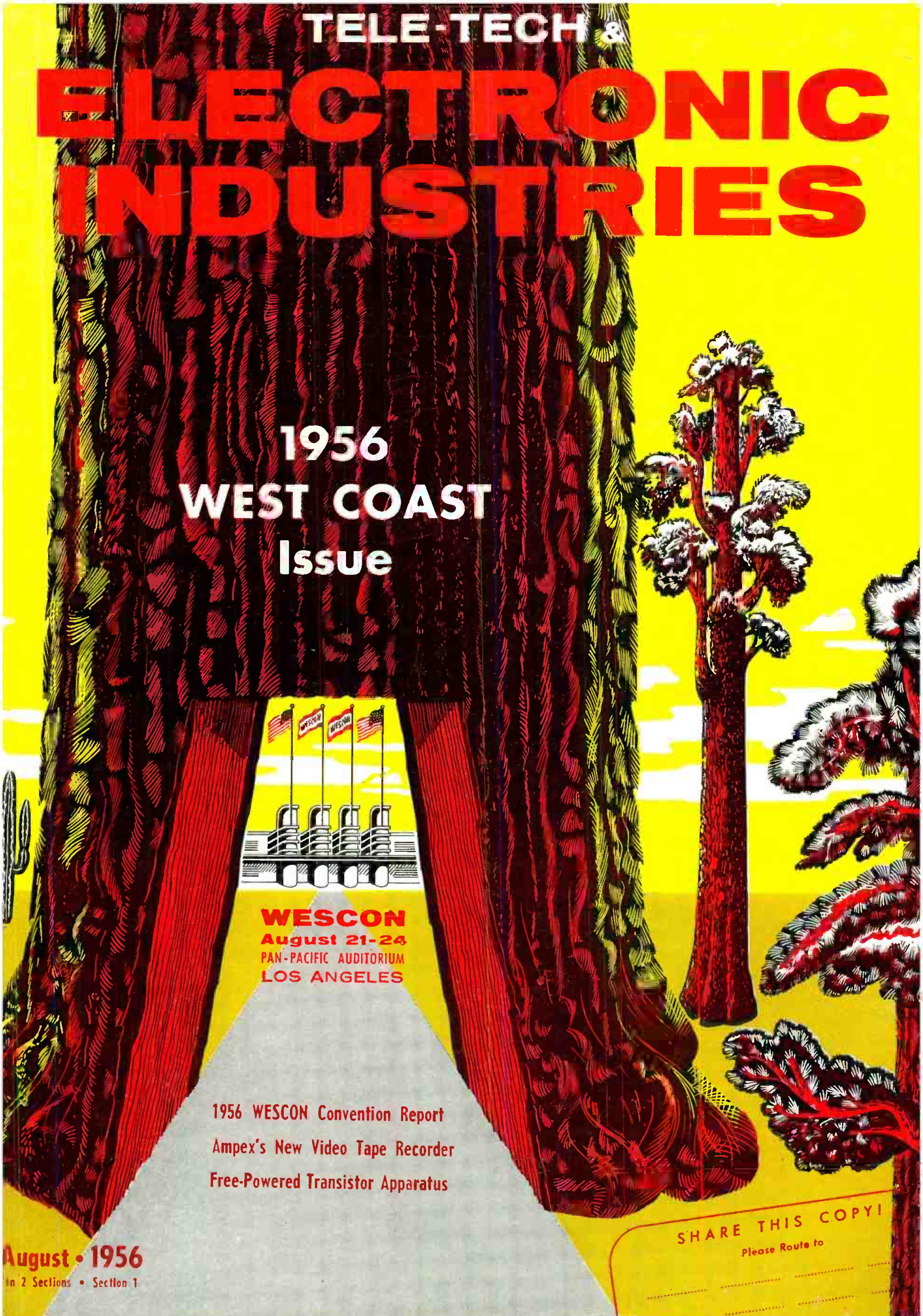
TELE-TECH &

ELECTRONIC INDUSTRIES



1956 WEST COAST Issue

WESCON
August 21-24
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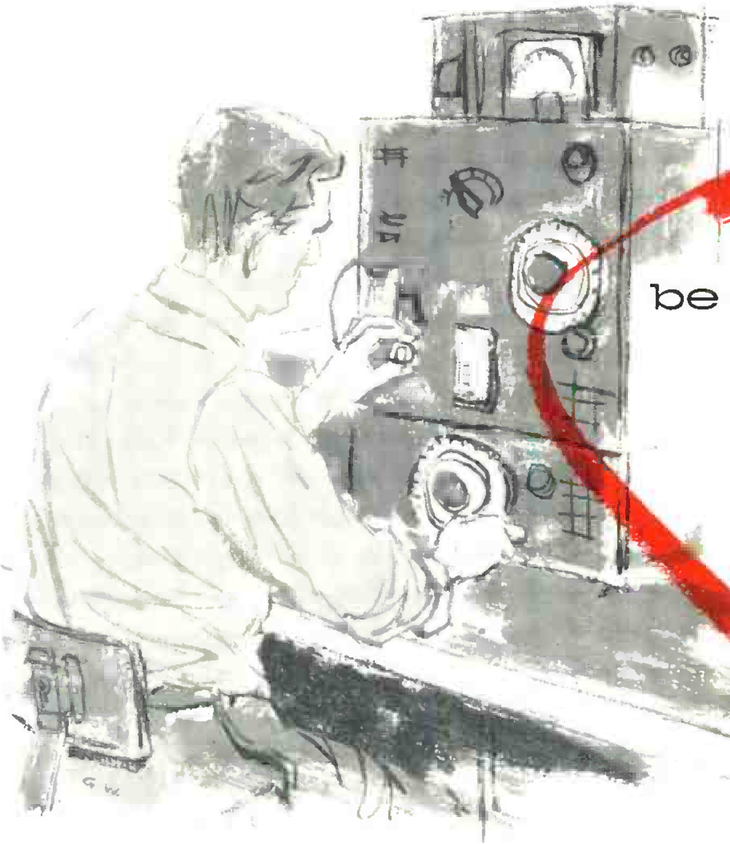

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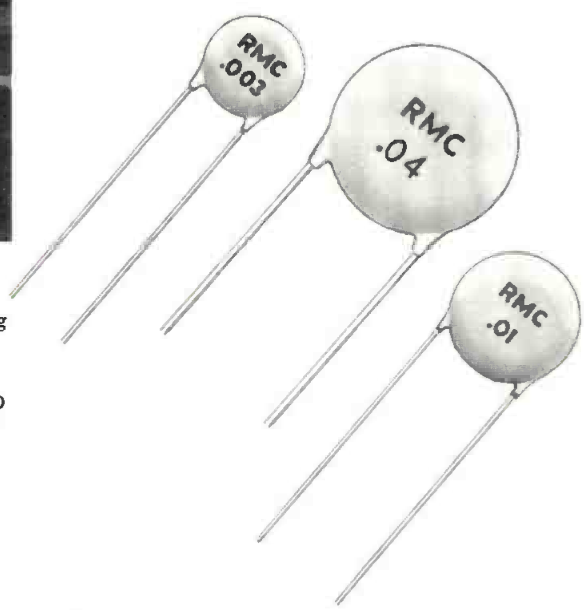

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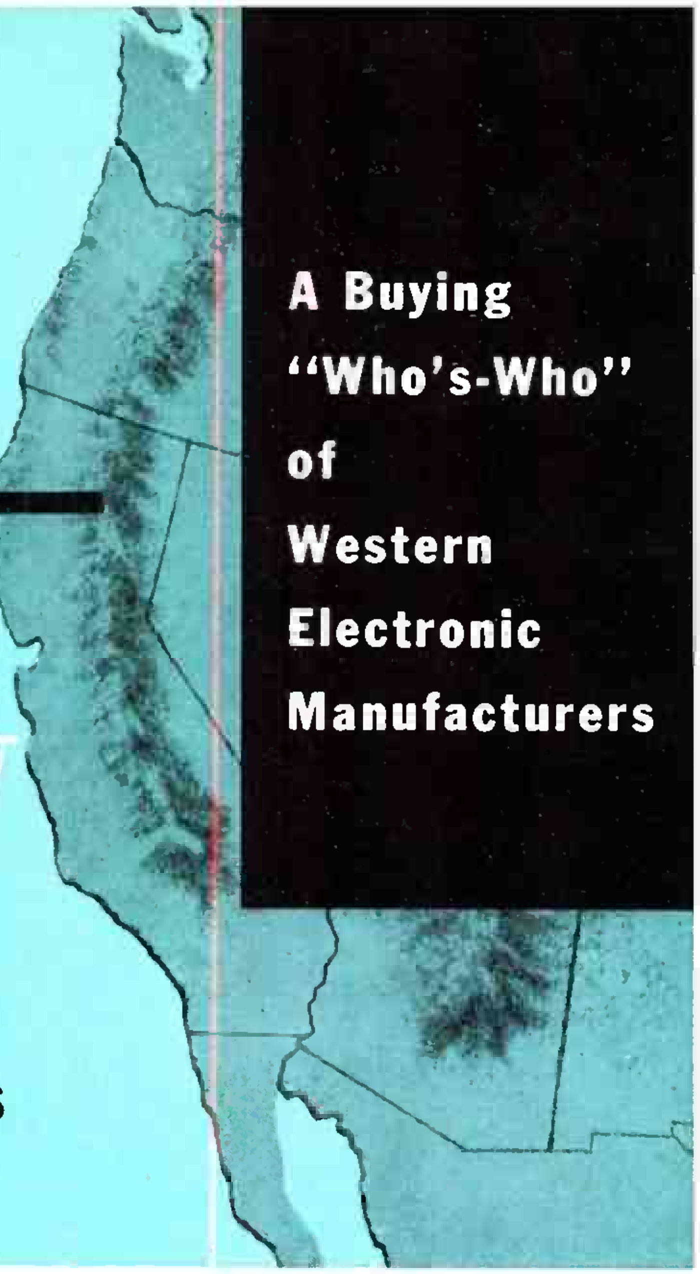

A Buying "Who's-Who" of Western Electronic Manufacturers

This directory is an alphabetical listing of West Coast electronic manufacturers. Address, person to contact and telephone number are included to speed contacts. Principal proprietary items are indicated as (p); avionic items as (a). Triangle signifies WESCON exhibitors, and asterisk signifies Eastern and Midwestern firms with W.C, facilities.

△Abbott Instrument & Eng'g 7579 Melrose Ave Los Angeles 46 Calif

Acme Camera Corp 2704 W Olive Ave Burbank Calif—John Kiel—VI 9-3144 (p) TV Recording Cameras

Aero Instrument Co 11423 Vanowen St N Hollywood Calif—T O Cox—ST 7-5433 (p & a) Frequency Meters

Aerojet-General Corp 6352 N Irwindale Ave Azusa Calif—W L Gore—CU 3-6111 (p) Infrared Military Devices

△*Aerovox Corp Pacific Coast Div 2724 S Peck Rd Monrovia Calif—T T Cary RY 1-5621 (p & a) Filters

△*Aircraft Marine Prods 3138 W El Segundo Blvd Hawthorne Calif—OS 5-1186

△*Air-Marine Motors 2055 Pontius Ave Los Angeles 25 Calif—T W Yeakle

AiResearch Mfg Div Garrett Corp 9851 Sepulveda Blvd Los Angeles 45 Calif —W R Ramsaur—OR 2-0131 (p) Amplifiers & Controls (a) Air Data Computers

Air Transport Mfg 1114 N Sycamore Ave Los Angeles 38 Calif—E L Hollywood Jr—HO 7-5175 (p) Control Cabinets (a) Guided Missile Controls

Allied Electronic Equip 604 Oakland Airport Oakland 14 Calif—J C Aldige Jr—LO 2-1400 (p & a) Headsets

Alfred Electronics 897 Commercial St Palo Alto Calif — A Y Jew — YO 8177 (p) Amplifiers

Allied Research & Eng'g 6916 Santa Monica Blvd Hollywood 38 Calif—B C Jones—HO 2-1251 (p) Waveguide Components (a) Electroforming Research & Devel

Allison Laboratories 14185 Skyline Dr Puente Calif—R E Allison—OX 4-4056 (p) Audio Frequency Filters

Alpar Mfg Corp 2910 Spring St Redwood City Calif—R V Laustrup—EM 8-4701 (p) Towers

△Altec Lansing Corp 9356 Santa Monica Blvd Beverly Hills Calif—G L Carrington—CR 5-5101 (p) Spkrs. Amplifiers (a) Transformers

△Alto Scientific Co 855 Commercial St Palo Alto Calif—T F Turner—DA 4-4733 (p) Transistorized Voltmeter

△Amelco Inc 2040 Colorado Ave Santa Monica Calif—R H Hudson TE 0-5475 (p) Etched Circuits (a) Missile Electronic Pkg

American Diathermy Prods 11858 Mississippi Ave Los Angeles 25 Calif—F W Christian—GR 7-5627 (p) Ultrasonic Generators

American Electric Motors 2112 N Chico Ave El Monte Calif—Jack McNutt—CU 3-5331 (p) Power Supplies

American Electronics Mfg 9503 W Jefferson Blvd Culver City Calif—Wayne Blackman—TE 0-5581 (a) Resolvers

American Thermo-Electric Co 7269 Santa Monica Blvd Los Angeles 46 Calif—Abraham Levy—HO 4-1632 (p & a) Vacuum Thermocouples

△Ampex Corp 934 Charter St Redwood City Calif—Robt Sackman—EM 8-1471 (p) Magnetic Tape Recorders. Instrumentation

Anatran Eng'g Corp 165 E Calif St Pasadena Calif—H. D. Wright—RY 1-9495 (p & a) Remote indicating & controlling mechanical Counters

Applied Electronics Co 1246 Folsom St San Francisco 3 Calif—S S Konigsberg—MA 1-2634 (p) Marine radiotelephones

Applied Precision Products 1431 S LaBrea Los Angeles Calif—R S Furst—WE 6-0444 (p) Film Recorders

Applied Research Labs 3717 Park Pl Glendale 8 Calif—Donald Aarons—CH 9-6193 (p & a) Quantometer

△Arga Div Beckman Instruments 220 S. Pasadena Ave S Pasadena Calif—Michael Dayton—PY 1-2141 (p & a) Electronic Controls. Testers

Arnold Magnetics Co 5962 Smiley Dr Culver City—F M Arnold—VE 8-4829 (p) Toroidal Coil Winder (a) Transistorized Power Supplies

Arnoux Corp 11924 W Washington Blvd Los Angeles 66 Calif—T Linhart. Jr —TE 0-6756 (p) Temperature Limit Controlling Systems (a) Magnetic Power Supplies

Associated Missile Products 2709 N Garey Ave Pomona Calif—F A McCann. Jr —LY 4-2811 (a) Aircraft & Missile Ground Support Equip

△*Audio Devices Inc 1006 N Fairfax Ave Los Angeles 46 Calif—A H Badge—OL 4-0887 (p) Audio Tape

△Avery Adhesive Label Co 1616 S Calif Ave Monrovia Calif—John Watts—RY 1-5237 (p) Pressure-sensitive tapes

△Babcock Radio Eng'g 7942 Woodley Ave Van Nuys Calif—F M Smith—ST 5-8648 (p) Radio Control Equip (a) Drone & Missile Guidance

Background Engineers 7313 Santa Monica Hollywood Calif—W J Tillisch—HO 5-4161 (p) Rear Projection Screens

Baughman Co E J 1914 N Cogswell Rd El Monte Calif—E J Baughman—FO 0-7536 (p) Pan & Tilts for Cameras

Beckman Div Beckman Instruments 2500 Fullerton Rd Fullerton Calif—A O Beckman—OX 7-1771 (p) Measuring & Recording Instruments

Beckman & Whitley 985 San Carolos Ave San Carlos Calif—E W Place—LY 3-7824 (p) Guided Missile Products

△Behlman Eng'g 114 S Hollywood Way Burbank Calif—J M Schroeder—TH 2-5410 (p & a) A C Power Supply

△Bendix Aviation Computer Div 5630 Arbor Vitae Los Angeles 45 Calif—D C Evans—OR 8-2128 (p) Digital Computers

△Bendix Aviation Pacific Div 11600 Sherman Way N Hollywood Calif—Herb Wilkinson—ST 7-2881 (p) Telemetering (a) Missile Guidance

Bennett Laboratories 2700 Bay Road Redwood City Calif—A E Bennett—EM 6-6845 (p) Wireless Intercoms

Benson-Lehner Corp 11930 W Olympic Blvd Los Angeles 64 Calif—D B Prell—BR 2-3484 (p & a) Data Reduction Equip

△Berkeley Div Beckman Instruments Inc 2200 Wright Ave Richmond 3 Calif—W W Harger—LA 6-7730 (p & a) Electronic Counters

Berlant-Concertone Instr Audio Div American Electronics 4917 W Jefferson Blvd Los Angeles 16 Calif—Bert Berlant—RE 1-2141 (p) Magnetic Tape Recorders (a) Data Recorders

Berndt-Bach Inc 6900 Romaine St Hollywood 38 Calif—A N Brown—HO 2-0931 (p & a) 16MM Motion Picture Cameras

Bill Jack Scientific Instrument Co 143 S Cedros Ave Solana Beach Calif—C P Owen—SK 5-1551 (p) Sub-Miniature Communications Systems (a) Pre-Flight Test Equipment

△Birtcher Corp 4371 Valley Blvd Los Angeles 32 Calif—H T Finch—CA 2-9101 (p) Ultrasonics

B J Electronics 3300 Newport Blvd Santa Ana Calif—KI 5-5581 (p) Test Equip (a) Digital Systems

Bodde Projector Co 11541 Bradley Ave San Fernando Calif—T W Baldrick—EM 5-2551 (p) Rear Screen Projectors

Bone Eng'g Corp 701 W Broadway Glendale 4 Calif—M H Orbaugh—CH 5-2638 (p & a) Aircraft Ground Pwr Support Equip

Booth Co A E 265 S Alexandria Ave Los Angeles 4 Calif—A E Booth—DU 9-4863 (p) Power Supplies

△Bourns Laboratories 6135 Magnolia Ave Riverside Calif—C E Calohan—DV 4-1700 (p & a) Potentiometers

Brainard Electronics 8586 Santa Monica Blvd Los Angeles 46 Calif—Lee Grayson—BR 2-1133 (p) Radio Receivers

△Brubaker Electronics 3652 Eastham Dr Culver City Calif—TE 0-6441

Burton Mfg Co 2520 Colorado St Santa Monica Calif—D E Frisbie—TE 0-7561 (p) Pressure Transmitters

Calbest Eng'g & Electronics 4801 Exposition Blvd Los Angeles 16 Calif—I Dubin—RE 1-7291 (p) Radio, TV & Electronic Chassis

California Chassis Co 5445 E Century Blvd Lynwood Calif—H P Balderson

California Magnetic Control Corp 11922 Valerio St N Hollywood Calif—Lillian F Glazer—ST 7-1104 (p) Transformers & Reactors (a) Power Inverters

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△Cal-Tronics Corp 11307 Hindry Ave Los Angeles 45 Calif—J F O'Rourke—OR 1-7694 (p) Hi Pot Continuity Tester

△Calvideo Tube Corp 5232 W 104 St Los Angeles 45 Calif—Stephen Tidik—OR 8-3979 (p) TV Picture Tubes

△Cannon Electric Co 3208 Humboldt St Los Angeles 31 Calif L E Baird—CA 5-1251 (p) Rack & Panel Connectors (a) Multi-contact "AN" Electrical Connectors

△Canoga Corp 5955 Sepulveda Blvd Van Nuys Calif—G H Nibbe—ST 6-9010 (p) Ferrite Isolators, Circulators

△Carad Corp 2850 Bay Rd Redwood City Calif—Wallace Burton—EM 8-2969 (p & a) Pulse Transformers

Carruthers & Fernandez 1501 Color St Santa Monica Calif—F C Fernandez—EX 4-6768 (p & a) Solenoids

△Cascade Research Corp 53 Victory Lane Los Gatos Calif—J E Stone—EL-4S 9900 (p & a) Microwave Ferrites

Castell & Co R A 740 Salem St Glendale 3 Calif—F A Paul—CH 5-6553 (p & a) Miniature Electrical Connectors

Celab Electronic Products 918 11 St Sacramento 14 Calif—Marshall Ford—GI 2-3645 (p) Pressure Resistors

Chadwick-Helmuth Co 472 E Duarte Rd Monrovia Calif—EL 8-1246 (p) Oscilloscope Sweep Generator

△*Chatham Electronics Div Gera Corp 6233 Hollywood Blvd Hollywood 28

Chemalloy Electronics Corp Gillespie Airport Santee Calif—Samuel Freedman—HI 4-7661 (p) Microwave Calorimeters (a) Metals

Chicago Telephone of Calif 105 Pasadena Ave S Pasadena Calif—D E Ridenour—CL 5-5141 (p & a) Variable Resistors

△Christie Electric Corp 3410 W 67 St Los Angeles 43 Calif—E E Hughes—PL 3-2607 (p) DC Power Supplies

Cinema Eng'g Div Aerovox Corp 1100 Chestnut St Burbank Calif—J L Fouch—VI 9-5511 (p & a) Resistors, Fixed, Wire-Wound Accurate

Circon Component Co Santa Barbara Municipal Airport Goleta Calif—M J Ainsworth—WO 8-2011 (p & a) Connectors

Clark Electronic Labs Pioneer Rd Palm Springs Calif—H L Spencer—8-3011 (p) Silicon Crystal Rectifiers (Power)

Coast Coil Co 5333 W Washington Blvd Los Angeles 16 Calif—C H Adams—WE 6-6188 (p) Precision A C Voltage Dividers

Cole Instrument Co 1000 N Olive St Anaheim Calif—F H Cole—KE 5-7263 (p & a) Test Equipment

△*Collins Radio Western Div 2700 W Olive St Burbank Calif—VI 9-3361

△Color TV Inc 973 E San Carlos Ave San Carlos Calif—E J Bradley—LY 3-8466 (p & a) Test Equip

*Computer Control Co 10966 Le Conte Ave Los Angeles 24 Calif—C B Kinne—GR 8-8705 (p & a) Digital Computer Bldg Blocks

Computer Eng'g Associates 350 N Halstead St Pasadena 8 Calif—Richard Campbell—RY 1-9158 (p & a) Analog Computer

△Computer Measurements 5528 Vineland Ave N Hollywood Calif—E C Titcomb—ST 7-0401 (p) Counters, Timers

Condor Radio 4068 E Paseo Grande Tucson Ariz—H B Brooks (p) Heat Dissipators

Connector Corporation of America 3223 Burton Ave Burbank Calif—R R Thomas—VI 9-2129 (a) Waveguide Flanges

Conrac Inc 19217 E Foothill Blvd Glendora Calif—W J Moreland—ED 5-1241 (p) Custom TV Chassis

△*Consolidated Electrodynamics Corp 300 N Sierra Madre Villa Pasadena Calif K A Neal—RY 1-8421 (p) Data Processing Instrumentation

Control Specialists Inc 115 E Arbor Vitae St Inglewood 1 Calif—I L Ashkenas—OR 8-4688 (p) Transistor Servo Amplifier (a) Automatic Flight Control Systems

△Convair Div General Dynamics Corp P O Box 1011 Pomona Calif—J P Syren—LY 9-5111 (a) Guided Missile Electronics

△Cornell-Dubilier Electric Corp 4144 Glencoe Ave Venice Calif—P M Kuefler—TE 0-6681 (p & a) Capacitors

Creative Eng'g Corp 10816 Burbank Blvd North Hollywood Calif—R. F. Blaine—ST 7-4759 (a) Antennas

Crescent Eng'g & Res 11632 McBean St El Monte Calif—S B Linn—FO 0-8882 (p) Transducers

Crittenden Transformer Works 1220 Nadeau St Los Angeles 1 Calif—R M Powers

Cryco Inc 1138 Mission St S Pasadena Calif—E W Johnson—PY 1-1174 (p) Crystals, Ovens

△Cubic Corp 5575 Kearny Villa Rd San Diego 11 Calif—D E Root—BR 7-6780 (p) Calorimetric Wattmeters

Culbertson Co G K 2515 Novato Pl Palos Verdes Estates Calif—G K Culbertson—FR 5-6062 (p) Record Players

Curtis Associates 24 Woodland Ave San Rafael Calif—Curt Ingram—GL 4-8554 (p) TV Picture Tubes

C-W Mfg Co Box 2065 El Monte Calif—R E Woods—(p & a) Quartz Crystal Frequency Control Units

△Cybergor Inc 1705 W 135 St Gardena Calif—FA 1-0864

Dalmotor Co 1375 Clay St Santa Clara Calif—Clark Coffee—AX 6-5958 (p & a) Miniature Motors

Dalmo Victor Co 1414 El Camino Real San Carlos Calif—G C Stewart—LY 1-1414 (p) Radar Antennas (a) Recorders, Test Equip

Datran Eng'g 3613 Aviation Blvd Manhattan Beach Calif—(p & a) Transducers

Davis Electronics 4002 W Burbank Blvd Burbank Calif—H M Davis—VI 9-1815 (p) Mobile Comm Equip

*Daystrom Pacific Corp 3030 Nebraska Ave Santa Monica Calif—J W Bamford—EX 3-6755 (p) Intervalometer (a) Gyroscopes

*Daystrom Pacific Corp Potentiometer Div 11150 La Grange Ave W Los Angeles Calif—W P Simpson—GR 8-3796 (p) Potentiometers

DeCoursey Eng'g Lab 11828 W Jefferson Blvd Culver City Calif—W E DeCoursey—EX 7-9668 (p & a) Filters

DeMornay-Bonardi Corp 780 S Arroyo Pkwy Pasadena Calif—T M Brown—SY 2-4142 (p) Microwave Test Equip

Detectron Corp 5528 Vineland Ave N Hollywood Calif—ST 7-0401 (p) Counters (a) Radiation Survey Instr

△Deutsch Co 7000 Avalon Blvd Los Angeles 3 Calif—H E Schwank—PL 1-4131 (p) Connectors

Developmental Electronics Corp 4213 S Bdwy Los Angeles 37 Calif—J W Jimenez—AD 4-7751 (p & a) Delay Lines

△Dilectron Div Gudeman Co 2669 S Myrtle Ave Monrovia Calif—George Wiesinger—RY 1-8631 (p & a) Ceramic Capacitors

Dirigo Compass & Instrument Boeing Field Box 37 Seattle 8 Wash—H V Wenger, Jr—LA 5940 (a) Test Equip

△Donner Scientific Co 2829 7 St Berkeley Calif—R E Krueger—TH 5-3150 (p) Analog Computers (a) Servo Accelerometers

△Dressen-Barnes Corp 250 N Vinedo Ave Pasadena Calif—G A Hall—SY 3-0691 (p & a) D-C Power Supplies

△D & R Ltd 402 E Gutierrez St Santa Barbara Calif—J A Moseley—WO 5-4511 (p) Flutter Measuring Instruments (a) High-Frequency Alternators

Dudek & Co R C 407 N Maple Drive Beverly Hills Calif—R C Dudek—BR 2-8097 (p) Fasteners (a) Connectors

△*Dumont Laboratories All B 11800 W Olympic Blvd Los Angeles Calif—R B Austrian—BR 2-6394 (p & a) Test Equipment

Dynamic Air Eng'g 7412 Maie Ave Los Angeles 1 Calif—Harry Glascock—LU 8-3292 (p & a) Blowers

Edcliff Instruments 1711 S Mountain Ave Durate Calif — H K Manning — RY 1-5671 (p & a) Linear Motion Potentiometers

Eeco Production Co 506 E 1 St Santa Ana Calif—T W Jarmie—KI 3-9384 (p) Plug-in Units (a) Amplifiers

△Eitel-McCullough Inc 798 San Mateo Ave San Bruno Calif—Frank Mansur—JU 8-1212 (p & a) Power Vacuum Tubes

Eldema Corp 9844 Remer St El Monte Calif—V D Walker—CU 3-3498 (p & a) Min Indicator Lights

Electrical Communications 765 Clementina St San Francisco Calif—E H Cogill—KL 2-1947 (p) Radio Pulsing Unit

Electrical Service 1271 Mission St San Francisco 3 Calif—Frank Merritt—UN 1-2245 (p & a) Electronic Controls

△Electrical Specialty Co 2820 E 12 St Los Angeles 23 Calif AN 9-9511

Electro Circuits Inc 401 E Green St Pasadena Calif—R L Shafer—RY 1-6311 (p) Calibrators, Ultrasonic Generators

△Electro Data 460 Sierra Madre Villa Pasadena Calif—E S McCollister—SY 5-4194 (p & a) Computers

Electro Development Co 14701 Keswick St Van Nuys Calif—Bay Vaccarello—ST 6-3660 (p & a) Slip ring assemblies

△Electro Eng'g 401 Preda St San Leandro Calif—M C Phillips—LO 9-3326 (p & a) Transformers

△Electro Instruments Inc 3794 Rosecrans St San Diego 10 Calif — Jonathon Edwards—CY 8-6144 (p & a) Digital Ohmmeters

Electromation Co 116 S Hollywood Way Burbank Calif—J M Johnson—VI 3-9291 (p) Synch Magnetic Film Recorders (a) Co-axial r-f Switches

△Electro-Measurements 4312 S E Stark St Portland 15 Ore—S J Averill—BE 4-9235 (p) Impedance Bridges

Electromec Co 5121 San Fernando St Los Angeles 39 Calif—W Howe—CH 5-3771 (p) Oscilloscopes

△Electro-Mechanical Specialties 6819 Melrose St Los Angeles Calif—James Goodman—WE 3-5866

Electronic Coil Co 2506 N Ontario St Burbank Calif—J E Wilcox (p) Coils

△Electronic Control Systems 2136 Westwood Blvd Los Angeles 25 Calif—P R Engels—BR 2-0845 (p) Automation Controls (a) Digital Flowmeter

△Electronic Eng'g Co of Calif 180 S Alvarado Los Angeles 57 Calif—W R McQuiston—DU 2-7353 (p) Packaged Plug-In Circuits (a) Data Processing Systems

Electronic Industries 7649 San Fernando St Burbank Calif—G B Clark—ST 7-8546 (p & a) Attenuators, Meters

Electronic Mfg Corp 227 W Chestnut Ave Monrovia Calif—A H Fester—EL 8-6149 (p) Environmental Test Equip.

