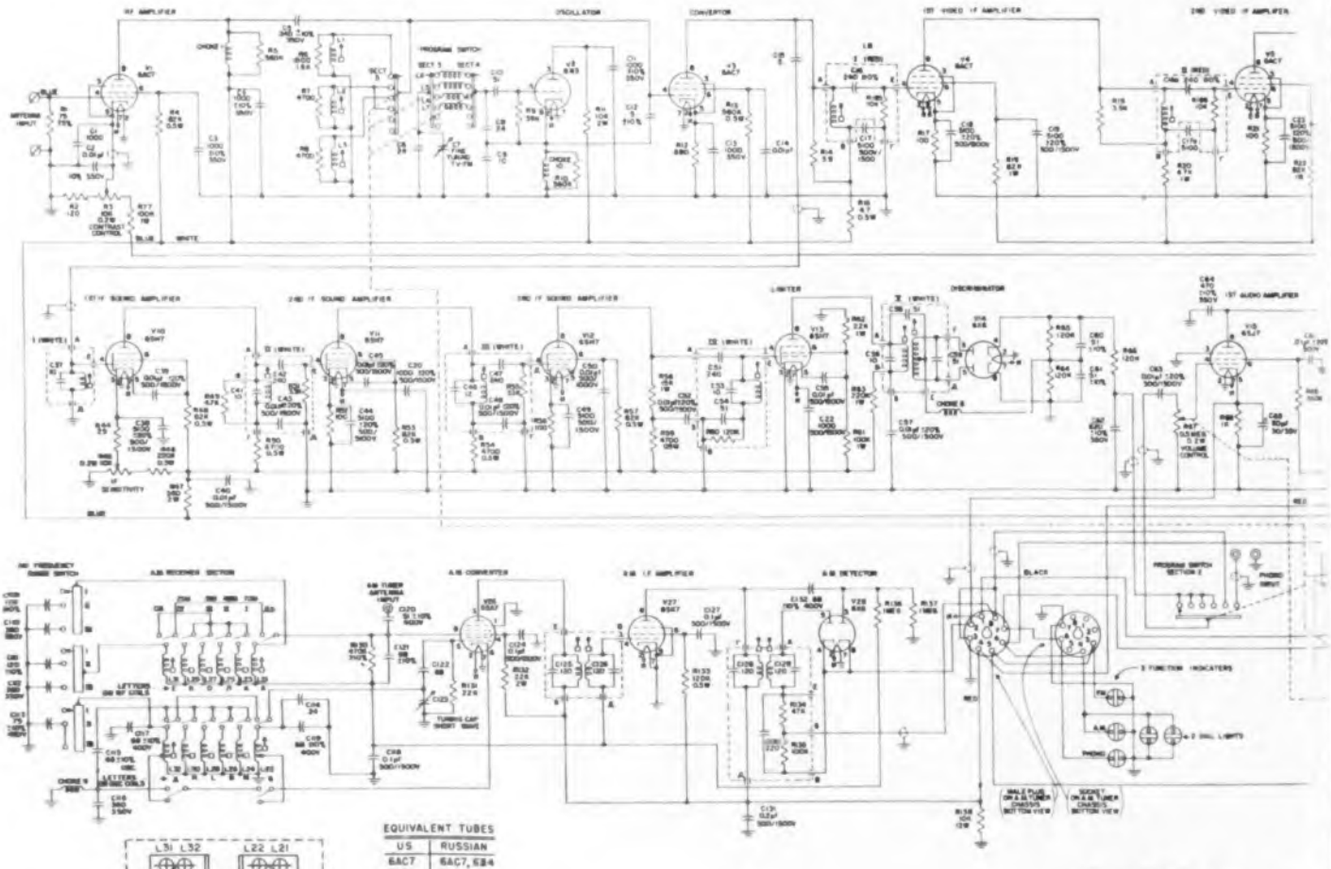


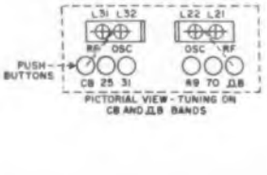
"Leningrad"

Schematic diagram and chassis photos provided by U.S. Air Force offer American electronic engineers opportunity to compare foreign design techniques

(Left) A. C. Omberg, Engineering Director of Bendix Radio Div., Baltimore, Md. demonstrates the "Leningrad" T-2 while being interviewed by T. White of WBAL-TV. Set has single channel, uses 32 tubes and would cost about $400 in the United States. Picture tube has 8-in. screen which emits sickly green hue.

(Below) Complete schematic diagram of the receiver. Note equivalent tube type list.



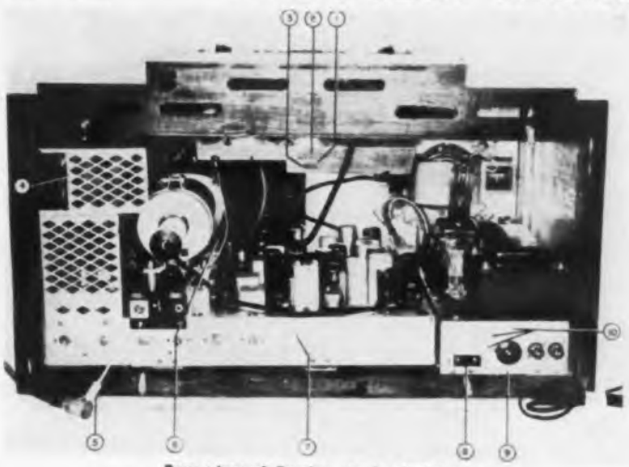


PICTORIAL VIEW - TUNING ON CB AND DB BANDS

EQUIVALENT TUBES

US	RUSSIAN
6AC7	6AC7, 6Ж4
6H6	6Х6
6J5	6Ф5, 6С2С
6SN7	6Н8Н
6F8	6Ф6
12J	1Ц1
5Z4	5Ц4С
25LK1B	25ЛК1Б
6AS7	6АС7, 6Л19
6SH7	6SH7, 6Ж1
6V6	6V6, 6Г6С
6SA7	6SA7, 6А7
—	Р-50, Ls50 П-50, Г-50

T-2— Modern Russian TV Receiver

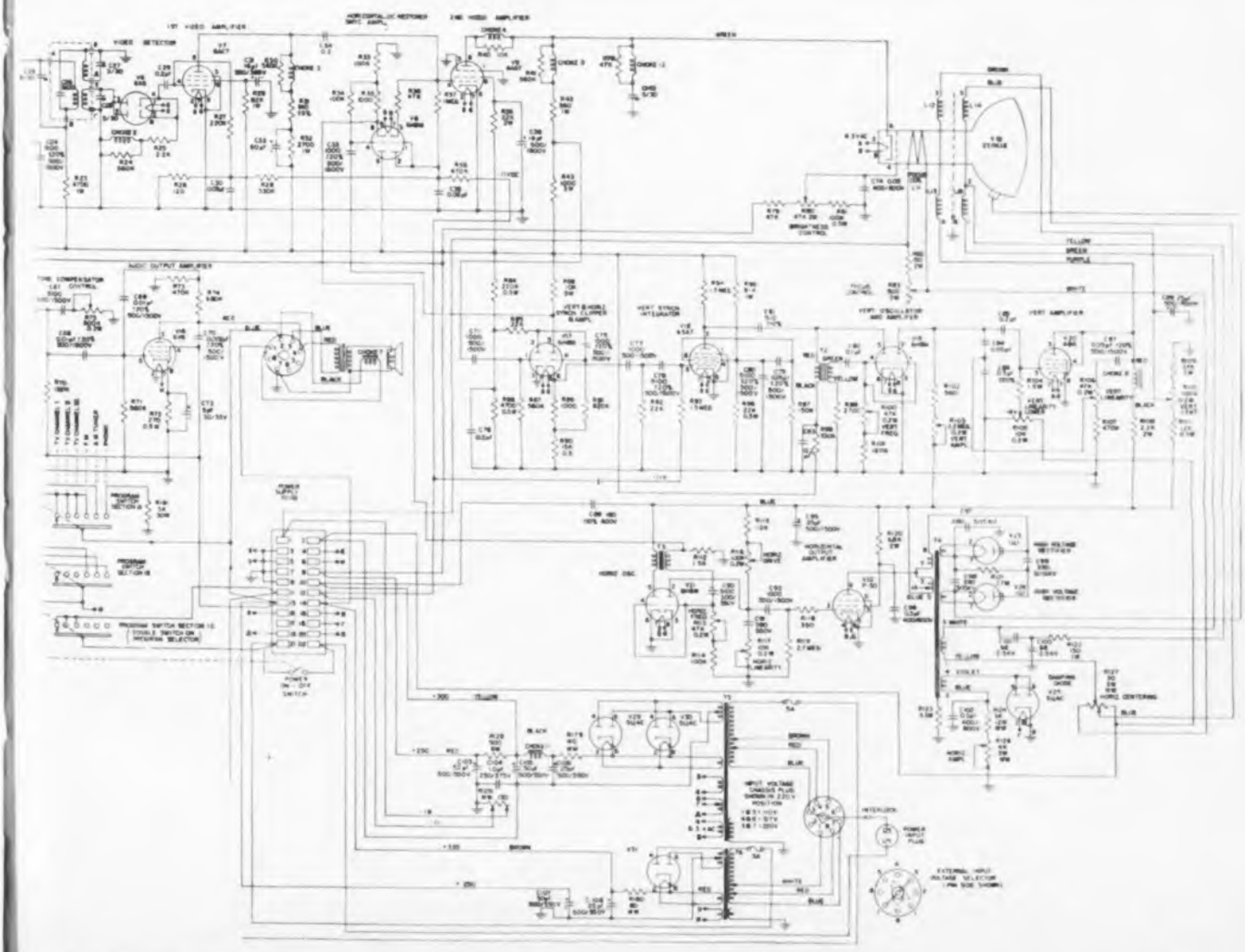


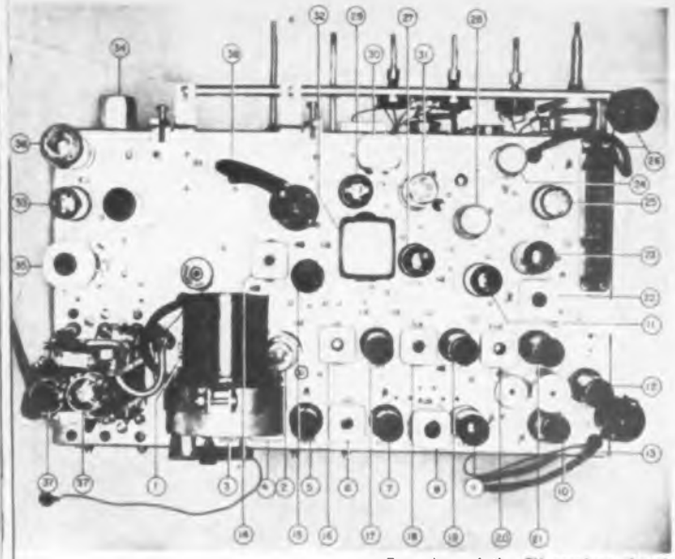
Rear view of Russian receiver's interior

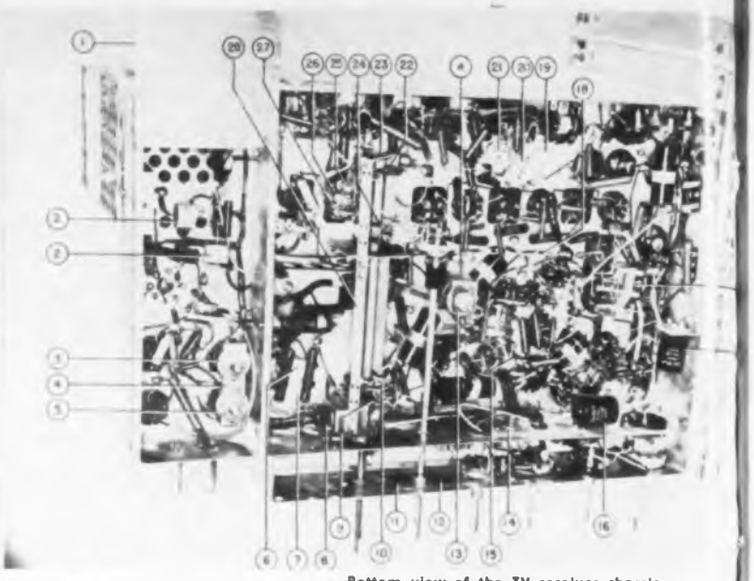
1. & 2. Manufacturing mark
3. AM tuner Serial No.
4. Hi-V Diode Access Door
5. 90° Antenna Connector
6. Manufacturer's mark
7. TV chassis serial No.
8. Interlock, Female Conn.
9. Power supply serial No.
10. Source voltage selection

Front quarter view of the television chassis

1. to 4. Manufacturing mark
5. Focus coil
6. Deflection coils
7. Manufacturing mark
8. 15KV clear plastic cap.
9. Sleeved resistor, R121
10-12. Manufacturing mark
13. Vert. Lin. (upper) control





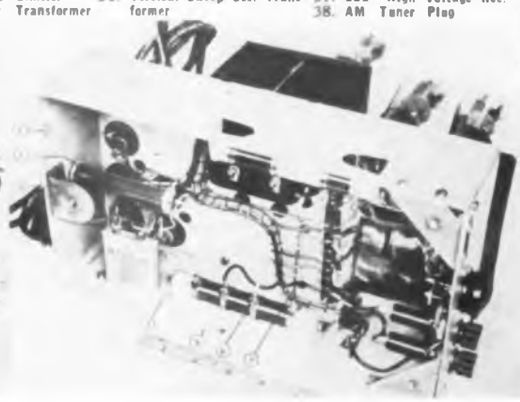


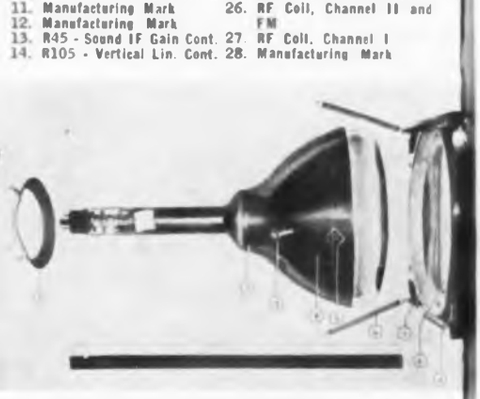
Top view of the TV receiver chassis

1. 6AC7 - RF Amp.
2. 6J5 - Local Os.
3. 6AC7 - Converter
4. Video IF Input
5. 6AC7 - 1st Video IF
6. Video IF Can
7. 6AC7 - 2nd Video IF
8. Video IF Output Can and 29 MC Sound Trap
9. 6X6 - Video Detector
10. 6AC7 - Video Preamp.
11. 6SN7 - DC Restorer and Horizontal Sync. Amp.
12. 6AG7 - Video Output Amp.
13. 23LK1B Cable and Socket
14. Sound IF Input
15. 6SH7 - 1st Sound IF
16. 1st Sound IF
17. 6SH7 - 2nd Sound IF
18. 2nd Sound IF Can
19. 6SH7 - 3rd Sound IF
20. 3rd Sound IF Can
21. 6SH7 - Sound Limiter
22. Discriminator Transformer
23. 6X6 - Sound Discriminator
24. 6SJ7 - Audio Preamplifier
25. 6V6 - Audio Output Amp.
26. Speaker Cable and Plug
27. 6SN7 - Sync. Clipper and Amp.
28. 6SA7 - Vertical Sync. Integrator
29. 6SN7 - Vertical Osc. and Amp.
30. Vertical Sweep Osc. Transformer
31. 6F6 - Vertical Sweep Output Amp.
32. Sweep Output Amp. Choke
33. 6SN7 - Hor. Sweep Osc. and Amp.
34. Hor. Sweep Osc. Transformer
35. P-50 Hor. Sweep Output Amp.
36. 524 - Damping Diode
37. 121 - High Voltage Rec.
38. AM Tuner Plug

Bottom view of the TV receiver chassis

1. Hor. Sweep Access Panel
2. High Voltage Capacitors
3. R117 - Hor. Lin. Control
4. Manufacturing Mark (2)
5. R116 - Hor. Drive Control
6. Manufacturing Mark
7. Manufacturing Mark
8. Function Switch, Sect. 1C
9. Function Switch, Sect. 1A, 1B
10. Function Switch, Sect. 2
11. Manufacturing Mark
12. Manufacturing Mark
13. R45 - Sound IF Gain Cont.
14. R105 - Vertical Lin. Cont.
15. Sleeved Resistor
16. Bakel. Cased Electrolytic
17. Discriminator Choke 6
18. B + Bus
19. C28
20. C27
21. C25
22. Function Switch, Sect. 5
23. Manufacturing Mark
24. Function Switch-Sect. 3, 4
25. RF Coil, Channel III
26. RF Coil, Channel II and FM
27. RF Coil, Channel I
28. Manufacturing Mark





Power supply chassis, top view

1. Transformer, T-6
2. Bakel Cased Electrolytics
3. 524-V31, Full Wave Rect.
4. 6P 11-Power Choke
5. 524-V29 and V30, Rect.
6. Transformer, T-7
7. Power Selector Plug
8. Power Plug Orien. Key
9. Power Plug

Power supply chassis, bottom view

1. Manufacturing Mark
2. Wire Wound Resistor
3. Mounting Foot
4. Metal Capacitor
5. Manufacturing Mark
6. Wire Wound Resistor
7. Ground Bus

Exploded view of CRT assembly

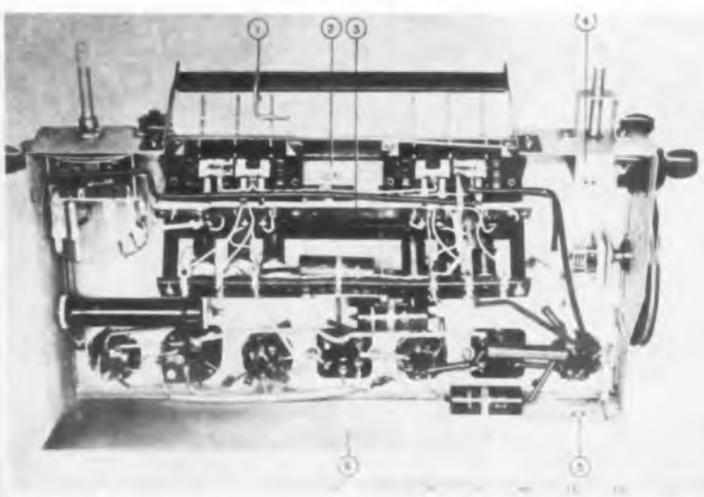
1. Retaining Ring
2. Manufacturing Mark
3. High Voltage Contact
4. Tube Type
5. Manufacturing Mark
6. Retaining Spring
7. Hair Felt Pad
8. Safety Glass
9. Molded End Plate

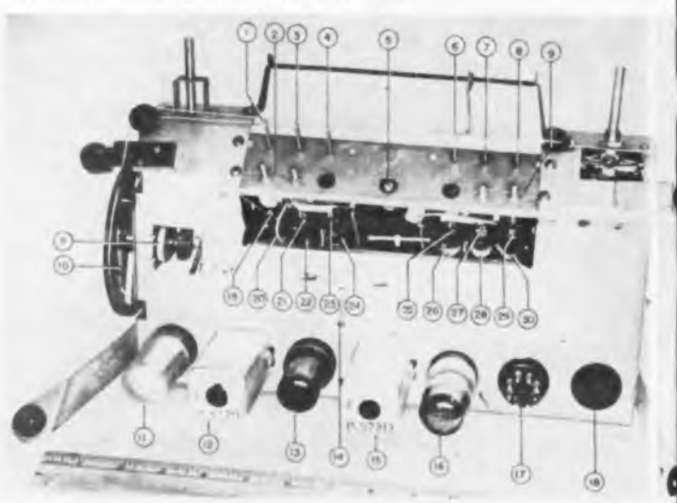
AM Tuner Chassis (bottom view)

1. Hook-Up Wire Tuning Indicator
2. Manufacturing Mark
3. Manufacturing Mark
4. Manufacturing Mark
5. Broadcast Antenna Input
6. Manufacturing Mark
7. 2B Push Button
8. Tuning Stop Tension Spring
9. 7G Push Button
10. 4F Push Button
11. Wave Trap Coil Mounting
12. 3J Push Button
13. 3S Push Button
14. CB Push Button
15. Broadcast Tuning Capacitor
16. Dial Cord Tension Spring
17. Mixer, Local Oscillator
18. 1st IF Transformer
19. IF Amplifier
20. Connector Clamp
21. 3rd Detector
22. 3rd Detector
23. Power Supply Plug
24. Program Selection Indicator Plug

AM Tuner Chassis (top view)

19. A-RF Coil-Band AS (150-410 KC)
20. T-RF Coil-Band I (70 Meters)
21. I-OSC Coil-Band AB (150-410 KC)
22. J-RF Coil-Band II (49 Meters)
23. B-OSC Coil-Band II (49 Meters)
24. K-OSC Coil-Band I (70 Meters)
25. C-OSC Coil-Band III (31 Meters)
26. N-OSC Coil-Band IV (25 Meters)
27. S-OSC Coil-Band CB (520-1500 KC)
28. D-RF Coil-Band III (31 Meters)
29. F-RF Coil-Band CB (520-1500 KC)
30. G-RF Coil-Band IV (25 Meters)





Switch Tuned UHF-VHF Antenna

Indoor unit for TV reception achieves large electrical volume with minimum physical size. Circuit compensates for mismatch at different frequencies

By GUY HILLS
Consulting Engineer
Tricraft Products Co.
1535 N. Ashland Ave.
Chicago 22, Ill.