Electronic Processes Corp 2190 Folsom St San Francisco 10 Calif—A F Hogland—UN 1-9595 (p) H F Generators

Electronic Production & Devel 138 Nevada El Segundo Calif—M J Haddad—OR 8-9527 (p) Regulated Power Supplies (a) Intercommunication Systems

△Electronic Products Corp 322 State St Santa Barbara Calif—WO 5-8505

△Electronic Specialty Co 5121 San Fernando Rd Los Angeles 39 Calif—T M Duay—CH 5-3771 (p) R F Systems

Electronic Windings Co 3001 Verdugo Rd Los Angeles 65 Calif—L H McCarron—CA 5-5671 (p) Electronic Coils

Electronics Devel Co 3743 Cahuenga Blvd N Hollywood Calif—D W Baisch—ST 7-3223 (p) Microwave Sound Diplexer (a) Air-to-ground TV Transmitter

Electron Products Inc 430 N Halstead St Pasadena Calif—I M Berry—(p & a) Capacitors

△Electro-Pulse Inc 11861 Teale St Culver City Calif—J E Niebuhr—EX 8-6764 (p & a) Pulse Test Equip

Electro-Switch & Controls 5755 Camille Ave Culver City Calif—J K Brose—TE 0-4643 (p & a) Relays

△*Elgin National Watch Electronics Div 2435 N Naomi St Burbank Calif—F S Schaumburg—VI 9-1446 (p & a) Relays

Endeco Eng'g Devel 922 E Anaheim St Wilmington Calif—C W Witt—TE 5-1430 (p) Marine Radiotelephones

△Endevco Corp 161 E Calif St Pasadena Calif—Wilson Bradley Jr—RY 1-5231 (p & a) Vibration & Shock Testing

Engineered Magnetics Div Gulton Mfg Corp 11818 Teale St Culver City Calif—J G Alexakis—TE 0-3939 (p) Power Supplies

Essex Electronics 7303 Atoll Ave N Hollywood Calif—W Hirschberg—ST 7-5451 (p & a) R-F-I-F Coils

Faber Mfg Co Merle 35 Stillman St San Francisco Calif—M F Faber—EX 2-7302 Vacuum Tube Components

△*Fairchild Controls Corp Components Div 6111 E Wash Blvd Los Angeles 22 Calif—RA 3-5191

△*Fairchild Electrotechnics Div Fairchild Engine & Airplane Corp 118 E 16 St Costa Mesa Calif—H E Roberts—LI 8-7701 (p) Resistance Bridge. Voltage Ratio & Bridge Balance Instruments

*Farnsworth Electronics Co Pacific Div 815 S San Antonio Rd Palo Alto Calif—V D Carver—YO 7-7249 (p) Hermetic Compression Seals (a) Rocket Hermetic Seal Components

Feay Co Neal 427 Olive St Santa Barbara Calif—N F Rasmussen—WO 2-0722 (p) Dials, Panels, Scales

△Filtron Co 10023 W Jefferson Blvd Culver City Calif—TE 0-6274

Fischer & Co R A 517 Commercial St Glendale 3 Calif—R A Fischer—CI 1-1362 (p) Ultra Sound

Fisher Research Lab 1961 University Ave Palo Alto Calif—C R Fisher—DA 2-4646 (p) Pipe Finders, Leak Detectors (a) Communication Equip

△Fluke Mfg Co John 1111 W Nickerson St Seattle 99 Wash—J M Fluke—AL 3322 (p) Precision Differential Voltmeters

Ford Eng'g Co 129 E "A" St Upland Calif—A S Voak—YU 2-4859 (p & a) Precision Variable Resistors

△Formica Co 1151 E Santee St Los Angeles 15 Calif—RI 9-2381

△Furane Plastics Inc 4516 Brazil St Los Angeles 39 Calif—Julian Delmonte—CH 5-1153 (p) Insulating Resins

△*General Electric Co Industrial Computer Section Menlo Park Calif—George Jacobi—(p) Data processing equip (a) Airborne data processing

△*General Electric Co Microwave Lab 601 Calif Palo Alto Calif—C J Marsh—DA 4-1661 (p & a) Klystrons

△*General Radio Co 1000 N Seward St Los Angeles 38 Calif—Frederick Ireland—HO 9-6201 (p) Adjustable Auto Transformers (a) Voltage Controls & Regulators

Genisco Inc 2233 Federal Ave Los Angeles 64 Calif—W A Barton—GR 8-1275 (p & a) Accelerometers

△Gertsch Products Inc 11846 Mississippi Ave Los Angeles 25 Calif—E P Gertsch—GR 8-7777 (p & a) Frequency Meters and Standards

△Giannini & Co G M 918 E Green St Pasadena Calif—J M Rau—RY 1-7152 (p & a) Transducers, Controls

Gilfillan Bros 1815 Venice Blvd Los Angeles 6 Calif—H G Tasker—DU 1-3441 (p) Navigation Systems (a) Automatic GCA

△Girard-Hopkins 1000 40 Ave Oakland 1 Calif—J C Hopkins—KE 2-8477 (p) Fixed Paper Capacitors

△Globe Electrical Mfg Co 1729 W 134 St Gardena Calif—FA 1-3311

G & M Equipment Co 7315 Varna Ave N Hollywood Calif—H W Arlidge—PO 5-4185 (p) Intercom (a) Spectrum Analyzer

△Goe Eng'g Co 219 S Mednick Ave Los Angeles 22 Calif—R 9-6559

Goldak Co 1544 W Glenoaks Blvd Glendale 1 Calif—H L Eggleston Jr—CH 5-6571 (p & a) Relay Amplifiers

Gonset Co 801 S Main St Burbank Calif — F R Gonset — TH 2-2139 (p) Communications Equip (a) Aircraft VHF 2-Way

Goodline Corp 309 Date Ave Alhambra Calif—Don Good—CU 3-4438 (p & a) Wire & Cable

Gordon Enterprises 5362 N Cahuenga Blvd N Hollywood Calif—Wm Sutphin—ST 7-5267 (p) Photo Processing

Goslin Elec & Mfg Co 2921 W Olive St Burbank Calif—M D Ord—TH 8-0776 (p) Transformers

Graphik Circuits Div Cinch Mfg Corp 221 S Arroyo Pkwy Pasadena Calif—S L Glaspell—RY 1-9667 (p) Electronic Hardware (a) Printed Circuits

Guild Radio & TV 460 N Eucalyptus Ave Inglewood Calif—Lou Dolgin—OR 8-7771 (p) Radios

Hadley Co Robert M 5112 S Hoover St Los Angeles 37 Calif—Arthur Hadley—AD 4-0131 (p & a) Transformers

Hallamore Electronics Brockhurt & Santa Ana Freeway Anaheim Calif—J R Frost—NE 6-2296 (p & a) Guided Missile Telemetering

Hallett Mfg 1601 W Florence Ave Inglewood Calif—S E Estes—OR 8-4751

△Hall-Scott Motors Co Electronics Div 2950 N Ontario St Burbank Calif—R Cripe—VI 9-2341 (p) Amplifiers, Relays (a) Analog Computer

△Hancock Electronics Corp 2553 Middlefield Rd Redwood City Calif—EM 6-8468

Hansen Electronics Co 7117 Santa Monica Blvd Los Angeles 46 Calif—H R Hansen—HO 9-3052 (p & a) Tape Resistors

Harder Co D C 3710 Midway Dr San Diego Calif—D C Harder—AC 2-5240 (p) Toroidal Coils

Harworth Mfg Co 409 El Camino Real Menlo Park Calif—Keith Harworth—DA 3-9965 (p) Metal Detectors

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1317 Fifteenth Street
Phone: GI 2-8901

SAN DIEGO OFFICE
1029 Rosecrans Street
Phone: AC 3-8106

ALBUQUERQUE OFFICE
107 Washington Street, S.E.
Phone: 5-5586

PHOENIX OFFICE
641 E. Missouri Avenue
Phone: CR 4-5431

LAS CRUCES OFFICE
126 South Water St.
Phone: JA 6-2486

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Helco Products Corp 7832 Balboa Blvd Van Nuys Calif—W J MacCauley—ST 0-6091 (p & a) Precision Potentiometers

△Helipot Corp 916 Meridan Ave S Pasadena Calif—D C McNeely—PY 1-2164 (p & a) Potentiometers

△*Hetherington Inc 139 Illinois St El Segundo Calif—C L Cox—OR 8-8417 (p) Aircraft Switches

△Hewlett-Packard Co 275 Page Mill Rd Palo Alto Calif—W N Eldred—DA 5-4451 (p) Test Equipment

△Hoffman Laboratories 3761 S Hill St Los Angeles 7 Calif—C E Underwood—RI 7-9661 (p) Military Communications Equip (a) Airborne Communications Equip

△Hopkins Eng'g 12900 Foothill Blvd San Fernando Calif—W Hopkins—EM 1-8693 (p & a) Capacitors

Houston Fearless Div Color Corp of America 11801 W Olympic Los Angeles 64 Calif—K B Elliott—BR 2-4331 (p) Film Processing Machines

Hudson Assoc 50 Drumm St San Francisco 11 Calif—H R Hudson—YU 2-4479 (p) Amplifers, Controls

Hufco Industries 2815 W Olive Ave Burbank Calif—O F Huffman—VI 9-2118 (p) Relays

△Huggins Laboratories 711 Hamilton Ave Menlo Park Calif—R A Huggins—DA 3-0013 (p & a) Traveling Wave Tubes, Amplifiers

△Hughes Aircraft Co Florence & Teale Sts Culver City Calif—C E Blandford—TE 0-7111 (p) Semiconductor Products (a) Guided Missiles

Hughey & Phillips 3300 N San Fernando Blvd Burbank Calif—I H Ganzenhuber—VI 9-1104 (p) Obstruction Lighting Equip

△Hupp Instrumation Co 2119 Sepulveda Blvd Los Angeles 25 Calif—R E Hupp—GR 8-3911 (p) Electronic Counters

△Hycon Mfg Co 2961 E Colorado St Pasadena 8 Calif—Don Oownie—RY 1-9381 (p) Digital Voltmeters & Digital Ratiometer (a) Camera Control Systems

△*Hycor Div Int'l Resistance Co 12970 Bradley Ave Sylmar Calif — W I Elliott—EM 5-3125 (p) Filters, Resistors

Illumitronic Eng'g Sunnyvale Calif—J D Giulie—RE 6-3155 (p) Coils

Industrial Electronic Engineers 3973 Lankershim Blvd N Hollywood Calif—J J Bylo—ST 7-1484 (p) Automation Systems

Instrument Devel & Mfg Corp 3018 E Foothill Blvd Pasadena Calif—P E Skaling—SY 5-5941 (p) Intervalometers

Interstate Eng'g Co Electronics Div 875 S East St Anaheim Calif—P H Reedy—KE 5-6007 (a) Systems Eng'g in Missile Test Range Instrumentation

△Int'l Electronic Research 145 W Magnolia Blvd Burbank Calif—J E Markley, Jr—VI 9-2483 (p) Tube Shields

△Int'l Rectifier Co 1521 E Grand El Segundo Calif—Eric Lidow—OR 8-6281 (p & a) Selenium Rectifiers

Int'l Research Associates 2221 Warwick Ave Santa Monica Calif—L E Brown—TE 0-4415 (p) Transistor Radio (a) Power Supply

Int'l Telemeter Corp 2000 Stoner Ave Los Angeles 25 Calif—W C Rubinstein—GR 8-7751 (p) Pay-As-You-See Television

Invar Instrument Co 1749 North Eastern Ave Los Angeles 32 Calif—S F Buck—AN 9-7759 (p) VHF TV Sweep Generator (a) Sub-Carrier Oscillator

Ircal Industries 2242 S Sepulveda Los Angeles Calif—GR 7-9449 (p & a) Encapsulated Resistors

*Iron Fireman Electronics Div 2838 SE 9 Ave Portland 2 Ore—RV Jack—BE 4-6551 (p) Relays (a) Gyroscopes

Irwin Laboratories 1238 S Gerhart Ave Los Angeles 22 Calif—W W Irwin—RA 3-1819 (p) Metal Analyzer

JA Mac Products 8845 NE Sandy Blvd Portland Ore—J W Jackson—AT 2-4418 (p & a) Antennas

Janco Corp 3111 Winona Ave Burbank Calif—J M Norris—TH 8-5792 (p & a) Resistors, Shunts

Javex P O Box 646 Redlands Calif—C J Reimuller—PY 3-5752 (p) TV Acces

△Jennings Radio Mfg 970 McLaughlin San Jose Calif—C K Townsend—CY 2-4025 (p & a) Capacitors, Relays

Jobbins Electronic Enterprises 771 Hamilton Ave Menlo Park Calif—C W Jobbins—OA 2-7661 (p) Coils

Jordon Electronics 3025 W Mission Rd Alhambra Calif—S T Schreiber—CU 3-6425 (p & a) Special Test Equipment

△Kaar Eng'g Corp 2995 Middlefield Rd Palo Alto Calif—N C Helwig—DA 3-9001 (p & a) Radiotelephones

*Kaiser Aircraft & Electronics Corp 850 San Antonio Rd Palo Alto Calif—W R Aiken—YO 7-7267 (p) Thin Cathode-Ray Tube

Karton 7882 Kartron St Huntington Beach Calif—T B Linton—LE 9-4606 (p) Shorted Turn Indicator

△Kay Lab 5725 Kearney Villa Rd San Diego 12 Calif—R T Silberman—BR 7-6700 (p) Amplifiers

△*Kearfott Co 253 N Vinedo Ave Pasadena 8 Calif—L C Spoor—SY 6-9139 (p) Microwave Ferrite Components (a) Microwave Components & Radar Test Sets

K-F Development Co 2606 Spring St Redwood City Calif—E V Oean—EM 8-5670 (p) Precision Wire Wound Resistors (a) Potentiometers

Knopp Inc 4224 Holden St Oakland 8 Calif—H P Knopp—OL 3-1661 (p & a) Transformers

△Lambda-Pacific Eng'g 14725 Arminta St Van Nuys Calif—Steve Suddjian—ST 7-0779 (p) Microwave Links

Land-Air Inc Instrument & Electronic Div Oakland 14 Calif (p & a) Receivers

Landsverk Electro Meter Co 550 W Garfield Ave Glendale 4 Calif—D L Collins—CI 1-2954 (p) Radiation Detection Equip

Lane Electronics Co 7254 Atoll Ave N Hollywood Calif—A J Lane—ST 7-3267 (a) Radio Panels

△Lansing Sound J B 2439 Fletcher Dr Los Angeles 39 Calif—R V Pepe—NO 3-3218 (p & a) Loudspeakers

Lawrence Laboratory 1668 Euclid St Santa Monica Calif—H F Schwedes—EX 5-8249 (p & a) Waveguide Component Castings

△Leach Corp Leach Relay Div 5915 Avalon Blvd Los Angeles 3 Calif—J L Elliott—AO 2-8221 (p & a) Relays

Lear Inc, Learcal Div 3171 S Bundy Dr Santa Monica Calif—D Fairchilds—EX 8-6211 (p & a) Airborne Communications

△Lenkurt Electric Co 1105 County Rd Palo Alto Calif—E E Ferrey—LY 1-8461 (p) Carrier Telephone

△Lerco Electronics 501 S Varney Burbank Calif—E L Deatrick—VI 9-5556 (p) Terminals

Levinthal Electronic Products 2821 Fair Oaks Ave Redwood City Calif—A J Morris—EM 8-2963 (p & a) Microwave Transmitters & Modulators

△Librascope Inc 808 Western Ave Glendale 1 Calif—K S Lee—CI 43181 (p & a) Computers & Controls

Lipps Co Edwin A 5485 W Washington Blvd Los Angeles 16 Calif—E A Lipps—WE 5-4141 (p) Tape Magnetic Recording Heads (a) Computer & Telemeter Recording Heads

Litton Engineering Labs P O Box 949 Grass Valley Calif—F L Towne—1730 (p) Glass working Lathes

△Litton Industries 336 N Foothill Rd Beverly Hills Calif—H W Jamieson—CR 4-7411 (p & a) Vibration Test Equip and Systems

Ling Electronics Inc 5120 W Jefferson Blvd Los Angeles 16 Calif—C G Pierce—WE 3-9595 (p) Vibration Test Equipment (a) Aircraft Vibration Testing Systems

Lockheed Aircraft Corp Missile Systems Oiv 7701 Woodley Ave Van Nuys Calif—W D Orr—ST 6-4210 (p & a) Missiles & Missile Systems

Loge Sound Engrs J M 2171 W Wash Blvd Los Angeles Calif—J M Loge—RE 4-9178 (p) Intercom Systems

Logistics Research 141 S Pacific Ave Redondo Beach Calif—Alfred Walker—OR 8-7108 (p) Digital Computer

△Luther Electronic Mfg 5728 W Washington Blvd Los Angeles 16 Calif—C L Johnson—WE 9-5826 (p) Heart Beat Indicator (a) Pulse Forming Networks

Lynch Carrier Systems 695 Bryant St San Francisco 7 Calif—E B Stone—EX 7-1471 (p) Carrier Telephone

△McKenna Laboratories 2503 Main St Santa Monica Calif—LaJune Coffman—EX 9-8846 (p) Ultrasonic Equip

McLaughlin Corp J L A 367 Bird Rock Ave La Jolla—J L A McLaughlin—GL 4-0141 (p) Single-sideband/Diversity Radio Receivers

Macson Co 3260 Motor Ave Los Angeles 34 Calif—J T MacDonald—TE 0-3000 (p) Connectors

Magna Electronics Co 9810 Anza Ave Inglewood Calif—G A Yingling—OR 8-5675 (p) Amplifiers

Magnasync Mfg Co 5546 Satsuma Ave N Hollywood Calif—D J White—PO 6-1692 (p) Recording & Reproducing Equip

MagneTec Corp 11785 W Olympic Blvd Los Angeles 64 Calif—J W Hawkins—GR 9-2257 (p) Tape Recording & Reproducing Heads (a) Magnetic Clutches

△Magnetic Research Corp 202 Center St El Segundo Calif—A R Hunter—OR 8-8921 (p) D C Power Supplies (a) Amplifiers

Mann Co W I 106 E Foothill Blvd Monrovia Calif—F G Gleason—EL 8-3206 (p) Specialized Potentiometers (a) Precision Optical Components & Assemblies

Manufacturers Lab 10610 Keswick St Sun Valley Calif—H P Stark—WE 8-9045 (p) Custom Recording Installations

Marchant Calculators 1475 Powell St Oakland 8 Calif—H G Ayers—OL 2-6500 (p) Digital Computers

Marco Industries Co 207 S Helena St Anaheim Calif—W W Bowles—KE 5-6037 (a) Visual Warning Systems

△Master Mobile Mounts Inc 1306 Bond St Los Angeles 15 Calif—RI 7-0638

Mattson Electronics Corp 1487 Lincoln Ave Pasadena 3 Calif—Ebert Mattson—RY 1-6386 (p) Amplifiers

May Eng'g 6055 Lankershim Blvd N Hollywood Calif—D M May—ST 7-2189 (p & a) Oelay Lines

Mayer Eng'g Frank 6442 Santa Monica Blvd Los Angeles 38 Calif — Vern Springford—HO 3-7121 (p) Comm Systems

△Meridian Metalcraft Inc 8739 S Millergrove Dr Whittier Calif—RA 3-1508

Mesa Plastics Co 11751 Mississippi Ave Los Angeles 25 Calif—F C Karas—GR 8-2310 (p & a) Molding Materials

Metzner Eng'g Corp 1041 N Sycamore Ave Hollywood 38 Calif—Wm Connelly—HO 2-22353 (p) Turntables

Mica Corp 4031 Elenda St Culver City Calif—R T Toppin—TE 0-6861 (p) Epoxy Copper Clad Laminates

△Microdot Inc 1826 Fremont South Pasadena Calif—W F Cox—RY 1-2782 (p & a) Coax Connectors

△Miller Co J W 5917 S Main St Los Angeles 3 Calif—J R Hummes—AD 3-4297 (p) R-F & I-F Transformers

△Miller Dial & Name Plate Co 4400 N Temple City Blvd El Monte Calif—CU 3-5111

Miller Instruments Inc WM 325 N Halstead Ave Pasadena 8 Calif—E E Hoskins—RY 1-6317 (p) Recording Oscillographs

Milli-Switch Corp 1742 Berkeley St Santa Monica Calif—A A Allen—EX 4-1733 (p) Sensitive Precision Snap Action Switches

△*Minn-Honeywell Regulator Co Transistor Div 6620 Telegraph Rd Los Angeles 22 Calif—RA 3-6611 (p & a) Transistors

△Monitor Products Co 815 Fremont Ave S Pasadena Calif—V D Wilson—RY 1-1174 (p & a) Crystals

Morrow Radio Mfg Co 2794 Market St Salem Ore—M C Pogue—SA 3-6952 (p) Two-way Radio Equip

△Moseley Co F L 409 N Fair Oaks Ave Pasadena Calif—F L Moseley—SY 2-1176 (p & a) X-Y Recorder

*Motorola Inc Research Lab 8330 Indiana Ave Riverside Calif—J F Byrne—OV 9-3141 (a) Weapons Systems, Microwave Equip Research & Devel

Mueller Laboratory 1052 N Allen Ave Pasadena 7 Calif—E F Gadler—SY 7-0909 (p) Electro-Magnetic Computers (a) Digital Computers

△Mullenbach Oiv Electric Machinery Mfg Co 2100 E 27th St Los Angeles 58 Calif—R J Mullenbach—LU 2-5331 (p & a) Electrostrictive Relays

△Mystik Tape Prods 3630 Tyburn St Los Angeles 65 Calif CL 6-4168

Nader Mfg Co 2661 S Myrtle Ave Monrovia Calif—Fred Bezold—DO 6-2121 (p & a) Transistorized D C Transformers

National Aircraft Corp Marvelco Electronics Div 3411 Tulare Ave Burbank Calif—W L Herron—VI 9-3251 (p & a) Semiconductors

△*National Carbon Co 22 Battery St San Francisco 6 Calif—YU 2-1360

Networks Electronic Corp 14806 Oxnard St Van Nuys Calif—H J Mock—ST 5-8805 (p & a) Thermal Relays

Newcomb Audio Products 6824 Lexington Ave Hollywood 38 Calif—Robert Newcomb—HO 9-5381 (p) Sound Equip

△Non-Linear Systems Del Mar Airport Del Mar Calif—A M Watson—SK 5-1134 (p) Digital Voltmeters

△*Norden-Ketay Corp Western Div 13210 Crenshaw Blvd Gardena Calif—L O Seerden—OR 8-7121 (p & a) Synchros & Resolvers

△North American Aviation 12214 Lakewood Blvd Downey Calif—LO 5-8651 (a) Guided Missile Systems

North American Instruments 2420 N Lake Ave Altadena Calif—Ted Lucas—RY 1-9378 (p) Oscillators (a) Transducers

Northwest Monitoring Service 2753 NE Douglas Roseburg Ore—J H Platz—OR 3-4198 (p) Precision Frequency Measurements

Nucleonic Products Co 1601 Grande Vista Ave Los Angeles 23 Calif—A J Jolles—AN 2-3503 (p) Germanium Diodes

*NYT Electronics Inc 2979 N Ontario St Burbank Calif—R L Hyder—TH 2-4450 (a) Transformers

Oberline Inc P O Box 921 Beverly Hills Calif—Oliver Berliner—CR 6-2726 (p) Broadcast Audio Equip

O'Brien Electric Corp 6514 Santa Monica Blvd Hollywood 38 Calif — Frank O'Brien—HO 4-1117 (p) Broadcast Program Switchers

△Optronic Co 136 Caputo Lane San Jose Calif—CH 3-0508

△Oregon Electronics Mfg 2232 E Burnside St Portland 15 Ore—C W McPherson—BE 6-9292 (p) Power Supplies