The trend in indoor TV antennas the last few years has been toward smallness and easily operated tuning means or the complete lack of any tuning adjustment. These two properties seem in demand even at the expense of considerable loss in performance.

Regardless of the particular design of the small antenna there is at least one fundamental limitation to which

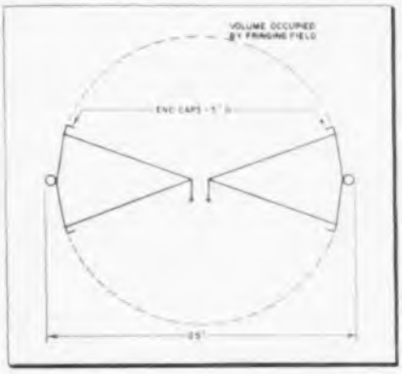


Fig. 1: Indoor TV antenna with end caps is physically small, has large electrical volume

it is subject:[1] its possible band width decreases very rapidly as its size is decreased. Its impedance can still always be matched to say a 300 ohm transmission line at any one frequency but the match rapidly deteriorates for frequencies different from that of good match. This means the antenna band width is small. Wheeler shows that the possible band width varies as the 4th power of frequency for a constant small antenna size (and is proportional to the volume of space occupied by the antenna).

In order to construct an antenna that has as much volume electrically as possible yet is small physically the dipole with end caps, Fig. 1, was chosen.

According to Wheeler's formulae considering the antenna to consist of two condenser plates of the size and positions of the end caps of Fig. 1 an effective volume of 6,220 cubic inches is obtained. This is equivalent to that of a sphere of diameter 91% of the length of the antenna of Fig. 1. On the basis of this volume the theoretical 6 db. band widths obtainable (irrespective of the circuits used for matching) are shown in Table I. A 16:1 voltage standing wave ratio indicates a 6 db. loss in transmission. Wheeler's formulae are for "small" antennae by which is meant antennae less than 1/2π times the wavelength as their greatest dimension. As the present 25-in. long antenna can therefore be considered small for frequencies less than 75 MC the theoretical band widths of Table I for channels 5 and 6 are less accurate than the others but are given to show the trend.

The measured band widths are always higher than the theoretical because of inevitable heat losses. The band width of course could always

Channel	Theoretical 6 db band width M. C.	Measured 6 db. band width M. C.
2	2.0	6
3	3.0	6
4	4.3	7
5	7.5	15
6	10.3	18
7 to 83	Antenna can no longer be considered small—see VSWR curves	

Table I: Theoretical and measured 6 db bandwidths of antenna for UHF and VHF reception

be increased by the process of resistive damping the antenna, but only at loss of signal. The theoretical band widths of the antenna indicate that for an antenna of this size only one VHF channel can be covered well in the low end of the band without a tuning adjustment no matter how the antenna is designed.

Matching—Low VHF Band

It is theoretically possible to match any impedance to any other impedance at one frequency by use of only two elements (such as a coil and a condenser). Since a short dipole has an impedance equivalent to a small resistance in series with a small capacitance the problem is to tune out the reactance of the capacitance and transform the resistance up to 300 ohms so that the antenna impedance will be purely resistive and

(*Continued on page* 106)

Fig. 2: Antenna with portion of outer covering cut away. Knob for rotating antenna eliminates need to grasp device in region sensitive to hand capacity

New Test and

POWER METER

RMS power is measured over the frequency range of dc through X-band without use of frequency limited bolom-

eter mounts by a new type power meter. Completely self-contained, it employs a single probe for all frequencies. Utilizing a power sensitive element that has no hot wire barreter, the unit can withstand 150% overload without burnout or other ill effects. The probe is permanently connected with the meter. The other side can be attached directly to the equipment under test. Two power scales are available: 0-20 milliwatts and 0-100 milliwatts. The power range can be extended by use of directional couplers, fixed pads, or variable attenuators. **Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

COMBINATION

In the combination shown, the top instrument is a model DZ16 precision voltage pulse generator the circuit of which consists of a precision dc voltage fed into a Western Electric relay (276D) and thence to a precise pulse forming network. The intermediate instrument is a model DZ15 single channel analyzer, or pulse discriminator, for obtaining an amplitude spec-

trum of pulses, as those occurring in nuclear measurements with proportional counters. The lower instrument a model DR8 linear amplifier, is designed for laboratory work in conjunction with ionization chambers, etc. It integrates the current pulse from radiation detectors, amplifies the voltage, differentiates it, and provides further amplification at one of three selected bandwidths. The model DR10 preamplifier (lower left corner) matches the impedance of the detector to the input of the DR8 linear amplifier. **Detectolab, Inc., 6544 N. Sheridan Rd., Chicago 26, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Q-STANDARD

An accurately known Q and reactance, suitable for precise measurements, is provided by type 513-A Q-Standard. It

consists of a specially developed winding in a hermetically sealed copper shield can filled with dry helium. A convenient carrying and storage case is included. Normal inductance is 250 μh and is specified to +1%. Distributed capacitance, when mounted on the type 160-A or 260-A Q meter is approx. 9 μμf and is specified to +2% **Boonton Radio Corp., Boonton, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

POWER OSCILLATOR

Model 1040 power oscillator provides a frequency of either 400 cps or 1,000 cps. Three watts with less than 1% of

distortion are provided at various output levels. A front panel control enables a continuously variable output from 0-120 v. Frequencies, factory-set to 0.25%, are maintained with high stability even with line voltage variations. Power requirements are 105-125 v., 60 cps. Dimensions, $5^{11}/_{16}$ x 9 x $6^{1}/_{8}$ in. Weight, 10 lbs. **Industrial Test Equipment Co., 55 East 11th St., New York 3, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

METER CALIBRATOR

The Kay-Lab calibrator line has been expanded to include models in the range of 0 to 1,000 v. and from 0.05 μa

to 100 mas. All units employ the Kay-Lab absolute dc power supply system. Model M30B-1 shown (formerly 123 and 123Y) affords calibrated output voltage from 1 to 300 v. in one volt steps, and is variable between steps by a calibrated potentiometer. No current is drawn from the standard cell. **Kalbfell Laboratories, Inc., P.O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif.**—TELE-TECH & ELECTRONICS INDUSTRIES.

OSCILLATOR

The low distortion, battery-operated Model MB-1 oscillator is a self-contained sine-wave generator requiring

no external power source that covers the frequency range from 2 to 20,000 cps. The unit incorporates a circuit with a battery-saving feature that is controlled by the power switch. Both dc and ac signals are available from 0.1 v. to 1.0 μv at output impedances from 10 to 500 ohms. Calibration is within 2% of the indicated frequency and distortion is less than ½% in the audio range. The Mb-1 is now available with a calibrated output attenuator and level meter, and the geophysical microvolter is incorporated in the unit as shown. **Southwestern Industrial Electronics Co., 2831 Post Oak Rd., P.O. Box 13058, Houston 19, Texas.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Measuring Equipment

PHASE DETECTOR

Consisting of two cathode followers, a continuously variable delay line, a balanced phase detector, and a sensi-

tive output indicator, type 205 will detect phase angle with an error less than 0.1° in communication systems. The unknown signal is delayed until the reading on the output indicator becomes zero or minimum, and the unknown phase angle is read on the dial of the continuously variable delay line. Accuracy is ± 0.1° in phase reading or ± 1% of the time delay indicated on the dial. Frequency range is 10 KC to 10 MC. The lower limit can be extended to 1 KC with an additional delay line or phase-shifting network. The upper limit can be extended with relaxing accuracy. Indicator sensitivity is 0.02, 0.04, 0.1, 1.0 and 10 v. rms. Input impedance is 1 megohm shunted with 12 μμf on both input channels. **Advance Electronics Co., Inc., P. O. Box 394, Passaic, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

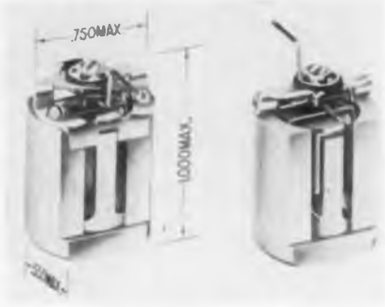
INSTRUMENT ACCESSORY

Model 901 stand enables mounting up to three "A" size cabinets on one stand, hence minimizes bench space and makes

instruments easier to attach, adjust, and read. Multiple ac outlets are provided in the base for instrument power cords. The mounted instruments shown are the model 301 audio oscillator (range 10 cps to over 1 MC), model 401 high resistance bridge (100 k to 100 megohms, 0.25%.), and the model 201 vacuum tube voltmeter for dc, ac, and resistance measurements. **Beckman Instruments Inc., Shasta Div., P.O. Box 296, Sta. A, Richmond, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

GALVANOMETER

A new moving coil galvanometer mechanism weighs only 0.8 oz. and consists of a soft iron outer pole structure, a non-magnetic yoke, and a magnetized core. The diameters are such that the yoke fits snugly with the pole structure, and the core within the yoke. Attached by two screws, a bridge locks the assembly, and a finger on it holds the core and frame in position. A slot in the bridge flange engages one of the frame legs, and prevents rotation of the yoke. The moving coil is contained by pivots and bearings in the bridge and frame base. All critical dimensions are machined from the bearing axis as a common center which is said to assure a more precise align-



ment than is possible to obtain with stamped assemblies. **Marion Electrical Instrument Co., 400 Canal, Manchester, N. H.**—TELE-TECH & ELECTRONIC INDUSTRIES.

RADIATION GAUGE

Beta rays from a radioactive source are utilized by a new gauge to measure the wall thickness and roundness of tubing. A source of beta radiation is moved inside the tube in relation to a sensitive means of detecting radiation on the outside of the tube. Changes in tube wall thickness affect the amount of radiation passing through the wall and

are translated into thickness readings and shown by a pen trace on a recorder chart. **Tracerlab Inc., 130 High St., Boston 10, Mass.**— TELE-TECH & ELECTRONIC INDUSTRIES.

OSCILLATOR ADDITION

A beat frequency oscillator has been added to the NM-20A radio interference and field intensity meter which

makes it the equivalent of the new NM-20B. The added feature enables the user to identify and copy unmodulated cw signals through the frequency range 150 KC to 25 MC. Owners of the NM-20A can add the circuit improvement by procuring the No. 90828-1 beat frequency oscillator kit which consists of ready-to-install parts, wire, hardware and installation instructions. Drill templates for locating and adding holes are included. **Stoddart Aircraft Radio Co., Inc., 6644 Santa Monica Blvd., Hollywood 38, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PULSE GENERATOR

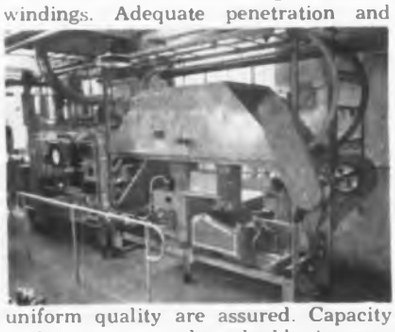
Model 4904 double pulse generator provides single and paired pulses for laboratory-testing electronic pulse cir-

cuits. The unit consists of two basic pulse-forming circuits that are triggered at a variable repetition rate by either an internal or an external frequency source; or, by a manually operated switch. A time delay circuit provides the variable separation between the first and second output pulses. Each pulse-forming circuit output is obtained from a power amplifier. Pulse width, individually and continuously variable from 0.3 to 10.0 μsec. Pulse amplitude, maximum 180 v. negative and 75 v. positive across a 2000 ohm load connected to the high-level output. Pulse spacing, variable from 0 to 100 μsecs or to half the repetition period, whichever is smaller. Repetition rate, 1 to 10,000 pps, internally controlled. **Beckman Instruments, Inc., Berkeley Scientific Div., 2200 Wright Ave., Richmond 3, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Lab and Plant Equipment

IMPREGNATOR

"Ballardev" impregnator provides automatic means of varnishing conductor windings. Adequate penetration and



uniform quality are assured. Capacity is 600 parts per day, double impregnated. Size of components handled up to 8 in. long by 4 in. diameter. Equipment size is 20 x 4 x 9 ft. Unit developed by Devroome Developments and F. J. Ballard, Ltd., England, consists primarily of parallel chain conveyor with horizontal flight bars between the conveyor chains which form a continuous circuit. Parts are dipped in tank and passed through oven in which hot air is circulated. Complete line of "Ulti-Meg" varnishes also available. **Electrovert, Inc., 489 Fifth Ave., New York 17, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PREFEEDER

The AE-266, a new heavy-duty wire prefeeder corrects uneven cutting lengths, damaged wire insulation and

excessive machine wear. Intermittently speeded and slowed by solenoid action to compensate for the difference between prefeeder wire pay-out speed and the stripping machine, automatic synchronization is obtained by setting a prefeeder scale at the same reading as that on the stripping machine. The coil in the prefeeder starter is energized from the control circuit of the machine; therefore the two units start and stop simultaneously. The prefeeder is powered by a ¼ h.p., single-phase, 110 v. motor. The motor power supply and the prefeeder solenoid supply are completely independent. **Artos Engineering Co., 2757 South 28th St., Milwaukee 46, Wis.**—TELE-TECH & ELECTRONIC INDUSTRIES.

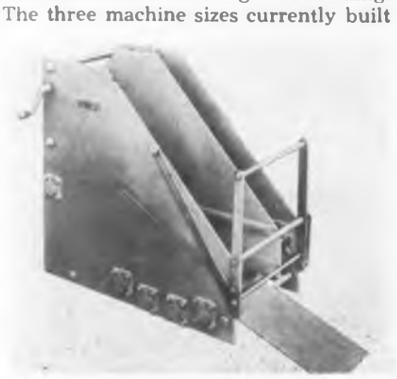
DYNAMOMETER

The eddy current dynamometer is designed for application in test laboratories and for production and inspection testing in companies that produce or use rotary electric equipment. Its features, it is said, are ease and speed of operation, reliability, repeatability, and accuracy. Accuracy of three torque ranges are; 0-16 in./oz., accuracy ± 1% of full scale reading; 0-8 in./oz., accuracy ± 2% full scale; 0.2 in./oz., accuracy ± 8% full scale. Accuracy of

two speed ranges: 0-7,200 rpm, ± 2% full scale reading, and 0-14,400 rpm ± 2% full scale. **Magtrol Inc., 533 S. Niagara, Tonawanda, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

AUTOMATIC FEED

A new device which automatically feeds all types of coiled stock to production machines features an automatic trip bar which actuates a motor switch as the slack loop is tightened. The motor feeds a new loop at 90 ft./min. and shuts off automatically at the correct loop size. Four driving rolls, mounted in cast iron pillow blocks, are equipped with roller bearings that are lubricated by "Alemite" fittings. The chain-driven rollers are actuated by the switch-equipped reversible motor. An adjustable guide plate partitions the roll area for various roll sizes. The plate is mounted on three lead-screws that are rotated simultaneously by an adjustment crank. Rolls can be rotated in either direction for feeding or rewinding. The three machine sizes currently built



are for 10, 13, and 15 in. roll-widths, 36 in. in diameter. **Benchmaster Mfg. Co., 1835 W. Rosecrans Ave., Gardena, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

TENSION METER

A tension meter, built under patents held by Dr. Erwin J. Saxl, is a high-capacity instrument capable of han-

dling tensions of 20 lbs. and more, such as are used in wire and cable making. Free from gear trains, the unit assures freedom from tooth deformation. The same meter is also provided with wider rollers which enable measurement of rayon tow strands, paper strips, plastic tapes, slit film, etc. **Tensitron, Inc., Harvard, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FLAT LAPPING MACHINE

The number "24" precision flat-lapping machine produces micro-inch finishes at high speed. The work-bench

height machine consists of a 2-in. thick, 24-in. diameter revolving lapping plate made of close-grained, heat-treated, cast iron that is supported by six precision ball bearings. The top has a grooved Archimedean spiral. The plate rests on a heavy cast iron mount that supports the whole mechanism. The permanently lubricated bronze gears are sealed in a cast aluminum gear box. A heavy steel base encloses the ½ hp, heavy-duty, 3 phase, 220-440, 1800 rpm motor. The machine is suitable for lapping sealing surfaces that must withstand high pressures or vacuums and other surfaces that must be held to extreme tolerances. **Spitfire Tools Co., 2931-35 N. Pulaski Rd., Chicago 41, Ill.**—TELE-TECH & ELECTRONICS INDUSTRIES.

SOCKETS - CONNECTORS - PLUGS
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of low loss mica components is exclusively a Cinch feature, a contributing factor in the choice of Cinch electronic components as STANDARD.

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New Electronic Equipments

CARRIER SYSTEM

Type 45A carrier telephone system provides up to 12 carrier derived voice channels on an open wire line and

coordinates with such systems as the Western Electric J and Lenkurt 42C. It can be installed on lines already equipped with carrier systems using frequencies up to 35 KC. Four staggered frequency allocations are available to enable installation of several systems on a single pole line. Sufficient gain and regulation are provided to permit repeater spacing of 170 miles in non-sleet areas. The broadband regulator provides up to 48 db of flat loss correction at 99 KC and up to 24 db of slope correction between 99 and 150 KC. Individual regulators in each channel compensate for up to 7 db attenuation due to line absorption peaks or other irregularities. All units for a complete 21-channel system plug into a prewired shelf on a 19-in. equipment rack. **Lenkurt Electric Co., 1105 Old Country Rd., San Carlos, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

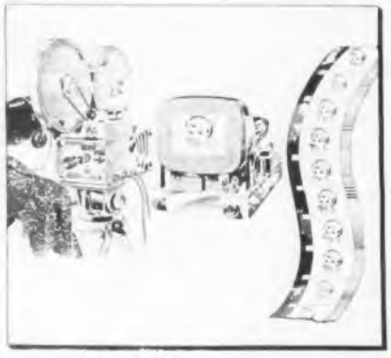
TAPE RECORDER

Model M80-AC professional tape recorder provides frequency response from 30 to 15,000 KC at 7½ in./sec., 30 to 20,000 KC at 15 in./sec. Flutter and wow is less than 0.1% at 15 in./sec. Advance warning record light prevents accidents and erased tapes. A standard phone jack is provided on the amplifier front panel for headphone monitoring. Less than 45 secs. is required to rewind 2,400 ft. of tape on a 10½ in. NARTB

reel. Playing time is 32 min. at 15 in./sec. Power: 275 watts at 117 v., 60 cps. **Magnecord, Inc., 225 West Ohio St., Chicago 10, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CAMERA SHUTTER

The "Super 1200" camera can kinescope-record a continous 30-minute operation using 1,200 ft. film magazines. Equipped with the new television transcription, "TV-T" shutter, it can photograph TV pictures from a receiver tube occurring at 30 frames/sec. onto 16mm motion picture film at the rate of 24 frames/sec. without loss of picture quality. With "TV-T" shutters, regular live action film cameras become valuable industrial television tools for making permanent film records with synchronized sound and pic-



ture, photographed from receiver tubes in closed TV circuits for later viewing and study. **Berndt-Bach, Inc., 7377 Beverly Blvd., Los Angeles 36, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PORTABLE RECORDER

Model 777 magnetic tape recorder has a self-contained speaker, an ac and self-contained power supply, and rechargeable batteries. It is light, com-

pact, and equipped with retractable legs and a shoulder carrying strap. Its low tape speed (1.87 in./sec.) enables it to record or play for a full hour. Frequency response is 200-4,000 KC. Flutter and wow, ½ of 1%. Distortion, less than 10%. **J. C. Warren Corp., 21 Hanse Ave., Freeport, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Technical Products
for the
Electronic Industries
on pages 104-105

PROGRAM EQUALIZER

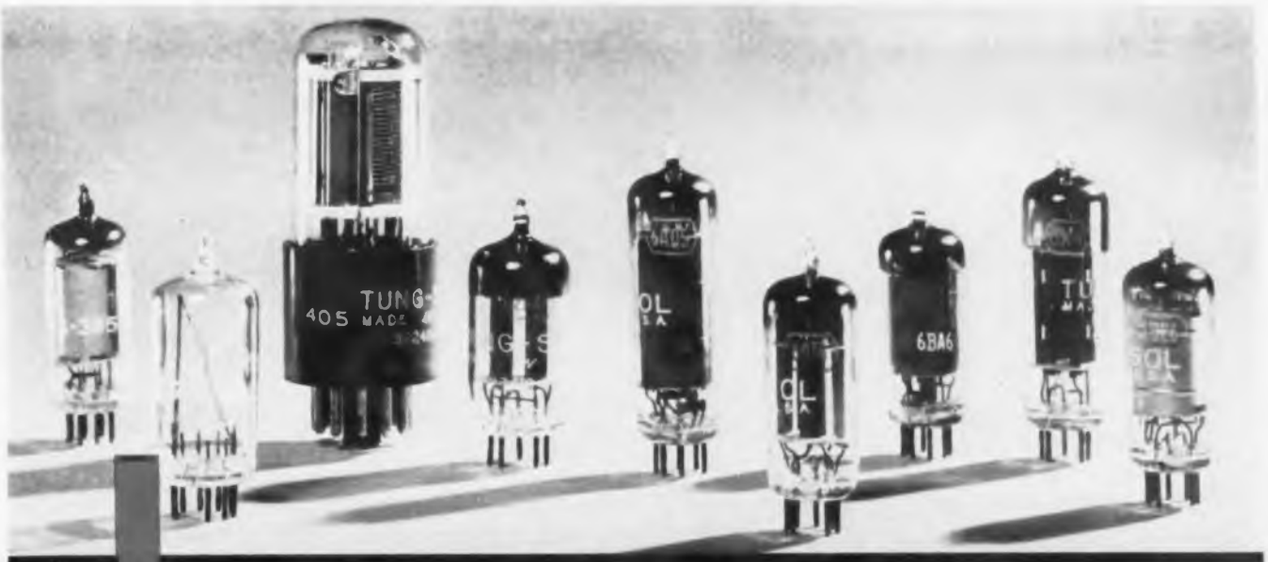
Type 4201 program equalizer requires only 3½ in. rack space, features low hum pickup through use of toroid coils,

and has the ability to return to positions of known operating conditions. Transmission deficiencies, when known, can be preset. Low frequency equalization is peaked at 40 cps and 100 cps in 2 db steps up to 12 db; high equalization is peaked at 3 KC, 5 KC, and 10 KC in 2 db steps up to 12 db. Selection is made by switch. Low frequency attenuation is in 2 db steps at 100 cps, maximum attenuation of 16 db; high frequency attenuation is in 2 db steps at 10 KC, maximum attenuation of 16 db. **Hycor Sales Co., 11423 Vanowen St., North Hollywood, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

IMAGE BOX

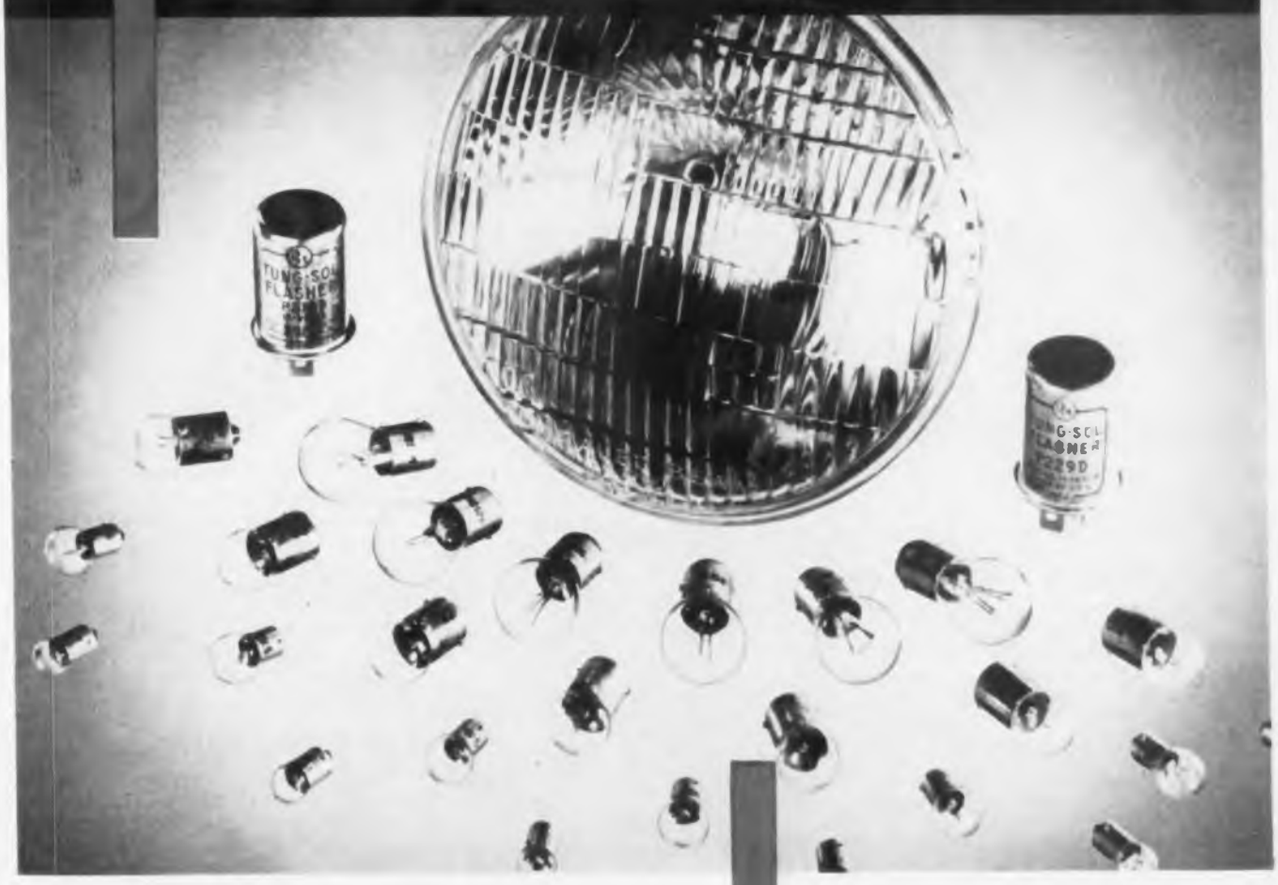
A new device, called an image box, consists of a specially ground glass plate, developed for GE by the Bausch and Lomb Optical Co., mounted in a light-protective hood on a pedestal. The height of the pedestal enables operation with a GE type TV-15C mirror change-over unit, or shimmed to operate with a type TV-15B mirror change-over. Images from films or slides projected on one side of the glass plate can be picked up from the reverse side by a regular studio camera, and relayed to the station's transmitter. Screen grain size in the televised image from the new image box is unnoticeable due to the quality of the ground glass which has no "hot" center spot. The image box is detachable to assure the most convenient studio mounting. Mobility of the unit enables super-

imposing a speaker over his slide presentation and other special effects. **General Electric Co., Electronics Park, Syracuse, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.



ELECTRON TUBES FOR EVERY AUTOMOTIVE APPLICATION

LAMPS FOR EVERY AUTOMOTIVE USE



All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

Tung-Sol Electric Inc., Newark 4, N. J.

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TUNG-SOL®

GEARED MOTORS

Two 400 cps ac geared motors are 3 in. and 2 in. long and have 1½ in. and 1.0 in. diameters, respectively. The larger has an output torque to 80 in./oz. at speeds from 1 rpm. The smaller has an output torque to 10 in./oz. from 1 rpm. **Mission-Western Engineers, Inc., 132 West Colorado Blvd., Pasadena 1, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SWITCH HOUSING

"Mycalex" 410x glass-bonded mica custom-molded switch housing is in production for airborne applications. In addition to immunity to repeated flashing, no carbon path is formed in tests. Other advantages offered by the material are closely dimensioned intricate functional designs, high dielectric strength, zero moisture absorption. **Mycalex Corp. of America, 60 Clifton Blvd., Clifton, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

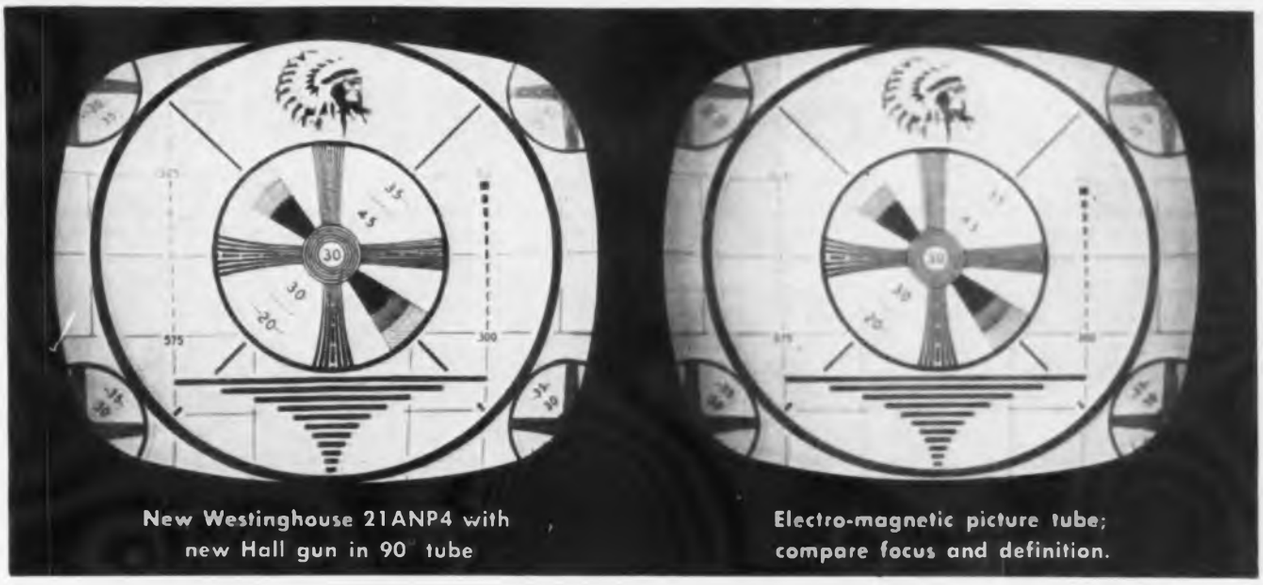
OSCILLATOR

The model 411 oscillator is suitable for making measurements requiring a sine wave signal over the range 20 cps to 1 mc. A resistance-capacity tuned type oscillator and a cathode follower in the input system are employed to provide uniform response. Frequency accuracy is maintained by the use of

deposited carbon resistors in the frequency determining network. Low level measurements are facilitated by a panel switch which reduces output voltage, distortion, and hum output. Other features are good case ventilation, a well-spread dial calibration, compact size, and light weight. **Clough-Brengle Co., Dept. TT, 6014 Broadway, Chicago 40, Ill.**—TELE TECH & ELECTRONIC INDUSTRIES.

MASKING DOTS

The adhesive discs shown were designed to reduce spray paint masking. Slightly overlapped, the removal of one disc lifts the edge of the next so that they can be removed one at a time or in a strip. Precision cut from heat resistant masking tape, the discs withstand baking temperatures up to 325° for 30 minutes without leaving troublesome adhesive on the work. Available in sixteenth inch diameters from ¼ in. to 4-in. **BY-BUK Co. 4314 West Pico Blvd., Los Angeles 19, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.



New Westinghouse 21ANP4 with new Hall gun in 90° tube

Electro-magnetic picture tube; compare focus and definition.

BETTER FOCUS

than any other 21" picture tubes

Set manufacturers recognize the inherent advantages of electrostatic picture tubes since they offer lower weight, use fewer components, and sets have lower assembly costs; yet, until now, picture quality was not as good as when electro-magnetic picture tubes were used.

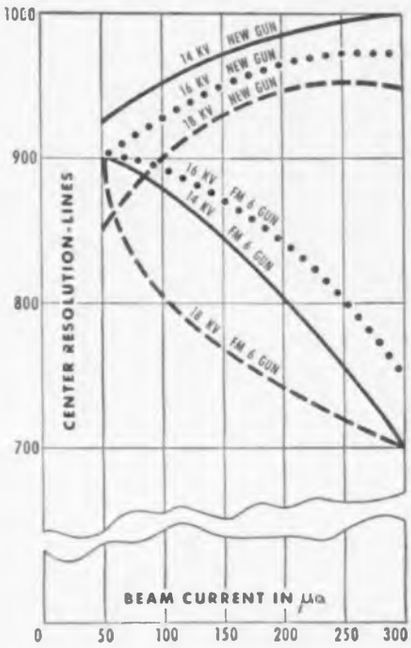
Now Westinghouse offers the 21ANP4 and the 21ANP4A; these 90° deflection electrostatic tubes offer pictures with better focus and higher definition than their electro-magnetic counterparts. In the unretouched pictures above, notice the better corner resolution, higher definition, and better contrast in the electrostatic tube. Photographs were made under identical conditions with voltages as follows: $E_{B2} = 16$ kv; $E_{G2} = 300$ v; $E_F = 6.3$ v.

New Westinghouse 90° picture tubes have an added 13 square inches of picture area, a better aspect ratio, are 3" shorter which allows shorter cabinets or elimination of the hat.

These tubes offer good focus at voltages from 10 to 18 kv without distortion, less shift in focus voltage as beam current varies, and better fringe area reception. They are more stable under conditions where voltage variations are encountered due to home-current variations or to variations in components. These tubes are interchangeable in different receiver circuits due to their inherent stability.

Westinghouse invites your tests! Qualified set manufacturers are requested to write or call for sample tubes which may be tested in their own laboratories as desired. Call your nearest Westinghouse Electronic Tube Sales Office, or write to Dept. B-2014 at the address below.

These tubes offer set manufacturers clear, easily defined sales advantages. Check now for further information.



This chart illustrates the ability of the gun to maintain sharp definition despite changes in beam current—relating center resolution to beam current over a range of anode voltages.

ET-95052

YOU CAN BE SURE...IF IT'S Westinghouse

RELIATRON™ TUBES

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

WASHINGTON
News Letter

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

COMPATIBLE COLOR-TV IS HERE!—On December 17, the FCC issued the long-awaited order authorizing a compatible color television system using NTSC signal standards. Within an hour after the announcement, both NBC and CBS put color-TV presentations on the air using this new system. Regular commercial transmissions in color, however, will not take place for about another forty days since the order is effective thirty days after it is printed in the Federal Register, and this is not expected until the end of December. Manufacturers are now tooling up for production and sets can be expected on the market in about six to nine months. Initially, the sets are expected to cost from $800 to $1,000 each and will employ 15-inch color tubes. Estimates of color set production for 1954 vary over wide limits, but most range from 100,000 to 200,000 units.

CAUTION PARAMOUNT—In its sanction of color television the FCC is certain to advise the American public that color video is still a long way off from widespread telecasting and reception. There have been so many exaggerated press and magazine forecasts about color television that the Commission in its role of protecting the public interest feels it is imperative the public not be deceived into thinking color television can be established over night with a wave of a magician's wand. Dr. W. R. G. Baker, Chairman of the NTSC, also emphasized that "It will take manufacturers of color transmitting equipment and home receivers considerable time to develop, field test and mass produce color equipment."

MASS PRODUCTION INDUSTRY—The fact that the radio-electronics manufacturing industry has always been a mass production field to bring to the public the benefits of the lowest possible prices for receiving sets has been largely disregarded in the published speculation about color video. Another paramount aim of the industry is to have new systems of radio and television completely field tested and as perfect as possible before becoming a public service. In the case of color television the manufacturers will have a long period of retooling and revamping of the production lines so as to attain a status of large-scale production for this new field of television.

JOINT SURVEY—Mobile radio, a field which receives virtually no general recognition by the public but is vital to the nation's economy and public safety, is to be surveyed under a joint program by the Radio-Electronics-Television Manufacturers Association and the FCC Safety & Special Services Bureau to determine an accurate and complete picture of the scope and size of these services. A test run for the questionnaire on the facilities was started in December in a major metropolitan area to determine the scope and form of the questionnaire to be used in the nationwide survey. All of the leading mobile radio and microwave manufacturers have been spearheading the joint RETMA-FCC plan.

MANUFACTURERS' RADIO—Importance of the uses of two-way mobile radio systems in cost savings, operating efficiency and greater safety in the nation's manufacturing plants was recently demonstrated to the FCC Commissioners and top Commission staff officials by the National Committee on Manufacturers' Radio Use of the National Association of Manufacturers. The committee has asked the FCC to consider frequency allocations and to promulgate rules and standards for a manufacturers' radio service.

SPLIT-CHANNEL IMPORTANCE—Greater utilization of the frequency spectrum in mobile radio communications through the engineering and implementation of split-channel assignments and operation is the currently dominant goal of manufacturers and user services in that field. FCC Commissioner E. M. Webster in a recent address before the IRE vehicular communications professional group declared that service allocations will be retained as geographical separation is utilized in the engineering of the split-channel assignments in the aim of producing the maximum in the spectrum's utilization. Several major mobile radio services—petroleum, utilities, land transportation and state highway departments—prior to the Commissioner's declarations supported plans for split-channel operations in separate meetings of their services' radio coordinating committees.

VALUE OF RADIO—Mobile radio communications have become an indispensable tool in the country's forestry industry in the efficiency of its operations, it was brought out by a leading figure in that industry recently at a meeting of more than 2,000 representatives of the forestry business. Radio has also been most valuable in forest fire emergencies, it was stressed. The industry spokesman cited that there was "little doubt many times the cost of the industry's entire radio system has been saved due to the quick communications in time of forest fire emergencies alone."

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

FIRST CHOICE AGAIN!

GPL

WNCT picks GPL cameras for TOP QUALITY PLUS ECONOMY

■ WNCT goes on the air in Greenville, N. C., with GPL studio and film equipment. On Channel 9, WNCT covers the rich eastern North Carolina tobacco and agricultural markets totaling close to 1,000,000 people.

"In this type of market," says A. Hartwell Campbell, general manager of WNCT, we shopped for not just quality but economy in cameras. That was a big factor in picking GPL.

"We checked with other stations, some with GPL chains, some with other makes. They confirmed our decision GPL was the best. The price was competitive, but we got all the GPL extras from picture quality to ruggedness, plus the economy mainly made possible by remote control operations.

"GPL projectors were the logicial choice, to give us quality plus economy again for films as well as live shows."

TV equipment that produces the best picture, and still gives a station owner economy, deserves consideration. Try these cameras, under your own operating conditions. Study the remote control features and compare operating costs. You'll discover how GPL can save you money . . . with the best.

Malcolm Nicholson, film editor of WNCT threads one of two GPL PA-100A projectors used by WNCT. Projectors have 4,000-foot capacity, and are remotely controlled.

WNCT's home nears completion in Greenville. Station has 100,000 watt video signal and 50,000 watt audio. The antenna towers 874 feet above the surrounding terrain.

WNCT engineers Bill Elks (left) and Heber Adams during practice sessions before completion of 35 x 50-foot studio. Lens change, focus and iris adjustment can be handled from control room, at any time as desired.

A phone call, wire or letter will bring complete information on cameras, projectors, transmitters, the new Watson-GPL vari-focal lens and all other TV equipment for studio or field.

General Precision Laboratory
INCORPORATED
PLEASANTVILLE NEW YORK

GPL

Export Department:
13 East 40th St., New York City
Cable address: Arlab

Cable address: Prolab

Camera Chains • Film Chains • Field and Studio Equipment • Theatre TV Equipment • GPL-Continental Transmitters

New Technical Products for the Electronic

SIDEBAND FILTER

The type S-15000 is a recent addition to the new series of single-sideband filters. Economical unit is particularly designed for amateur and low-cost commercial sideband communications receivers. It consists of stabilized toroids and other high quality components that will attenuate at 50 KC carrier at 20 db, and most of the upper sideband 40 db.

Audio response through the filter would be 300 CPS to 3300 CPS. **Burnell & Co., 45 Warburton Ave., Yonkers, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

ROTARY SWITCH

The 8-pole rotary switch, type 87-EM has a 15 amp. current-carrying capacity. From 1 to 5 positions per pole are available with shorting-type action; up to 3 positions per pole with non-shorting action. Spacing is 15° between live positions with shorting-type action; 30° spacing with non-shorting action. Silver alloy rotors, slip rings and contacts are used exclusively. Contact panels and rotors are fabricated from XXXP phenolic in accordance with MIL-3115B. **The Daven Co., 191 Central Ave., Newark, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

HEADSET

Weighing only 1.6 oz., "Twinset" features a new method of sound reception. Two receivers rest on the temples, and actual sound is piped into the ear through a ball-and-socket jointed, tubular, sound arm which, according to the manufacturer, eliminates pressure, ear cup discomfort, and disturbing background noise. The five-foot single cord that replaces the "Y" cord provides greater freedom of movement. Matched in-phase magnetic receivers

deliver a pure, non-resonating signal. Sensitivity is 101 db above 0.000204 dynes/sq. cm. for 10 μw input. The unit is CAA approved. **Telex, Inc., Telex Park, St. Paul, Minn.**—TELE-TECH & ELECTRONIC INDUSTRIES.

DESIGN KIT

The PT-1000 kit includes all the hand tools, materials, chemicals, module parts, and standard accessories neces-

sary for the design and construction of "Project Tinkertoy" modules, sub-assemblies, or complete modular design equipment. The kit includes simple, detailed instructions that enable the immediate design or redesign of new sub-assemblies and equipment employing such modules. **Communication Measurements Laboratory, Inc., 350 Leland Ave., Plainfield, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SERVO MOTORS

Three new servo motors that weigh 1.45 oz., 7.3 oz., and 1.6 lbs., respectively possesses the following characteristics: type K402390 mechanical data; rotor inertia 0.46 gm-cm^2, theoretical acceleration 49,000 rad/sec^2. Electrical data; no load speed, 6,500 rpm; stall torque, 0.3 oz./in., maximum output 0.490 w., single phasing none. Data at stall; fixed and control phase voltage, 26 v.; frequency, 400 cps; current, 166 ma.; power input, 3.1 w.; power factor, 0.63; R-ohms, 98.5; X-ohms, 123; Z-ohms, 157. Type K402380 mechanical data; rotor inertia 3.03 gm-cm^2; theoretical acceleration 33,800 rad/sec^2. Electrical data: no load speed, 3,300 rpm; stall torque, 1.45 oz./in.; maximum output, 1.23 w.; single phasing,

Industries

none. Data at stall: fixed and in series control phase voltage, 115 v.; frequency, 60 cps; current, 53 ma.; power input, 5.0 w.; power factor, 0.82; R-ohms, 1780; X-ohms, 1240; Z-ohms, 2170. Control phase in parallel: 57.5 v.; 60 cps; current 106 ma.; power input, 5.0 w.; power factor, 0.82; R-ohms, 445; X-ohms, 310; Z-ohms, 542. Type 1138E1Y mechanical data; rotor inertia 20.0 gm-

cm^2; theoretical acceleration, 26,500 rad/sec^2. Electrical data: no load speed, 3,500 rpm; stall torque, 7.5 oz. in.; maximum output, 6.0 w.; single phasing, none. Data at stall: (fixed phase and control phase in series) voltage, 115 v.; frequency, 60 cps; current, 175 ma.; power input, 14.0 w.; power factor, 0.70, R-ohms, 460; X-ohms, 470; Z-ohms, 660. Control phase in parallel: 57.5 v.; 60 cps; 350 ma., power input 14.0 w.; power factor 0.70; R-ohms 115; X-ohms, 117; Z-ohms, 164. **Ketay Manufacturing Corps., 555 Broadway, New York 12, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

ELECTRICAL TAPE

A new "Scotch" high-strength electrical tape, (No. 56) has a one-mil "Mylar" polyester film backing, and a

thermosetting adhesive that sets after exposure to 250°F for three hours, or at 300°F for one hour. After curing, it withstands operating temperatures up to 220°F and has greatly increased resistance to solvents. Dielectric strength is greater than 5,000 v. Insulation resistance is greater than 100,000 megohms. Electrolytic corrosion factor is 1.0. Tensile strength is 30 lbs. in width. Stretch before breaking is 100%. Yellow in color the new tape is available in 72-yd. rolls and comes in ¼ to 1 in. widths. **Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn.**—TELE-TECH & ELECTRONIC INDUSTRIES.