Osborne Electric 712 S E Hawthorne Portland Ore—G L Osborne—FI 6448 (p & a) Transformers

△Oster Mfg Co Avionic Div 7339 W 90 St Los Angeles 45 Calif

Owen Labs 55 Beacon Pl Pasadena Calif—R P Owen—RY 1-5921 (p) Transistor Test Sets

Pace Eng'g 6914 Beck Ave N Hollywood Calif—Bernard Helfand—PO 5-0453 (p) Recording Cameras, Vibration Measuring Equip

Pacific Mercury TV Mfg 8345 Hayvenhurst Ave Sepulveda Calif—J Axe—EM 2-3131 (p) TV Receivers (a) Glide Slope Receivers

Pacific Relays Inc 12027 Vose St N Hollywood Calif—N F Leo—ST 7-0209 (a) Sub-Miniature Relays

Pacific Scientific Co 6280 Chalet Or Bell Gardens Calif—D G McAllister—AN 2-1123 (a) Rate Gyroscopes

△Pacific Semiconductors Inc 10451 W Jefferson Blvd Culver City Calif—N J Egli—TE 0-4881 (p) Germanium Diodes

Pacific Transducer Corp 11836 W Pico Blvd Los Angeles 64 Calif—R S Clarke—GR 8-1134 (p) Audio Sweep Frequency Generators

△Packard-Bell Co 12333 W Olympic Blvd Los Angeles Calif—H L Vick—BR 2-2171 (p & a) Comm Systems

Palmer Inc M V 4002 Fruit Valley Rd Vancouver Wash—Martin Palmer—OX 3-0590 (p) Telephone components, switches, relays

△Palo Alto Eng'g Co 448 Olive Ave Palo Alto Calif—DA 5-3251

△Parsons Co Ralph M 135 W Dayton St Pasadena Calif—E C Lee—SY 3-6158 (p) Telemetering Equip (a) Custom Flight & Production Instrumentation

△PCA Electronics Inc 2180 Colorado Ave Santa Monica Calif—D J Wells—TE 0-6716 (p) Pulse Transformers

Pearson Electronics 895 Commercial St Palo Alto Calif—P A Pearson—(p) Custom-built Pulse Equipment & Transformers

Peerless Electrical Prods Oiv Altec Lansing Corp 9356 Santa Monica Blvd Beverly Hills Calif—E B Harrison—CR 5-5101 (p & a) Transformers

△Penta Labs 312 N Nopal St Santa Barbara Calif—J E Lannan—WO 5-4581 (p) High Power Vacuum Tubes

△Perkin Eng'g Corp 345 Kansas St El Segundo Calif—Philip Diamond—OR 8-7215 (p & a) Power Supplies

Pfleger Products 3901 W 54 St Los Angeles 43 Calif—G H Nelson—AX 2-8313 (p) Machined Parts

△Phaostron Instrument & Electronic Co 151 Pasadena Ave S Pasadena Calif—W A Beswick—CL 5-1471 (p & a) Electric Panel Meters

*Photo Chemical Products of Calif 1715 Berkeley St Santa Monica Calif—J T Cain—EX 5-0919 (p & a) Finishing & Permanent Marking of Aircraft & Electronic Equip

\Photocon Research Products 421 N Foothill Blvd Pasadena Calif—C E Grinstead—SY 2-4131 (p) Dynagages (a) Precision & Magnetic Counters

'ioneer Electronics Corp 2235 S Carmelina Los Angeles 64 Calif—L M Perrish—BR 2-8053 (p) Cathode-Ray Picture Tubes

*Polytechnic Research & Development Co 737 N Seward St Hollywood 38 Calif —W A C A Yearsley—HO 5-5287 (p) Microwave Test Equip

\Pomona Electronics Co 1126 W 5 Ave Pomona Calif—J J Musarra—LY 9-9549 (p) Test Socket Tube Adapters

'onder & Best 814 N Cole Ave Hollywood 38 Calif—D L Ohlson—OH 9-6251 (p) TV Lenses

'recision Crystal Lab 2223 Warwick Ave Santa Monica Calif—W Rogers—TE 0-5049 (a) Quartz Crystal Frequency Control Units

'recision Radiation Instruments Inc 4223 W Jefferson Blvd Los Angeles 16 Calif —Paul Sperling—WE 1-5917 (p) Geiger Counters & scintillators

'recision Technology Inc 66 South P St Livermore Calif—D F Mastick—HI 7-3343 (p) Image Converter Cameras

'rescott TV Co 7352 Beverly Blvd Los Angeles 36 Calif—M Prescott—WE 3-7193 (p) TV Receivers

'rinted Cellophane Tape 521 N La Brea Ave Los Angeles 36 Calif—Don Gevirtz —WE 8-2134 (p & a) Cable Marking

'rofessional Electronics Co P O Box 1181 La Jolla Calif—E P Shultz—(p) Medical Electronics

'ruyn-Moore Inc 1338 Cota Ave Long Beach 13 Calif—C C Moore—HE 5-7417 (p) VHF-UHF Antenna Equip

'SP Eng'g Co 8608 Otis St South Gate Calif—S L Lambert—LO 7-1451 (p & a) Solenoids

\Pulse Eng'g Co 2431 Spring St Redwood City Calif—EM 8-9559

lRK Electronic Prods 445 N Circle Dr Fresno 4 Calif—Bert Williams—7-1423 (p) Turntables

ladar Engineers 401 E 45 St Seattle 5 Wash—W T Harrold—ME 2828 (p & a) Cable Test Set

*Radio Corp of America 11819 W Olympic Blvd Los Angeles 64 Calif BR 2-8841—(p & a) Radar

ladio Specialty Mfg Co 2023 SE 6 Ave Portland 14 Ore—H J Sterne—BE 2-8123 (p) Portable Receivers

\Ramo-Wooldridge Corp 8820 Bellanca Ave Los Angeles 45 Calif—OR 8-7161

lansom Research P O Box 382 San Pedro Calif—D H Ranson—TE 2-6848 (p & a) Counters & Timers

latigan Electronics 3614 Maple Ave Los Angeles 11 Calif—L T Ratigan—AD 3-4141 (a) Pulse Delay Networks

\Rayco Electronic Mfg 11116 Cumpston St N Hollywood Calif—ST 7-7770

*Raytheon Mfg Co Point Mugu Calif (a) Electronic Equip, Flight Test Equip

\Rea Co J B 1723 Cloverfield Blvd Santa Monica Calif—J H Parnell—EX 3-7201 (p) Digital Computer (a) Gyros

leed-Curtis Nuclear Industries 307 Culver Blvd Playa del Rey Calif—W W Reed —EX 8-5411 (p) Counters, Detectors

legulator Engr & Devel 11545 W Jefferson Blvd Culver City Calif—R G Kelly—TE 6507 (p & a) Power Supplies

\Remler Co 2101 Bryant Ave San Francisco Calif—G A Gianandrea—VA 4-3535 (p) Amplifiers & Controls (a) Aircraft Announcing Systems & Loudspeakers

\Repath Inc Paul R 641 E 61 St Los Angeles 1 Calif—L W Murphy—AD 3-7262 (p & a) Silicone & Nickel Laminations

esdel Eng'g 330 S Fair Oaks Pasadena 1 Calif—R A Carlson—SY 5-5197 (p) Velocity Measuring Systems (a) Dovap Transponders

\Resin Industries Sub Borden Co Gutierrez & Olive Sts Santa Barbara Calif—D L Cochran—WO 3134 (p & a) Vinyl Insulation Sleeving

\Rheem Mfg Co R&D Labs Gov't Prods Div 9236 E Hall Rd Downey Calif—H C Bream—TO 1-6810 (p) Instrumentation Amplifiers (a) Airborne Telemetering Equip

\RHO Eng'g Co 2242 Sepulveda Blvd Los Angeles 64 Calif—H C Gordon—BR 2-2956 (p & a) Encapsulated Precision Wound Resistors

Richardson Co 815 N Cahuenga Blvd Hollywood 38 Calif—Sidney Richardson—(a) Connectors

Robinette Co W C 802 Fair Oaks Ave S Pasadena Calif—W C Robinette—RY 1-1594 (p) Servo Mechanisms

△Roesch Inc Douglas 2200 S Figueroa St Los Angeles 7 Calif—M O Rice—RI 7-9361 (p) Remote Control Television (a) Electronic Cables

△*Rosen Eng'g Products 15016 Ventura Blvd Sherman Oaks Calif—R W Murray (p & a) FM/FM Telemetering

Rototest Labs Inc 2803 Los Flores Blvd Lynwood Calif—W H Grumet—NE 6-2245 (p) Component Testing

Roylyn Inc 1706 Standard Ave Glendale 1 Calif—F B Parker—CI 2-1146 (p & a) Couplings

△RS Electronics Corp 435 Portage Ave Palo Alto Calif—Robert K-F Scal—DA 3-9063 (p) Radar & Communications Receivers (a) Radar Subassemblies

△Rutherford Electronics Co 3707 S Robertson Blvd Culver City Calif—C E Rutherford—TE 0-4362 (p & a) Pulse Generators

△San Fernando Electric Mfg Co 1509 1 St San Fernando Calif—L R Smith—EM 1-8681 (p & a) Capacitors

Santa Monica Bay Sheltered Workshop 2521 5 St Santa Monica Calif—J E Anthony—EX 9-7741 (p) Toroidal Windings (a) Toroids

Sargent-Rayment Co 4926 E 12 St Oakland 1 Calif—Will Rayment—KE 6-5277 (p) Hi-Fi Tuners, Amplifiers & Pre-amplifiers

Schafer Custom Eng'g 235 S 3 St Burbank Calif—Paul Schafer—TH 4-2461 (p & a) Telemetering Systems

Seals Ltd 1010 Mission St S Pasadena Calif—Wes Speer—RY 1-3191 (p) Hermetic Connectors

△Sequoia Process Corp 871 Willow St Redwood City Calif—Beardsley Graham—EM 9-0331 (p) Hyrad Insulation (a) Plastic Insulated Hookup Wires & Cables

*Servomechanisms Inc Western Div 12500 Aviation Blvd Hawthorne Calif—Louis Lenart—OS 5-7111 (p) Amplifiers (a) Master Data Computers

Servonic Instruments 1145 S Fair Oaks Pasadena Calif—J A DeJulio—SY 9-1332 (p & a) Pressure Transducers

Shamban Eng'g 11617 W Jefferson Culver City Calif—W S Shamban—EX 7-2195 (p & a) Plastic Insulators

△Shasta Div Beckman Instruments Richmond Calif—LA 6-7730

Shockley Semiconductor Lab 391 S San Antonio Rd Mountain View Calif—G S Horsley—DA 3-6138 (p) Semiconductors

Sieler Design Prods 10460 San Pablo Ave El Cerrito Calif—Geo Sieler—LA 5-0164 (p) Speakers

△Sierra Electronic Corp 1050 Britton Ave San Carlos Calif—C A Walter—LY 1-0711 (p) RF Power Measurement Devices (a) Directional Couplers

Solar Mfg Corp 46 & Seville Ave Los Angeles 58 Calif—Dorr Wagner—LU 3-1411 (p) Ceramic Capacitors (a) JAN approved capacitors

Sonic Specialties Inc 701 S Electric Alhambra Calif—W D Geiger—CU 3-6587 (p) AM-FM Tuner

△Southern Electronics Co 239 W Orange Grove Ave Burbank Calif—George Gansell—VI 9-3193 (p) Capacitors

△Spectrol Electronics Div Carrier Corp 1704 S Del Mar Ave San Gabriel Calif—H E Hood—AT 9-4178 (p & a) Precision Potentiometers

Spinco Div Beckman Instruments 743 O'Neill Ave Belmont Calif—George Clifford—LY 3-7693 (p) Ultracentrifuges

Stancil-Hoffman Corp 921 N Highland Ave Hollywood 38 Calif—W V Stancil—HO 4-7461 (p) Magnetic Tape Recorders (a) Airborne Tape Recorders & Reproducers

Standard Wire & Cable Co 3440 Overland Ave Los Angeles 34 Calif—I M Harris—TE 0-4647 (p & a) Wire

Stanford Laboratories Co P O Box 252 Menlo Park Calif—W S Geisler Jr—EM 8-4127 (p & a) Traveling wave tubes

Stephens Tru-Sonic Inc 8538 Warner Dr Culver City Calif—Bernard Cirlin—TE 0-3775 (p) Microphones

Stewart Eng'g Co Box 277 Soquel Calif—E L Peterson—GR 5-4790 (p) Backward Wave Oscillators

△Stoddart Aircraft Radio Co 6644 Santa Monica Blvd Hollywood 38 Calif—A T Parker—HO 4-9294 (p) Radio Interference Field Intensity Measuring Equip (a) Line Impedance Stabilization Networks

△*Sylvania Electric Products 500 Evely Ave Mountain View Calif—Ray McClintock—YO 7-6981 (p) Traveling Wave Tubes

Symphony Radio & TV Corp 925 S Western Ave Los Angeles 6 Calif—S Solet —RE 4-1173 (p) Transistors

Tally Register Corp 5300 14 N W Seattle 7 Wash—E P Bayley—DE 5500 (p) Digital Plotter (a) Pulse Width Digitizer

TA-Mar Inc 11571 W Jefferson Blvd Culver City Calif—E S Hough Jr—TE 0-7479 (p) Radio Remote Control

Technical Devel Co 4060 Ince Blvd Culver City Calif—R A Yarcho—TE 0-5461 (p) Sync Motors (a) Guided Missile Telemetering

△Technical Devices Co 2340 Centinela Ave Los Angeles 64 Calif—M K Allen—GR 7-0708 (p) Wire Cutter

Technical Products Co Instrument Div 6670 Lexington Ave Los Angeles 38 Calif—J H Krebs—HO 4-8121 (p) Frequency Analyzer

△*Technology Instrument Corp 7229 Atoll Ave N Hollywood Calif—J M Looney Jr—PO 5-8620 (p) Potentiometers

Tectron 7721 Melrose Ave Hollywood 46 Calif—S B Cohen—WE 3-3270 (p) Amplifiers

△Tektronix Inc P O Box 831 Portland 7 Ore—R L Ropiequet—CY 2-2611 (p) Oscillographs

Telecomputing Corp 12838 Saticoy St N Hollywood Calif—T C Taylor—ST 7-8181 (p) Computing Equip

Telemeter Magnetics Inc 2245 Pontius Ave Los Angeles 64 Calif—Erwin Tomash—BR 2-6636 (p) Magnetic Core Memories (a) Ferrite Cores

Tele-Systems Inc 6442 Santa Monica Los Angeles 38 Calif—HO 3-7121 (p) Comm Systems

Teletronic Labs Inc 1835 W Rosecrans Ave Gardena Calif—Daniel Rose—FA 1-0627 (p) Intercom Systems

Televideo Corp of America 114 E Jefferson Blvd Los Angeles 11 Calif—Jaime Balugo—AD 2-7282 (p) TV Picture Tubes (a) Deflection Yokes

△*Tensolite Insulated Wire Co Pacific Div 1516 N Gardner St Los Angeles 46 Calif—Miriam Smith—HO 5-6060 (p & a) Wire & Cable

△Thermador Electrical Mfg Electronics Plant 2000 S Camfield Ave Los Angeles 22 Calif—RA 3-5188

Thomas Associates 4607 Alger St Los Angeles 39 Calif—H P Thomas—CH 5-3748 (a) Instrument Cases

Thompson Fibre Glass Co 1733 Cordova St Los Angeles 7 Calif—W E Benke RE 3-9161 (p) Insulators

△Timely Instruments & Controls 1645 W 135 St Gardena Calif—M Schulman —DA 4-6067 (p & a) DC Voltage References

Transco Products 12210 Nebraska Ave Los Angeles 25 Calif—W P Stratton—BR 2-5687 (p & a) Coax Switches

Trans Electronics Co 7349 Canoga Ave Canoga Park Calif—Harvey Stump—DI 8-1757 (p) Transistor & Diode Research & Production Test

△Transformer Engineers 325 N Halstead Ave Pasadena 8 Calif—E E Hoskins —RY 1-6317 (p) Recording Instruments

Transonic Inc 808 16 St Bakersfield Calif—Jerry Cummins—FA 2-7872 (p & a) Transformers

Trans-Tel Corp 736 N Highland Los Angeles 38 Calif—Ben Williams HO 2-2463 (p) Comm Systems

△Triad Transformer Corp 4055 Redwood Ave Venice Calif—L W Howard—EX 7-2145 (p & a) Transformers

Tri-Dex Co P O Box 1207 Lindsay Calif —K B Howard—2-4051 (p) Etched Circuits (a) Insulators

Trutone Electronics 812 N Highland Ave Los Angeles 38 Calif—H M Cohen—HO 4-1202 (p) Hi-Fidelity Equip

△*Tung-Sol Sales Corp 8575 Washington Blvd Culver City Calif—TE 0-5505

△Tur-bo Jet Products 434 S San Gabriel Blvd San Gabriel Calif—CU 3-5191

△U M & F Mfg Corp 10929 Vanowen St N Hollywood Calif—ST 7-5526

United Control Corp 4540 Union Bay Pl Seattle 55 Wash—H H Suskin—PL 9200 (p) Temperature Control Systems (a) Transistor Amplifiers

△United ElectroDynamics Div United Geophysical 1200 S Marengo Ave Pasadena Calif—Matthew Slavin—RY 1-1134 (p) Transistorized Instruments (a) Transistorized Telemetering Equip

△United Geophysical Corp 1200 S Marengo St Pasadena 15 Calif—L A Martin—RY 1-1134 (p) Low Frequency, High Gain Amplifiers

△Universal Electronics 1720 22 St Santa Monica Calif—Edward Lacey—EX 3-7707 (p & a) Power Supplies

△U S Eng'g Co Div Litton Industries 521 Commercial St Glendale 3 Calif —CH 5-5777

U S Relay Co 1744 Albion St Los Angeles 31 Calif—L D Bunce—CA 2-9146 (p & a) Relays

△Vacuum Tube Prods 506 S Cleveland St Oceanside Calif—J J Sutherland—SA 2-6567 (p) Vacuum Gauges & Controls (a) Special Vacuum Tubes

Valor Electronic Components Co 5808 Marilyn Ave Culver City Calif—T J —Johnson—TE 0-3241 (p) Min Pulse Transformers

△Vanguard Electronics 3384 Motor St Los Angeles 34 Calif—E L Almo—TE 0-7344 (p) Inductance

△Varian Associates 611 Hansen Way Palo Alto Calif—W M Silhavy—DA 5-5631 (p & a) Microwave Electron Tubes

△Vector Electronic Co 3352 San Fernando Rd Los Angeles 65 Calif—V S Scoville—CL 7-8237 (p & a) Turrets, Sectional Cases

△Viking Industries 21343 Roscoe Blvd Canoga Park Calif—F V Criswell—DI 7-8500 (p) Connectors

Waco Inc 2032 Bdwy Santa Monica Calif Ex 3-7274 (p & a) Coils, Power Supplies

△Walkirt Co 145 W Hazel St Inglewood 3 Calif—W L Kirchoff—OR 8-2873 (p) Plug-In Circuitry (a) Resin Embedments Miniaturization

△Walsco Electronics Corp 3225 Exposition Pl Los Angeles 18 Calif—W L Schott—AX 3-7201 (p & a) Electronic Hardware

Wave Particles Corp P O Box 252 Menlo Park Calif—W S Geisler Jr—EM 8-1579 (p & a) Traveling Wave Tubes

Weber Aircraft Corp 2820 Ontario St Burbank Calif—J H Doyle—TH 8-5543 (p) Analog Computer

Welch Connectors 520 Morino St Los Angeles Calif—K Oster—EX 3-6251 (p) Tube Connectors & Sockets

West Coast Electrical Mfg 233 W 116 Pl Los Angeles 61 Calif—R W Worthington—PL 5-1138 (p & a) Solenoids

West Coast Electronics 9261 W 3 St Beverly Hills Calif—CR 4-5124 (p & a) Band Beacon

West Coast Research Co 2371½ Westwood Blvd Los Angeles 64 Calif—H M Spivack—BR 2-2048 (p) Automation & Servoe Control Systems

Western Coil Products 2989 Middlefield Rd Palo Alto Calif—J M Kaar—DA 5-2718 (p) R-F & I-F Coils, Chokes & Transformers

△Western Devices Inc 8930 Lindblade St Culver City Calif—W C Strumpell—TE 0-6811 (p) Cabinets

Western Gear Corp 2600 E Imperial Hwy Lynwood Calif—L A Myhre—NE 6-2161 (p) Rotary Transformers (a) Actuators

△*Westinghouse Electric Corp 600 St Paul Ave Los Angeles 17 Calif—E A Helling—MA 6-3881 (p) Specialty Transformers (a) Radar Transformer Components

△Westline Products Co 600 E 2 St Los Angeles 54 Calif—Maury Engle—TR 2641 (p & a) Wire Markers

△Westport Electric 149 Lomita St El Segundo Calif—OR 8-9993

△Wiancko Eng'g Co 255 N Halstead Ave Pasadena 8 Calif—L W Hart—RY 1-5226 (p) Pickups (a) Accelerometers

Williams Ship Radio Co 4366 Mentone San Diego 7 Calif—R R Williams—AC 3-3097 (p) Marine Transmitters

Winkler Labs 5225 N 20 St Phoenix Ariz (p) Vibration Measuring Equip

Wolfe Co F C 3644 Eastham Dr Culver City Calif (p) Hermetic Seals

△Wright Eng'g Co 180 E Calif St Pasadena 1 Calif—H D Wright—(p) Measuring Instruments

△Wyco Metal Products 6918 Beck Ave N Hollywood Calif—F N Weiss—ST 7-5579 (p) Cabinet Racks

△Zero Mfg Co 1121 Chestnut St Burbank Calif—J M Fisher—VI 9-5521 (p & a) Instrument Cases

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TELE-TECH &

ELECTRONIC INDUSTRIES

Vol. 15, No. 8 — August, 1956

FRONT COVER: California's most distinctive sights, the giant redwood, and Pan-Pacific Auditorium, Los Angeles, home of WESCON, symbolize this 5th Annual West Coast issue of Tele-Tech & ELECTRONIC INDUSTRIES. Details on the activities, technical program and product exhibits at WESCON start on p. 76.

MONTHLY NEWS ROUND-UP

SECTION ONE:

NEW ELECTRONIC EQUIPMENT

DEPARTMENTS

SECTION TWO: WEST COAST ELECTRONIC INDUSTRIES DIRECTORY

Federal

THE SELENIUM RECTIFIER WITH THE GREATEST

Manufacturer Acceptance

More design and component engineers in the radio-TV industry have placed their approval on Federal Selenium Rectifiers than any other make—

And HERE'S why— point by point:

- **LONGER LIFE**... 5,000 hours life expectancy in approved applications.
- **HIGHER OUTPUT VOLTAGE**...3 to 6½ higher B+ output volts than competitive selenium rectifiers in conventional doubler circuits.
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- **PROVEN MECHANICAL CONSTRUCTION**... brass eyelet or aluminum stud construction used exclusively. Patented "dead-center" construction allows stack to be tightened until rigid, without affecting the pressure-sensitive selenium characteristic.
- **UNDERWRITERS LABORATORY ACCEPTANCE FOR 85° C OPERATION**... Federal's popular radio-TV types have been tested and accepted by UL for operation at cell temperatures of 85° C.
- **CONSERVATIVE RATINGS**...rectifiers offered to the industry are rated only after exhaustive temperature rise and aging tests on minimal grade units to insure full value and satisfaction.
- **MORE UNIFORM QUALITY**...Federal rectifiers are automatically 100% tested and inspected to meet standard forward and reverse current specifications, as well as for dielectric strength.
- **LARGEST PLANT CAPACITY**...production facilities to satisfy any quantity requirement.
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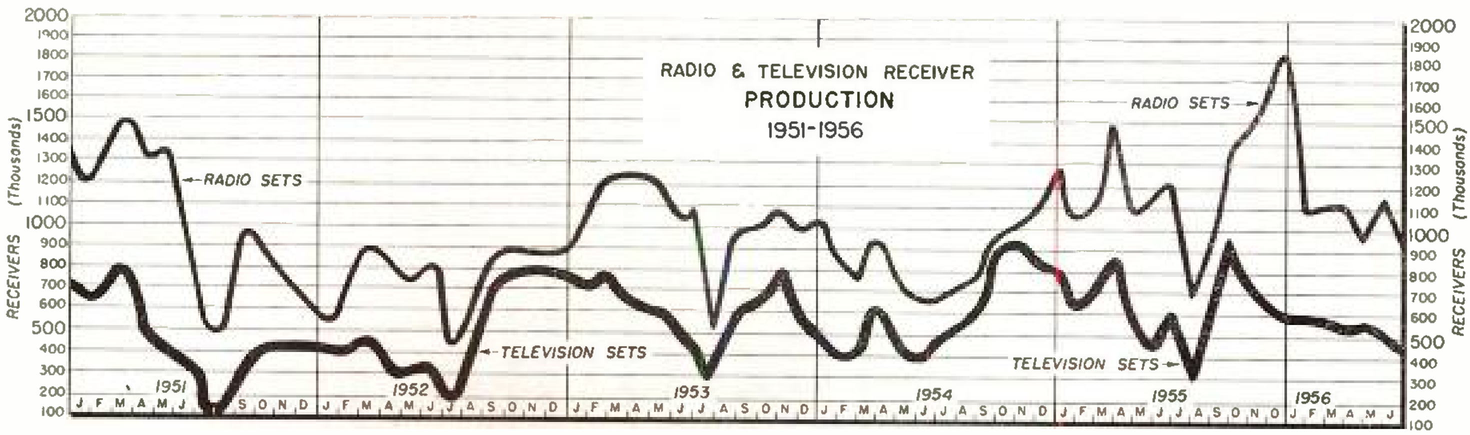
TOTALS



FAILURES OF ELECTRONIC MANUFACTURERS

(during period Apr. 30, 1955—Apr. 30, 1956)

	1955	1956
Failures	26	29*
Av. Age of Companies (years)	6.5	11
Total Liabilities	$14,460,000	$11,055,000

* Products manufactured: components, 17; equipment, 8; phonos, 2; recorders, 1; electronic organ, 1.

From a report by Edward C. Tudor, chairman of the Credit Committee, RETMA to the 32nd RETMA convention, June 12, 1956.

BROADCAST STATIONS IN U. S.

	On the Air	CP's	Applications
AM	2980	160	284
FM	490	57	7
TV	*379 VHF 98 UHF	**108 UHF 44 VHF	107 VHF 26 UHF

* Includes 16 VHF and 5 UHF non-commercial stations

** Includes 14 UHF and 8 VHF non-commercial stations

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by Government procurement agencies in June 1956.

Actuators	$131,494
Amplifiers	474,841
Amplifiers, RF	179,788
Amplifiers, Servo	128,876
Analyzers, Spectrum	67,178
Antennas	1,690,222
Antenna Towers	152,146
Audio Oscillators	467,583
Batteries, Dry	1,538,382
Batteries, Storage	288,357
Batteries, Zinc—Silver Oxide	74,301
Battery Packs	208,117
Calibrators	76,026
Chargers, Battery	271,197
Code Generators	51,388
Computers	763,900
Connectors	316,884
Control Monitors	261,852
Controls	4,732,938
Converters, Analog	40,923
Converters, Frequency	241,700
Countermeasures Sets	45,026
Crystal Units	207,410
Delay Measuring Sets	35,139
Diathermy Equipment	31,185
Dosimeters	330,460
Filters, Band Pass	329,397
Generators, Signal	91,607
Handsets	548,376
Headsets	201,783
I. T. V. Systems	39,990
Indicators	1,252,969
Indicators, Azimuth	160,284
Indicators, Pressure	180,051
Inspection Sets, Magnetic	169,039
Insulators	50,988
Intercom Units	186,889
Inverters	197,340
Kits, Avionic Modification	296,074
Kits, Modification	2,313,317
Loudspeakers	31,080
Magnetic Tapes	45,048
Meters	27,550
Meters, Audio Level	64,459
Meters, Crystal Impedance	25,401
Meters, Frequency	508,045
Meters, Noise & Field	62,400
Meters, Power	47,329
Meters, Radiological Survey	499,400
Microphones	423,436
Monitors, Clear Text	382,266
Monitors, Frequency	223,200
Monitors, Radar Performance	31,600
Multimeters	633,522
Multiplexers	500,105
Oscillographs	44,502
Oscilloscopes	904,876
Potentiometers	28,820
Power Supplies	168,871
Radar Equipment	9,973,375
Radio Beacon Communication Sets	568,081
Radio Central Systems	396,279
Radio Compasses	1,154,356
Radio Direction Finders	45,653
Radio Receivers	2,539,273
Radio Receiver-Transmitters	6,511,383
Radio Sets	3,189,385
Radiosondes	2,365,470
Radio Transceivers	31,578
Radio Transmitters	552,022
Receivers, Anti-Jamming Test	97,749
Recorders	3,966,659
Recorders, Video Tape	75,021
Rectifiers, Metallic	131,850
Relays	60,080
Relays, Motor Driven	52,460
Relays, Polar Telegraph	28,952
Relays, Rotary	28,780
Relays, Solenoid	84,620
Simulators	74,498
Simulators, Target	29,637
Solder	26,336
Studio Equipment, Broadcast	61,254
Switches	815,770
Switches, Rotary	60,465
Switching Assemblies	253,693
Telemeter Ground Equipment	1,259,023
Telemeter Transmitters	66,964
Telephone Sets	1,062,699
Telephone Switchboards	168,345
Telephones Switching Centers, Transistorized	668,666
Telephone Jack Assemblies	72,750
Telephone Terminals	489,873
Teletype Units	4,983,207
Terminals	98,615
Test Sets	571,259
Test Sets, Audio	41,100
Tests Sets, Electric Cable	61,500
Test Sets, Impedance	66,810
Test Sets, Insulation	39,520
Test Sets, Radar	38,318
Test Sets, Radio	357,183
Test Switchboards	34,614
Timing Sets	464,935
Transformers	45,522
Transmissometers	80,349
Transmitters, Pressure	69,778
Transmitters, Rate of Fuel Flow	215,662
Tubes, Electron	1,490,456
Tubes, X-Ray	29,400
Vibrators	25,120
Voltage Dividers	31,539
Windows, Electrically Conducting	30,556
Wire & Cable	2,787,206

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These are the smallest hermetic audios made.

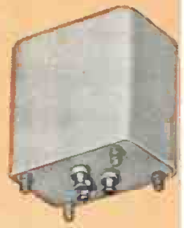
Dimensions . . . 1/2 x 11/16 x 29/32 . . . Weight .8 oz.

TYPICAL ITEMS

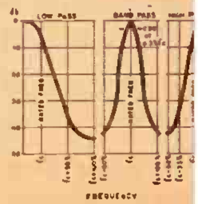
Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri MA	Response ±2 db (Cyc.)	Max. level dbm
H-30	Input to grid	TF1A10YY	50*	62,500	0	150-10,000	+13
H-31	Single plate to single grid, 3:1	TF1A15YY	10,000	90,000	0	300-10,000	+13
H-32	Single plate to line	TF1A13YY	10,000*	200	3	300-10,000	+13
H-33	Single plate to low impedance	TF1A13YY	30,000	50	1	300-10,000	+15
H-34	Single plate to low impedance	TF1A13YY	100,000	60	.5	300-10,000	+ 6
H-35	Reactor	TF1A20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC, 4,400 ohms.				
H-36	Transistor Interstage	TF1A15YY	25,000	1,000	.5	300-10,000	+10

:an be used with higher source impedances, with corresponding reduction in frequency range and current

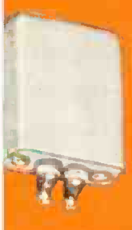
COMPACT HERMETIC AUDIO FILTERS



UTC standardized filters are for low pass, high pass, and band pass application in both interstage and line impedance designs. Thirty four stock values, others to order. Case 1-3/16 x 1-11/16 x 1-5/8 – 2-1/2 high . . . Weight 6-9 oz.



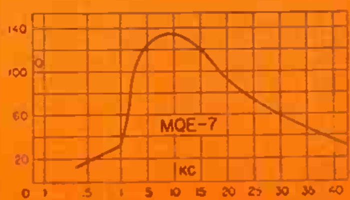
HERMETIC MINIATURE HI-Q TOROIDS



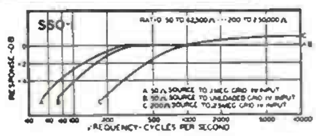
MQE units provide high Q, excellent stability and minimum hum pickup in a case only. 1/2 x 1-1/16 x 17/32 . . . weight 1.5 oz.

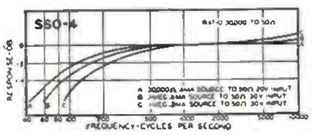
TYPICAL ITEMS

pe No.	Inductance	DC Max.
QE-1	7 mhy.	135
QE-3	20 mhy.	80
QE-5	50 mhy.	50
QE-7	100 mhy.	35
QE-10	.4 hy.	17
QE-12	.9 hy.	12
QE-15	2.8 hy.	7.2



SUB-SUBOUNCER AUDIO UNITS





UTC Subouncer and sub-subouncer units provide exceptional efficiency and frequency range in miniat size. Constructional details assure maximum re bility. SSO units are 7/16 x 3/4 x 43/64 . . . Wei 1/50 lb.

Type	Application	Level	Pri. Imp.	MA D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. I
*SSO-1	Input	+ 4 V.U.	200 50	0	250,000 62,500	13.5	3
SSO-2	Interstage /3:1	+ 4 V.U.	10,000	0-.25	90,000	750	3
*SSO-3	Plate to Line	+20 V.U.	10,000 25,000	3 1.5	200 500	2600	
SSO-4	Output	+20 V.U.	30,000	1.0	50	2875	
SSO-5	Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res.						
SSO-6	Output	+20 V.U.	100,000	.5	60	4700	
*SSO-7	Transistor Interstage	+10 V.U.	20,000 30,000	.5 .5	800 1,200	850	

* Impedance ratio is fixed, 1250:1 for SSO-1,1:50 for SSO-3.
Any impedance between the values shown may be employed.

OUNCER (WIDE RANGE) AUDIO UNITS

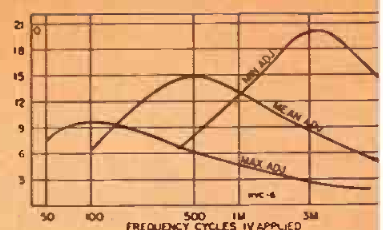
Standard for the industry for 15 yrs., these units provide 30-20,000 cycle response in a case 7/8 dia. x 1-3/16 high. Weight 1 oz.

TYPICAL ITEMS

ype No.	Application	Pri. Imp	Sec. Imp
-1	Mike, pickup or line to 1 grid	50, 200/250, 500/600	50,000
-4	Single plate to 1 grid	15,000	60,000
-7	Single plate to 2 grids, D.C. in Pri.	15,000	95,000
-9	Single plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600
-10	Push pull plates to line	30,000 ohms plate to plate	50, 200/250, 500/600
-12	Mixing and matching	50, 200/250	50, 200/250, 500/600
-13	Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C., 6000 ohms		

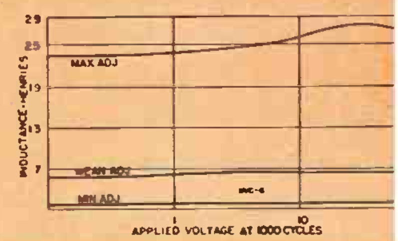
HERMETIC VARIABLE INDUCTORS

These inductors provide high Q from 50 - 10,000 cycles with exceptional stability. Wide inductance range (10 - 1) in an extremely compact case 25/32 x 1-1/8 x 1-3/16 . . . Weight 2 oz.



TYPICAL ITEMS

TYPE No.	Min. Hys.	Mean Hys.	Max. Hys.	DC Ma
HVC-1	.002	.006	.02	100
HVC-3	.011	.040	.11	40
HVC-5	.07	.25	.7	20
HVC-6	.2	.6	2	15
HVC-10	7.0	25	70	3.5
HVC-12	50	150	500	1.5



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TELE-TIPS

HI-FI is acquiring a host of fancy new names as it reaches into new areas of the world. Here is a rundown on the latest, courtesy of the New York Times.

Arabic—shaded elhassasieh
French—haute fidelite
German—3-D Klang
Greek—alitheni apodosi
Italian—alta fedelta
Russian—chastosta visokoy tochnosti
Spanish—alta fidelidad

PORTABLE ELECTRO-CARDIOGRAPH invented by a Hamburg, Germany professor is claimed to make it possible to diagnose heart ailments of patients thousands of miles away by telephone.

ELECTRONIC 'PROF SAVER' devised by University of Tennessee professor computes the average of 10 differently weighted marks for semester's work in engineering drawing.

IRE, Long Island section, got such a tremendous response to their announcement of a field trip to Grumman Aircraft that they had to drop the idea. More than 1,000 replies were received.

SALARY INCREASES were received last year by 75% of American business executives in the "middle management" category, those between the policy-making level and general foreman. Thirty-five percent of the raises were between 5% and 9% of salary and were given for reasons of merit.

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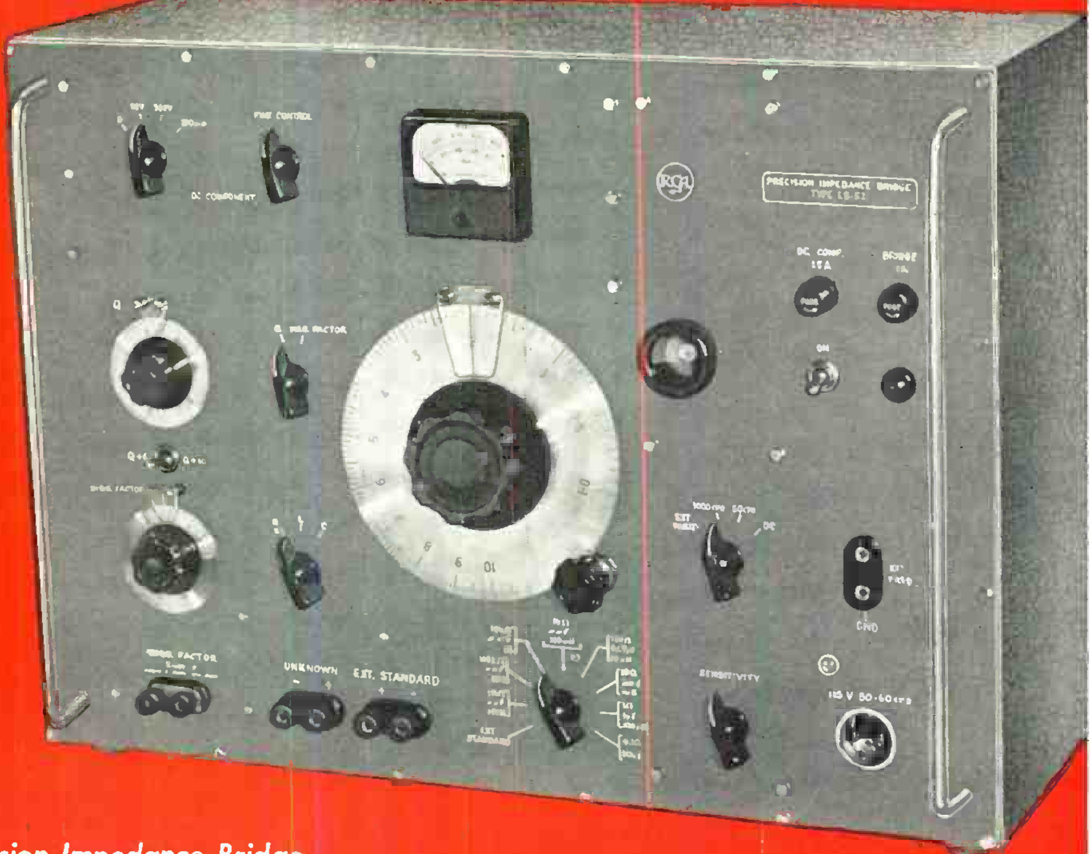

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Anthony Scala has been elected president of Chatham Electronics Div., Gera Corp., Livingston, N. J. He was formerly vice president and general manager, and is still a vice president of Gera and a director of the parent organization, RKO Industries Corp.

Philip S. Fogg has become chairman of the board of Consolidated Electrodynamics Corp., Pasadena, Calif., and Hugh F. Colvin has succeeded him as president of the firm. Mr. Fogg will continue as Consolidated's chief executive officer.

James O. Burke has been elected president of Standard Coil Products Co., Inc., Melrose Park, Ill. He succeeds Glen E. Swanson, who becomes chairman of the board.

Robert S. Goodyear has been named president of Fenwal Electronics, Inc., Framingham, Mass., a new firm specializing in precision thermistor manufacture and in sensing elements incorporating thermistors.

C. Arthur Foy has been made manager of sales promotion for the Audio Div.; Albert J. Melrose is now manager of the Central Mid-West District, including metropolitan Chicago; and Ralph H. Sprague is manager of the newly-designated Mid-West District for the Audio Div., all of Ampex Corp., Redwood City, Calif. Foy is headquartered in Redwood City, while Melrose and Sprague are located in the Ampex Chicago offices.

Harold S. Geneen was recently elected executive vice president of Raytheon Mfg. Co., Waltham, Mass.

James J. Halloran has been elected secretary-treasurer of Electro Engineering Works, Inc., San Leandro, Calif. He is also vice president in charge of engineering for the firm. Mr. Halloran succeeds Alex W. Fry.

Mrs. Sylvia Anthony Nelson, of Mt. Vernon, Ohio, has been made chairman of the board of Electronics Equipment Engineering, Inc., Dallas, a new firm in the field of building airborne electronic accessories for civil and military aviation.

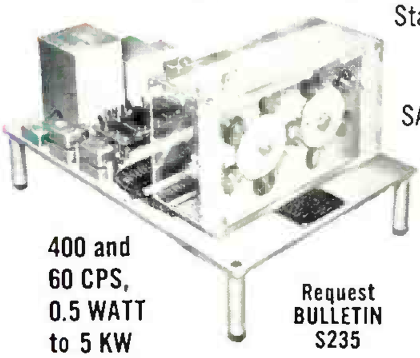
Amphenol Electronics Corp. of Chicago, has established an engineering and sales office at 5356 West Pico Blvd., Los Angeles, under the direction of a newly-appointed district manager, James Schaefer. Marshank Sales Co., Los Angeles, will continue to handle Amphenol business in its area. Wally Wasson has been named Chicago district manager for Amphenol,

(*Continued on page* 176)

MAGNETIC AMPLIFIERS · INC

632 TINTON AVENUE, NEW YORK 55, NEW YORK • Tel. CYpress 2-6610
WEST COAST DIVISION
136 WASHINGTON ST., EL SEGUNDO, CALIFORNIA • Tel. EAstgate 2-2056

SERVO MAGNETIC and TRANSI-MAG® AMPLIFIERS



Standard AC and DC Amplifiers include:

MAGNETIC PRE-AMP + SATURABLE TRANSFORMERS, MAGNETIC PRE-AMP + HIGH GAIN MAGNETIC AMPLIFIERS, and the TRANSI-MAG incorporating TRANSISTORS and HIGH GAIN MAGNETIC AMPLIFIERS.

400 and 60 CPS, 0.5 WATT to 5 KW

Request BULLETIN S235

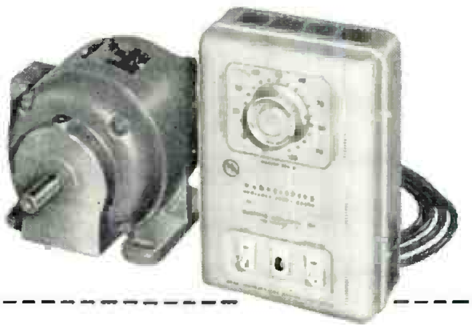
SPECIAL PURPOSE ANALOG COMPUTERS

Complete SERVO SYSTEM ENGINEERING for automation and control, including design, development and production.

MAGNE-SPEED® VARIABLE SPEED DRIVES

JR. – 1/8, 1/15, 1/40 HP.
SIZE I – 1/4, 1/3, 1/2 HP.
SIZE II – 3/4, 1, 1½ HP.
SIZE III – 2, 3, 5 HP.

Request BULLETIN S580



SIZES I, II, III and JR.

Non-electronic, stepless instant starting; compact, 50:1 speed range, good regulation without tachometer. Long life, virtually maintenance-free, low cost; fast response, reversibility, dynamic brake, local or remote control.

AUTOMATIC UNIVERSAL TRANSISTOR and POWER-TRANSISTOR CURVE TRACER

Displays Collector and Transfer Curves on Cathode Ray Oscilloscope. Handles all types of transistors and power transistors. Curve tracer permits rapid determination of parameters. For selecting, matching and detecting anomalies and rejects.

Model 200A – TRANSISTOR CURVE TRACER – BULLETIN S393
Model 300A – POWER-TRANSISTOR CURVE TRACER – BUL. S667

MODEL 240 PHASE ANALYZER and VACUUM TUBE VOLTMETER

Easily operated instrument for making complex measurements. Phase and voltage AC signals measured simultaneously, and read directly from dial and meter scales. Indispensable for alignment of SERVO SYSTEMS, measurement of input requirements of non-linear loads and determination of amplifier input impedances.

Request BULLETIN S675

VOLTAGE-CURRENT-FREQUENCY REGULATORS

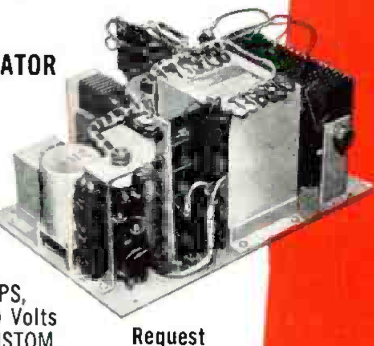
MODERN TUBELESS, REGULATED RECTIFIER LINE — Virtually maintenance-free operation.

SIZES:

1—3-32 V. D.C., 5 Amps.
2—3-32 V. D.C., 15 Amps.
3—3-32 V. D.C., 30 Amps.
4—1.5-16 V. D.C., 10 A.
5—1.5-16 V. D.C., 30 A.
6—1.5-16 V. D.C., 60 A.

DIESEL or MOTOR GENERATOR—ALTERNATOR REGULATORS

Provides high accuracy, fast response and dependability. Rugged construction, employs no tubes. Meets applicable government specifications. Standard 30 KVA, 400 CPS, 3-Phase 4-Wire 115/200 Volts PACKAGE SUPPLY or CUSTOM DESIGNS for specific machines.



Request BULLETIN S436

MAGNETIC AMPLIFIERS · INC

A COMPLETE LINE OF DEPENDABLE ENCAPSULATED RESISTORS

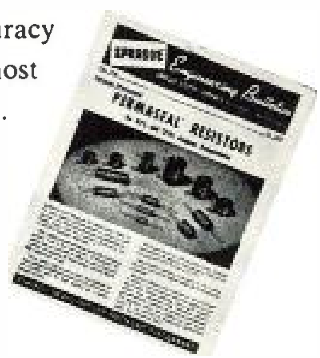
PERMASEAL®

PRECISION WIREWOUND RESISTORS FOR 85C AND 125C AMBIENTS

For applications requiring accurate resistance values at 85C and 125C operating temperatures—in units of truly small physical size—select the precise resistor you want from one of the 46 standard Permaseal designs in tab or axial lead styles.

Winding forms, resistance wire and embedding material are matched and integrated, resulting in long term stability at rated wattage over the operating temperature range. The embedding material is a special plastic that extends protection well beyond the severe humidity resistance specifications of MIL-R-93A and Proposed MIL-R-9444 (USAF).

These high-accuracy units are available in close resistance tolerances down to ± 0.1%. They are carefully and properly aged by a special Sprague process so that they maintain their accuracy within the limits set by the most stringent military specifications.



FOR COMPLETE DATA WRITE FOR COPY OF SPRAGUE ENGINEERING BULLETIN NO. 122A

SPRAGUE

SPRAGUE ELECTRIC COMPANY • 233 MARSHALL ST. • NORTH ADAMS, MASS.

As We Go To Press...

World Radio Experts To Meet in Warsaw

Warsaw will serve as host this summer to about 500 radio-communications experts from all parts of the world. They convene in the Polish capital on August 9 for the Eighth Plenary Assembly of the International Radio Consultative Committee (IRCC) whose fourteen study groups will examine technical problems and operations.

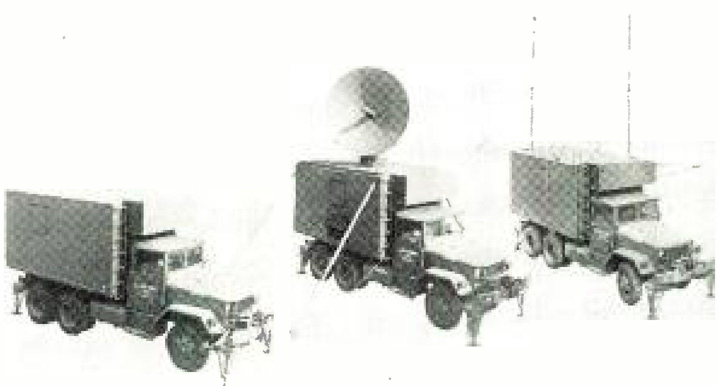
The IRCC, with headquarters in Geneva, was founded in Washington in 1927 and is a permanent body of the International Telecommunication Union.

Air Force Receives New Ground Guidance Set

The United States Air Force has announced the delivery of new, air-transportable close-support ground guidance radar to operational elements.

This Close Support Control Set, called the MSQ-1A, was designed and built by the Reeves Instrument Corporation, a subsidiary of Dynamics Corporation of America, at a cost of approximately $40.000,000.

The Air Force indicates that the MSQ-1A system consists of three basic vans—radar, computer, and communications. The radar van tracks friendly aircraft and furnishes continuous data to the computer van for evaluation.



These computer, radar, and communications vans are part of the USAF air-transportable Close Support Control Set

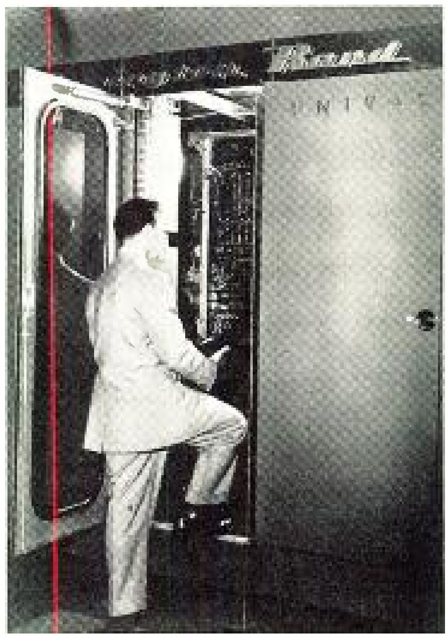
Sylvania Centralizes Operations In Univac Processing Center

A nation-wide private wire system has been put into operation to link the seventy-one plants, laboratories, sales offices, warehouses, divisional headquarters, and executive offices of Sylvania Electric Products, Inc.

The versatile network, leased from Western Union, automatically routes coded messages to the appropriate station. Administrative messages are routed to telegraph printers where they are received ready for delivery to the department or person concerned. Coded data messages, however, are classified and transmitted automatically to the Data Processing Center in Camillus, where a "Univac" computer and subsidiary electronic equipment convert the information into summarized data on which can be based decisions at the corporate, divisional, or plant level.

In the case of a piece of data processing information originating at a Sylvania plant or other facility, the information is punched on paper tape. The tape is fed into electronic equipment which translates the message into electrical impulses that travel by the network from the transmitting point to the switching center, where the message is automatically punched on paper tape. Through a similar process, the message is transmitted from the switching center to the Data Processing Center at Camillus.

At the Center, an electronic device again converts the information to paper tape, which in turn is converted to punched cards. The information on the punched card is conveyed to a unit which translates the information to metal magnetic tape. Then, a unit called a "Uniservo" carries the information from the magnetic tape into the "Univac" where computations are made in accordance with instructions fed into the computer. Magnetic tape then carries the completed computation, via "Uniservo," to a high speed printer, where the results of the computation are put on paper in readable form.



An 18,000-mile private wire system feeds all Sylvania data into this 10-ton central computer. Data correlation results previously requiring weeks can now be obtained in a matter of hours

More News on page 14

Sylvania develops a

power

NEW

new

POWER TRANSISTOR—

provides 2½ watts
Class A output with
*5% total harmonic distortion

FEATURES—

- 10 watts maximum collector dissipation
- 2 amps max. collector current
- 40 volts max. collector voltage
- New heliarc-weld hermetic seal
- 30 db minimum power gain (typically 35 db)
- 85° C storage temperature
- 100° C operating temperature
- derating—3° C per watt (typically 2° C per watt)

new

DETECTOR-DRIVER

Type 12J8—delivers 20 mw signal
power output with
*5% total harmonic distortion

CHARACTERISTICS—

- zero signal plate current —14 ma
- zero signal screen current—3 ma
- plate resistance —2000 ohms
- transconductance —540 µmhos
- plate voltage —12.6 volts
- heater voltage —12.6 volts

low distortion* pack for HYBRID AUTO RADIO

combined engineering forces produce new power transistor and detector-driver tube—full line of 12-volt tube types completes auto radio complement.

SYLVANIA, in close co-operation with leading auto radio manufacturers, has just completed a full-time joint engineering project to develop a transistor-tube "power pack" for new hybrid auto radio designs.

Result of this combined engineering program is a new power transistor and the type 12J8 detector-driver tube especially designed to produce high current at low plate voltage for optimum power coupling to the output transistor.

Other important power transistor features include a heliarc-weld hermetic seal for ruggedness and a storage temperature of 85° C to eliminate heat problems under inoperative conditions.

Sylvania also offers a full line of 12-volt tubes to complete auto radio complements.