UHF-VHF Antenna

(Continued from page 93)

equal to the impedance of the 300 ohm lead in.

While a minimum of two reactive elements must be changed to move the point of perfect match from one frequency to the next it was decided for this antenna to use three in order to keep the antenna balanced. A simplified circuit of the matching network is shown in Fig. 3. As indicated in the figure the antenna dipole with end caps looks, in the low VHF band, like a resistance in series with a capacitance impedance wise. Two coils L have more reactance than the antenna capacitance so that the impedance at the lead in terminals in the absence of C_1 would look inductive. The values of L are chosen such that when a value of C_1 is used which parallel resonates the antenna-coil combination the parallel resonant impedance is not only purely resistive but equal to 300 ohms.

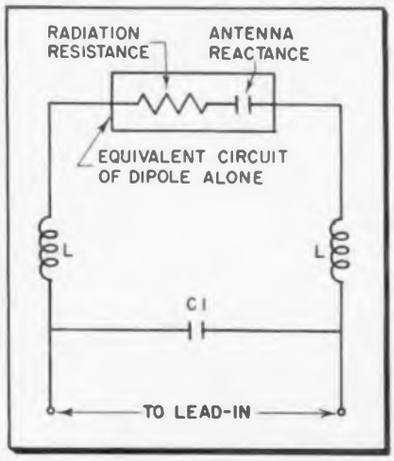


Fig. 3: Simplified circuit of matching network

The complete circuit of the antenna

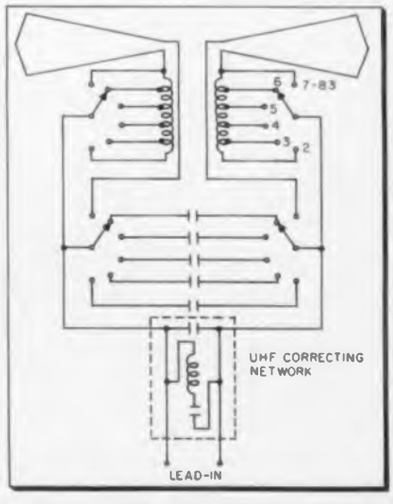


Fig. 4: Double-wafer four-pole selectro switch selects channels in complete circuit

FOR SUPERB FILM REPRODUCTION in COLOR AND MONOCHROME

SEE THE NEW PHILCO

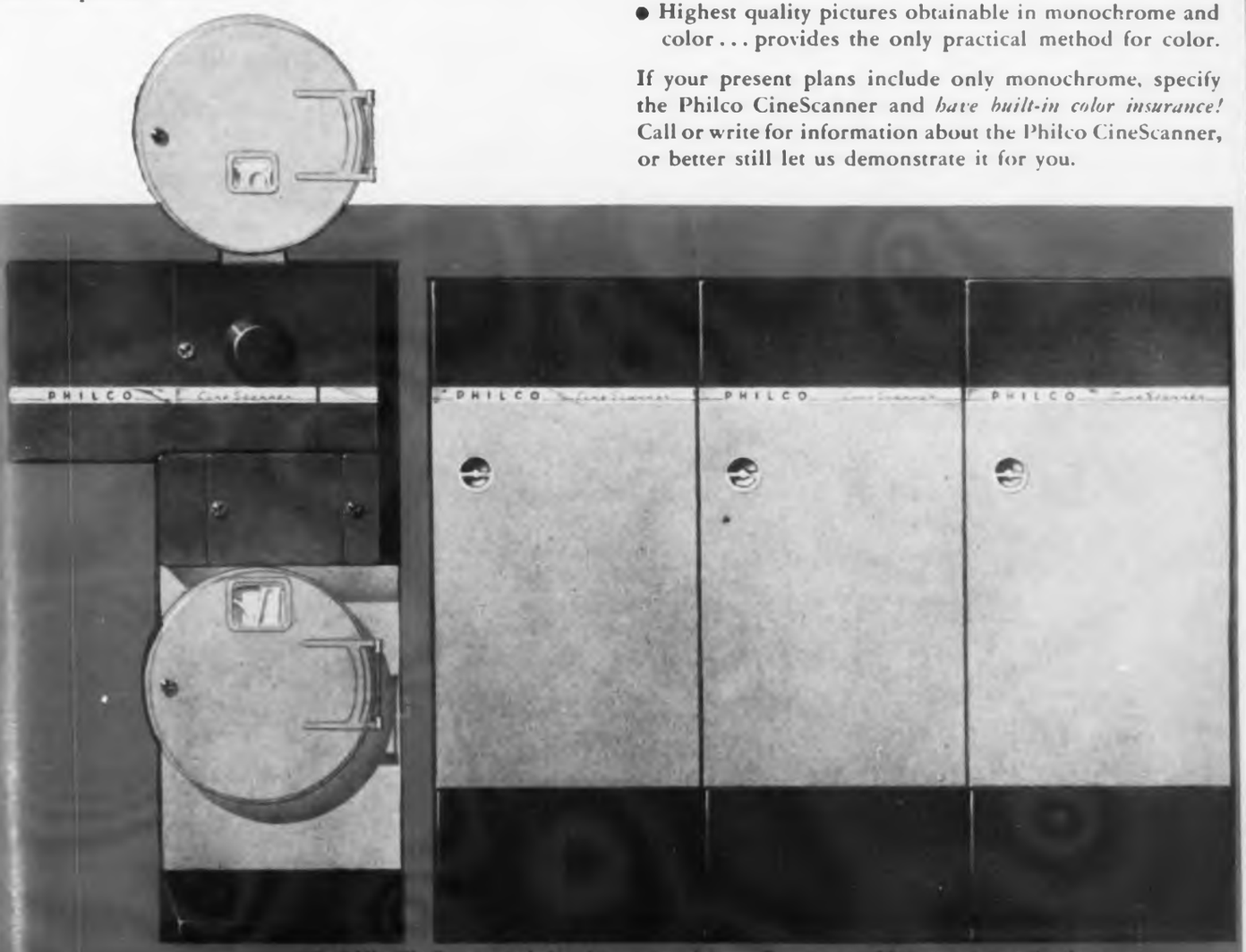
CineScanner

This is the revolutionary new television Film Scanner developed by Philco, demonstrated to industry and now in production.

Designed to provide the best possible film projection for both color and monochrome film, the CineScanner has these important features:

- Quiet continuous film motion . . . no complicated intermittent mechanism to wear and cause film breakage.
- Cold light source . . . no film burning.
- Instantaneous run-up time with provision for quick starts and stops . . . remote control available.
- Highest quality pictures obtainable in monochrome and color . . . provides the only practical method for color.

If your present plans include only monochrome, specify the Philco CineScanner and *have built-in color insurance!* Call or write for information about the Philco CineScanner, or better still let us demonstrate it for you.



The Philco CineScanner is designed to occupy minimum floor space and for greatest operational use.

PHILCO QUALITY

PHILCO CORPORATION

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is shown in Fig. 4. A two wafer four pole selector switch is used for selecting different channels.

Since the antenna is nearly one half wave length long in the high VHF band all that was necessary to

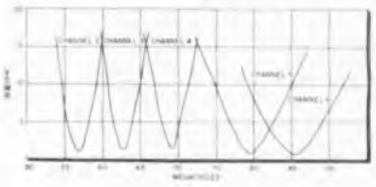


Fig. 5: SWR for low VHF band positions

obtain a good impedance match was to so shape the dipole elements from diverging metal straps as shown in Fig. 1 that effectively two cones with end caps are formed. No external matching network was needed here.

Matching—UHF Band

The connections for receiving channels 7-13 are the same as for channels 14-83. The standard selector switch has too much series inductance and distributed capacitance for good UHF switching however and destroys the good UHF impedance match that the antenna would otherwise have. In order to correct for this mismatch a one μμf condenser, C_2 of Fig. 4 is placed across the lead in one inch from the switch terminals and a series reso-

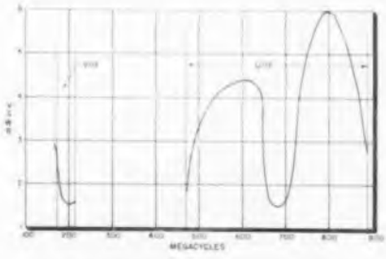


Fig. 6: SWR for high band VHF and UHF

nant circuit, C_3, L_3, resonant at 400 MC is shunted across the lead-in 7 in. from C_2. These elements are so small as to have negligible effect in the VHF bands.

The VSWR of the completed antenna is shown in Fig. 5 and Fig. 6.

A photograph of the unit is shown in Fig. 2 with a portion of the top of the outer radome covering tube cut away. The antenna is mounted to the base by means of a rotating joint for ease of orientation. A knob is mounted at the top of the unit to be used in rotating the antenna so that it will not be necessary to grasp the antenna in a region where hand capacity will effect the operation.

First Transatlantic Telephone Cable

The Long Lines Dept. of AT&T has announced plans to construct the first telephone cable system across the Atlantic Ocean. It will be by far the longest underseas voice cable in the world and the first laid at depths found in mid-ocean. An agreement has been signed for construction of the cable by AT&T, the British Post Office, and the Canadian Overseas Telecommunication Corp. It will be owned jointly by these three organizations. Developmental and research work on such a cable has been going on for 25 years. The project will take three years to complete and will cost $35,000,000.

The submarine cable will contain a group of telephone circuits between New York and London, and another group between Montreal

Route of projected transatlantic telephone cable system. It will be by far the longest (some 2,000 nautical miles) underseas voice cable in the world and the first to cross an ocean

and London. It will handle 36 simultaneous conversations. At the gateway cities the circuits will connect with the telephone systems of the respective countries. The transatlantic portion of the system, with its many vacuum tube repeaters, will be 2,000 nautical miles in length and will be laid in depths up to three miles on the ocean floor between Scotland and Newfoundland. It will then connect with another submarine cable extending 300 miles westward to Nova Scotia.

There will be over 100 underwater repeaters on the transatlantic segment of the proposed system. The repeater is housed in a copper tube 7 ft. long and 1.5 in. in diameter. The three vacuum tubes used in each of these amplifiers have been under development for years and have withstood both laboratory and underwater operating tests of the severest kind. The voice currents will travel along coaxial conductors which will be insulated by a solid layer of polyethylene. Power to operate the vacuum tubes on the ocean bed will be fed in from both ends of the cable along the same coaxial conductor. The cable will be protected by a wrapping of copper foil, over which there will be a heavy cover of jute and steel wires, producing an overall diameter of 1.25 in.

CUES for BROADCASTERS

(*Continued from page* 89)

made of standard size E laminations by a local transformer manufacturer. The center section core, where most of the flux is, is large enough to cover the entire width of a 10½ in reel of tape.

In use, the reel of tape is rotated slowly and evenly on top of the eraser, so that all of the tape passes over the center of the core. Then it is slowly withdrawn from the field. The switch is turned off when the reel is about 3 ft. away. The whole procedure takes about 15 seconds. Although bulk-erased tapes have less noise than head-erased tapes, it is usually not possible to produce lower noise recordings because the bias on the record head would have to be disconnected. To check possible noise reduction, record a bulk-erased tape with the recorder operating normally, but with no input signal, and again with the tape lifted off the erase head with a shim. Check the difference in noise on playback.

Some care must be exercised in disconnecting the erase head, as it is probably fed by the same oscillator that provides record bias. The waveform, purity and magnitude of the bias must not be disturbed.

Testing Harmonic Radiation

GERALD W. LEE, Canada House, Trafalgar Square, London, England

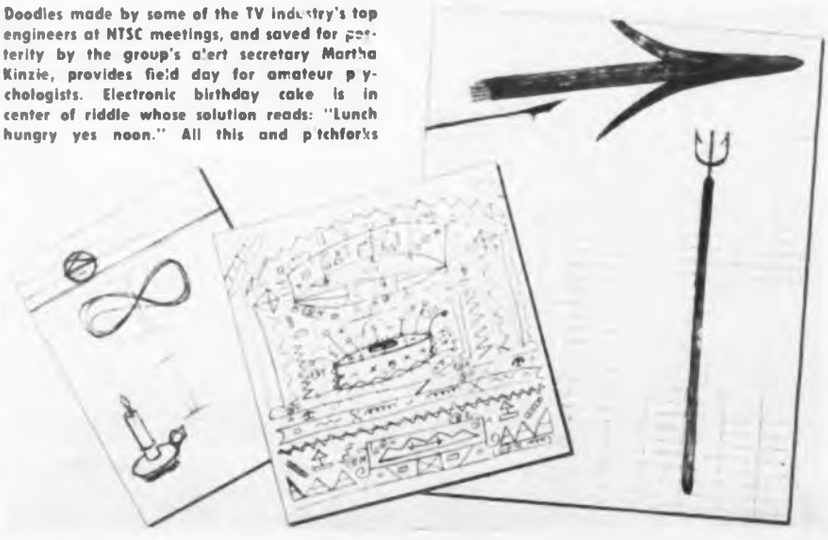
CANADIAN broadcast transmitter regulations state that no single frequency harmonic shall exceed 0.05% of the output at the fundamental frequency or ½ watt whichever is greater; and the root sum square of all r-f harmonics shall not exceed 0.1% of the output at the fundamental frequency or 1 watt whichever is greater.

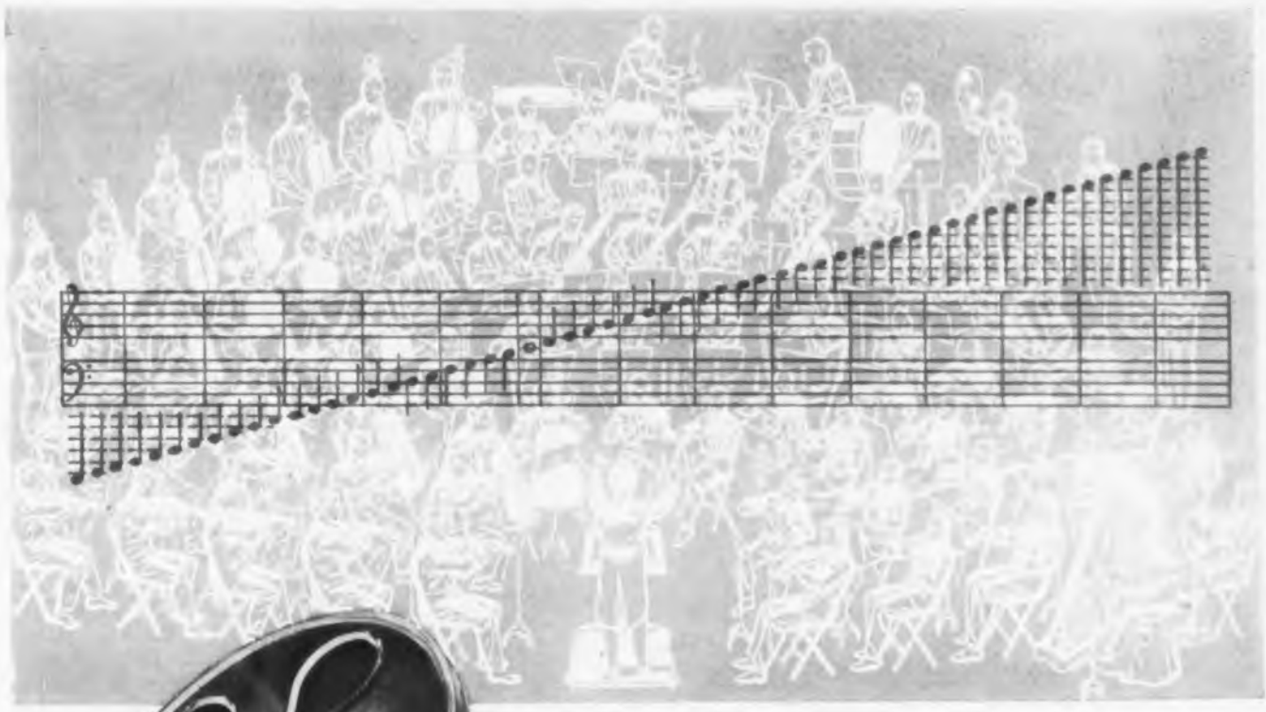
As field intensity meters are rarely of greater accuracy than 5%, these regulations cannot be satisfied by directly measuring the harmonic radiation, and more accurate methods must be devised. One used successfully on a number of stations is to compare the harmonic radiation from the broadcast transmitter with the radiation from a test transmitter with accurately calibrated output, on the same frequency as the harmonic. The procedure is as follows:

1. Set up a portable test transmitter at the broadcast transmitter location, and adjust to the required harmonic frequency, and ½ watt radiated output.
2. Set up a field intensity meter a suitable distance away and measure the test transmitter radiation.
3. Shut down the test transmitter and energize the broadcast transmitter at licensed power.
4. Without re-adjusting, except for frequency trimming, read the harmonic radiation on the field intensity meter.
5. Compare the two measured radiations. If the broadcast transmitter harmonic is stronger than the test transmitter further tuning adjustments are required before the broadcast transmitter satisfies the regulations. This procedure can be run through for each harmonic. To get the root sum square, the test transmitter output is adjusted downward to equalize each harmonic in turn; then the RSS of the test transmitter outputs taken, which must be below one watt. In practice, there is usually very little radiation above the second harmonic.

NTSC DOODLES

Doodles made by some of the TV industry's top engineers at NTSC meetings, and saved for posterity by the group's alert secretary Martha Kinzie, provides field day for amateur psychologists. Electronic birthday cake is in center of riddle whose solution reads: "Lunch hungry yes noon." All this and pitchforks





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Suppose you're recording a symphony orchestra. Every note and overtone of every instrument must come through with the same relative value as in the live performance. And Audiotape's more uniform frequency response preserves this tonal balance to the fullest possible extent.

This means faithful, well-balanced reproduction of all musical instruments, from the lowest rumble of the bass tuba to the highest overtones of the piccolo. It's a factor to which the trained ear is particularly sensitive — an Audiotape advantage that appeals strongly to the most critical professional recordists.

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Export Dept., 13 East 40th St., New York 16, N.Y. Cables "ARLAB"

Transistor

(*Continued from page 87*)

How is it assembled? In Fig. 1 is a magnified, cross-sectional view showing a germanium wafer which has been etched so that its thickness at one spot has been reduced to about 0.0002 in. In the craters thus produced there are electroplated electrodes of the metal indium. Note that the collector is slightly larger than the emitter and that a base lead is taken from the n-type germanium crystal. This mighty-midget is now ready to be surrounded with heat-insulating material and placed in its hermetically-sealed metal container which is spot-welded to the base as shown in Fig. 2.

Technique of Producing the Surface-Barrier Transistor: Extremely pure germanium crystals are grown in the usual manner. These are sawed into thin, rectangular wafers. A wafer is clamped on a micrometer-adjustable table so that the desired spot on both faces will be placed in the center of the etching spray, as shown in Fig. 3. Electro-chemical etching with a spray containing indium salts takes place when current is supplied by connecting the proper battery polarity to the germanium wafer and to the conducting spray. The liquid is fed through the nozzles rather slowly, but the exact time it requires to penetrate the wafer is carefully observed by the operator, employing a microscope as illustrated in Fig. 4. Let us assume that the "drilling" or etching time required is 35 sec. This test hole can be seen in Fig. 1. The wafer is then moved by a small amount by moving the table on which it is clamped and a new hole is started by the etching process, only this time the process is stopped after, say 33 sec. The result is that a layer of germanium about one molecule thick remains between the craters.

Indium Electroplate

Etching is stopped at the desired time and the electroplating of indium on both sides ot the thin layer is begun by reversing the polarity of the battery by means of the switch shown in Fig. 3. Plating is continued until electrodes have been built up to convenient size for the soldering of the lead wires. After this the unit is ready for test and mounting.

Mr. Woods said that heretofore inability to control production methods has limited transistor production but now with the Philco technique, the highest mechancial precision with tolerences of 10 millionths of an inch can be obtained in "ma-

chining" germanium. It is believed Philco is also trying the technique on silicon, but on this subject they had nothing to report. It must be remembered that germanium is photo-sensitive and therefore must be processed under controlled light conditions.