Designers of transistorized equipment will find Sylvania's new transistor highly useful in all power applications calling for a maximum collector dissipation of 10 watts.

Engineering Sample Offer

Sylvania will honor all bona-fide requests for engineering samples of the new hybrid "power pack" including the new power transistor and driver tube 12J8, plus samples or information on 12-volt types to complete your auto radio complement.

For samples of the power transistor for use in other applications, write on your company letterhead indicating your intended use.

SYLVANIA®

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., Montreal

LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY

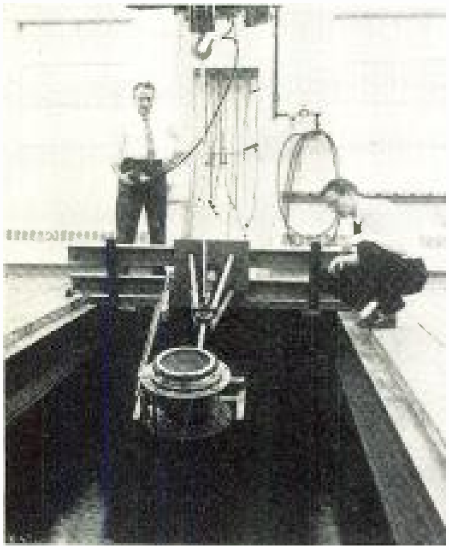
For product information, use inquiry card on last page.

Barium Titanate Sonar Transducer

A new type of sonar transducer element made of barium titanate, a non-strategic material, has increased ability to handle underwater sound energy, as compared to strategic materials (such as nickel) which were previously used.

Increased efficiency will result from the new transducer elements because the mechanical and electrical losses in barium titanate are lower than materials previously used. This means that smaller transmitting equipment may be used on shipboard.

Barium titanate also has a high dielectric constant and since it is a low impedance material the voltage requirements are low. This will permit high power operation without voltage breakdowns which have often limited sonar operations. The natural properties of barium titanate make it an ideal material for sonar transducer elements.

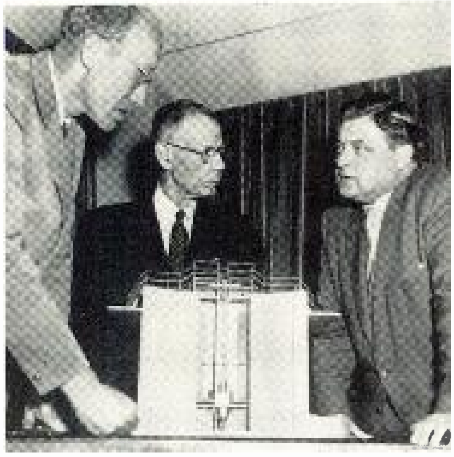


New sonar test facilities at GE

New Plant For Atlas Missiles

A new $40,000,000 "Convair Astronautics" plant will be built in San Diego by Convair Div., General Dynamics Corp., for the manufacture of the Atlas intercontinental ballistic missile.

The Atlas is one of the three intercontinental missiles now under development by the U.S.



Gen. Walter Bedell Smith, of AMF Atomics, Inc., discusses new reactor with German officials

New Reactor For Free Europe

A "Swimming Pool" research reactor will be built by AMF Atomics, Inc., subsidiary of American Machine & Foundry Co., at Munich's Technische Hochschule, one of Germany's leading advanced technological institutes.

Unprecedented in free Europe, it will be the first reactor to be installed at a university for training engineering students in nuclear science, and will be the heart of a new nuclear research center at the university.

Construction of the one megawatt "swimming pool" type reactor is scheduled to start in October

Triggered Radar Beacon Aids Midair Rendezvous

A new flying aid is a high powered, airborne radar beacon that enables long range aircraft of the Strategic Air Command to locate each other and pinpoint the exact position in space of tanker planes, regardless of darkness or weather Other tactical applications of the device for precisely accurate aerial rendezvous and reconnaissance still are unannounced.

Signals can be triggered automatically by the interrogating radar of fuel-hungry Air Force planes, to locate an individual tanker aircraft. Assured mid-air refueling can double or triple the effective reach of USAF's long-range aircraft.

TV Service Survey Shows Customers Usually Pleased

That an overwhelming majority of the nation's 36,000,000 television set owners are well satisfied with the promptness, quality, prices and courtesy of TV service technicians was disclosed in the latest nationwide survey conducted by Elmo Roper, market research expert, for the RCA Service Company, Inc.

The survey revealed that 91 per cent of the set owners interviewed were pleased with the quality of the serviceman's work, the same percentage reported the serviceman was pleasant and couteous, 83 per cent were satisfied with the price and 89 per cent thought their call for service was answered promptly. Eighty-three per cent said they would call the same service firm again.

Fifty-two per cent of all persons interviewed, who made calls for service during the past year, reported "same day" service: 18 per cent received service the next day; nine per cent during the next two days—or 79 per cent of all service calls were answered within two days of the call.

While the median cost of service calls increased in the past 15 months, reflecting the increased age of the average TV set, 83 per cent of the persons interviewed reported satisfaction with the prices charged, while 13 per cent said the prices were "not very good" and four per cent did not know or did not answer.

Olympic buys Presto

Olympic Radio & Television, Inc., of New York, has announced the purchase of Presto Recording Corporation of Paramus, New Jersey, as part of its continuing expansion in the electronics field.

Presto, a manufacturer of tape and disc sound recording and playback equipment for industrial and home use, will operate under its present management but as a wholly-owned subsidiary of Olympic.

More News on page 18

COLLINS 212F-1 **STUDIO CONSOLE**

Complete flexibility

Collins announces the new 212F-1 Speech Input Console — an attractively styled, packaged unit featuring complete flexibility. It provides complete control over simultaneous broadcasting and auditioning from any combination of three out of eight possible inputs. The addition of two pre-amplifiers provides for mixing five of twelve possible inputs. The 212F-1 also provides for monitoring of program, audition, or remote lines, and control of speakers and warning lights. *Available now — $995.*

Flexible

- Modular construction
- Plug-in amplifiers, relay unit and power supply
- All components in console cabinet — no additional rack space required
- Only three tube types, only two amplifier types
- Three cue pots
- Two spare key switches for custom wiring

Convenient

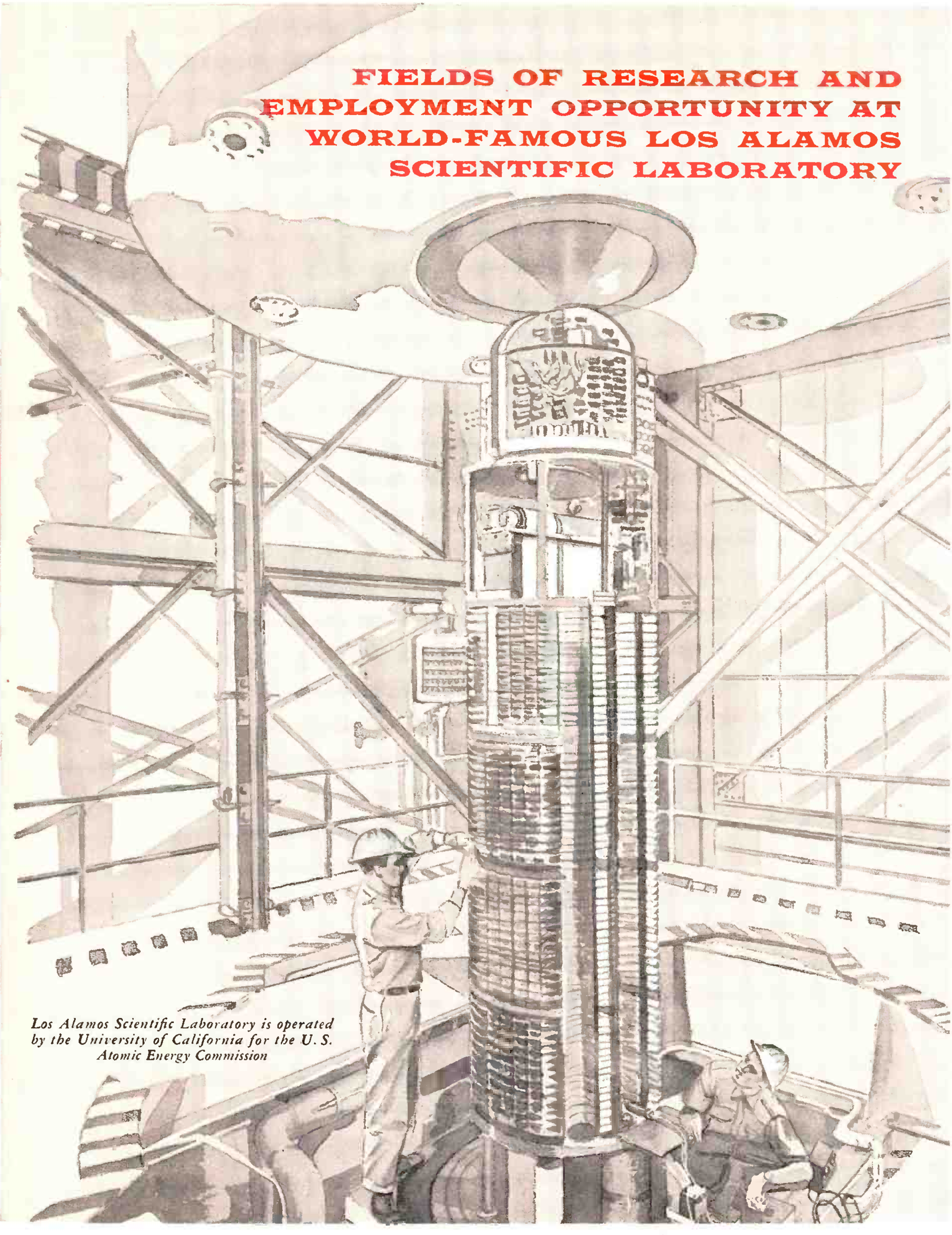
- Easy accessibility to all cabling, wiring and sub-units
- Front panel hinged — tilts forward for instant inspection or removal of all amplifiers, power supply and relay unit
- A test cable to externally service any of the amplifiers, power supply or relay unit while console is in operation
- All mixer knobs and associated key switches color coded
- Plastic covered write-in strips for input switches, remote switches and mixer attenuators

For complete information on Collins 212F-1 Studio Console contact your nearest Collins representative.

Collins CREATIVE LEADER IN COMMUNICATION

COLLINS RADIO COMPANY, 315 2nd Avenue S.E., Cedar Rapids, Iowa • 1930 Hi-Line Drive, Dallas 2 • 2700 W. Olive Ave., Burbank 261 Madison Ave., New York 16 • 1200 18th St. N.W., Washington, D.C. • 4471 N.W. 36th St., Miami 48 • 1318 4th Avenue, Seattle Dogwood Road, Fountain City, Knoxville • COLLINS RADIO COMPANY OF CANADA, LTD., 11 Bermondsey Road, Toronto 16, Ontario

FIELDS OF RESEARCH AND EMPLOYMENT OPPORTUNITY AT WORLD-FAMOUS LOS ALAMOS SCIENTIFIC LABORATORY



Los Alamos Scientific Laboratory is operated by the University of California for the U. S. Atomic Energy Commission

Theoretical Physics and Mathematics

In the field of theoretical physics, the Laboratory carries on studies of nuclear theory, equations of state, mathematical analysis methods, hydrodynamics problems and various aspects of applied mathematics. The Theoretical Division is also concerned with the conceptual design of nuclear weapons, and supports many non-weapons activities such as the nuclear reactor and propulsion programs. The equipment used includes the Los Alamos-developed Maniac, the Maniac II, two IBM 704's and an IBM 701.

Experimental Nuclear Physics

Much of the work in experimental physics is concerned with nuclear properties of various materials. Fundamental studies are made of nuclear forces, neutron and charged-particle reactions and cross sections. Experimentation in controlled thermonuclear reactions is assuming increasing importance. Among the facilities available are three Van de Graaffs, two Cockcroft-Walton machines and a variable energy cyclotron.

Electronics and Instrumentation

The Laboratory is engaged in the design and development of nuclear physics research instruments, scintillation counters, fast pulse amplifiers, multi-channel analyzers, fast oscilloscopes, radiation detection instruments, electronic controls and control systems, and high-speed cameras which operate at 15 million frames per second. Electronics specialists also assist in the design of digital computers and of instruments for studying nuclear and thermonuclear detonations.

Nuclear Reactor Research

In connection with the peacetime applications of nuclear energy, the Laboratory is currently developing several advanced power reactors of unusual design. In addition, two research reactors are available for experimental studies. The remotely controlled critical assembly machines, known as Topsy, Godiva and Jezebel, constitute neutron research tools of a unique character.

Nuclear Propulsion

The Laboratory is actively engaged in the application of nuclear energy to the new and challenging field of self-propelled mobile reactors. There are studies in progress relative to engine design, heat transfer, controls and instrumentation.

Chemistry

Research in chemistry is devoted largely to inorganic and physical studies, especially of materials such as uranium, plutonium, deuterium and tritium used in nuclear energy systems. Radiochemical methods are applied in various investigations. Much work is being done on reaction kinetics, the effects of radiation on chemical reactions, complex ion formation and the determination of heats of combustion and solution. Extensive analytical studies include the use of a great variety of instruments, as well as the techniques of microanalysis.

Metallurgy and Metallurgical Engineering

Research activity and development in this field includes investigation of the metallurgical properties of materials used in nuclear energy systems; studies of extremely refractory substances, ceramics, cermets and plastics; the behavior of materials under extremely high temperatures and high pressures; studies of the properties of plutonium and its alloys, with increasing reference to their use in reactors, and of uranium and its alloys; development of fabrication techniques for various metals and alloys; and the high temperature properties of refractory metals tungsten, molybdenum, columbium, etc.

Weapons Physics, Design and Testing

Still the nation's principal institution for nuclear and thermonuclear weapons research, the Laboratory takes nuclear weapons from the concept stage to proved performance as determined by field tests. Activities in weapons research and development include the mechanics and dynamics of initiating a nuclear energy release; the behavior of supercritical systems; the testing of nuclear devices and weapons assemblies in Nevada and in the Pacific; engineering design of tests and prototypes of nuclear systems; and the design and development of nuclear weapons components and the techniques for their manufacture.

Explosives Research and Development

Work in this field includes study of fabrication, storage and stability problems of explosives; making and evaluating novel organic chemical compounds of possible use as explosives; mechanics and dynamics of explosive phenomena; and physical and chemical properties of explosive material using mass spectrometer, infra-red spectrometer, X-ray equipment and other analytical techniques. High explosives are employed in research on equations of state and shock wave phenomena.

Mechanical Engineering

Design and development work is carried on in connection with weapons design, field test facilities, the power reactor and propulsion programs, servo-mechanisms and remote control systems. High explosives systems are designed and manufactured. Other types of work are estimating, cost analysis and liaison between architectural engineers and contractors.

Chemical Engineering

Chemical engineering work includes studies of heat transfer, fluid flow, solvent extraction, evaporation, distillation and systems at extreme temperatures and pressures. Problems supporting inorganic and physical chemistry research projects are also undertaken. Other activities are the remote control handling of radioactive materials and corrosion and erosion studies.

Electrical Engineering

Much effort is devoted to the design of induction heating systems for study of alloys at extremely high temperatures; of DC power supplies at currents up to 100,000 amperes; of servomechanism controls for nuclear reactors; and of high magnetic field systems. Work is done in planning, building and installing power distribution systems and their controls.

The Laboratory now has staff openings for technically qualified people interested in these fields of research and development. For additional information address your inquiry to

Director of Personnel
Division 1105

los alamos

scientific laboratory

OF THE UNIVERSITY OF CALIFORNIA

LOS ALAMOS, NEW MEXICO

Electronic Industries Boom in Puerto Rico

Since 1950, the manufacturing activities of electronics branch plants in Puerto Rico have expanded to a present level of $11½ million a year. Products include radios, radar equipment, pulse generators, diodes, cathode ray tubes, sub-components, exposure and light meters, rectifiers, television antennas, carbon and steel gages, and crystal ovens. So far,

This plant, making exposure meters, is part of Puerto Rico's industrialization program

25 U. S. mainland firms have set up electronics branch plants in Puerto Rico, including Sperry Rand, Sylvania, Hermetic Seal, Weston, and Carborundum.

Mainland plants are finding component production in Puerto Rico offers many advantages including a ten year "tax holiday" on local taxes, no federal taxes, favorable wage differential, and various helpful inducements offered by the local government.

Further details can be obtained from Economic Development Administration, 579 Fifth Ave., New York 17.

22-In. Color TV Line

A new line of color TV receivers, featuring a 22-inch rectangular all-glass color tube, has been announced by the television-radio div. of Westinghouse Electric Corp. At the same time, a new line of 21- and 24-inch black-and-white TV receivers, and several additional radio receivers were introduced.

More News on page 20

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period July through October, 1956 that are of special interest to electronic engineers

Aug. 20-21: The National Telemetering Conference, sponsored jointly by the IRE, the AIEE, the IAS, and the ISA, in Los Angeles, Calif.

Aug. 20-24: Conference on Scientific and Technical Writing, by the Institute for Cooperative Research of the University of Penn., Philadelphia, Pa.

Aug. 21-24: WESCON Show, Pan Pacific Auditorium, Los Angeles, Calif.

Aug. 22-Sept. 1: 23rd Annual (British) National Radio Show, sponsored by the Radio and Electronic Component Manufacturers Federation, at Earls Court, London, England.

Sept. 10-12: Inf. Theory Symposium, sponsored by IRE-PGIT and M. I. T.; at Cambridge, Mass.

Sept. 11-12: Second RETMA Conference on Reliable Electrical Connections, at Irvine Auditorium, University of Penn., Philadelphia, Pa.

Sept. 12-14: Third National Conference on Tube Techniques, sponsored by the Working Group on Tube Techniques of the Advisory Group on Electron Tubes; at Western Union Audit., 60 Hudson St., New York.

Sept. 14-15: Prof. Gp. on Broadcast Transmission Sys., 6th Ann. Fall Symposium; tech. sessions at Mellon Institute Auditorium, Pittsburgh, Pa.

Sept. 17-18: Adv. Gp. on Electron Tubes, Working Gp. on Semiconductor Devices—Transistor Reliability Symposium; at Western Union Audit., 60 Hudson St., New York.

Sept. 17-21: Symposium on radiation effects on materials, sponsored jointly by The Atomic Industrial Forum and ASTM; at ASTM Pacific Area National Meeting, Los Angeles, Calif.

Sept. 17-21: 11th Annual Instrument-Automation Conference and Exhibit, sponsored by the ISA, at the New York Coliseum, New York, N. Y.

Oct. 1-3: 12th Annual Conference of the NEC; at the Hotel Sherman, Chicago, Ill.

Oct. 1-3: Canadian IRE Convention and Exposition; in the Automotive Bldg., Canadian Natl. Exhibtn. Park, Toronto.

Oct. 8-9: Second National Symposium on Aeronautical Communications, sponsored by the IRE Prof. Gp. on Communications Systems; at the Hotel Utica, Utica, N. Y.

Oct. 9-10: Conference on Computer Applications, sponsored by Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

Oct. 15-17: Radio Fall Meeting, sponsored jointly by the IRE and RETMA, at the Hotel Syracuse, Syracuse, N. Y.

Oct. 16-18: Conference on Magnetism and Magnetic Materials, sponsored by the Magnetics Subcommittee of the Basic Science Committee of AIEE, at the Hotel Statler, Boston, Mass.

Oct. 25-26: Annual Display of Aircraft Electrical Equipment, by the Aircraft Electrical Society, at PanPacific Auditorium, Los Angeles, Calif.

Oct. 29-30: Third Annual East Coast Conference on Aeronautical and Navigational Electronics, sponsored jointly by the Baltimore Section of IRE and the IRE Prof. Gp. on Aeronautical and Navigational Electronics; at the Fifth Regiment Armory, Baltimore, Md.

Abbreviations:

- ASTM: American Society for Testing Materials
- AIEE: American Institute of Electrical Engineers
- IAS: Inst. of Aeronautical Sciences
- IRE: Institute of Radio Engineers
- ISA: Instrument Society of America
- NEC: National Electronics Conference
- RETMA: Radio-Electronics-TV Manufacturers Assoc.
- WESCON: Western Electronic Show and Convention

Raytheon — World's Largest Manufacturer of Magnetrons and Klystrons

1. **MINIATURE** — Actual size shown. Diameter, 1¼". Overall length, 2". Ideal for pulsed beacon applications.

2. **EXCELLENT VIBRATION PERFORMANCE** Reliable characteristics up to 10 g.'s from 20 to 1000 c.p.s.

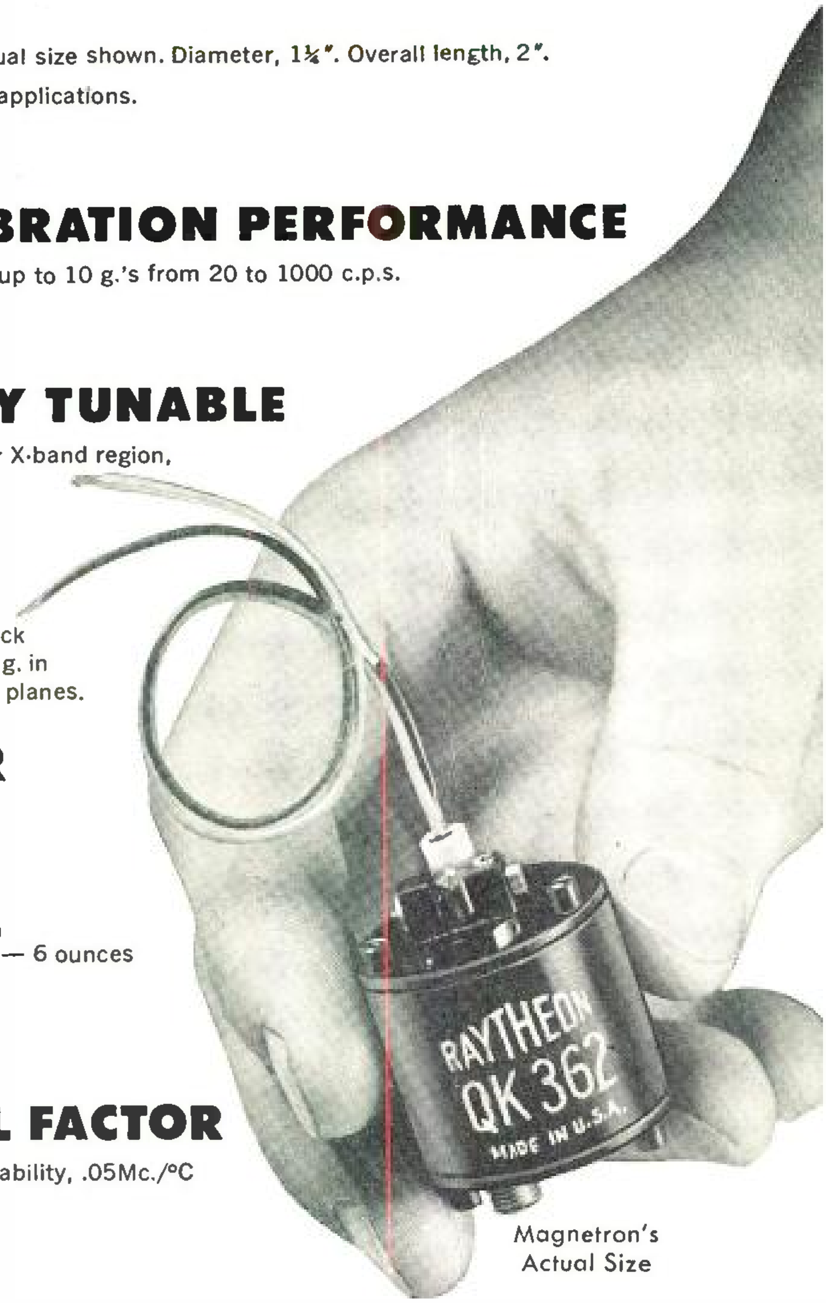
3. **MECHANICALLY TUNABLE** Tunes mechanically over X-band region, 9300-9500 Mc min.

4. **RUGGED** Withstands 1,000 g. shock along cathode axis. 500 g. in two other perpendicular planes.

5. **PULSE POWER** 50 watts peak

6. **LIGHTWEIGHT** — 6 ounces

7. **LOW THERMAL FACTOR** Exceptional frequency stability, .05Mc./°C



Magnetron's Actual Size

CHALLENGING CHARACTERISTICS

FOR YOUR NEW EQUIPMENT DESIGNS

For specifications on the extraordinary QK 362 magnetron write today. Similar tubes at other frequencies and power levels are available. Ask for copies of latest bulletins listing most of our unclassified Magnetrons and Klystrons and special tubes. Call on us for help in your microwave problems. There is no cost or obligation, of course.

Excellence in Electronics

RAYTHEON

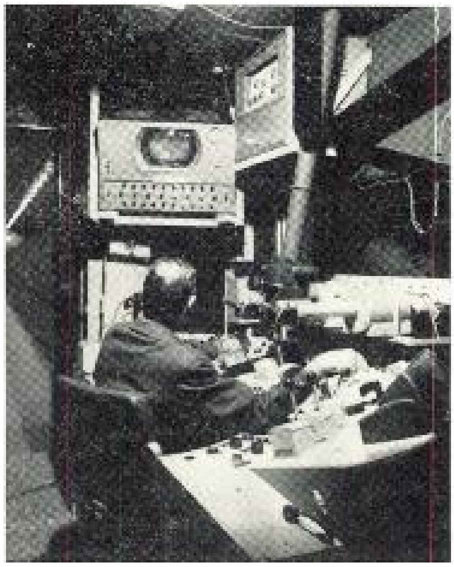
RAYTHEON MANUFACTURING COMPANY

Microwave and Power Tube Operations, Section PT-72
Waltham 54, Massachusetts

Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Receiving Tubes, Picture Tubes, Transistors.

ITV for Atomic Plant Uses Color Wheel

Scientists are now using specially-designed color television to help them perform work in radioactive areas at the Hanford plutonium plant, operated by General Electric for the Atomic Energy Commission.



Color TV guides the operator of a giant overhead crane in a radioactive area

Crane operators, who formerly observed their work by means of a periscope, now have a closed circuit color TV system. High image brilliance on the TV screens and added depth perception afford easier operation of giant crane hooks.

Color TV was chosen primarily because the remote manipulation problem involves color coded objects and also because it gives added depth perception and better object resolution.

The TV system uses the rotating color wheel principle because of the resulting simplicity, economy, color rendition, definition, and low maintenance cost.

New SAGE Computer Joins Defense Network

The first large-scale computer for the nation's vast new electronic air warning network is now being installed.

Our growing continental air defense system, known as the Semi-Automatic Ground Environment (SAGE) system, combines the

(*Continued on page* 176)

UNCASED TOROIDS

Basic inductor component. Plain, wax or plastic dipped with flex-leads. Hi Q values 10cps to 10mc. Complete range of sizes: subminiature, wedding ring and up to 12" OD. Standard inductances stocked for immediate delivery. Mass production utilizing CAC-designed winding equipment enables swift completion of large orders.