Advantages of method: The thin germanium barrier, affording high frequency operation, can be obtained by a relatively simple, accurate, reproducible operation. The germanium is not mechanically strained. The good performance of the alloy type transistor can be obtained without the indefinite, hit-or-miss penetration of the alloying metal electrodes.

While indium was used in experimental work it has been found that zinc, cadmium and tin (but not

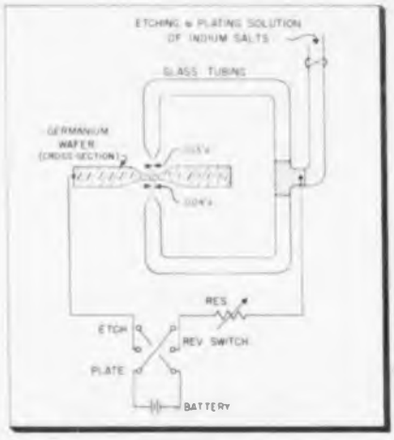


Fig. 3: Electro-chemical etching of germanium wafer is controlled by polarity switch. Etched area is plated with indium and leads soldered

lead) can be employed. The barrier is clean and easily electroplated. One of the difficulties of early commercial transistors was inoperativeness due to a layer of moisture which accumulated on the germanium surface, but with the surface-barrier type, although etched by a stream of liquid, it seems to suffer no ill effects of moisture.

Electrical Performance of Surface-Barrier Transistors: It is too soon for the characteristics of these newly developed transistors to be available but some idea as to their performance can be gained from statements by Mr. Woods and Mr. Smith.

The maximum battery voltage required is 3 volts. Compare this with 22 volts needed for some other types of transistors.

The power consumption in the Philco device is 2 milliwatts compared to 50 mw for some types.

It is well known that some types of transistors do not operate at high frequency, that is beyond 1 MC, in

TRANSISTOR (Cont.)

spite of much research here and abroad. The surface-barrier type is listed as operating at "50 MC plus" and Mr. Woods said that reliable operation had been obtained up to 70 MC.

There is a limit to the breadth of the frequency band over which some of the types operate and another important feature is the "noise" output of the device. We naturally want the former to be as wide as possible and the latter as low as possible. Here again it was indicated that the Philco device was equal to or better than the best of the existing types.

Demonstrations: Mr. Smith showed to the press representatives a model of a Sea Rescue Beacon. Underneath a little wooden boat were the elements of a sea battery; on top was a

Fig. 4: Operator carefully observes etching of germanium for surface-barrier transistor

surface-barrier transistor oscillator radiating into a vertical wire antenna. When the boat was dropped into a dish of salt water, the battery was energized and the miniature transmitter sent out a signal that was picked up some distance away as an audible beat note on a radio receiver. This showed that a life raft could be equipped to send out such a signal to aid in directing searching aircraft.

A pocket radio receiver, roughly 6 x 3 x 1 in., equipped with the new transistors was demonstrated while receiving speech from the usual portable transmitter. It was powered by two flashlight cells. The low power consumption of the Philco transistors would permit the use of such a receiver for 10 hours a day for many months without battery renewal.

The field of electronic computers was mentioned. Here there would be a saving of power and weight and an increase in speed of switching when using the surface-barrier transistor.

Patents: Patent applications have

been filed covering the various features connected with this new transistor. Some time ago Bell Labs. licensed companies to use their transistor patents, requiring as part of the contract that these licensees give a free license to BTL under any transistor patents they might obtain. It is the belief of one reporter that from the long list of BTL licensees, Philco's name was missing. If this is still the state of affairs, then Philco will be in an especially strong position with the patents they may secure in the transistor field. During the past decade, the growth of Philco's general patent situation has been such as to put that corporation in a major patent position in the electronic industry.

Commercial Situation: It was stated that no sales price nor date of commercial production on these new transistors could be set now.

AIEE TV Technical Program Set

The technical paper program sponsored by the Committee on TV and Aural Broadcasting Systems for the 1954 AIEE Winter Convention has been announced by Chairman Charles E. Dean. The convention will be held in the Statler Hotel, New York City, Jan. 18-22. Papers to be presented are:

Differential Gain and Phase Measurements in Color TV Systems—H. Kelly, Bell Tel. Labs.

Photo-Electric Colorimeter for Color TV—J. B. Chatten, Philco

Phase Analyzer for Color TV—J. F. Fisher, Philco

Transmission of Color Over Intercity Networks—J. A. Rae, A. T. & T.

Color TV Camera Equipment—F. W. Millspaugh, RCA

Equipment for Color TV Broadcasting—R. Popkin-Clurman, Telechrome

Color TV Studio Design from an Operational Standpoint—R. Montford, NBC

Color TV Equipment for the Broadcaster—O. W. B. Reed, Jr., Jansky and Bailey

High-Gain Side-Firing Helical Antennas for UHF TV Broadcasting—H. G. Smith, Cornell U.

The Wavestack, a New Type of Antenna for VHF Broadcasting—G. B. MacKimmie, RCA, Canada

A UHF Transmitter Employing Klystron Power Amplifiers—W. H. Sayer, DuMont Labs.

An On-Channel TV Satellite System—L. E. Rawls, Station WSM

Community TV Systems—M. F. Malarkey, Jr., Trans-video Corp.

Very Small Speaker-Type Personal Broadcast Receiver—K. James, Emerson

An Improved Vertical Sync Circuit—A. M. Levine, H. Altman & L. Feit, Federal Telecommunications Lab.

A Radio-Relay Remote-Control System for FM Broadcast Stations—T. R. Humphrey, Rural Radio Network

Automatic Remote Broadcast Stations—S. H. VanWambeck, Hammarlund

Torque Requirements of a Radar Antenna—Melvin Mark, Raytheon

Fellow Awards for 1954 Announced by IRE

Seventy-six radio engineers and scientists have been named Fellows of the Institute of Radio Engineers by the Board of Directors. The grade of Fellow is the highest membership grade offered by the Institute and is bestowed only by invitation on those who have made outstanding contributions to radio engineering or allied fields.

Presentation of the awards with citations will be made by the President of the Institute at the Annual Banquet on March 24, 1954 at the Waldorf-Astoria Hotel in New York City during the IRE Convention.

Recipients of the Fellow award are:

Foreign Recipients

D. C. Espley, Chief Engineer, Telecommunications Research Laboratories of the General Electric Co., Ltd., North Wembly, England.

A. W. Montgomery, Joint General Manager Standard Telephones and Cables Ltd., London, England.

Yasujiro Niwa, President, Tokyo Electrical College, Tokyo, Japan.

M. J. H. Ponte, Director, Compagnie Generale de Telegraphie Sans Fil, Paris, France.

Herre Rinia, Director of Research, Philips Research Labs. N.V., Philips Gloeilampenfabrieken, Eindhoven, Netherlands.

Canadian Recipients

J. E. Hayes, Chief Engineer, Canadian Broadcasting Corp., Montreal.

George Sinclair, Associate Professor, University of Toronto; President, Sinclair Radio Laboratories, Ltd., Toronto, Canada.

B. R. Tupper, Manager and Chief Engineer, Northwest Telephone Co., Vancouver, B.C., Canada.

United States Recipients

E. I. Anderson, Assistant Manager, Industry Service Lab., RCA Laboratories Div., New York, N.Y.

A. V. Astin, Director, National Bureau of Standards, Washington, D.C.

W. F. Bailey, Engineer, Hazeltine Corp., Little Neck, N.Y.

D. S. Bond, Research Engineer, RCA Laboratories Div., Princeton, N.J.

M. R. Briggs, Manager, Missile Ground Control Engineering, Westinghouse Electric Corp., Baltimore, Md.

I. F. Byrnes, Vice President of Engineering, Radiomarine Corporation of America, New York, N.Y.

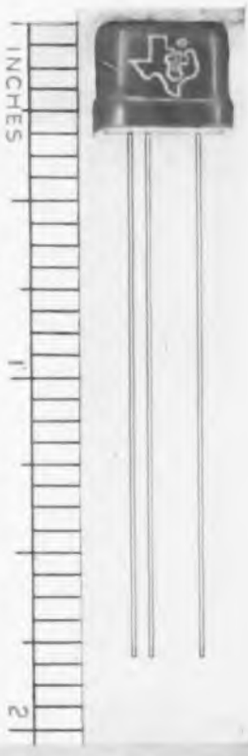
Madison Cawein, Consultant, Diamond Power Corp., Lancaster, Ohio.; P. R. Mallory and Company, Inc., Indianapolis, Ind.

J. G. Chaffee, Technical Staff, Bell Telephone Labs., Inc., New York, N.Y.

Britton Chance, Director, Johnson Research Foundation, University of Pennsylvania, Philadelphia, Pa.

(*Continued on page* 118)

TI transistors will FIT in Your Future!



FORTY PERCENT SIZE REDUCTION has been made in Texas Instruments junction transistor cases. With case length now less than a third of an inch, TI transistors offer you a major opportunity for equipment miniaturization.

This important size reduction was achieved without reducing the quality or changing the construction of the proven TI junction transistor. Transistor fabrication methods, materials, and moisture-proof glass-to-metal hermetic sealing remain the same.

Texas Instruments junction transistors undergo an exhaustive testing procedure to insure their close adherence to published specifications (see distribution curves below). And not only must all transistors pass more than 20 test procedures—in addition to continual visual checks—but also they are aged over 48 *hours* at rated output. They are then completely re-inspected, as a positive operating double-check.

If *you* want transistors combining small size with high quality, they are now in production and available in five types from Texas Instruments Incorporated. Write for bulletins DL-S 310 (junction) and DL-S 312 (point-contact). Custom-built units also are available.

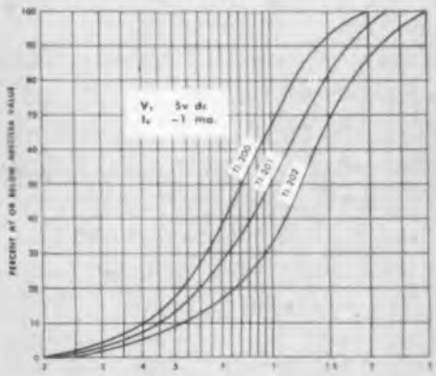
ELECTRICAL DATA:

	n-p-n junction transistors type 200	type 201	type 202	
RATINGS, RECOMMENDED MAXIMUM:				
Collector Voltage	30	30	30	volts
Collector Current	5	5	5	ma.
Collector Dissipation (at 25° C)	50	50	50	mw.
Ambient Temperature	50°C	50°C	50°C	
AVERAGE CHARACTERSTICS (AT 25° C.):				
Collector Voltage	5	5	5	volts
Emitter Current	−1	−1	−1	ma.
Collector Resistance (Minimum)	4	4	4	megohms
Base Resistance	150	170	200	ohms
Emitter Resistance	22	22	35	ohms
Current Amplification Factor* (Minimum)	9	19	49	
Collector Cutoff Current (Maximum)	10	10	10	μa.
Collector Capacitance	15	17	19	$\mu\mu$fd.
Noise Factor** (V_C = 2.5 V., I_C = −.5 ma)	26	23	20	db
Frequency Cutoff** (α_{CO})	90	1.10	1.30	m.c.

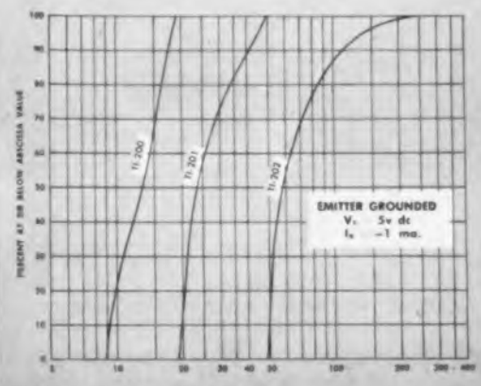
*Emitter Grounded

**Noise Factor and Frequency Cutoff are average and individual units may vary

STATISTICAL DISTRIBUTION CURVES
Based on 100 transistors of each type



α_{CO} — Alpha Cutoff Frequency — megacycles



K — Current Amplification Factor

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

IRE FELLOWS (Cont.)

Marvin Chodorow, Associate Professor, Stanford University, Stanford, Calif.

D. H. Clewell, Director, Field Research Labs., Magnolia Petroleum Co., Dallas, Texas.

R. B. Colton, Major General (retired), U.S. Army, Washington, D.C.

M. S. Corrington, Radio Engineer, RCA Victor Div., Camden, N.J.

P. M. Craig, Vice President of Engineering, Radio and Television Div., Philco Corp., Philadelphia, Pa.

C. A. Culver, Senior Physicist, Southwest Research Institute, San Antonio, Texas.

F. M. Doolittle, President and Treasurer, Connecticut Broadcasting Co., Hartford, Conn.

W. L. Dunn, Vice President in charge of Sales and Engineering, Raytheon Television and Radio Corp., Chicago, Ill.

N. E. Edlefsen, Director, Electromechanical Engineering Dept., North American Aviation, Downey, Calif.

M. A. Edwards, Manager of Engineering, X-Ray Dept., General Electric Co., Milwaukee, Wis.

C. L. Engleman, Captain, U.S. Navy.

D. H. Ewing, Director of Research Services, RCA Laboratories Div., Princeton, N.J.

R. M. Fano, Associate Professor, Massachusetts Institute of Technology, Cambridge, Mass.

E. P. Felch, Technical Staff, Bell Telephone Laboratories, Inc., Murray Hill, N.J.

J. L. Finch, Design Superintendent, RCA Communications, Inc., New York, N.Y.

R. M. Foster, Professor of Mathematics, Polytechnic Institute of Brooklyn, Brooklyn, N.Y.

A. W. Friend, Director of Engineering and Development, Magnetic Metals Co., Camden, N.J.

E. G. Fubini, Supervising Engineer, Airborne Instruments Laboratory, Inc., Mineola, N.Y.

I. A. Getting, Vice President, Engineering and Research, Raytheon Manufacturing Co., Waltham, Mass.

J. E. Gorham (Deceased), Formerly Chief, Thermionics Branch, Signal Corps Engineering Lab., Belmar, N.J.

C. A. Gunther, Assistant Chief Engineer, Engineering Products Dept., RCA Victor Div., Camden, N.J.

J. P. Hagen, Naval Research Lab., Washington, D.C.

N. L. Harvey, Chief Engineer, Sylvania Electric Products, Inc., Buffalo, N.Y.

Walter Hausz, Manager, Development Engineering, General Electric Co., Syracuse, N.Y.

W. D. Hershberger, Professor of Engineering, University of California, Los Angeles, Calif.

R. D. Huntoon, Director, Corona Labs, National Bureau of Standards, Corona, Calif.

R. G. E. Hutter, Head, Physical Research Branch, Sylvania Electric Products, Inc., Bayside, N.Y.

J. F. Jordan, Chief Engineer, Baldwin Co., Cincinnati, Ohio.

W. R. Koch, Group Manager, RCA Victor Div., Camden, N.J.

J. D. Kraus, Professor of Electrical Engineering, Ohio State University, Columbus, Ohio.

J. B. H. Kuper, Chairman, Instrumentation and Health, Brookhaven, National Lab., Upton, N.Y.

J. M. Lafferty, Research Associate, General Electric Research Lab., Schenectady, N.Y.

J. J. Lamb, Director of Electronic Research, Remington Rand, Inc., South Norwalk, Conn.

Reuben Lee, Advisory Engineer, Westinghouse Electric Corp., Baltimore, Md.

W. D. Lewis, Director of Switching Research, Bell Telephone Laboratories, Inc., Murray Hill, N.J.

W. W. Mieher, Department Head, Armament Radar, Sperry Gyroscope Co., Great Neck, N.Y.

B. M. Oliver, Director of Research, Hewlett Packard Co., Palo Alto, Calif.

J. M. Pettit, Associate Professor of Electrical Engineering, Stanford University, Stanford, Calif.

Donald A. Quarles, Assistant Secretary of Defense for Research and Development, Department of Defense, Washington, D.C.

W. H. Radford, Professor of Electrical Communications, Massachusetts Institute of Technology, Cambridge, Mass.

Eugen Reisz, New York, N.Y.

T. C. Rives, Manager, General Electric Advanced Electronic Center at Cornell University, Ithaca, N.Y., General Electric Co., Syracuse, N.Y.

(*Continued on page* 120)

CITIZENS' RADIO

Stewart-Warner's "Portafone" two-way radio is one of first of its kind to receive FCC approval. Unit operates at 465 mc. Transceiver in 10.5 in. case weighs 28 oz. alone; 5.5 lbs. with portable case and battery. Output is 500 mw, and receiver sensitivity is about 12 μv

IRE FELLOWS (Cont.)

G. M. Rose, Jr., Manager, Advanced Development Group, RCA Victor Div., Harrison, N.J.

P. C. Sandretto, Assistant Technical Director, Federal Telecommunication Labs, Nutley, N.J.

Kurt Schlesinger, Head, Television Research Dept., Motorola, Inc., Chicago, Ill.

A. H. Schooley, Associate Superintendent, Naval Research Lab., Washington, D.C.

H. J. Schrader, Manager, Advanced Development FPD, RCA Victor Div., Camden, N.J.

A. C. Schroeder, Television Engineer, RCA Laboratories Div., Princeton, N.J.

G. R. Shaw, Chief Engineer, Tube Department, RCA Victor Div., Harrison, N.J.

R. F. Shea, Supervisor, Semiconductor Applications Engineering, General Electric Co., Syracuse, N.Y.

Samuel Silver, Professor of Engineering Science, University of California, Berkeley, Calif.

E. A. Speakman, General Manager, Fairchild Guided Missile Div., Wyandach, N.Y.

W. L. Webb, Manager, Missile Section, Bendix Products Div., Bendix Aviation Corp., Mishawaka, Ind.

P. T. Weeks, Wellesley Hills, Mass.

J. O. Weldon, President, Continental Electronics Manufacturing Co., Dallas, Texas.

K. R. Wendt, Manager, Advanced Development, Sylvania Electric Products, Inc., Buffalo, N.Y.

E. M. Williams, Project Engineer, Naval Ordnance Lab., Silver Spring, Md.

J. R. Wilson, Director, Electronic Apparatus Development, Bell Telephone Laboratories, Inc., Murray Hill, N.Y.

D. E. Wooldridge, President, Ramos-Wooldridge Corp., Los Angeles, Calif.

"Audio Jury" Evaluates Car Sounds

Chrysler Corp. has developed a procedure for tape recording car sounds and playing them back to a jury of "ears" to determine motorists' reactions to noise levels, which cannot otherwise be measured in terms of human hearing. Microphones are placed in the car at passengers' ear levels and the sounds are recorded on Magnecord binaural tape recorders. The tapes are played back to a group of average drivers who rate the amplified sounds subjectively. The resulting data guides design engineers. For example, in one test of a cooling fan, a 5% increase in fan speed made a substantial difference to the listening jury, despite the fact that the db meter reading remained unchanged.

KELLOGG SWITCHBOARD

Air Associates

Motorola

GENERAL ELECTRIC

WILCOX ELECTRIC COMPANY

HUGHES

UNION PACIFIC RAILROAD

Bendix AVIATION CORPORATION

SANGAMO ELECTRIC COMPANY

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MELPAR, INC.

RCA RADIO CORPORATION of AMERICA

...and many more!

C-A-C MOLDED TOROIDS

Stocked in Standard Inductances for immediate delivery...

NEW!

With the new molded toroid simplifying mounting problems and with the resultant demand increasing daily, C-A-C now offers an added convenience to buyers by stocking standard types for immediate delivery.

Write for file of complete specifications and listing of stocked inductances. C-A-C molded toroids meet the performance requirements of Military specifications.

Why is it?...

From a modest beginning five years ago, Communication Accessories Company has grown to one of the largest exclusive toroid coil winding producers in the U. S. today. Why?

We like to think that this growth is due to the thorough,, careful handling we apply to each coil . . . and because of the particular skill of our people. Whatever the reason, we'll continue — doing the best we know how — thankful for the trust that important companies have placed in us.

write for this catalog ———

COMMUNICATION ACCESSORIES Company

HICKMAN MILLS, MISSOURI

Styroflex for Eiffel Tower TV

A $6\frac{1}{8}$ in. styroflex cable was recently installed in the Eiffel Tower, Paris, France to connect new superturnstile antenna built by Compagnie Generale de Telegraphie sans Fil, to the TV transmitter. Photos below give an idea of the magnitude of this installation. The station has a 12 mc bandwidth and operates over the 175 to 187 mc range. Output of picture transmitter is 20 kw and that of the sound transmitter is 7 kw. For further details on styroflex cable see Tele-Tech, Nov. 1951, page 42.

Manufacturing styroflex cable at Felten & Guilleaume Carlswerk plant in Koln-Mulheim, Germany

Cable was shipped to France on gigantic reels. Reels were too large to be transported overland conveniently and had to be moved on barges

View of cable as installed in Eiffel Tower

BOOKS

Microwave Theory and Technique

By Herbert J. Reich, Philip F. Ordung, Herbert L. Krauss, and John G. Skalnik. Published 1953 by D. Van Nostrand Co., 250 Fourth Ave., New York 3, N. Y. 901 pages. Price $12.50.

With the far-reaching growth of the microwave art, the need has arisen for a text or reference work to provide a comprehensive fundamental analysis of microwave devices and the theory of their operation. The authors, all members of the electrical engineering faculty of Yale University, have been eminently successful in fulfilling this need. The book rates with the best on the subject.

The first two chapters cover the elements of field theory. The next four analyze the characteristics of transmission lines, waveguides and baluns. Chapter 7 covers antennas, and Chapter 8 measurements. Chapters 9 through 15 should be of considerable value to design engineers since they stress the physical principles underlying the function of microwave resonators, amplifiers and oscillators. Detailed attention is given to the various types of klystrons, magnetrons and traveling-wave tubes. A symbol index and a section on laboratory experiments at the end round out this most noteworthy book. AJF

Timing Engineering

By Myrten C. Saake. Published 1953 by Ribble Engineering Co., 74-90 Montgomery St., Jersey City 2, N. J. 243 pages. Price $5.00.

This informative book centralizes a vast store of knowledge on automatic timing systems for industrial processes. No attempt is made to present a profound analysis of timing problems. Rather it is a very practical handbook, which clearly describes the various types of timing and counting systems, and follows up with a large number of specific applications. This volume is to be highly recommended to production engineers, process designers, and anyone engaged in automation and quality control work. After a brief introduction covering the basic scope of timing, the text covers the circuitry and available equipment.

Hyperbolic Protractor for Microwave Impedance Measurements

By G. A. Deschamps. Published 1953 by International Telephone & Telegraph Corp., 67 Broad St., New York 4, N. Y. Includes plastic protractor developed at Federal Telecommunication Labs., and 44-page technical instruction booklet. Price $2.50.

Recording TV

(*Continued from page* 81)

cording installations. Enormous savings in money for program recording are anticipated as Dr. E. W. Engstrom, vice president of the Laboratories Div., revealed cost estimates. For the same program, recording on magnetic tape would be 5% to 10% of that which would have to be expended for recording on color film, and 10% to 20% of that necessary for recording on b-w film.

The demonstration at Princeton was presented in five parts. The first three parts were devoted to playbacks of previously recorded TV programs in black-and-white and also in color. Part four consisted of a live color television program via microwave from New York, the second half of which was simultaneously played back from tape the instant after it was recorded. A delayed complete playback of the program for part five concluded the demonstration. There were no apparent technical difficulties throughout the demonstration and the quality of the pictures being played back off the tape was extremely good for both b-w and for color. On a comparative basis the taped video was readily discernible against the live program. For b-w, relatively speaking, the recording appeared to look 90-95% as good as the original while for color a figure of 85-90% might be ascribed.

Although detailed technical information on the operation of equipment was not provided at this time, Dr. Engstrom did summarize some of the salient points as follows: The heart of the equipment lies in the newly developed high-frequency recording heads and to advances in the "servo-type" tape transport that permits an almost constant tape speed. For b-w recording, the equipment uses a ¼-in. tape and records video in one channel and sound in the other. For color, five channels on a ½-in tape are employed. The five channels are for red, green and blue, and for sync and sound signals. The tape in either case travels at the rate of 30 ft./sec. The video bandwidth for each channel (b-w or color) is 3 MC. It should be noted that in the recording of color-TV the present technique has been to demodulate the NTSC color signal at Princeton and to apply video information in separate color channels. Bandwidth limitations at present being at 3 MC will not accomodate the NTSC color subcarrier at 3.5 MC. RCA engineers do not regard this as an obstacle, however, saying

that research is still in progress to reduce tape speed and to expand bandwidth and that the 0.5 MC difference factor is well within sight. The present equipment, using reels 17-in. in diameter, records a 4-minute TV program. Work is now being directed toward a 19-in. reel to carry a 15-minute program.

Video tapes may be re-used or re-recorded as many as 20 to 25 times. It is the re-use factor which accounts mainly for the extremely low cost of the medium.

Radio Fall Meeting

This years' Radio Fall Meeting held at the King Edward Hotel in Toronto, Canada broke all previous records for attendance. Nearly 900 American and Canadian engineers joined in this highly successful conclave. Some candid snapshots taken during the event are shown below.

(Upper left) Dr. W. R. G. Baker, vice president General Electric Co. and Ralph Hackbush of Hackbush Electronics Ltd. in a lively pre-banquet discussion. (Right) Walter H. Furneaux v.p. of Aerovox Corp. at the banquet.
(Lower photo—l to r) B. F. Osbahr, Exec. Editor Tele-Tech; L. G. Cumming, Tech. Secretary of IRE; George W. Sterling, FCC Commissioner.

Mrs. Martha Kinzie, G.E., plaque recipient for her outstanding work in connection with the NTSC, addresses the banquet assembly. Shown also in photo (l to r) FCC Commissioner G. Sterling, Dr. W. R. G. Baker, GE v.p., and Virgil Graham, (JETEC Chairman), Sylvania Electric Products Inc.

PERSONAL

Leslie E. King has been appointed project engineer at Hydro-Aire, Inc., West Coast transistor manufacturing firm, and subsidiary of Crane Co., licensed to manufacture and sell transistors by Bell Telephone Laboratories. Mr. King will be in charge of Hydro-Aire's transistor research and development program.

Edmond S. Winlund has been appointed chief engineer of Gray Research and Development Co., subsidiary of The Gray Manufacturing Co., Manchester, Conn. Mr. Winlund, formerly associated with Radio Corporation of America and Westinghouse Electric

Edmond S. Winlund

Corp., is broadly experienced in radio broadcast transmitters, marine radar devices, and dielectric and induction heating equipment, and is a specialist in radio and microwave equipment for railroads.

Grant Graham fills the newly created post of product applications engineer at Triad Transformer Corp., Venice, Calif.

Robert S. Thomson has been appointed mechanical engineer for J. C. Warren Corp., Freeport, N. Y. Priorily, he was field engineer for Chemical Compounding Co. of Brooklyn, N. Y.; chief engineer for Johnson Cushing Nevell, New York City, and senior design engineer for Republic Steel.

Leslie Hill, Ph.D., has been appointed director of research for Pentron Corp., Chicago, Ill., manufacturers of recorders, high fidelity components, and accessories. Formerly, he developed electronic and mechanical devices for the British and Egyptian governments

Stanley L. Allen, Jr., Edmund J Bumsted, Joseph M. Gardner, Eugene L. Keenan, Robert E. Lee, Clyde T McGee, and **Walter E. Wilhelm** have joined the technical staff of the Hughes Research and Development Laboratories, Culver City, Calif.

Myles Spector has rejoined the Insuline Corporation of America, Long Island City, N. Y., after a tour of duty in the Air Force. He is in charge of the company's new product development program.

Paul E. Wible has been made a project engineer for Varo Manufacturing Co., Garland, Texas. Mr. Wible, with the Naval Ordnance Plant at Indianapolis, Ind., before his association with Varo, will conduct research and development in the field of electronics.

Robert E. Ricketts has been made chief engineer of Radio City Products. He will be located at 152 West 25th St.,

Robert E. Ricketts

New York City. His office will be attached to the Research, Development and Engineering Laboratories.

Dr. Raymond M. Fuoss has been employed as a consultant by United States Testing Co., Inc., Hoboken, N. J., and will be responsible for research activities in the company's Boston laboratories. He will also coordinate the work done between the Boston branch and the main laboratories in Hoboken. Dr. Fuoss, an authority in dielectrics, electrolytes, and polymers, has held various positions in the academic field and in industry since he received his Ph.D. from Brown University in 1932.

Caywood C. Cooley has been made vice-president and general manager of Jerrold Service Corp. Mr. Cooley was formerly engineering assistant to Milton J. Shapp, president of Jerrold Electronics Corp., Phila., Pa. **Robert J. Tarlton**, former head of Jerrold Service Corp., becomes manager of Jerrold Electronics' new Community Operations Division.

H. E. Crow has become chief engineer of Dage Laboratories, Inc., 1454 East North St., Decatur, Ill. Mr. Crow was chief engineer of station WHEN, Syracuse, N. Y., and also WBKB, Chicago, Ill. He was also associated with RCA, Zenith, and the Thorgeson Mfg. Co.

Simon Holzman has been appointed to the new post of field engineer by JFD Mfg. Co., Inc., Brooklyn, N. Y. His duties will include field testing antennas and other electrical TV accessories in key areas.

A Critical Look at Transistors

The first burst of enthusiasm over this new device, in the early months of its introduction, when people started to transistorize everything they could has now subsided. Relatively few transistorized equipments are offered commercially. Why?

So we asked a military man in a position to know, what he thought about transistors. His comments follow.

About 60 types of transistors are offered commercially but only a portion of these are actually available for shipment on order. These are about equally divided between the point-contact and junction types. The latter are mostly for low frequency use; the former will operate up to 5 MC. Although characteristics have been published on many types, the manufacturers at this stage are continually changing and improving their product, so we are hopeful for a better device, especially increased output, say several watts. Of course we would like transistors operating at higher frequencies and we know now that they should be 100% hermetically sealed. Temperatures above 160° F. cause trouble with germanium transistors; in fact, for some critical uses 130° F. is the limit in temperature. Silicon will have to be depended upon for operation at the higher temperatures. However theory says that silicon will not displace germanium for all uses.

Reliability

The mechanical simplicity and ruggedness of this device is good. It should have indefinite life. What caused the early failures we hear about? First, the difficulty of moisture. It was found that a layer of water vapor one molecule thick destroyed the performance of germanium. There were regions of high conductance near the junctions in the units. Hearing aids suffered until the cause was remedied by sealing.

Second, the mechanical strength and rigidity of the transistor mounting had to be improved because a change in the position of the contacts of the point-contact type of only 1° reduced or completely spoiled the usefulness of the device.

Third, complaints were heard that the output characteristic of some of the transistors were discontinuous. Actually what was encountered was the effect of regions of negative resistance.

In spite of early announcements to the contrary, there *are* reliability problems in connection with the transistor.

Do you want more information about PRODUCTS *advertised in*

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& ELECTRONIC INDUSTRIES

LEADING MANUFACTURERS

are using space in this issue to acquaint you with their products. Perhaps you want more information on some of them—on one or two, or possibly a score. You can cover all of your needs with the cards below. They are convenient and postfree.

Use the convenient postage-free card below to get information quickly about products listed here—all advertised in this issue

301 **Advance Electronics Co.** Phase-detectors
302 **Airdesign, Inc.** Custom-built transformers
303 **Alden Products Co.** Free test jack samples
304 **Allied Photo Engravers, Inc.** Etched electronic circuits
305 **Allied Radio Corp.** Free electronic supply catalog
306 **Alpha Metals, Inc.** Rosin filled solder
307 **American Lava Corp.** Low loss coil forms
308 **American Microphone Co.** Free microphone catalog
309 **American Phenolic Corp.** Free connector catalog
310 **Amperite Co., Inc.** Thermostatic delay relays
311 **Anderson Associates, H. V.** Metallizing consultants
312 **Arnold Engineering Co.** Silicon steel E-cores
313 **Artos Engineering Co.** Wire cutting-stripping machines
313A **Atlantic Transformer Corp.** Audio & mag. amplifier transformers
314 **Atlas Sound Corp.** Microphone stands
315 **Audio Devices, Inc.** Magnetic tape, 7-in. reels
316 **Auto-Test, Inc.** Electronic vehicle test equipment
317 **Bell Telephone Labs., Inc.** Transistors
318 **Bendix Aviation Corp., Red bank Div.** Reflex klystron tubes
318A **Berndt-Bach, Inc.** TV sound-on-film equipment
319 **Birtcher Corp.** Free subminiature tube clamp catalog
320 **Blaw-Knox Co.** Antenna towers
321 **Bliley Electric Co.** 15-100 mc sealed crystals
322 **Bradley Laboratories, Inc.** Vacuum-processed rectifiers
323 **Burnell & Co.** Toroids and filter networks
324 **Bussmann Mfg. Co.** Free fuse & clip bulletin
325 **Camera Mart, Inc.** Electric film timer
326 **CBS-Columbia** Engineering personnel
327 **Ceco Distributing Corp.** All-directional dolly
328 **Chicago Tele. Supply Corp.** Variable resistors for printed circuits
329 **Cinch Mfg. Corp.** Sockets-connectors-plugs
330 **Cinema Engineering Co.** Audio attenuators
331 **Cleveland Container Co.** Low-loss tubing
332 **Clippard Instrument Lab., Inc.** Automation aids, comparators
333 **Communication Accessories Co.** Molded toroids
334 **Corning Glass Works** High temperature film-type resistors
335 **Cunningham, Son & Co., Inc. James** Crossbar switches
336 **Daven Co.** Precision wirewound resistors
336A **DeJur Amsco Corp.** Precision connectors
337 **Dialight Corp.** Free pilot light handbook
338 **Diamond Microwave Corp.** Microwave test equipment
339 **DuMont Labs., Inc., Allen B.** Oscillograph-record camera
340 **Edison Inc., Thomas** Thermal relays
341 **Eisler Engineering Co., Inc.** Welders, turntables, cams
342 **Eitel-McCullough, Inc.** UHF klystrons
343 **Elco Corp.** Subminiature tube-sockets & shields
344 **Electro Motive Mfg. Co., Inc.** Free mica capacitor samples
345 **Electro Products Labs.** Communications power supply
346 **Fairchild Camera & Instrument Corp.** Precision potentiometers
347 **Federal Telecommunication Labs.** Engineering personnel
348 **Ford Instrument Co.** Engineering personnel
349 **Freed Transformer Co.** Test instruments, transformers
350 **Gates Radio Co.** Communications transmitters
351 **General Electric Co.** Filament & neon glow lamps
352 **General Electric Co.** Junction transistors
353 **General Electric Co.** Free broadcast amplifier data
354 **General Precision Lab., Inc.** TV camera & film chains
355 **General Radio Co.** Production comparison bridge
356 **Gertsch Products, Inc.** VHF frequency meter
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Computer Circuits

(*Continued from page 84*)

ordinary computer applications. Again, the problem was to use high temperature material. Ceroc "T" wire was used, with Mycalex chosen as core material and a high temperature silver paint as the ground plane. After winding, the delay lines were impregnated with silicone resin and baked. Considerable work was done on these lines to achieve the desired delay and impedance characteristics resulting in a maximum delay of 0.7 microsecond on a 2½-in. stick at 2200 ohms impedance A by-product of this work was a delay line with an essentially zero temperature coefficient of delay.

The silicone resin mentioned frequently is the General Electric SR-82. We have used this compound as a general purpose insulating varnish and binder with excellent results. It comes as a clear liquid and can be cured at 200° C. for one hour, or at lower temperatures for a longer length of time.

Another component developed exclusively for this project was the high temperature version of the quartz acoustic delay line. Two years ago the solid acoustic delay line was definitely in the development stage. The job of making a high temperature version of this unproven component was given to Andersen Laboratories, Inc., Hartford, Conn. We wish to acknowledge the work of that organization and of Mr. Walther Andersen in producing a satisfactory component under trying circumstances. The only modification we have made in these lines is a change in the case structure to minimize change of contact pressure with temperature. It must be emphasized that these high temperature quartz lines are not, by any means, production items and are still highly experimental. Quartz lines to operate to 120° C., however, are readily made.

Overall Structure

In considering the construction of this particular computer, there are several factors which should be emphasized. This machine, being the first of its kind, must necessarily be an engineering model and, hence, have its components parts accessible for developmental changes. Further, even a serial computer has a great deal of inter-unit signal wiring, and this must be provided. In the original specifications, no provision was made for forced air or other cooling, so good conduction paths must be provided for our heat sources. Also, superimposed on these

COMPUTER CIRCUITS (Cont.)

requirements was our desire to have a semi-standard unit type sub-chassis.

Our solution to the above problem is shown in Fig. 3. The sub-chassis is composed of an aluminum "L" bracket to which the component mounting boards are riveted. We have used turret lugs as rivets, thereby supplying electrical ground lugs where needed. Note that the vacuum tube, the main heat source, is secured directly to the aluminum by a subminiature shield mount so that a good thermal ground is achieved. The sub-chassis is mounted by four screws which attach the foot of the aluminum "L" to a heavy aluminum base plate (affording thermal conduction away from the sub-chassis).

Sub-units were mounted on $\frac{5}{8}$-in. centers as shown in the small assembly in Fig. 3 and the interwiring is carried on the series of fourteen terminals at the top of the component board. This number has proven, with careful layout, to be just sufficient. By clipping the wires and loosening the mounting screws, any chassis may be removed for modification or repair. Some idea of the scope of the machine may be gathered from the fact that it is built on four panels, each of which has four rows of 18 chassis.

Circuits

With the components chosen and a system of construction devised, one might say, "Let's build the machine." In effect, this is what we did; but very warily, testing each circuit thoroughly.

The first circuits to be constructed and tested were the well known and conventional computer circuits, typified by the coincidence gate shown schematically in Fig. 4. This simple unit is composed of a gating pentode, pulse transformer, two load resistors, and a series grid resistor. Its function is to yield an output when, and only when, there is a signal present on both grid one and grid three. Other elemental units built and tested include diode "or" circuits, Eccles-Jordan flip-flops, inhibiting circuits, etc. A group of these were assembled into a two input serial adder. Fig. 5 is a logical diagram of this adder. Its function is conventional, embodying a straight through path for a single "one," a coincidence path for "one pulse one," and the necessary carry loop.

The standard computer circuits, such as those described, featuring on-off type circuits, have been stabilized to the extent that fairly large

component variation is tolerable. Since we had been able to find components which would still function at 200° C., it came as no great surprise that the simple computer circuits would also function at this temperature. What has been extremely gratifying is that these circuits have operated at 200° C. with a minimum of trouble from the time they were designed and tested at room temperature. In fact, the characteristics of these circuits change so little in running from room temperature to 200°

Fig. 9: Acoustic delay unit and delay line

C. that it is difficult to observe. Fig. 6 is the typical output from a gate at room temperature and at 200° C. Without the caption, it would be hard to say which was which.

The relative ease with which we were able to deal with the standard computer circuits did not extend itself to the more complex circuitry. The auxiliary units which are necessary to the functioning of any computer were more serious problems. Typical of these was the acoustic delay line system.

System Operation

Briefly, the system operates in the following manner. The first unit of the system is the modulator in which the serial pulse information modulates a r-f carrier. The pulse bursts of r-f energy are conducted to a piezoelectric crystal which is bonded to a quartz slab. The energy, converted to ultrasonic vibrations, travels a complex path through the quartz to another crystal where it is reconverted to electrical energy. The output signal is greatly attenuated (approx. 40 db) and must be amplified before it can be detected and used as video pulse information.

The electronics of this system proved to be no great problem temperature-wise, since all of the modulators, amplifiers, and detection systems we tried exhibited the same temperature stability that our computing circuits had. The difficulty lay

in the temperature coefficient of attenuation of the quartz delay line, which we can see in Fig. 7. You can see that the signal strength remains nearly constant out to 125° Centigrade, at which point it begins to drop off with increasing severity showing 13 db increase in attenuation at 200° C. This effect is felt to be due to softening of the bonding agent between the piezoelectric crystals and the quartz slab.

The normal approach was to build excess gain into the amplifier so that the weakest signal would be adequate. However, there was another factor: the signal-to-noise ratio. With a single isolated pulse passing through the line, the noise level was normally 20 db down. The noise present is mostly due to acoustic dispersion within the quartz and occurs in several positions relative to the signal pulse. Consequently, when many pulses are present, the noise impulses often reinforce each other and appear considerably above the −20 db level. We were then faced with this problem. An amplifier with sufficient gain to give good signal output at 200° C. would amplify noise into spurious pulses at room temperature.

The successful solution was the insertion of a low gain video amplifier (Fig. 8) between the output of the band pass amplifier and the rest of the computer. Then, from the first stage of the video amplifier, by means of a peak detector circuit, we generated an automatic gain control voltage. This voltage was used to bias the output coil and detector load of the amplifier so that only the top third of the output voltage was used as input to the video amplifier. A fixed bias of −10 volts was superimposed on the automatically controlled voltage to insure stability when no signal was present. This system has proven reliable in numerous test runs to high temperature.

A note should be made that the acoustic delay circuitry, being largely radio frequency in nature, must be carefully shielded both from internal interaction and the effects of nearby video circuits. Fig. 9 is a photo of a complete system and of one of the quartz lines.

One effect of temperature on acoustic delay systems is of importance, due to its effect on other circuits. That is, its temperature coefficient of delay. This coefficient of approximately −70 parts per million per degree Centigrade, is a fundamental quantity of the machine and, because of pulse timing, must influ-

ence the temperature performance coefficients of other circuits such as the clock pulse generator.

By the very nature of the serial computer, there must be a direct relation between the long delay of the acoustic unit and the number of information pulses corresponding to the delay time. You can see, then, that the clock pulse generator must have a temperature frequency coefficient equal and opposite to the temperature delay coefficient of the acoustic line.

We were aware of this problem from the beginning, and so had chosen for a clock oscillator the Wein Bridge type, so often used by Hewlett Packard. The reason for the choice was that, in addition to

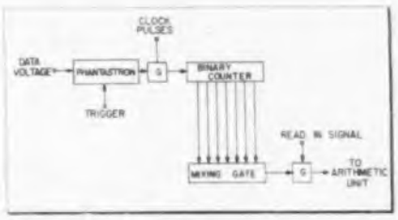

Fig. 10: Analog-digital conversion system

good stability, this oscillator used resistor-capacitor networks to control its frequency of oscillation. If you recall, we had a choice of resistive and capacitive temperature coefficients to work with. By a judicious choice of components, we were able to achieve the temperature coefficient of frequency that we desired. The nominal clock frequency is, incidentally, 500 kc.