PLASTIC CASED TOROIDS

CAC compression molded toroids per Mil specs have become the standard of the industry. Most compact design — may be stacked — mounted by center bushing which absorbs mounting pressures — sturdy, tinned terminals — arrangements available up to 6 terminal connections. Standard inductance values shipped from stock — special inductances and configurations supplied promptly on request.

C-A-C®

TOROIDAL INDUCTORS

Precision . . . Delivery . . . Quality . . .

Growth and development of CAC has been rapid since its organization following World War II. It is made up of young, but highly experienced management and personnel. Unique manufacturing equipment (much of it CAC-designed) and leadership in production "know-how" offer PRECISION . . . DELIVERY . . . and QUALITY.

Whether your need is for one toroidal component . . . or a million, CAC is prepared to serve you.

COMMUNICATION ACCESSORIES CO.

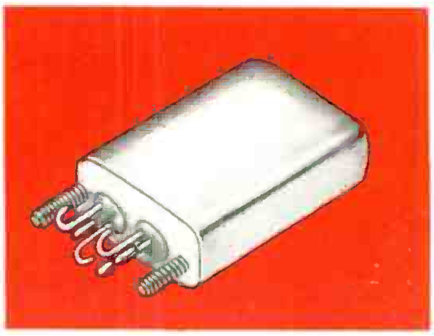
World's Largest Exclusive Producer of Toroidal Windings

HICKMAN MILLS, MISSOURI • PHONE KANSAS CITY, SOUTH 1-5528

A Subsidiary of Collins Radio Company

HERMETICALLY SEALED CASED TOROIDS

CAC "HS" series provides metal encased, hermetically sealed units complying with MIL specifications. Mounting area minimized — extremely low hum pickup — terminals of proven design using Teflon assure permanent seal at temperature extremes. Rugged construction — convenient mounting facilities. To insure stability, cores are thermo-cycled prior to encasement. Standard inductances in stock.

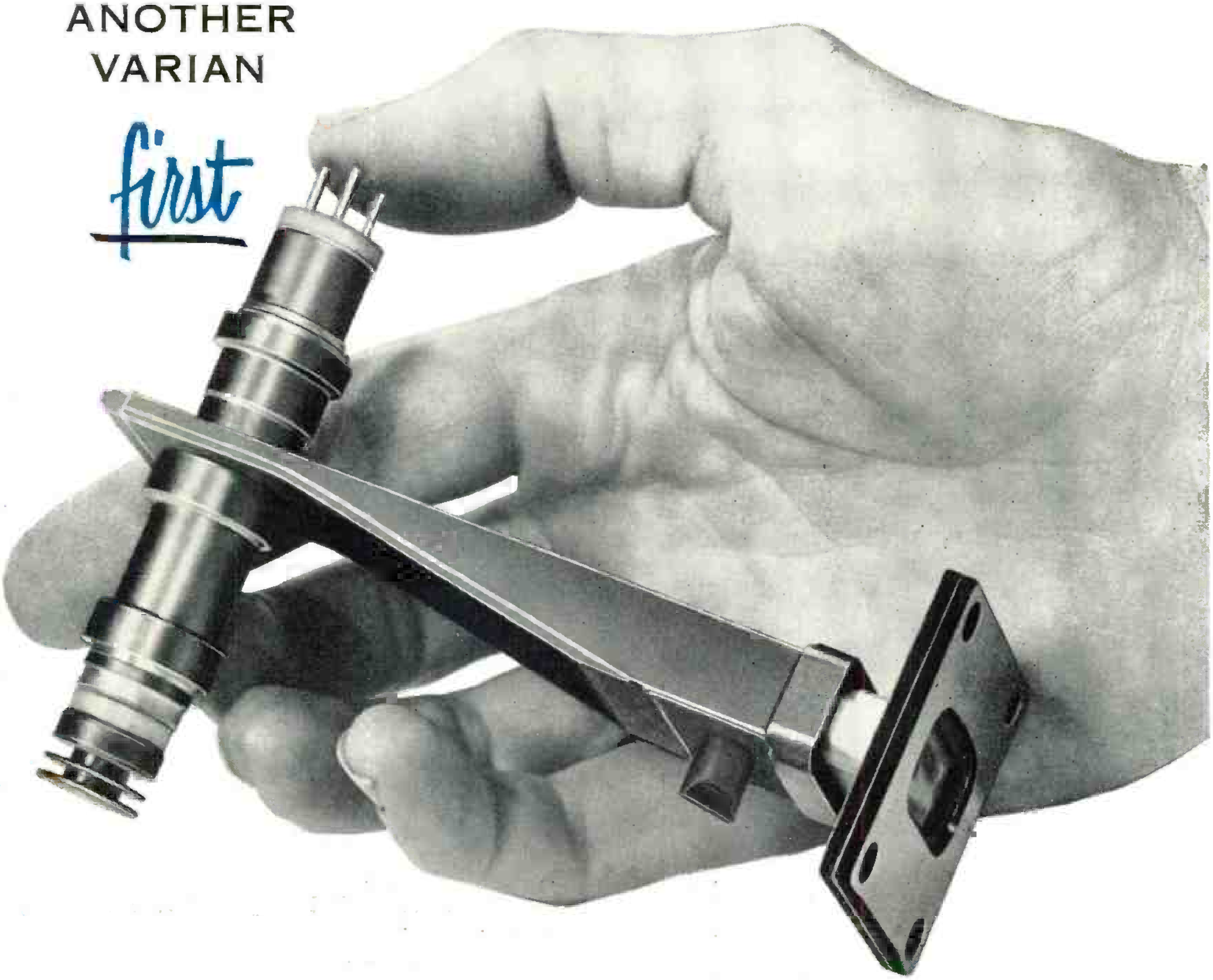


SUBMINIATURE TOROIDS

Uncased, plastic molded and hermetically sealed in three standard core types (others available). Designs for all requirements—for chassis mount or printed circuits.

For the engineer whose design considerations dictate the utmost in electrical performance versus size, CAC's subminiature toroids present the answer.

Catalogs on Individual Components are Available on Request.



VOICE under the SEA

Relies on ALSIMAG®

For dependable service on the ocean floor AlSiMag precision insulators are used in the new Transatlantic Voice Cable

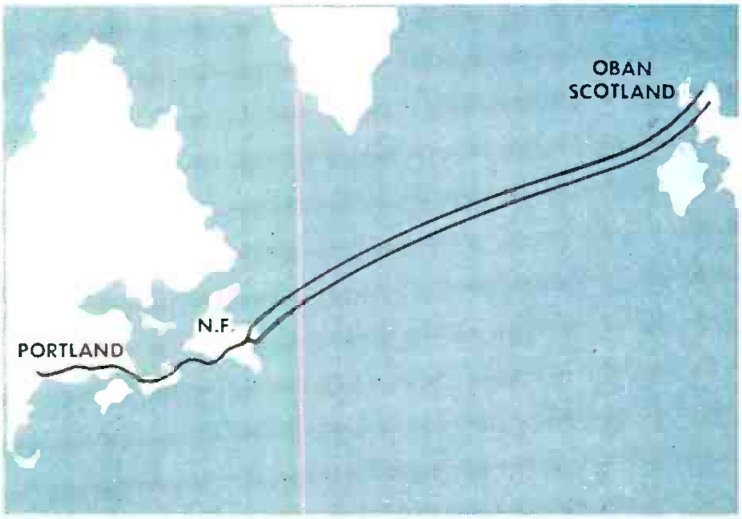
For 25 years communications engineers have studied the problems of laying a voice cable under the Atlantic Ocean to link the Americas with Europe. Today, the "voice" is nearing reality. The new link, a twin cable system, will be completed this year.

The almost incredibly exacting standards involved in making parts of the transatlantic cable have produced some truly remarkable engineering—engineering that accepts results no less than perfect. A select group of suppliers share in the achievement and AlSiMag is proud to be among them.

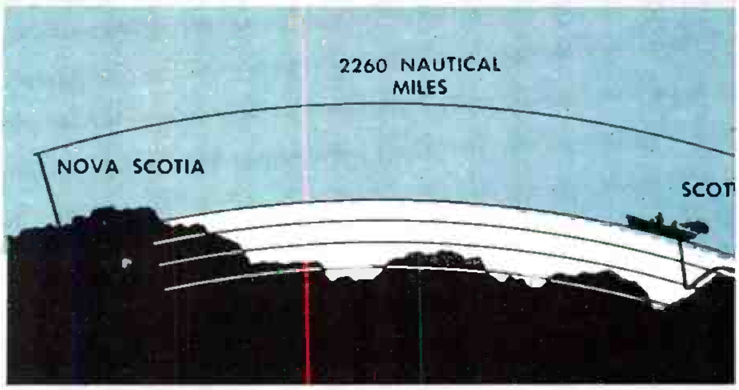
Men who perform "impossible" tasks stake their success on their creative ability plus the quality of their products. When technical ceramics are required on such critical applications, almost without exception the choice is AlSiMag. There are many reasons for this: One is the wider choice of materials available in AlSiMag. The exact composition for the required performance may be chosen from the many available . . . **right in physical characteristics, right in electrical characteristics, right in every way!**

AlSiMag performs at higher temperatures . . . withstands greater thermal shock . . . is stronger, more durable . . . permanently rigid . . . chemically inert . . . thoroughly dependable! AlSiMag can be fabricated in intricate designs to tolerances that compare favorably with precision metal work. AlSiMag will not rust, corrode or deteriorate with time. AlSiMag is the product of fifty-five years of specialized experience plus the finest production equipment . . . high speed presses, high temperature, continuous-fire kilns . . . every possible facility for the finest possible ceramics. In a wide range of shapes and sizes. Volume production or small quantity lots.

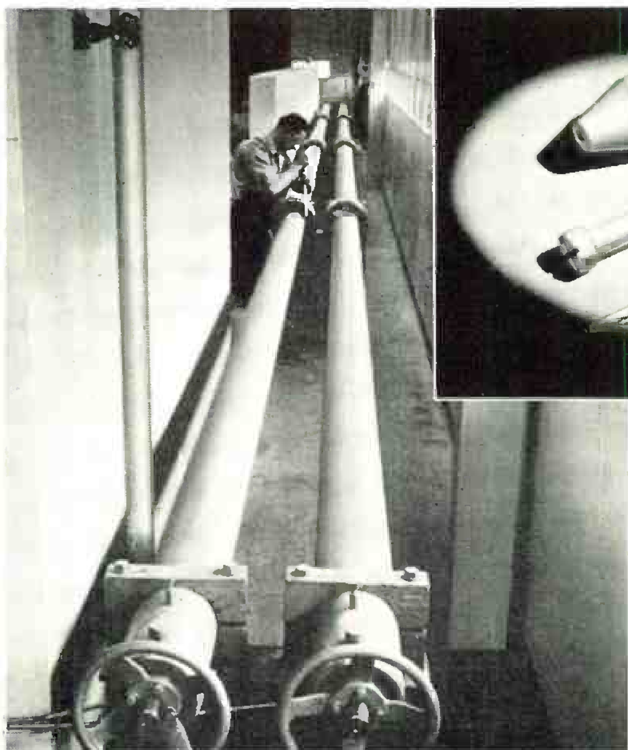
Highly technical applications, however, are not the end of the service story. AlSiMag is entirely practical . . . and vastly superior . . . for everyday industrial use. Economical, too! For any ceramic requirement, your best buy is AlSiMag. Send blueprint or sketch for full details.

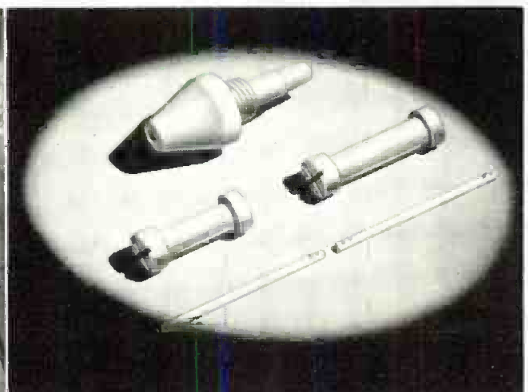


Route of transatlantic telephone cable system between Portland and Oban.



Profile of the ocean bottom on which the cable will rest.





Dependable service on the ocean floor . . . for years but for decades . . . calls for most careful selection of components. To economically feasible, the repeater units m have an exceptionally long life, since to r the cable for replacing just one repea would be a very costly operation. In the n transatlantic cable, impulses will be rela by a series of repeaters, built by West Electric Co., spaced some 40 miles apart. Th rugged, low-cost AlSiMag parts are comp ents of these repeaters.

AMERICAN LAVA CORPORATION
CHATTANOOGA 5, TENN.
55TH YEAR OF CERAMIC LEADERSHIP

A subsidiary of Minnesota Mining and Manufacturing Company

AMERICAN LAVA SALES OFFICES IN PRINCIPAL CITIES

Finished repeaters, with cable leads at each end, are tested at up to 7,500 pounds a *indispensable for measurement and reception*

MICROWAVE

MODEL R

with these special features:

EXCELLENT GAIN STABILITY—Equipped with automatic gain control, as well as "signal-lock" Automatic Frequency Control. Performance stable over entire frequency band.

HIGH SENSITIVITY—Achieved with unique double-tuned cavity pre-selector which tracks automatically with local oscillator. Efficient wideband microwave input coupler and crystal mixer maintains sensitivity.

SELF-CONTAINED—Complete with electronically regulated low and high voltage power supplies; signal metering circuits; IF, local oscillator, audio-video, and FM plug-in sub-units. Four interchangeable, plug-in microwave tuning units cover frequency range 950-11,260 mc.

ALL-PURPOSE—Receives AM, FM, CW, MCW and pulse-modulated signals. Equipped with recorder output, trigger output (constant amplitude), video and audio outputs. Meter reads directly in db.

UNI-DIAL CONTROL—Automatically tracks klystron voltages, double tuned pre-selector, oscillator, and linear direct reading frequency dial—all simultaneously.

POLARAD *PROVEN RELIABILITY* **ELECTRONICS CORPORATION** 43-20 34th STREET, LONG ISLAND CITY 1, N. Y.

BROADBAND
950–11,260 MC

FIELD INTENSITY RECEIVER

UNI-DIAL CONTROL

One of the most complete and versatile measurement instruments ever designed for reception and quantitative analysis of microwave signals in the range 950-11,260 mc.

The Polarad Model R Microwave Receiver is ideal for the reception and monitoring of all types of radio and radar communications within its range. It permits comparative power and frequency measurements, by means of its panel mounted meter, of virtually every type of signal encountered in microwave work.

It is compact and functional, featuring four integrally designed plug-in, interchangeable RF microwave tuning units to cover 950-11,260 mc; non-contacting chokes in pre-selector and microwave oscillator to assure long life and reliability; and large scale indicating meter for fine tuning control.

Call any Polarad representative or direct to the factory for detailed specifications.

SPECIFICATIONS:

Basic Receiver: Model R-B
Tuning Unit Frequency Ranges:
Model RL-T: 950 — 2,040 mc
Model RS-T: 1,890 — 4,320 mc
Model RM-T: 4,190 — 7,720 mc
Model RX-T: 7,260 — 11,260 mc
Signal Capabilities:
AM, FM, CW, MCW, pulse
Sensitivity:
—80 dbm or better throughout range on all models
Frequency Accuracy:
±1%
IF Bandwidth: 3 mc
Video Bandwidth: 1.5 mc
Image Rejection: Greater than 60 db
Gain Stability with AFC: ±2 db
Automatic Frequency Control
Pull-out range 10 mc off center
Recorder Output: 1 ma full scale
Trigger Output:
10 v. pulse across 100 ohms
Audio Output:
5 v. undistorted across 500 ohms
FM Discriminator
Deviation Sensitivity: .7 v./mc

Skirt Selectivity:
60 db — 6 db bandwidth ratio less than 5:1
IF Rejection: 50 db
Input AC Power:
105-125 v., 60 cps, 440 watts
Input Impedance: (ANT) 50 ohms
VSWR: Less than 4:1 over band
Range of Linearity: 60 db
Receiver Type: Superheterodyne
Maximum Acceptable Input
Signal Amplitude: 0.1 v. rms without external attenuation
Video Response: 20 cps to 1.5 mc
Size: 17" w x 23" d x 19" h
Weight: 180 lbs.
Price:

Model R-B (Basic Unit):	$1,500
Model RL-T:	2,500
Model RS-T:	2,500
Model RM-T:	2,500
Model RX-T:	2,500

Note: To the basic cost of $1,500 add cost of tuning units required.
Prices subject to change without notice

AVAILABLE ON EQUIPMENT LEASE PLAN

FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY

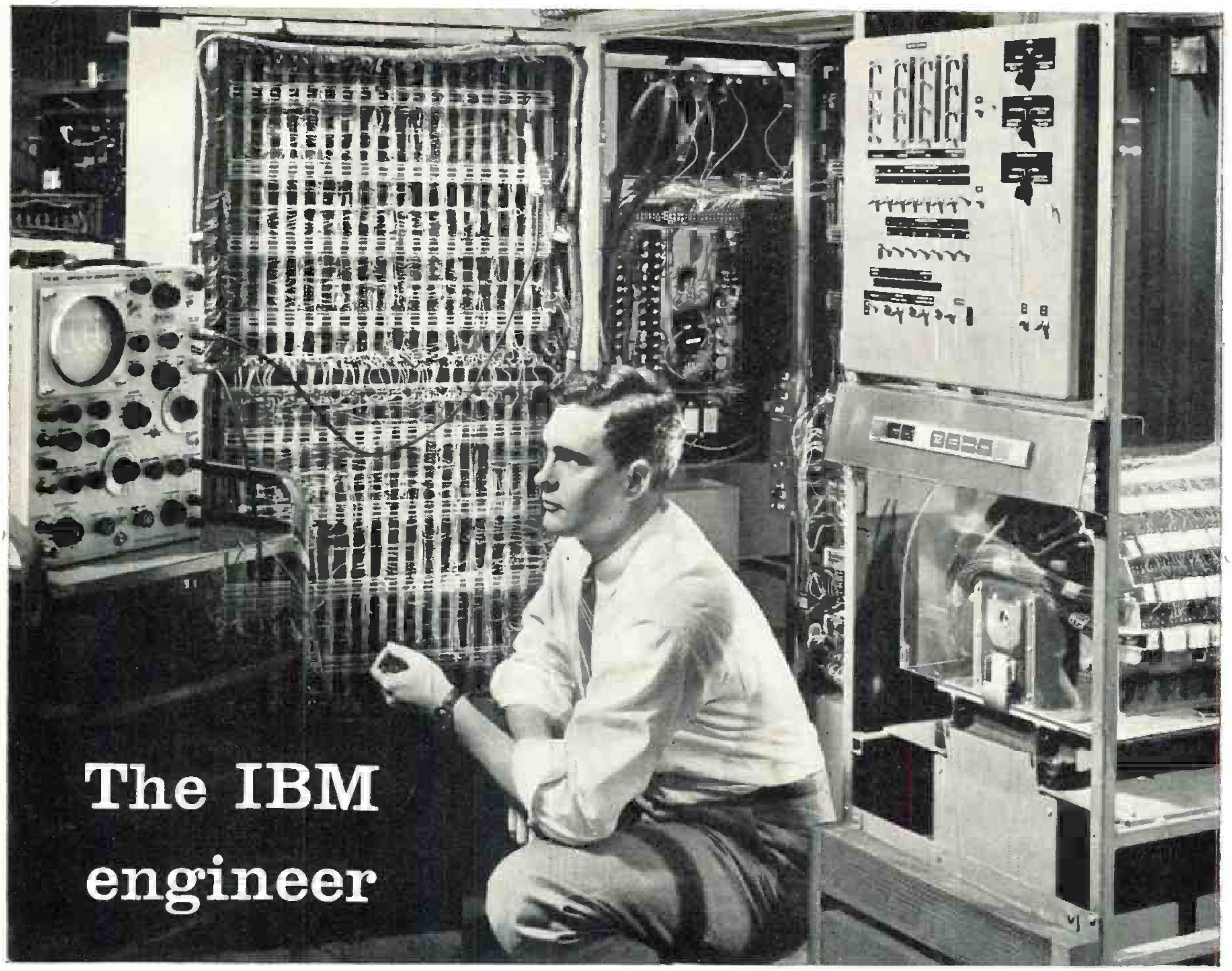
CONSULT US ON YOUR MICROWAVE RECEIVER PROBLEMS.

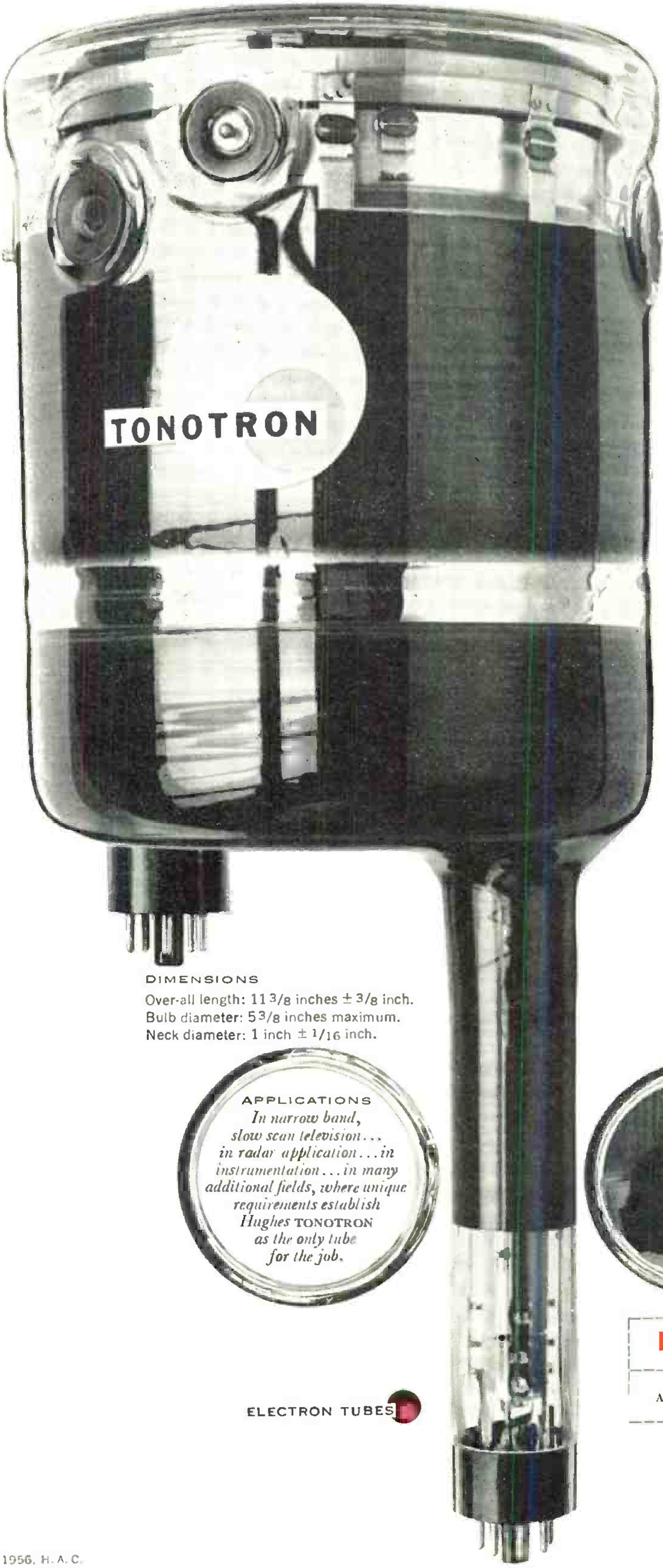
for these applications:

- Broadband receiver for AM, FM, CW, MCW, and Pulse Modulated signals
- Field intensity meter
- Frequency measurements
- Leakage, interference and radiation measurements
- Bandwidth measurements
- Measurement of relative power of fundamental and harmonic signal frequencies
- Trigger pulse amplifier
- Noise figure measurements of r-f amplifiers
- Antenna field patterns
- Attenuation measurements
- Propagation studies
- Microwave relay link site selection
- Direction finding
- Filter measurements
- Standing wave measurements

REPRESENTATIVES: Albuquerque, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cleveland, Dayton, Denver, Fort Worth, Kansas City, Los Angeles, New York, Philadelphia, Portland, St. Louis, San Francisco, Schenectady, Syracuse, Washington, D. C., Winston-Salem, Canada; Arnprior, Ontario. Resident Representatives In Principal Foreign Cities

For product information, use inquiry card on last page.


The IBM
engineer



Hughes Products proudly announces

TONOTRON

Full circle persistence • New brilliance

Defies sunlight

Hughes Products introduces the TONOTRON, *another in its series of new, direct-display cathode ray tubes designed for commercial, industrial, and military applications.*

FEATURES

With TONOTRON, high-fidelity picture reproduction is possible for the first time. This new tube displays black, white, and *all* intermediate shades—with persistence which can be adjusted to maintain nearly maximum brilliance throughout the major portion of a 360-degree sweep. Both persistence and rate of decay can be controlled to suit a variety of specific applications. And TONOTRON's extreme brilliance makes observation possible in the brightest sunlight without a hood.

DIMENSIONS

Over-all length: 11 3/8 inches ± 3/8 inch.
Bulb diameter: 5 3/8 inches maximum.
Neck diameter: 1 inch ± 1/16 inch.

APPLICATIONS

In narrow band, slow scan television . . . in radar application . . . in instrumentation . . . in many additional fields, where unique requirements establish Hughes TONOTRON *as the only tube for the job.*

ELECTRON TUBES

HUGHES PRODUCTS

A DIVISION OF THE HUGHES AIRCRAFT COMPANY

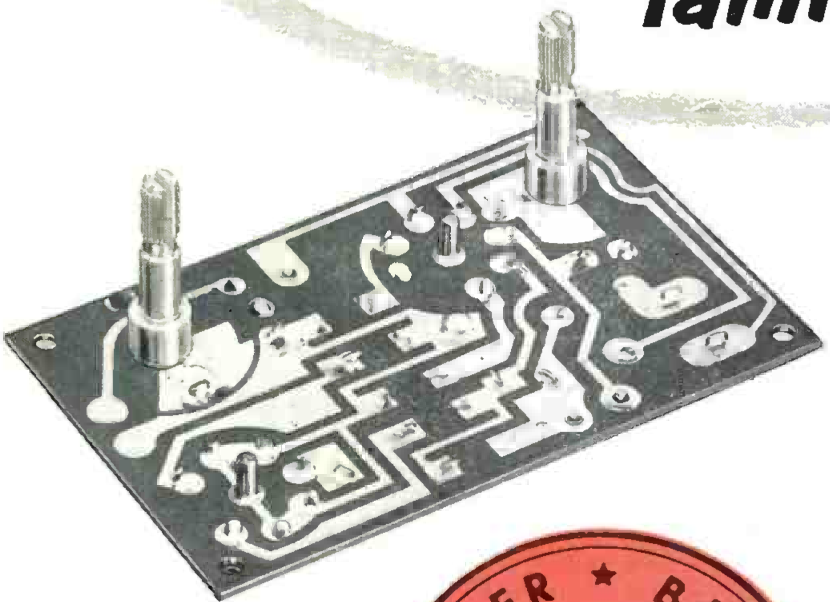
For additional information, please write:
HUGHES PRODUCTS
ELECTRON TUBES
International Airport Station, Los Angeles 45, California

For product information, use inquiry card on last page.