The rest of the clock pulse generator presented no temperature problem. Two triode amplifiers and a fixed electrical delay line gave the two phases our logic required. Output drivers were class A cathode followers, requiring some of the higher wattage Welwyn resistors.

The entire unit has made many successful high temperature test runs.

One of the circuits we found most difficult to temperature compensate was the analog-to-digital conversion unit. Analog computer elements were rejected for this job because of their inherent temperature instability, but, since the input data was analog in nature, the problem had to be faced at this point. Several systems were considered, both in the laboratory and on paper. Our final choice, based on simplicity, since size was definitely a factor, and on the possibility of resistive capacitive compensation, was the screen coupled Phantastron.

The Phantastron is a circuit that,

when triggered, will yield a pulse whose duration is proportional to a limiting voltage imposed upon the Phantastron tube's plate. The limiting voltage is provided by the analog input data.

A block diagram of the conversion system using the Phantastron is shown in Fig. 10. When triggered, the Phantastron issues a pulse which opens the gate and allows clock pulses to count into the binary counter. Circuit components can be chosen so that the duration of the Phantastron output pulse is related to the clock frequency in such a way that the number accumulated in the binary counter is a direct representation of the analog data voltage. The mixing gate shown is a device to yield a serial binary number from the stationary number represented in the binary counter. The gate in its output is to read the information into the machine.

As could be expected by now, the binary counter and associated gates functioned very well at rated temperature, but not so the Phantastron. Original tests indicated that we were somewhat outside the range that our component choice method could correct.

There was no startling or original solution to this problem; only the application of a large amount of hard work. The circuit was analyzed down to the smallest component. Each one was optimized as to temperature coefficient and, finally, after nearly a hundred high temperature tests, we achieved some success. The final unit had a coefficient of conversion which was essentially zero to 170° Centigrade. From there to 200° C., the reference number increased a maximum of 3%. This is a smaller error than would be expected from the analog equivalent of the device over such a temperature range.

We have presented to you a resume of our experiences in building a digital computer to operate at extremely high temperatures. At the same time, we hope we have given useful technical information to those engaged in high temperature work. We have not hesitated to name the components that have been successful for us, but we definitely do not wish to say that these are the only ones that will work.

In the relatively short space of this development we have not been able to make prolonged tests of the equipment. Even so, we feel that some comment on service life is pertinent. Some reasonably complex units involving 75 to 100 vacuum

tubes have operated over 30 hours at high temperature and our original two input adder has logged over 50 hours at 200° C. without failure.

Another conclusion we have drawn from this project is that we have reached the practical temperature limit, at least for the present. We have measured hot spots in our apparatus as high as 230° C. At this temperature, every component we have used, with the exception of structural metal and copper wire, is nearing its absolute temperature limit. For example, the fine electrical glass used in subminiature vacuum tubes fails due to electrolysis if the bulb temperature rises above 250° C. Even the Ceroc teflon magnet wire has a maximum rating of 250° C. The list should include all resistors and capacitors and, of course, our quartz delay line's attenuation is increasing alarmingly, just over 200° C. For the present, at least, that old magic number 200° C. stands as the electronic temperature limit.

It should be pointed out that the result of this work is by no means production equipment but, rather, an engineering model. Some problems remain to be solved before 200° C. computers could be put into production. One fact is definite. Switching type circuits present much less of a problem than do class A or linear circuits.

We would like to close with one last acknowledgement to the component manufacturers with their conservative rating, healthy safety factors and progressive research departments. Without their help, 200° C. computers would have remained a dream.

TRANSMITTER for WLW-A

Pictured at signing of contract for delivery of a 50 KW television transmitter to WLW-A, Atlanta, are (seated) R. E. Dunville, president, Crosley Broadcasting Corp.; (standing, left to right) James Evans, sales engineer, Standard Electronics Corp., subsidiary of Claude Neon, Inc. K. T. Murphy, vice president and controller, Crosley Broadcasting Corp., William H. Zilliger, vice president, Standard Electronics

FM/FM Telemetering

(Continued from page 97)

feeding two notch exciters simultaneously from two transmitters operating on two radio frequencies separated by a few megacycles. The dimensions of the links between the transmitters and network are such that a very high degree of isolation is achieved between transmitters. The dimensions of the links between coupler and notch exciters provide for the correct phasing when the notches are used to form a single array.

The notch exciter shown at (A) on Fig. 4 is used to excite a plane surface as a dipole. The notch is an electrical quarter wavelength deep from the trailing edge and is tuned by a small condenser across one end. The width of the notch is about 1/72 of a wavelength.

General Characteristics: The majority of the airborne building blocks with the exception of the pickups, commutators, transmitters, and antenna systems are designed as plug-in units. These are accommodated in standard jack strips comprising one to eight elements and interchangeable connections. A six-element jack strip is shown at (A) on Fig. 1. It will be noted that provision is made in the cover to fit isolating screens at either end of a number of sections devoted to a single plug-in assembly. In the figure these shields, reading from left to right, are arranged for a one-element, two-element, and three-element unit.

Standard Tests

All telemetering airborne component-subassemblies are subjected to acceleration, vibration, pressure, and temperature tests. Where appropriate stability under power supply changes and other tests are called for in the Production Test Specification, the standard prototype tests include:

Vibration—±15 in two directions at right angles at 50 CPS.

Pressure—Minimum 7.5 mm Hg with

Temperature—Exposed to 300° F. atmosphere for 10 minutes and operate after exposure to —50° F. for 1 hour and 5 minute warm-up period.

Voltage Stability—±1% bandwidth shift for ±10% change in plate supply and ±20% change in filament supply.

The whole system as shown installed in a test rocket at (E) on Fig. 2, must be at near 100% reliable as possible. Accuracies vary with the type of measurement and test

conditions. Pressures and voltages have an accuracy of ±2% of full scale or better, while for temperatures the error may rise to ±5% full scale and for strains measured by strain gauges the error may be as high as ±10%. Stability of pick-ups in storage maintains their original calibration good to within ±1%.

System Considerations

The Applied Physics Lab. Telemetering Group was set up to provide complete telemetering services to other groups in the Laboratory engaged in a research program. The immediate goals were therefore extreme versatility and reliability and the meeting of a series of deadlines. The wide range of requirements may be illustrated by two typical installations. One employs three high frequency subcarrier bands with continuous very high response information on one and a number of intelligence channels of lower response on each of the other two bands. This latter is accomplished by time division, or sampling of the channels in turn with a commutator switch, for a total of 15 intelligence channels. This complex modulation signal is used to frequency modulate a single r-f carrier. Contrast this installation with a second employing two r-f carriers, each modulated by ten subcarrier bands. The highest of these bands transmits alone 35 odd channels, while of the remaining nine some carry continuous information and others a few commutated channels switched at a low-rate to provide long samples of each function or measurand. This system transmits a total of some eighty intelligence channels.

The reliability, which approaches 100% in actual flight tests, has only been achieved by very rigid testing specifications carried out all down the line from the arrival of manufactured parts, through component sub-assembly production, to final installation check-out. The great majority of this testing and inspection is today performed at the associate contractors engaged in these operations, and this has necessitated a gradual increase in the responsibilities of these contractors after careful indoctrination and long experience in this type of work.

The requirement to meet deadlines, more especially when much of the assembly and installation was carried out at APL, led to the bypassing of many of the finer points which the research worker would like to pursue, and which, if a complete study is to be made, must ul-

timately be included in the final report.

To achieve a more precise knowledge of the system necessary with the increased complications of the applications presently in view, a series of tests have been planned, and some have been completed. Several of these tests appear to require the development of new test gear and specific details of this new equipment can be obtained from the Telemetering Group. Their general character will be indicated in the text.

A block diagram of a typical test rocket is given in Fig. 17.

Subcarrier Bands

The 10 subcarrier bands have been proved in flight tests including the firing of special rockets as telemetering test vehicles. A study of the records obtained, together with those from many laboratory experiments, have led to an intensive study into the specification for the modulating signals applied to the r-f transmitter/modulator for optimum operation within the bandwidth available. As a result of these tests a procedure has been established, which indicates the degree of pre-emphasis which should be incorporated in the modulation circuits, dependent on the number and value of the subcarriers to be included.

To apply these specifications a new piece of gear has been acquired. This is capable of measuring the independent subcarrier amplitudes in a complex signal employing frequency division modulation over the range 1000 CPS to 160 KC, to include the second harmonic of our highest subcarrier frequency. This enables the setting up of each subcarrier signal to a precise value according to the prescribed pre-emphasis curve, rather than the establishment of a precise total signal and less accurate individual components as had been the earlier procedure.

Aims of Second Study

A second study, which is being undertaken, is aimed at determining the exact electrical characteristics of each element of each intelligence channel with respect to its individual role in the overall system. Such items as phase shift, attenuation, or amplification, harmonic distortion and noise introduction will be included. To make satisfactory phase measurements an accuracy of 1° must be maintained over the con-

tinuous frequency range 10 CPS to 70 KC, and the instrument should provide a direct reading scale of 0-180° or 0-360°. An Audio Sweep Frequency Generator, operating over a frequency range of 10 CPS to 100 KC, with a linear sweep adjustable both in range and sweep rate, is another item of test gear which was found necessary. This equipment has provided automatic calibration to indicate several known frequencies during each sweep. Studies of the

(*Continued on page* 142)

Color TV Screen Formed Photographically

In the development of a color television picture tube screen, three different phosphor materials may be placed in an interspersed dot pattern on a glass plate; a phosphor for each of three primary colors, red, blue, and green. In the accompanying photo, D. J. Bracco, engineer at Sylvania Research Laboratories, Bayside, N.Y. uses a photographic method of forming the complex color TV picture

tube screen. Light from the point source zirconium lamp passes through an aperture plate containing more than 200,000 precisely spaced small holes. Rays of light fall in the desired dot pattern on a photographic emulsion containing the color phosphor. After controlled exposure and processing, only the phosphor remains in the pattern. The process is repeated for the other two phosphors with the screen and aperture plate moved slightly to permit the new dots to fall between those previously formed. A full color picture is produced by each of three electron streams being made to fall on the appropriate set of color phosphor dots.

FM/FM TELEMETERING (Cont.)

amplitude response, attenuation, and noise are completed; the phasing study is about to commence.

Considerable thought has been given to the solution of the problems arising from the need for high speed commutation of a large number of intelligence channels in the two highest subcarrier bands of 40 and 70 KC, as indicated in the second typical installation described. In particular the alternatives of PAM and PWM as the type of signal best suited to modulate the subcarrier oscillators have been considered, together with their influence on the design of a decommutation equipment in the telemetering receiving station.

It should be noted that if the 70 KC subcarrier is modulated by a PWM train, there remain nine other bands with widely varying frequency response from 25 CPS to 7 KC to supplement the large number of channels with relatively low frequency response—a very versatile system which combines the advantages of the several simpler systems. Probably some combination of FM/FM and PWM/FM systems on separate r-f transmitters would be the only installation to offer even greater facilities for telemetering measurands with the widest possible range of response and switching characteristics.

Specific Measurements

New requirements make it desirable to transmit a greater variety of intelligence on one subcarrier band by sharing the time than has hitherto been necessary. This means that types of intelligence such as pressure, acceleration, and motion normally measured with an inductance pickup must now be carried on the same oscillator as types of intelligence normally transmitted as a voltage and employing a voltage controlled oscillator. Since it would not be practical to use the inductance controlled oscillator for transmitting voltages, and a satisfactory circuit for switching a number of inductance pickups to an oscillator has not been fully proved, the alternative of finding satisfactory pressure, acceleration and motion pickups with voltage outputs must be adopted. The decision to use automatic data reduction equipment, as soon as it becomes available, further advocates the use of linear pickups to facilitate the inclusion of calibration corrections in the output of the reduction machine. Linearity is not a specification of the present series of inductance

pickups which may exhibit a 3/1 change over the bandwidth specified; dc or resistance type pickups, on the other hand, can be made essentially linear, although the accompanying voltage oscillator introduces a small degree of nonlinearity.

The problem of converting from inductance to resistance type pickups is complicated by the lack of experimental evidence as to the performance of the units commercially available under the conditions experienced in our applications. It is well-known that grades of wire, which afford a good contact surface for the potentiometer wiring, and still maintain a satisfactory life are not those grades which insure stable electrical values for the potentiometer, which readily oxidize and otherwise introduce contact resistance. Increasing the contact pressure may introduce hysteresis, and will certainly affect the period of satisfactory operation for most grades.

The separation of the potentiometer and commutator functions, as achieved in certain units would, in its present form, be applicable only to instruments where the movement can be converted into a wide arc. This is due to the difficulty of obtaining sufficient changes in ratio with this type of construction for movements of a few degrees. The output voltage of most existing potentiometer pickups is usually low, which raises problems of obtaining adequate sensitivity for the oscillator without the use of an amplifier, and the consequent increase in space needed to make this type of measurement. A national survey has not as yet provided a complete solution to this problem when the environmental conditions likely to be experienced in the period of the operation of the resistance type pickups, are taken into account.

Pickups based on the use of a strain gage element, although in wide usage on other programs, do not fit in too well with the present system. In any case the oscillator is more complex or an amplifier is necessary, as discussed earlier.

Receiving Station Developments

The problem of providing a basic telemetering receiving station had resulted in standard main units until the development of automatic decommutating equipment and primary magnetic recorders had been completed. Although the practice of employing crystal controlled r-f transmitters is under test, the corresponding crystal controlled re-

ceivers do not as yet appear a necessity. It is possible with the presently available FM receivers to conserve bandwidth by eliminating transmitter carrier drift and allowing closer channel spacing. The original station, a block diagram of which is given in Fig. 18, consisted of the following five main units:

1. Helical beam antenna—Fig. 19.
2. FM receiver.
3. Subcarrier audio discriminators including plug-in bandpass filters.
4. Low pass filters.
5. Magnetic oscillographs or camera/scope recorders.

A magnetic tape recorder, however, has now been developed exhibiting adequate frequency stability and noise characteristics for primary recording. This can eliminate items 3, 4, and 5 at test fields, it being necessary only to employ them during playback operation in the recording laboratory.

The eight-turn helical antenna has a gain of 12 db, when receiving circular polarization and 8 db for plane polarized wave. It is sufficiently broadband to accept 2 transmission waves spaced 5 MC apart in the 200 MC band. It was designed by the Physical Laboratory of New Mexico A and M College in cooperation with APL/JHU.

APL Specification

The FM receivers are built commercially to meet an original specification prepared by the Telemetering Group at APL. Though not achieving the theoretical noise figure, they have a noise factor of approximately 8 db absolute. The i-f is 500 KC between half-power points and the audio stages give essentially flat response from 300 CPS to 80 KC. The Discriminator is linear for a deviation of ±150 KC around mid frequency. The receivers operate over the band 175 to 260 MC and include AFC circuits with a time constant of 2.5 millisecs. Provision is made to read and supply a recording signal of field strength, and an audio monitor is incorporated into the chassis.

The r-f head uses a spiral inductuner and grounded grid amplifier, and, with the local oscillator and mixer, forms a plug-in unit. The i-f stages are likewise built as a single plug-in unit. The whole assembly is treated for fungus and salt spray where possible.

The bandpass and low pass filters are supplied commercially to APL specifications. The former are designed to pass the sub-carrier bands

which are ±7.5% of center frequency from 400 CPS to 14.5 KC, and ±15% for the top three bands. Over this range the response is flat to 3 db. At ±9% and ±18% respectively, the signals are attenuated only 6 db and at least 20 db by ±11% and 22% respectively. The low pass filters are employed to remove unwanted subcarrier and other high frequencies present in the output of the discriminator and serve to maintain the audio deviation ratio of 5. They introduce a certain degree of ringing at the beginning of a commutated sample which reduces the length of the readable portion of the sample, but still leaves an adequate readable section. Experiments by several groups, using Gaussian type characteristics, appear to offer a comprise solution to this twofold problem. The low pass filters must pass dc and a range of frequencies up to the maximum intelligence frequency for each band. Their char-

(*Continued on page* 146)

New Thermador Plant Opened in Los Angeles

Transfer of tooling and assembly lines for transformer production from the Thermador location, and of the motor production lines from their former Alhambra plant, now puts the Electronics Division of Thermador Electrical Manufacturing Co., Los Angeles, Calif. under one roof. Built on an 8-acre site, the new plant is a

Transformer winding section of the Thermador Electronic plant, Los Angeles, Calif.

modern, fireproof structure laid out especially for the production of electronic devices developed by Thermador.

Besides offices and engineering staff rooms that occupy 5,000 sq. ft., the facilities include complete die and tool shops, a battery of high-speed automatic presses for lamination stamping, heat treating and annealing ovens, vacuum impregnation equipment for transformer and motor coils. In addition, laboratory testing facilities can simulate varying climatic, humidity and temperature conditions that might be encountered anywhere in the world.

acteristic must be linear within 0.1 db to half this maximum frequency, and within 0.5 db to the maximum, falling off to at least ±20 db at double the maximum frequency.

Audio Discriminators

The audio discriminators were originally built to APL Specifications and are available commercially. Following an audio amplifying stage, provision is made for plugging-in the appropriate band-pass filter. The discriminators, shown in block diagram on Fig. 20, are of the pulse averaging type, and they incorporate plug-in frequency determining networks on a chassis with a common design for all bands. Circuits to limit the output, in the event of input failure, are included and the input and output amplitudes may be adjusted through a large number of steps, affording a wide range of operation. Monitoring and metering instruments are on the panel. The units are linear to ±0.1% over the subcarrier bands.

When the camera/scope is used, it is necessary to introduce a special amplifier to provide for a balance to dc at the oscilloscope whose case is otherwise above ground. The low pass filters must then be of the balanced type to prove effective in suppressing the subcarrier frequency.

Vibration Analysis

The analysis of the vibration records has been attempted using two techniques. Each has its advantages and disadvantages as is to be expected. In the first method the tapes were played back and analyzed on a Sonagraph. Unfortunately, the frequency range of this instrument is not compatible with the more significant vibration frequencies nor has it proved sufficiently stable for this special application. A multiplication of the recorded frequencies had to be obtained by the recording and playback being run at different tape speeds. This process, however, introduces errors in the recording and also affects the efficiency of the Sonagraph analysis. The advantages of this technique are the presentation of a complete frequency spectrum (amplitude vs. frequency) over a very limited time interval, and the ease of including a reference spectrum from a calibrating signal commutated with the test signals.

In the second method, now in general use, the tapes are played back through a chain of overlapping narrow band filters, designated the

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help sell sets

Non-Swivel Type Removable Caster that fits into bracket. Designed for use at front of cabinet, with swivel casters at back. Caster bracket slips into slot in permanently mounted bracket.

Swivel Type Caster and Bracket with 1⅝" non-marking wheel. Constructed with narrow mounting area for purposes of concealment. Strengthens corner cabinet, so that customary corner block could be eliminated.

Swivel Type Caster, designed to eliminate screws. Caster slips into grooves cut in corner block and can be inserted by dealer, making casters an optional purchase.

Swivel Type Caster and Bracket, suitable for credenza-type cabinets where concealment is no problem, with 2" non-marking composition wheel. A sturdy, easily operated caster and a bracket that strengthens cabinet.

Nagel-Chase are specialists in the production of casters for manufacturers. Shown above are some of the various styles available, all especially designed for use on TV cabinets.

Your customers are partial to movable cabinets. A sturdy, precision-built, Nagel-Chase Caster and Bracket will assure easy mobility, and provide another sales feature to help build your volume.

Nagel-Chase will gladly consult with you on your caster requirements. Write today for full information.

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2811 NO. ASHLAND AVENUE CHICAGO 13, ILL.

FM/FM TELEMETERING (Cont.)

Filterset, and the output of each filter recorded continuously on a magnetic oscillograph of the multichannel type. Instantaneous amplitudes present in each filter are thus recorded simultaneously. The record must now be calibrated and reduced manually to produce data, since the spectrum in time is not present as a single record but is on a number of oscillogram channels. Instantaneous data is, however, more accurate than the analysis over a limited time interval on the Sonagraph, and comparison of performance at various times can be made without making additional records.

Decommutation

Automatic decommutation equipment, unless built in great quantity to meet different systems, must necessarily limit the versatility of the transmitting system. APL and others have built decommutators to accept as wide a range of switching rates and sample lengths as possible, commensurate with the accuracy required and the complexity allowed. Both PAM and PWM decommutators have already been designed and the former are commercially available. It is not expected that the decommutators will take care of "discreet sampling," or samples sufficiently long to see higher frequencies than the simple rate visible as superimposed traces on the commutated square wave.

Automatic Data Analysis

Prototype automatic data analysers have been developed at ASCOP and Benson-Lehner. Both will provide tabulated data as well as plots of function vs. time, with calibrations and zero errors incorporated in both results. The ASCOP device employs electro-mechanical pickup of the deviation of the oscillograph telemetering trace and converts it into a binary count. The calibration data from a second pickup is obtained and used to modify the stored count before tripping a light flash to make a photographic plot. Benson-Lehner use only electromechanical techniques to provide an ink plot, converting the deviation ± calibration into a rotational movement of a drum. This movement is used to position a print bar which strikes at the correct instant to make a plot of the converted data.

Several makes of semi-automatic data analysers are in use by a number of telemetering organizations.

It is the author's opinion and hope that useful applications of the FM/

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Principles of Rectification
Principles of Amplification
Low Frequency Amplifiers
Principles of Oscillators
Principles of Modulation
Principles of Detection
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FM FM TELEMETERING (Cont.)

FM telemetering system in a repackaged industrial form will be found in many fields of engineering and production to further cement the ties between the Armed Services and Industry, so vital to the defense of this Great Nation.

Goldsmith Receives IRE Founders Award

Dr. Alfred N. Goldsmith, editor of the Institute of Radio Engineers and renowned pioneer in the radio engineering field, has been awarded the Founders Award by the IRE.

The award, which is given only on special occasions to an outstanding leader in the radio industry, was bestowed on Dr. Goldsmith "for outstanding contributions to the radio engineering profession through wise and courageous leadership in the planning and administration of technical developments which have greatly increased the impact of electronics on the public welfare." Presentation of this award will be made at the annual banquet to be held at the Waldorf-Astoria Hotel, New York, N.Y. on March 24, 1954 during the Institute's national convention.

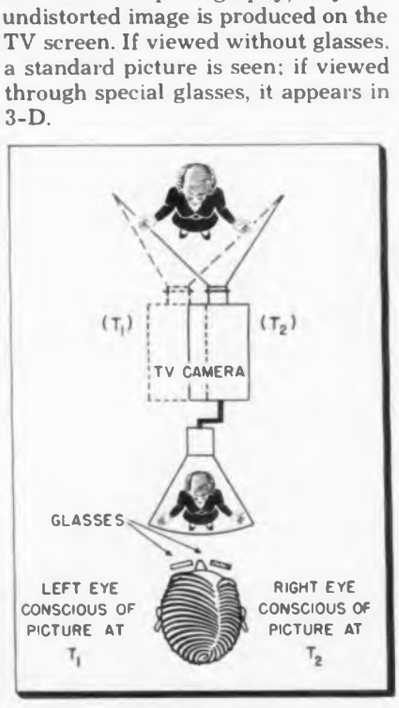
Dr. Alfred N. Goldsmith

A co-founder of the IRE in 1912, Dr. Goldsmith has served as its editor continuously since that date, with the exception of one year when he held the presidency.

Dr. Goldsmith received the Modern Pioneer Award from the National Association of Manufacturers in 1940, the IRE Medal of Honor in 1941, the Townsend Harris Medal from the College of the City of New York in 1942; the Medal Award of the Television Broadcasters Association in 1945, and the Radio Pioneers 1952 Special Citation. He is a Fellow of the Institute of Radio Engineers, a Fellow of the American Institute of Electrical Engineers, and a past president of the Society of Motion Picture and Television Engineers.

COMPATIBLE 3-D TV

A new method of stereoscopic viewing of TV pictures has been developed by Geneoscope Co., 100 W. Olive St., Bloomington, Ill. It is accomplished with an image produced monoculously, in the manner presently employed in producing live TV scenes. No change is required in studio pick-up or transmitting equipment, but merely in the utilization of the camera and object televised. Unlike the double-image stereo technique used in motion pictures and still photography, only one undistorted image is produced on the TV screen. If viewed without glasses, a standard picture is seen; if viewed through special glasses, it appears in 3-D.



Operation of new 3-D TV system At time T_2, right eye sees picture on screen, but red filter in front of left eye slows down image transmission of left eye to mind, so mind is conscious of left eye seeing picture that was on screen moment before, with camera at T_1

Geneoscope takes advantage of the distance between two taking points of one camera by virtue of transverse camera motion. It utilizes the time lag between the arrival of light on the retina and the after-image in the mind to create the illusion of binocular sight. By increasing the time lag of the left eye, at any one moment the mind will be conscious of a different picture than that for the right eye; essentially the left eye "sees" what the right one saw a moment before, when the camera was in a slightly different position.

This is accomplished by a red filter over the left eye which retards the chemical dilution of the red pigment of the retina of the eye (which "paints" the picture for the eye), thereby slowing down the transmis-

sion of the images from the left eye to the mind. A yellow filter is provided for the right eye to eliminate ciliary muscle torque and its resulting physical discomfort. Black masks for the filters and TV screen heighten the depth illusion.

Additional details on page 10.

INS Facsimile Service Adds Sound to Sight

The audio transmission of tape recordings of news events with photos of those events over the INS Facsimile circuit has been introduced by International News Service.

The addition of "sound on fax" will make available both sight and sound coverage of news anywhere in the world within minutes after it happens.

Both pictures and tape recordings can be fed into the Facsimile network from any point. They can also be brought in by radio from overseas. The audio transmission is recorded by the station on its own tape recorder, while the pictures are received by the facsimile recorder.

New Design-Reliability Booklet Available

Electronic engineers, particularly those concerned with reliability of military gear, will find much interesting information in the Navy's new booklet, "Suggestions for Designers of Electronic Equipment." It contains material on simplification and reliability, common faults, and 100 points of design "do and don't." The booklet is published by the Engineering Div., U. S. Navy Electronics Lab., San Diego 52, Calif.

Interest in English Tube Company Bought

Superior Tube Co., Norristown, Pa. has purchased a controlling interest in Fine Tubes Ltd., Surbiton, Surrey, England. Fine Tubes was founded in 1943 by the late H. J. Carter and Malcolm A. Rowe. Located in the geographic center of the British electronic industry, it has grown rapidly until it has become one of the United Kingdom's largest producers of seamless nickel cathodes and other electronic parts.

The association is expected to result in important technical advantages for both organizations in civilian and military uses of electronic equipment. Superior will also obtain an entree to foreign markets that cannot be served from the United States.

News of MANUFACTURERS' REPS

Lew H. Morse recently formed a new firm, Radio-Technical Sales Co., to provide sales representation on industrial and distributor items in Nebraska, Iowa, Kansas, Missouri, Oklahoma, and Arkansas. Initially, it is planned to cover industrial components and test equipment, sound equipment, and TV accessories.

Jack Cappels has formed J. L. Cappels & Associates, manufacturers' representatives. They will specialize in electronic instruments.

Arthur B. Anderson Co., 1434 West 31st St., Minneapolis, Minn., will represent Hammel-Dahl Co., Providence, R. I., manufacturers of automatic control equipment, throughout Minnesota, North and South Dakota, and part of Wisconsin.

Robert F. Lamb was appointed manufacturers' agent to represent Potter & Brumfield, Princeton, Ind. in the Buffalo, N. Y. area.

Henderson Sales Co., 8131 Manchester, Brentwood, St. Louis 17, Mo., have been appointed sales representatives for the St. Louis area by Burndy Engineering Co., Inc., Norwalk, Conn. Henderson will handle the complete line of Burndy electrical connectors for utilities, contractors, and industrial and electrical manufacturing applications.

George Petitt, 549 West Washington St., Chicago, Ill., has been appointed to handle Illinois jobbers and small industrial accounts outside of Chicago. **Samuel L. Stroum Co.**, 1612 Broadway, Seattle, Wash., will handle the jobbers and industrial accounts in Washington and Oregon.

George Mulvin, with headquarters at Burbank, California, has become national sales representative for Hydra-Electric Co., of Burbank, Calif. manufacturers of fuel and hydraulic pressure switches and electro-hydraulic aircraft accessories.

Win W. Tompkins, 941 Newell Rd., Palo Alto, Calif. recently became representative for General Transformer Co., 18240 Harwood Ave., Homewood, Ill. (Chicago suburb). Mr. Tompkins, a jobber's representative, covers Northern California from the Oregon border through Fresno into Reno, Nevada.

Frank R. Hill, of Oakland, Calif., has become associated with David H. Ross Co., San Carlos, Calif., representatives for the Columbia Wire & Supply Co. 2850 Irving Park Rd., Chicago, Ill., warehouse and national distributors for Anaconda "Densheath" and radio wires and cables.

Perlmuth-Colman & Assoc. announced their removal to new, enlarged quarters at 2419 South Grand Ave., Los Angeles 7, Calif. The new facilities include modern offices, conference and sales rooms, and larger warehouse space.

BULLETINS

Unitized Equipment

The 1954 edition of the Alden handbook, "Ideas-Techniques-Designs" provides new data and planning sheets on plug-in packages and basic chassis for unitizing equipment and giving it 30-second interchangeability. New models of connectors and interconnecting systems have been added. Available to manufacturers and designers on letterhead request to Dept. HB, Alden Products Co., 117 North Main St., Brockton 64, Mass.

CTS-Rated Tube

A technical information sheet covering the 6CU6 horizontal deflection amplifier tube, especially designed for heavy use, is available from CBS-Hytron, Columbia Broadcasting System, Inc. Div., Danvers, Mass.

Oscillograph

A new publication, bulletin GEC-449B, on the general-purpose oscillographs, type PM-10, is available from the General Electric Co., Schenectady 5, N. Y.

Tape Splicing

"Sound Talk", bulletin No. 26, released by Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn., discusses magnetic tape splicing, splice weakness, recorded signal loss; also gives instruction on splicing for audio recording and critical recordings for computer and instrumentation work.

Audio Components

The 1954 edition of the Audio Guide, available at the Terminal Radio Corp., 85 Cortland St., New York 7, N. Y., contains 130 pages of information concerning high fidelity sound equipment.

Uniformity Analyzer

Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio, has released a descriptive brochure that discusses and illustrates the Brush uniformity analyzer used to measure yarn variations in weight-per-unit-length.

Rectifiers

The design, application specification, and circuitry of selenium rectifiers are comprehensively described in the second addition of "Federal's Selenium Rectifier Handbook", published the Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.

Radio Compass

A new bulletin containing dimensional drawings, circuit diagrams, and technical information on the "Norelco" miniaturized radio compass control is available at North American Philips Co., Inc., Electronics Div., 750 South Fulton Ave., Mount Vernon, N. Y.

Components

Langevin Manufacturing Corp., 37 West 65th St., New York 23, N. Y., have released an institutional booklet covering the company's performance and capabilities in the manufacture of transformers, reactors, amplifiers, and power supplies.

Luminescent Chemicals

Luminous Resins Inc., 166 W. Washington St., Chicago 2, Ill, licensee of Luminescent Plastics Corp., announce the availability of the article, "Plastics That Glow In The Dark."

Quality Control

Industrial X-Ray, Inc., 220 Hempstead Turnpike, West Hempstead, N. Y., a non-destructive testing laboratory, has just published a brochure, "Quality Control Through Radiography" which demonstrates the applications of radiographic testing.

Power Tube Chart

Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y., has prepared a 3-color, 15 x 16-½ chart that shows the rating in power output versus frequency for "Amperex" power tubes in typical operation. The chart includes FCC frequency allocations and associated applications correlated with tube performance. A somewhat similar chart covering rectifiers, thyratons and ignitrons made by the company is also available.

BULLETINS

(Continued from page 157)

Welding Alloys

A 16-page brochure released by Eutectic Welding Alloys Corp., 40-40 172 St., Flushing, N. Y., describes in detail the history, products, manufacturing equipment and procedures, and the research projects and discoveries of the organization.

Rope

Rochester Ropes Inc., Culpeper, Va., have prepared an interesting booklet on "Wirelon"—nylon covered wire rope—which gives sizes, breaking strengths, etc.

Rotary Equipment

Bulletin No. 153 contains 15 pages of essential data and technical information covering motors (4-25 oz.) designed and constructed in accordance with latest approved engineering practice by Mission-Western Engineers, Inc., subsidiary of Western Gear Works, 132 W. Colorado St., Pasadena, Calif.

Electronic Parts

Dale Electronic Distributors, Div. of Dale-Connecticut, Inc., 150 James St., New Haven 13, Conn. offers a 216-page "Reference Manual and Buyer's Guide" covering the electronic components and equipment of many of the first-rank manufacturers.

Stereophonic Sound

"Stereophonic Sound and Altec," an interesting 16-page booklet prepared by Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif. and 161 Sixth Ave., New York 13, N. Y., presents the historic development of the art and the difference between stereo and other screen sound methods.

Cinema Supplies

Entitled Sturelab No. 10, the 80-page, 11x8-1/2 in. catalog, published by S.O.S Cinema Supply Corp., 602 West 52nd St., New York 19, N. Y., presents over a thousand items and 300 illustrations covering motion picture production equipment for producers, TV stations, film laboratories, educational institutions, and industrial photography.

Color TV

Telechrome, Inc., 88 Merrick Road, Amityville, N. Y., has issued a 4-page brochure that illustrates and describes, by text and diagram, basic, supplementary, and recommended equipment and facilities for the production of NTSC color pictures.

Transformers

One side of a new catalog page issued by Electrometric, Inc., Woodstock, Ill., gives detailed information on Type TX100 miniature i-f 3/4 in. transformers. The other side describes a complete line of TV coils.

Electronic Components

Catalog RC-9, a new 56-page publication by Stackpole Carbon Co., Electronic Components Div., Tannery St., St. Marys, Pa. gives complete electrical and mechanical specifications, dimensions, and application data for all standard Stackpole electronics components.

TV Equipment

"Custom Built Equipment for Television", catalog B-30, by RCA Victor Division, Engineering Products Dept., Camden 2, N. J. shows typical examples of custom-built equipment.

Waveguide Data

"Microwave Nomograms and Charts", a new 20-page booklet by Airtron, Inc., 1109 W. Elizabeth, Linden, N. J., presents waveguide engineering data, and curves and practical techniques used in designing and using waveguide components.

INDUSTRY NEWS

Sylvester Weaver, Jr., has been named President of the National Broadcasting Co., it was announced by Brig. Gen. David Sarnoff, Chairman of the Board. At the same time, the appointment of **Robert Sarnoff** as NBC executive vice-president was made.

Dr. P. S. Christaldi, one of the senior scientists of the organization, has been made manager of the instrument division of Allen B. Du Mont Laboratories, Inc. Formerly assistant manager,

Dr. P. S. Christaldi

he replaces Rudolph Feldt who recently resigned. Dr. Christaldi has been associated with the Allen B. Du Mont Laboratories since 1938.

Richard H. Rudolph has been appointed manager of sales, **Edwin O. Vandeven,** manager of product planning, **Guy O. Whelchel,** manager of marketing administration and research, and **Samuel R. Tedford,** manager of advertising and sales promotion of the General Electric Electronics Division's Commercial Equipment Dept., Syracuse, N. Y.

E. W. Nielsen has been elected president of Best Manufacturing Co., Irvington, N. J., manufacturers of radio loud speakers, TV components, and electronic devices.

Robert F. Negele has joined Acme Tool & Specialties Co., Chicago, Ill., as sales manager and will assist in the administration of the company's antenna and contract parts divisions. Mr. Negele was formerly field engineer for A.R.F. Products, Inc., River Forest, Ill.

Robert F. Lewis, former technical director, has been appointed vice-president of Prodelin Inc., Kearny, N. J. Active in the development of antenna systems and transmission lines for many years, after service with RCA Manufacturing Co., Columbia Broadcasting System and Harvard Radio Laboratories, Mr. Lewis was commissioned a major and placed in charge of antenna activities of the American-British Laboratories in England and on the Continent during World War II.

TELE-TECH ADVERTISERS — JANUARY, 1954

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

INDUSTRY NEWS

(*Continued from page* 160)

Harry C. Hackett, who joined National Vulcanized Fibre Co., laminated plastics manufacturers, Wilmington, Del., in 1912, has been promoted to staff sales manager. **James O. Otis,** who joined the company in 1934 as sales engineer will become sales manager.

Daniel J. Webster has been made marketing manager of Raytheon Manufacturing Co., Waltham, Mass. He will have charge of all the firm's marketing activities on finished products.

Larry Eigenrauch has been named sales manager of Eclipse-Pioneer Division Foundries of Bendix Aviation Corp., and will have complete charge of all foundry sales operations. **Willard Neuert** will assume the duties of production manager and be in charge of supplies, purchasing, pattern procurement, material control, and traffic.

Richard I. Kern has been appointed western manager of Miniature Precision Bearings Inc. at the new Santa Barbara, Calif., branch plant where he will assume direction of an intensive marketing development program within the West Coast industry.

John A. Curtis has been appointed general sales manager of the Westinghouse Electronic Tube Division. From 1942 to 1945, Mr. Curtis was vice-president of the Halstead Traffic Communications Corp., and before joining Westinghouse, he was manager of the track equipment department of Pullman-Standard Car Manufacturing Co.

Thomas T. Goldsmith, Jr., Irving G. Rosenberg, and **C. Edwin Williams** have been appointed vice-presidents of Allen Du Mont Laboratories Inc., respectively, to be in charge of research, tubes and government, instruments and transmitters. Dr. Goldsmith is a member of the Du Mont Laboratories directorate, and also president and director of Du Mont Television & Electronics, Ltd., Can. He joined the company in 1936 as director of research. Mr. Rosenberg, former director of operations for the receiver and cathode-ray divisions, joined the company in 1942. Mr. Williams, former director of instrument and transmitter operations and government and special contracts, joined Du Mont in 1945 as general manager of the company.

A. W. Keen has been made commercial engineering manager for the TV picture tube division of Sylvania Electric Products Inc. at Seneca Falls, N. Y. Priorily, he was manager of the application coordination section at Sylvania's Research Center in Bayside, Long Island.

J. Harry DuBois, vice-president of engineering, was elected a director of Mycalex Corporation of America to fill the vacancy made by the recent retirement of **James L. Robertson.**

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A. *Naturally, no! That's why* **DAVEN** *has earned the right to add a superlative in naming its line*

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RESISTORS

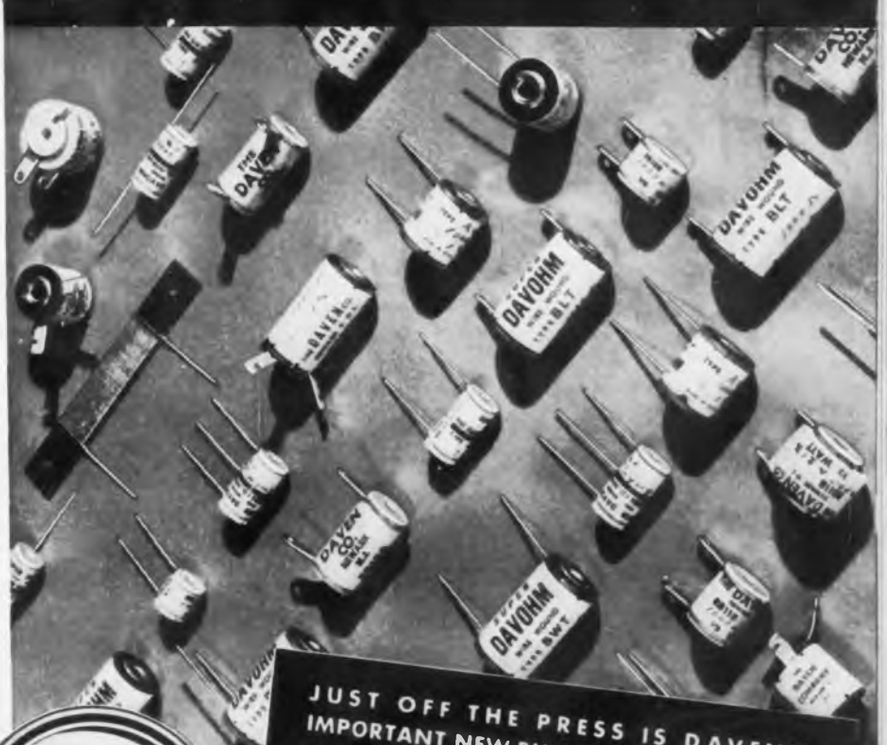
● Brands of Resistors vary as widely in the completeness of a line and in performance, as do brands of any other product.

DAVEN originated the first pie-type, wire wound Resistor more than a generation ago. Since that time, DAVEN has designed and manufactured Precision Wire Wound Resistors of every conceivable type to meet the increasing demands of the electronics industry.

SUPER DAVOHM RESISTORS are noted for their high stability and accuracy under extreme temperature and humidity conditions. DAVEN Resistors are made in accordance with JAN-R-93 specifications and are in use in all types of Army, Navy and Air Force electronic equipment.

DAVEN has developed special small precision Resistors for use in miniaturized assemblies. All types of mountings, sizes, tolerances and temperature coefficients are available from a large variety of standard types. That's why DAVEN can fill your precision Resistor needs.

Take advantage of DAVEN's advanced engineering and manufacturing techniques to help with any Resistor problem confronting you.



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179 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

Why you can expect peak performance from regular RCA receiving tubes

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● It's a matter of bonus values! At no greater cost to you, RCA receiving tubes give you the superior performance and reliability usually claimed for specialty-designed types of other manufacturers. That's because RCA receiving tubes are being improved constantly to keep pace with your present and future design requirements.

For Instance

The RCA-5U4-G features a new electrolytic coating on its channel filament which produces a uniform, hard emitter —leading to greatly increased life over the older version.

The RCA-6W4-GT incorporates a new RCA-developed carbonized plate-coating material having improved heat-dissipating properties. Result! The RCA-6W4-GT offers longer life and increased reliability.

The RCA-6AL5 utilizes double helical heaters to insure low hum. Cathodes are pinched to minimize cathode shift within the mount. Both features make possible greatly reduced microphonics. Carefully controlled contact potential assures high and uniform sensitivity.

RCA's continuing program of quality improvement means superior receiver performance, less factory-line rejects, and fewer "in-warranty" failures. And remember, this *peak performance* from regular RCA receiving tubes costs you no more . . . actually costs you less in the long run.

For additional technical information write RCA, Commercial Engineering, Section A50Q, Harrison, N. J. For application assistance, simply call your nearest RCA Field Office:

(EAST) Humboldt 5-3900
415 S. 5th St., Harrison, N. J.

(MIDWEST) Whitehall 4-2900
589 E. Illinois St., Chicago, Ill.

(WEST) Madison 9-3671
420 S. San Pedro St., Los Angeles, Cal.

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