Taylor Fibre Co.

says...

"Using Revere Rolled Copper we are able to produce superior copper-clad laminates!"



At the top of the page opposite is a section of an etched printed circuit enlarged 10 times. These particular lines are of .008 thickness, spaced .012 apart. They show the kind of printed circuits obtainable by combining Revere Rolled Printed Circuit Copper and Taylor laminates. Note the fine line etching, the close spacing and the sharp definition of the edges . . . the smoother surface (freer from pits, pinholes and imperfections) . . . the more uniform thickness with no sacrifice of conductivity. Results—consistently satisfactory etching at better production rates.

Laminators and users alike also have found that Revere Rolled Copper produces no peaks or valleys, that its smooth, hard surface of uniform density permits resist to clean off easily for there are no pores to hold resist and cause trouble when soldering.

They have noted, too, that Revere Rolled Copper is free from oxidation as it comes from the mill and is without lead inclusions. And because of its clean surface, fluxes wet readily, while in the automatic soldering operation it makes possible a uniform solder coat every time free of skips or bald spots.

Those are the very reasons why you should insist that Revere Rolled Copper be used when ordering blanks from your laminator. It is available in unlimited quantities in standard coils of 350 lbs. in widths up to 38" and in .0015 and .0027 gauges, weighing approximately 1 oz. and 2 oz. per square foot. Revere Rolled Copper exceeds requirements of standard specifications and meets ASTM B5 specification for purity with 99.9% minimum.

REVERE
COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N.Y.

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill., Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

COPPER ★ BRASS 1801 REVERE ★ ALUMINUM

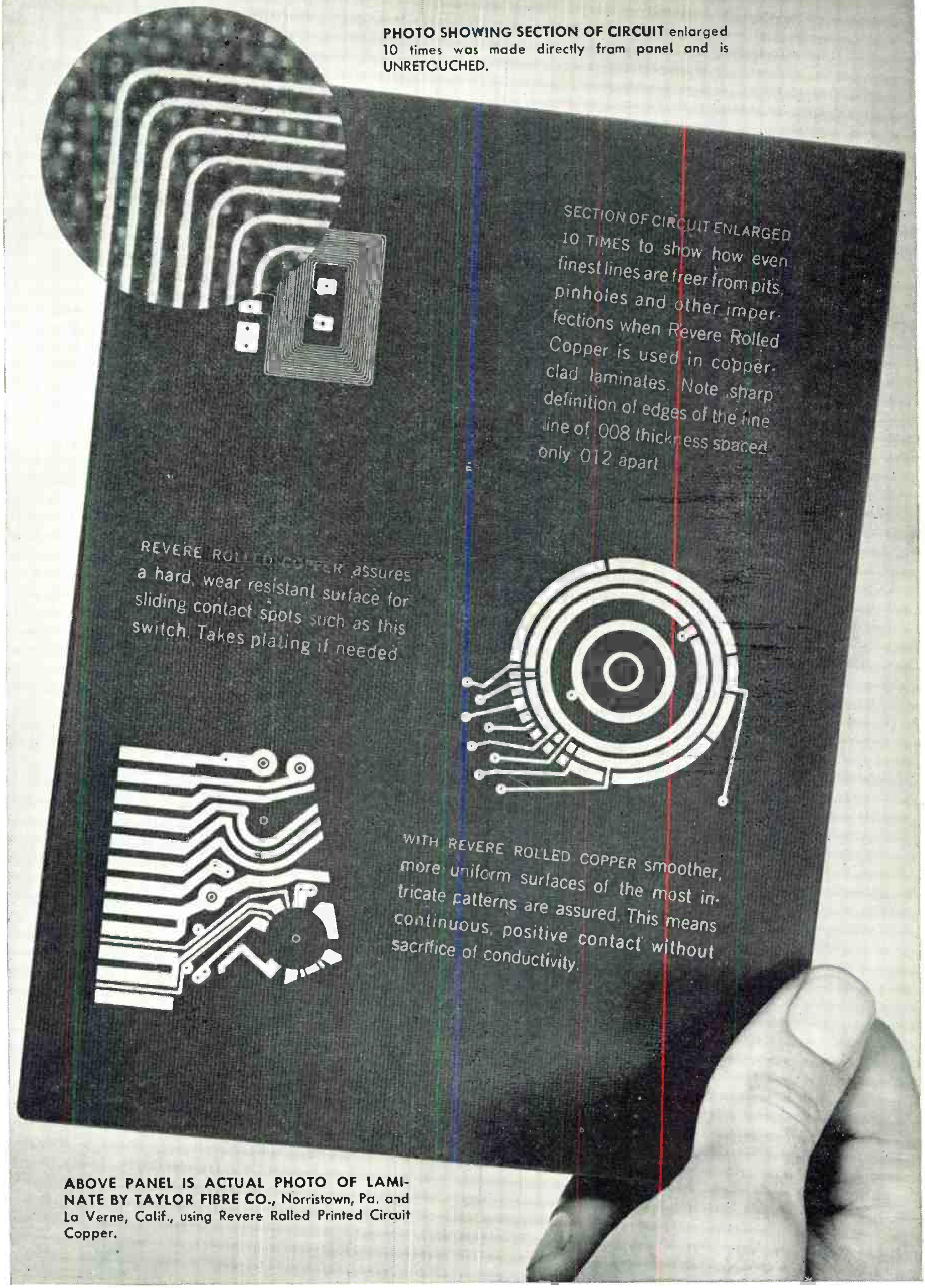
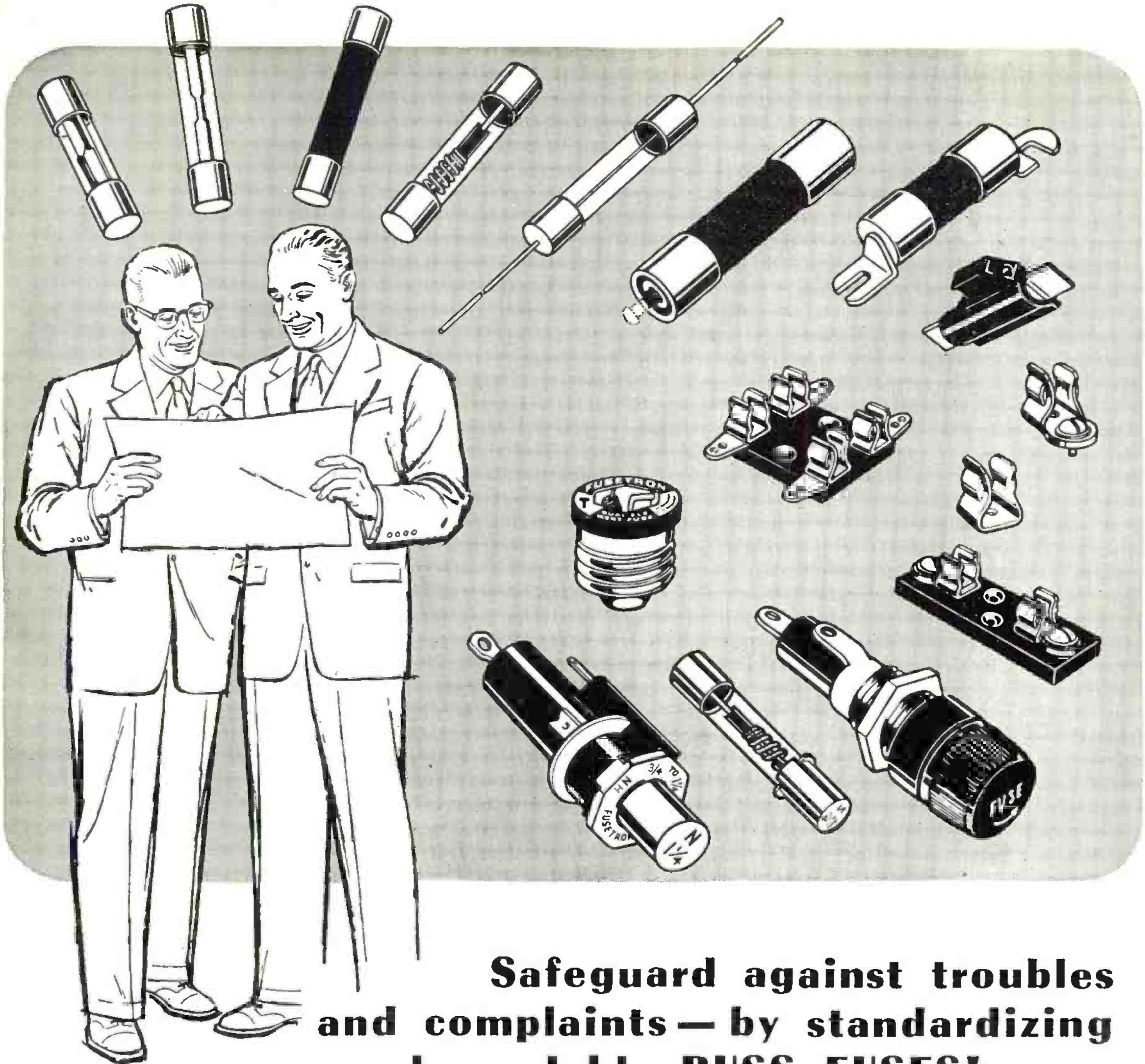


PHOTO SHOWING SECTION OF CIRCUIT enlarged 10 times was made directly from panel and is UNRETOUCHED.

ABOVE PANEL IS ACTUAL PHOTO OF LAMINATE BY TAYLOR FIBRE CO., Norristown, Pa. and La Verne, Calif., using Revere Rolled Printed Circuit Copper.

For product information, use inquiry card on last page.



Safeguard against troubles and complaints — by standardizing on dependable BUSS FUSES!

BUSS fuses give you double protection against loss of customer goodwill because . . . BUSS fuses blow only to protect — never needlessly. To make sure of proper operation, BUSS fuses are tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

By specifying BUSS fuses, you are safeguarding users of your equipment against irritating useless shutdowns due to faulty fuses blowing needlessly. And you are providing them with maximum protection against damage caused by electrical faults.

Most important, the reputation of your product for service and quality is not harmed by the faulty operation of poor quality fuses.

To meet your needs, a complete line of BUSS fuses is available, plus a companion line of fuse clips, blocks and holders.

If your protection problem is unusual, BUSS places at your service the world's largest fuse research laboratory and its staff of engineers to help you select the fuse or fuseholder best suited to your application.

For more information available on BUSS and Fusetron small dimension fuses and fuseholders . . . Write for bulletin TT.

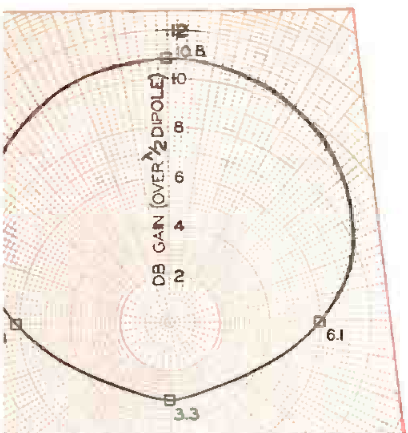
Makers of a complete line of fuses for home, farm, commercial, electronic, automotive and industrial use.

BUSSMANN MFG. CO. *(Div. of McGraw Electric Co.)*
University at Jefferson, St. Louis 7, Mo.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

856

Power where it's Needed!



Gain Pattern, Type 201

ANDREW

This new ANDREW 450 MC base station antenna has been designed for the many base stations that are not in the center of their desired coverage area. Such stations, placed to take advantage of mountain tops, or located at operations headquarters, can now concentrate their highest gain in the direction where the need is greatest.

In planning a new radio system or improving an existing system, consider the advantages of an integrated ANDREW antenna system. The following example shows how an ANDREW system, using the Type 201, can give improvement over ordinary equipment in all directions and more than *9 db improvement* in the best direction.

	Relative Gain, db		
Typical Existing System	**Front**	**Side**	**Back**
Base Station Antenna (Typical)	5.0	5.0	5.0
Station Cable Loss, 100 feet RG-17/U	(2.5)	(2.5)	(2.5)
Mobile Antenna, ¼ λ Whip (RG-58)	0*	0*	0*
Combined Antenna System	2.5	2.5	2.5
ANDREW Type 201 System			
Base Station, Type 201	10.8	6.1	3.3
Base Station Cable Loss, 100 feet Type HO HELIAX	(1.0)	(1.0)	(1.0)
Mobile Antenna, Type 233 (RG-8)	1.8*	1.8*	1.8*
Combined Antenna System	11.6	6.9	4.1
IMPROVEMENT, db	9.1	4.4	1.6

*Gain of Type 233 is relative to assumed 0 db gain of ¼ λ whip with RG-58/U, and includes allowance for lower loss of RG-8/U feed cable.

Write for Bulletin 8417 giving complete information on Type 201. Also, be sure your library contains ANDREW Catalog 21, a complete, 100-page guide to antenna and transmission line systems.

Andrew
CORPORATION
363 EAST 75th STREET · CHICAGO 19

Offices: New York · Boston · Los Angeles · Toronto

LEADING MANUFACTURER of ELECTRONIC INSTRUMENTATION and HIGH-VACUUM EQUIPMENT in the UNITED STATES

Consolidated

...recognized leader

in the fields of:

- *Chemical Analysis*
- *Process Monitoring and Control*
- *Dynamic and Static Testing*
- *Automatic Data Processing*

Recording Oscillographs
Analog-to-Digital Converters
Direct-Writing Oscillographs
Oscillogram Processors
Magnetic Tape Equipment
Galvanometers
Data Amplifiers
Power Supplies
Vibration Meters
Vibration Pickups
Hyge Shock Testers
Pressure Pickups
Electromanometers
Mass Spectrometers
Gas Chromatographs
Process Refractometers
Oxygen Analyzers
Ultraviolet Analyzers
Titrilog Sulfur Recorders
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Analytical Service
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Whenever you need high-accuracy, high-speed data for new product development, product improvement, or quality control, CEC can help you. The instruments, equipment, and systems available through Consolidated will place you in command of any analytical or control problem.

See Consolidated at
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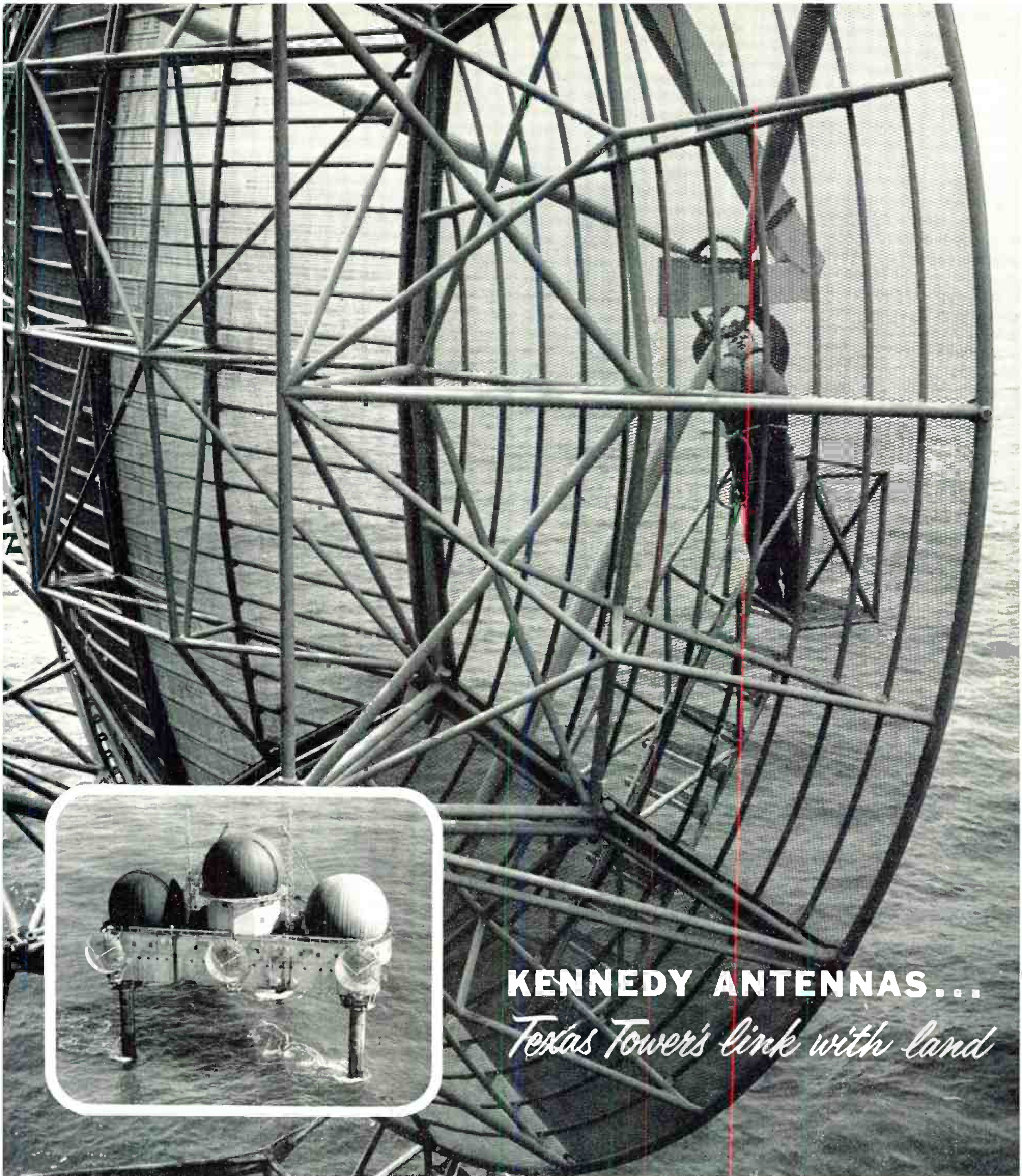
Consolidated Electrodynamics

CORPORATION

300 North Sierra Madre Villa, Pasadena, California

NATIONWIDE COMPANY-OWNED SALES & SERVICE OFFICES



Perched high above the Atlantic, an Air Force technician makes an adjustment on a 28′ scatter antenna — one of three standard Kennedy antennas assigned to a very special job on Texas Towers. These silent sentries relay incoming signals to the mainland, where the message can be read the same instant it is received off shore. Like the many mighty Kennedy antennas performing defense duty all over the free world, they're solid evidence that Kennedy is the name to remember when you are faced with antenna problems.

ANTENNA EQUIPMENT

D. S. KENNEDY & CO.

COHASSET, MASS. — TEL: CO4-1200

Tracking Antennas — Radio Telescopes — Radar Antennas — Ionospheric Scatter — Tropospheric Scatter

Electronic Industries News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

ACOUSTICA ASSOCIATES, INC., Glenwood Landing, L. I., N. Y., has been awarded a substantial Air Force development contract in the guided missile field for ultrasonic cleaning equipment.

ALTEC SERVICE CORP. has changed its name to **ALTEC COMPANIES, INC.** There are no changes in the names of activities of the subsidiary companies.

AMERICAN BOSCH ARMA CORP. recently dedicated a new $1,164,000 addition to their Columbus, Miss. plant of its wholly-owned subsidiary, American Bosch Arma Mississippi Corporation.

BENRUS WATCH CO. proposes the purchase of PIC Design Corp., Lynbrook, N. Y., manufacturer of precision instrument components. Plans for an expansion of PIC Design include a new plant in the Lynbrook-East Rockaway Area.

COMMUNICATION EQUIPMENT SECTION, GENERAL ELECTRIC, will transfer its activities to a new plant soon to be constructed at Gainesville, Florida. Approximately 1700 personnel will be employed in the new plant.

CONSOLIDATED VACUUM DIV., CONSOLIDATED ELECTRODYNAMICS CORP. has changed its name to Consolidated Electrodynamics Corp., Rochester Division, effective June 1, 1956.

CONSOLIDATED ELECTRONICS INDUSTRIES CORP.'S Board of Directors has approved the acquisition of Technical Electronics Corp., Culver City, Calif., manufacturers of motors, system analyzers, and packaged electronic circuits.

DAYSTROM NUCLEAR DIVISION, DAYSTROM, INC. will supply and install a new nuclear reactor at Brookhaven National Laboratory, Long Island. Contract includes the core, process instruments, console and wiring, work to be concluded by 1958.

EMERSON RADIO & PHONOGRAPH CORP. has developed and built for the Air Force a trainer for teaching radar operators to guide aircraft to a target, bomb the target and return—solely through the use of SHORAN radar.

FEDERAL ELECTRIC CORP., Lodi, N. J., subsidiary of International Telephone and Telegraph, has been awarded the operation and maintenance contract for the "White Alice" communication network in Alaska by the USAF.

FEEDBACK CONTROLS, INC., has completed a consolidation of its Alexandria, Va. plant and its Cambridge, Mass. engineering office into new quarters in Waltham, Mass.

FENWAL ELECTRONICS, Framingham, Mass., affiliate of Fenwal Inc., has entered the field as manufacturer of precision thermistors.

GENERAL ATRONICS CORP., 125 City Line Ave., Bala-Cynwyd, Pa., has been established for the purpose of developing new products and techniques in electronics and in the physical and mathematical sciences. President of the new firm is David E. Sunstein, formerly head of the Government Research Dept., Philco Corp., Philadelphia.

INTERNATIONAL TELEPHONE AND TELEGRAPH CORP. and **UNDERWOOD CORP.** have announced that discussions with respect to a possible association of interests have been terminated.

GLENN L. MARTIN CO. of Baltimore, has been awarded a contract by the Dominican Republic for a nuclear-powered electrical generator system.

NORDEN LABORATORIES, White Plains, N. Y., division of the Norden-Ketay Corp., has been elected to membership in the Radio Technical Commission for Aeronautics.

RCA DEFENSE ELECTRONIC PRODUCTS has established a new department to handle administration, sales, and details of RCA custom-built spares for military electronic equipment. Heading the new activity is Herbert C. Elwes as Manager, RCA Defense Spares Marketing.

SOCIETY OF TECHNICAL WRITERS (STW) and the **ASSOCIATION OF TECHNICAL WRITERS AND EDITORS (TWE)** are working on plans for a merger of the two into a single organization. Initial plans call for a joint National Convention of STW and TWE on Nov. 15 and 16 at the Hotel Statler, New York.

SPERRY RAND CORP. will construct a new $1,250,000 research and development facility at Salt Lake City, to be known as the Sperry Utah Engineering Laboratory.

F. J. STOKES MACHINE CO., Philadelphia, has changed its name to F. J. Stokes Corp.

SYLVANIA ELECTRIC PRODUCTS INC. has acquired a new plant in Hillsboro, N. H., to be used in the manufacture of transistors and crystal diodes. Sylvania has also established a new Microwave Physics Laboratory at Mountain View, Calif.

ULTRASONIC MANUFACTURERS ASSOC. has formed an engineering standards committee composed of members from seventeen leading ultrasonic manufacturers in the U. S.

MID-WEST

A.C. SPARK PLUG DIV., GENERAL MOTORS, has changed its name to A.C. Electronics Division Corp.

AMERICAN PHENOLIC CORP., Chicago, announces a change of name to Amphenol Electronics Corp.

CARBOLOY DEPT., GENERAL ELECTRIC CO., will now be known as the Metallurgical Products Department, General Electric. Department headquarters remain in Detroit.

COOK RESEARCH LABS., Skokie, Ill., division of Cook Electric Co., will occupy a new plant now under construction in Morton Grove, Ill. The new 31,000 square foot structure will be utilized mainly for Radar Research.

EDUCATIONAL TELEVISION & RADIO CENTER, Ann Arbor, Mich., will acquire a new $200,000 home on or about October 1. The two-story L-shaped building will provide more than 8500 square feet of floor space.

MAGNAVOX CO. of Tennessee has initiated a major building program which will add approximately 70,000 square feet to the company's facilities in Greeneville.

SHURE BROTHERS INC. has moved into a new $1,000,000 building at 222 Hartrey Ave., Evanston, Ill.

TEXAS INSTRUMENTS, INC., Semiconductor Products and Components Divisions, have combined their engineering, manufacturing and marketing operations.

WEST

BERKELEY DIV., BECKMAN INSTRUMENTS, has been awarded a contract by General Motors Allison Division for analog computer to be used in designing advanced jet engines at the Allison plant, Indianapolis.

JACQUES BIALEK has opened an office as Management Consultant to the Electronics Industry at 3631 W. Slauson Avenue, Los Angeles 43.

BJ ELECTRONICS, subsidiary of Borg-Warner Corp. has moved to new quarters at 330 Newport Blvd., Santa Ana, Calif.

CAL-TRONICS CORP., Los Angeles manufacturer of electronic test equipment, has formed a new Foto-Etch Circuits Division to develop and produce printed circuits. General Manager is W. G. Weigel. The plant is located at 2631 Southwest Drive, Los Angeles.

CONSOLIDATED ELECTRODYNAMICS CORP. has completed the construction of a $1,500,000 3-story research, engineering and marketing building in Pasadena, Calif.

ELECTRO ENGINEERING WORKS, INC., transformer manufacturer, has completed the move to their new 20,000 square foot building at 401 Preda Street, San Leandro, Calif.

G. M. GIANNINI & CO., INC. has opened a new electromechanical division at Sherwood Lane, Caldwell Township, N. J.

MARVELCO ELECTRONICS DIV., NATIONAL AIRCRAFT CORP., has established an electronic research and development center at 5063 Harbor Drive, San Diego, to handle projects in telemetering, data-handling and display, guidance-navigation, and computer research.

McCOLPIN-CHRISTIE CORP. announces the change of name to Christie Electric Corp. Organization and personnel remains the same.

PCA ELECTRONICS INC. has moved its Santa Monica factory to new quarters at 16799 Schoenborn Street, Sepulveda, Calif.

PERKIN ENGINEERING CORP., El Segundo, Calif., has opened a new regional Sales-Engineering office at 1060 Broad Street, Newark 2, N. J.

TELEMETER MAGNETIC INC., subsidiary of International Telemeter Corp., has moved to new quarters at 2245 Pontius Avenue, Los Angeles 64.

FOREIGN

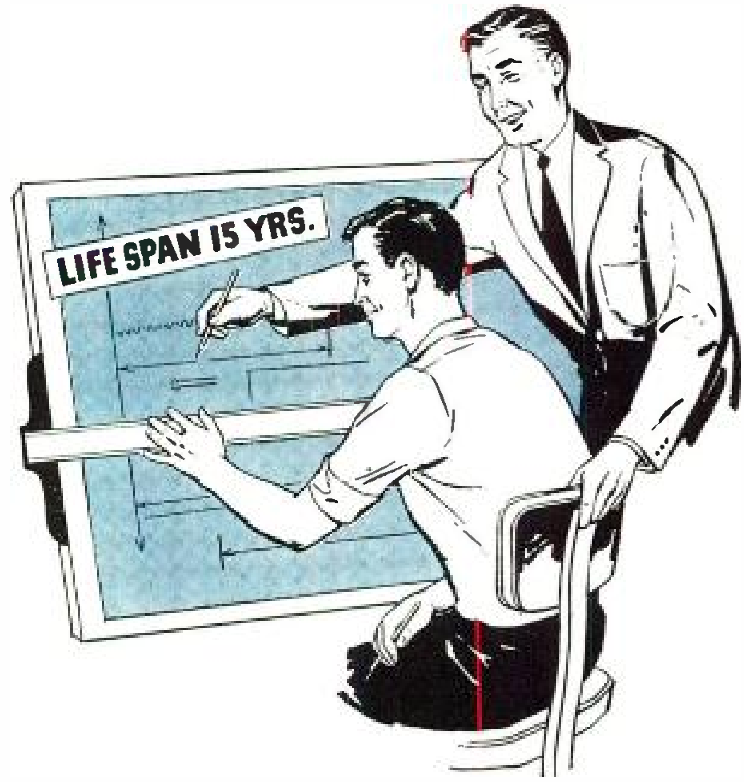
KEARFOTT CO., INC., subsidiary of General Precision Equipment Corp. has arranged with R. B. Pullin & Co. Ltd., London, England, for manufacture of Kearfott's products in the United Kingdom. Equipment to be manufactured overseas will include servomotors, synchros, tachometer generators and servomotor-tachometer combinations.

PSC APPLIED RESEARCH LTD., Toronto manufacturer of instrumentation, has opened a new environmental test laboratory to test to aeronautical standards.

SUN LIFE ASSURANCE CO. OF CANADA has ordered a Univac tube computer from Remington Rand to be installed in its head office in Montreal.

TELESISTEMA MEXICANO S.A., Mexico City, has purchased a Philco, VHF, one-kilowatt TV transmitter with associated studio equipment to be installed at Guadalajara.

planning on LONG LIFE?



El-Menco DUR-MICA Capacitors *will match your equipment's life expectancy to at least 15 years!*

A recent series of the toughest trials has proved El-Menco DM15, DM20 and DM30 Dur-Mica Capacitors outlast all others. Accelerated conditions of 1½ times rated voltage at ambient temperature of 125° centigrade found El-Menco capacitors still going strong after 10,000 hours. Similar conditions obtaining under normal usage would equal a lifetime of over 15 years!

Tougher phenolic casing means *longer life, greater stability*, over wide temperature range.

Meet all humidity, temperature, and electrical requirements of both civilian and MIL-C-5 specs.

Parallel leads simplify use in television, electronic brains, miniature printed circuits, computors, guided missiles, and other civilian and military applications.

DM15

Actual Size

DM20

El-Menco Dur-Mica DM15, DM20, and DM30 Capacitors Assure:

1. LONGER LIFE
2. POTENT POWER
3. SMALLER SIZE
4. EXCELLENT STABILITY-SILVERED MICA
5. PEAK PERFORMANCE

Tell us your specific needs. Write for FREE samples and catalog on your firm's letterhead.

El-Menco Capacitors

Take Your Own Word For It. Test El-Menco Dur-Mica Capacitors Yourself.

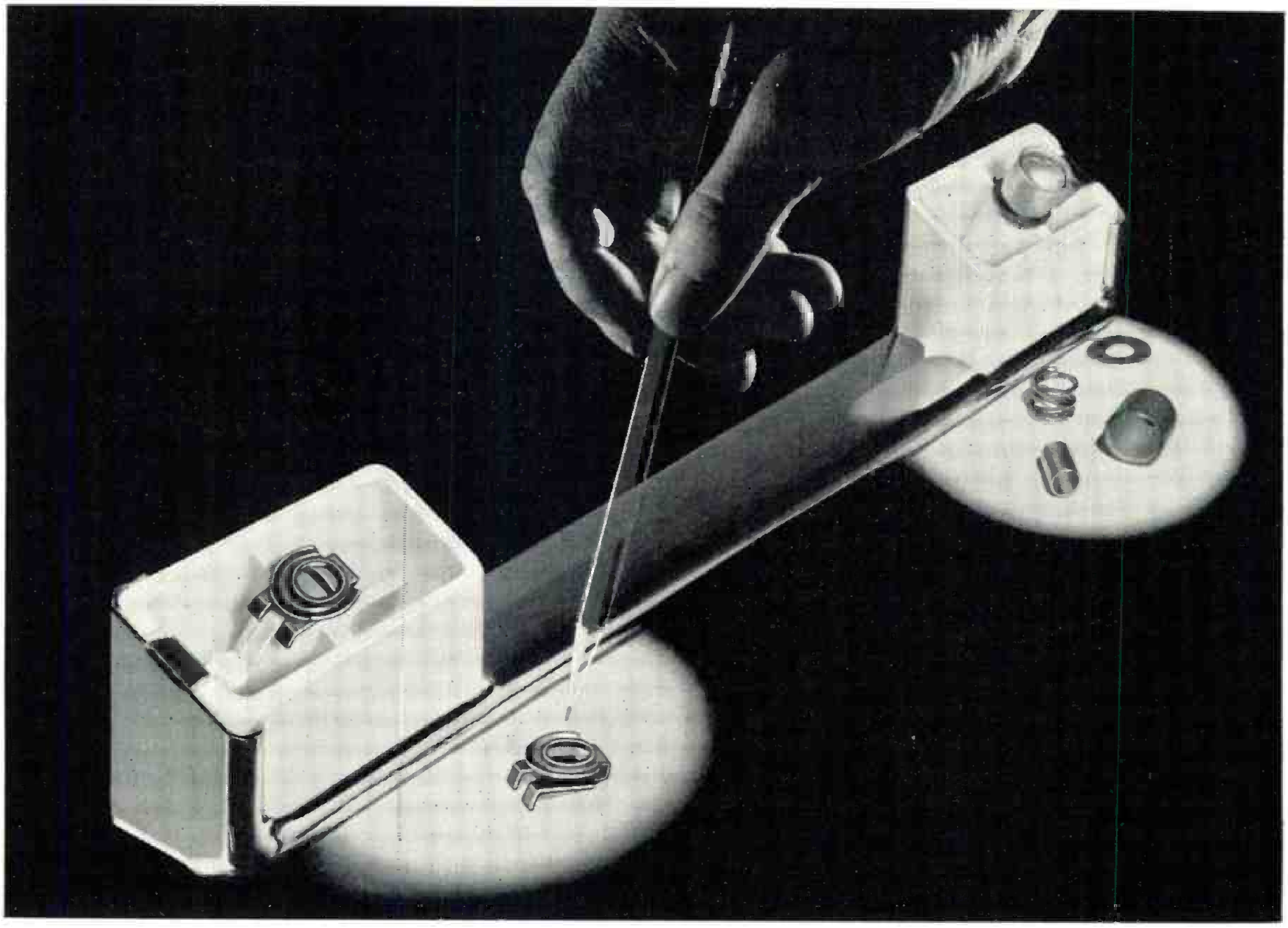
THE ELECTRO-MOTIVE MFG. CO., INC.

WILLIMANTIC, CONNECTICUT

• molded mica • mica trimmer
• tubular paper • ceramic

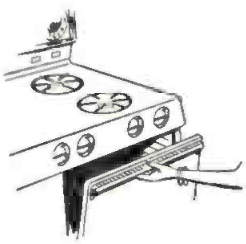
Arco Electronics, Inc., 64 White Street, New York, N Y.
Exclusive supplier to jobbers and distributors in United States and Canada.

For product information, use inquiry card on last page.



Engineered by Tinnerman...

One-Piece SPEED CLIP® replaces 4-part fastener, helps assembly and shipping . . . and saves money!



Four separate parts plus screw were required to fasten each end of the removable door handles on kitchen ranges manufactured by the Caloric Appliance Corporation, Topton, Pennsylvania.

Tinnerman fastening specialists teamed up with Caloric designers to eliminate 3 of the parts!

Now . . . a special one-piece, multi-purpose SPEED CLIP plus screw do the same job more efficiently and at lower cost, and reduce small parts handling. Faster, easier assembly . . . fewer parts to buy, inventory and handle. Packed inside the oven for safe shipment with SPEED CLIPS in place, the door handles are dealer-applied in far less time, can be easily removed by the housewife for cleaning.

The resiliency of the spring steel SPEED CLIP prevents crazing or chipping, enables it to absorb varying panel thicknesses and porcelain enamel build-up. Changeover was made without retooling or redesigning door handle or keyhole-shape mounting holes.

Find out now where SPEED NUT brand fasteners belong on your assembly line. There are more than 8000 variations to choose from. Call your Tinnerman representative for complete details and write for our Fastening Analysis Bulletin No. 336.

TINNERMAN PRODUCTS, INC. • Box 6688, Dept. 12, Cleveland 1, Ohio

Canada: Dominion Fasteners, Limited, Hamilton, Ontario. *Great Britain:* Simmonds Aerocessories, Limited, Treforest, Wales. *France:* Simmonds, S. A., 3 rue Salomon de Rothschild, Suresnes (Seine). *Germany:* Hans Sickinger GmbH "MECANO", Lemgo-i-Lippe.

TINNERMAN

Speed Nuts®

FASTEST THING IN FASTENINGS®

For product information, use inquiry card on last page.

Direct readings of

FREQUENCY
TIME
PERIOD

New (hp) 523B

ELECTRONIC COUNTER

10 cps to 1.1 MC!

- **Extreme dependability**
- **Etched, unitized circuits**
- **Permits viewing time-interval start and stop points on oscilloscope**
- **High accuracy crystal oscillator circuit**
- **Trouble-localizer lights**
- **Counts pulses of selected voltage level**

Construction of the new *-hp-* 523B is highest quality throughout. Etched circuits are rugged, ultra-dependable. Circuits are arranged for complete visibility. Trouble-localizer lights and plugs disconnecting circuit elements further simplify maintenance.

Exclusive features include a pulse output for oscilloscope Z-axis modulation permitting visual identification of the time-interval start and stop points on the input waveform measured. There is also a pulse count discriminator counting only pulses of voltage above a pre-determined level; and a high accuracy, high stability crystal controlled oscillator. Controls are color-coded, concentric, functionally arranged. Readings are direct in clear, bright numerals; decimal is automatic and illuminated.

The broad range and versatile usefulness of *-hp-* 523B is indicated by the Specifications at right. Model 523B is designed for utmost speed and simplicity in measuring production quantities, rpm, nuclear pulses, power line frequencies, repetition rates, time intervals, pulse lengths, shutter speeds, velocities, relay times, frequency ratios, phase delay, etc. With transducers, *-hp-* 523B also provides local or remote measurement of weight, pressure, temperature, acceleration, etc.

BRIEF SPECIFICATIONS

FREQUENCY MEASUREMENT:	
Range:	10 cps to 1.1 MC
Accuracy:	± 1 count ± crystal stability
Input Minimum:	0.2 v RMS
Input Impedance:	Approx. 1 megohm, 30 μμf shunt
Gate Time:	0.001, 0.01, 0.1, 1, 10 seconds
Reads Directly In:	KC. Automatic decimal
PERIOD MEASUREMENT:	
Range:	0.00001 cps to 10 KC
Accuracy:	±0.3% (1 period); ±0.03% (10 periods)
Input Minimum:	1 v RMS
Input Impedance:	Approx. 1 megohm, 40 μμf shunt
Gate Time:	1 or 10 cycles of unknown
Standard Counting:	10 cps, 1 KC, 100 KC, 1 MC, External
Reads Directly In:	Sec, msec, μsec; automatic decimal
TIME INTERVAL MEASUREMENT:	
Range:	3.0 μsec to 100,000 sec (27.8 hrs)
Accuracy:	±1/ std. freq. counted ± stability
Input Minimum:	1 v peak. dc coupled
Input Impedance:	Approx. 1 megohm, 25 μμf shunt
Trigger Slope:	Pos. or neg. on start/stop independent or common channels
Trigger Amplitude:	–300 to +300 v adjustable
Standard Counting:	10 cps, 1 KC, 100 KC, 1 MC, External
Reads Directly In:	Sec, msec, μsec, automatic decimal
STABILITY:	2/1,000,000 per week. Also WWV
DISPLAY TIME:	Variable 0.1 to 5 sec, or indefinite
OUTPUTS:	Secondary standard: 10 cps, 1 KC rectangular, 100 KC, 1 MC sine wave.
PRICE:	$1,175.00

Data subject to change without notice. Price f.o.b. factory.

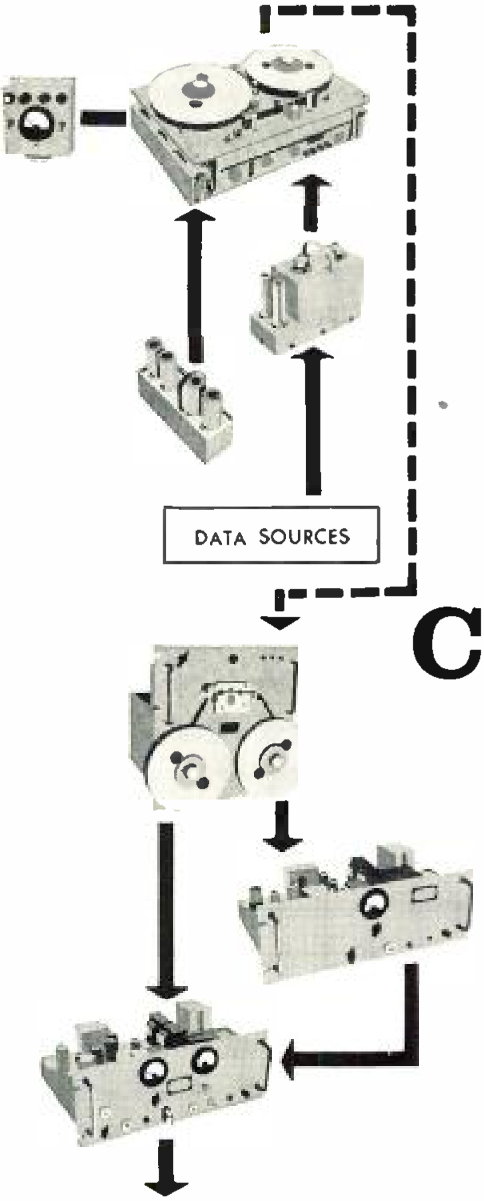
See this new -hp- equipment at WESCON Booths 1050-1051

HEWLETT-PACKARD COMPANY
3695K Page Mill Road, Palo Alto, California, U.S.A.
Cable "HEWPACK" DAvenport 5-4451
Field engineers in all principal areas

(hp) complete coverage in quality counters

For product information, use inquiry card on last page.

In choosing data recording equipment, it is now feasible to tailor the equipment to present and future data handling needs. It is no longer necessary to tailor your entire program to equipment limitations.



Choosing A System

for magnetic tape DATA recording

When magnetic recording was in the audio phase of its development, there was just one recording method —direct recording. But today, several methods are available. And while direct recording is still common in audio work, it has taken a back seat to modulated carrier techniques in the more critical field of *data* recording.

To take advantage of the broad range of equipment and techniques now available, start with a thorough-going analysis of your own present *and future* data handling . . . data processing needs. Then, match the techniques and individual components *to those needs.*

Choose the recording method first: Direct recording is limited in data work by its poor amplitude reproduction and poor low frequency response on playback. Pulse width modulation (PWM) recording is excellent for recording a large number of channels with limited frequency response. Digital recording offers extremely high data accuracy, but relatively low information capacity.

FM recording, electronically compensated for wow and flutter, offers a combination of high overall system performance, frequency response, and information capacity, suiting it for most analog recording applications. Any or all of these methods can be supplied in the same recording system by inserting the proper plug-in circuitry.

Consider physical requirements next: Where you plan to use a system is an extremely important factor. To record data in a missile or jet, you will obviously need different equipment than would be used in a laboratory. But reel size, tape width, tape speeds, must also be selected. And heads, available for recording from 2 to 24 data tracks or even more, should be specified early. Keep in mind also the planned final disposition of the data, whether to a computer, direct writing recorder, or other equipment.

Finally, select system components and accessories: In FM carrier recording alone, you can choose from at least three recording oscillators, two reference generators, and several signal and compensation discriminators. Speed control servos, power supplies, and remote controls also require attention.

Needless to say, much of this process of selection requires special experience, and should be placed in the hands of the competent data recording systems manufacturer. But the important thing to remember is that data recording on tape is a field in itself, with special techniques and special equipment that can be matched to virtually any recording need. The day when the problem had to be tailored to the equipment is long past.

More detailed information on recording systems and equipment, and how to select them, is provided in "The Role of Magnetic Tape In Data Recording," available on request to Davies Laboratories, Inc.

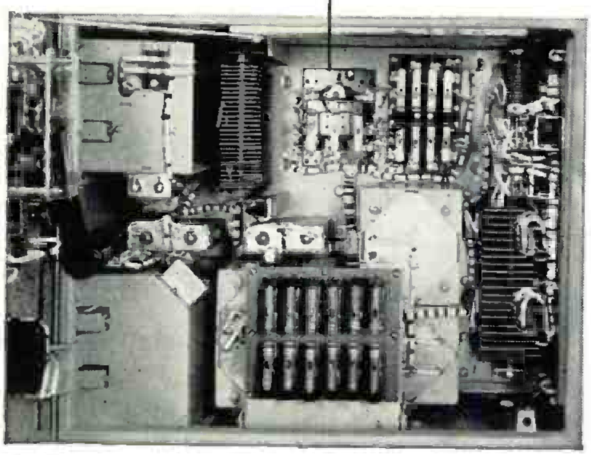
Davies

LABORATORIES, INCORPORATED

4705 QUEENSBURY ROAD • RIVERDALE, MARYLAND

For product information, use inquiry card on last page.

...and Radio Receptor Selenium Rectifiers help make that accuracy possible!



Power supply and amplifier cabinet made by **Belock Instrument Corp., New York,** for U. S. Navy gun fire control systems. Five Radio Receptor rectifiers are utilized in this unit.

The timing and precision of U. S. Naval gunfire depends on complex fire control systems for which Radio Receptor's customer, **Belock Instrument Corp.** manufactures power supply and amplifier cabinets. Five Radio Receptor power rectifiers are included in each unit because the manufacturer knows that ruggedness, long life and reliability are always prime features of every RRco. stack.

On target with the fleet — and in hundreds of other applications for government and industry, RRco. rectifiers constantly prove they can pass the stiffest requirements with flying colors. If *you* have a problem involving rectification, submit your specs to our engineering department. We'll be glad to make recommendations, without obligation of course.

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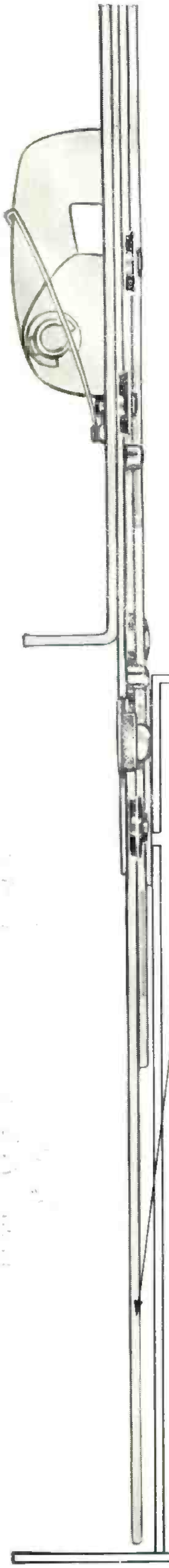
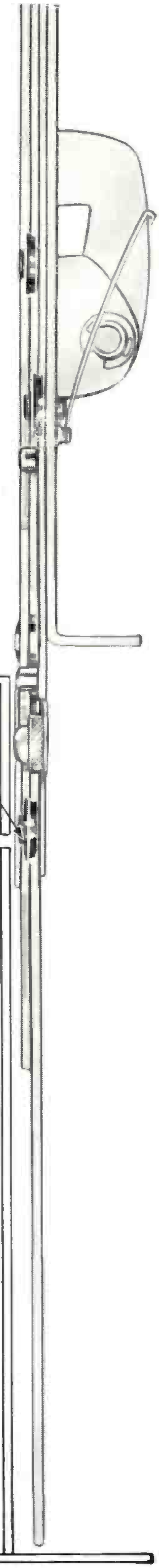




New Grant 3400 *thinslide*

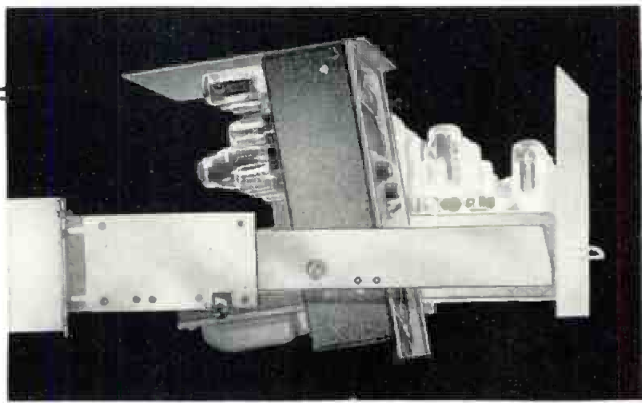
mounts standard 17" chassis
in standard 18" rack or cabinets

REQUIRES ONLY 19/64" SPACE PER SIDE–

YET HAS

FULL ROLLER ACTION

(fits RETMA *rack hole spacing)*



The Grant 3400 Thinslide requires only 19/64" space per side—installs readily in standard racks and cabinets. Allows instant access to chassis measuring from 10" to 16" deep. Tilts through 100° for under-chassis servicing. Positive lock in "out" position. Lock has finger-tip release for instant return or removal of chassis. Eight hardened steel rollers carry the rated load of 100 lbs. smoothly and easily—durability insures frictionless rolling for thousands of cycles of use.

Slide mounting not only provides for quick access—it usually eliminates need for rear access doors and rear aisles—a very important saving of space.

The Grant 3400 is a versatile slide, suited for use in your *product*, in *plant equipment*, *prototype* and *breadboard* work, and in *production line or field test equipment*. Very moderate cost allows a wide range of applications in original equipment.

Write today for Grant 3400 Thinslide Technical Bulletin—contains full data and specifications.

Grant INDUSTRIAL SLIDES

Grant Pulley and Hardware Corporation
factories: **31-75 Whitestone Parkway, Flushing 54, N. Y.**
944 Long Beach Avenue, Los Angeles 21, Calif.

Robert Oakes Jordan

In the article reproduced here, just as it appeared in the May 16 issue of "Down Beat", Mr. Robert Oakes Jordan reports his completely unbiased and impartial findings on the vitally important subject of tape quality. A leading authority in the high-fidelity field, and tape recording in particular, his comments are of interest to all users of tape recording equipment, professional and amateur alike.

High Fidelity — DOWN BEAT

By Robert Oakes Jordan

IT LOOKS AS though 1956 will be a year for magnetic tape recording. Perhaps it might be wise to review the subject of tape.

Looking back over the recent history of magnetic recording and its plastic tape medium, it is easy to see the progress in both.

Factors, more often than not overlooked, which are concerned with the use and storage of tape should be known and used by every person having a tape recorder.

During the last year, one of the long-term projects at our laboratory in Highland Park, Ill., has been the independent study of magnetic recording tape. We are interested in finding out just which practises in its use must be observed and how the user can best assure the safekeeping of his recorded tapes.

SEVERAL HUNDRED reels of magnetic tape from all the tape manufacturers were studied. Not more than 5 percent of this tape was submitted by manufacturers as samples. The bulk was bought by the laboratory.

In this a nontechnical report, we will tell of those factors considered most important for the tape user. It is our opinion that output consistency is the single most important factor governing the choice of any recording tape. Output consistency means that the tape must produce the same quality of sound as it is played back, month after month, year after year.

If the manufacturer has complete control of his tape production processes, then serious variation should not occur. If there are variations in the thickness of the oxide, its composition, or its method of application to the plastic base, then there will be a variation in the performance of the tape. If the user gets too little signal in playback or too much, either is a serious tape fault.

IT IS SELDOM possible for the tape user to judge the quality of the tape he uses because faults and inconsistencies identical to tape failures may be caused by poorly adjusted or maintained tape recorders. Virtually any brand of tape will provide adequate results from the majority of nonprofessional recorders now on the market. However, if you want professional results, then reel-to-reel, batch-to-batch output consistency is important.

In the tests, we found some remarkable variations in marketed tapes for consumer use. Among those faults found most often are these:

- *Nonuniformity of oxide coating*, causing signal-level variations or "dropouts" in which little or no signal was recorded.
- *Pits or pocket voids*, where air bubbles or dirt have caused very small pits in the oxide coating. In some cases the ring magnetization of the rim of these pits or holes will cause playback signal variation.
- *Nonuniformity of plastic base surface*, in which, if the plastic base has microscopic hills or valleys in its surface, the oxide coating, though perfectly smooth at the playing surface will vary in depth along the tape. This can cause that noise-behind-the-signal, perplexing to professional recording engineers as well as amateurs.
- *Uneven slitting*, in which the magnetic tape is processed and coated in wide rolls and must be slit to whatever marketable width is desired. Large roller knives must be employed in the slitting process. If these knives get dull or exhibit any heat change one to another, the tension of one slit edge of the tape varies from that of its other edge. This change of edge tension over the length of a reel of tape will cause erratic travel of the tape over the recording and playback heads.
- *Poor oxide adhesion to the plastic base.* While this fault is becoming more and more rare, it is still a factor to consider when buying "bargain" or used bulk tape. The drawbacks to good recordings are evident in the clogging effect of the loosened oxide powder.

After the tests, we chose Audio Tape Type 51, made by Audio Devices, which through two years of tests and use, proved to be the most consistent of all the major tapes.

29

audiotape

TRADE MARK

WINS INDEPENDENT TAPE TEST BY LEADING HI-FI AUTHORITY

. . . as reported in DOWN BEAT *magazine*

The tape test described by Mr. Jordan emphasizes two very important facts. (1) Different brands of recording tape vary widely in output uniformity. (2) Of all the leading brands tested, standard plastic-base Audiotape rated highest in consistent, uniform quality.

This outstanding Audiotape performance is the calculated result of extra care and precision in every step of the manufacturing process, from selection of raw materials to final coating, slitting and packaging. And this same uniformity extends throughout the entire Audiotape line.

Now there are 5 DIFFERENT TYPES of Audiotape, with base material and thickness to meet the exact requirements for every recording application. But whatever type you select, there's only *one* Audiotape *quality*—the very finest that can be produced. Ask your dealer for our new Bulletin No. 250, describing the newly-expanded Audiotape line. Or write to Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.

AUDIO DEVICES, Inc.

444 Madison Ave., New York 22, N. Y.

In Hollywood: 1006 N. Fairfax Ave. ● In Chicago: 6571 N. Olmsted Ave. ● Export Dept: 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

Styroflex Coaxial Cable

Goes to Sea With the U. S. Navy!

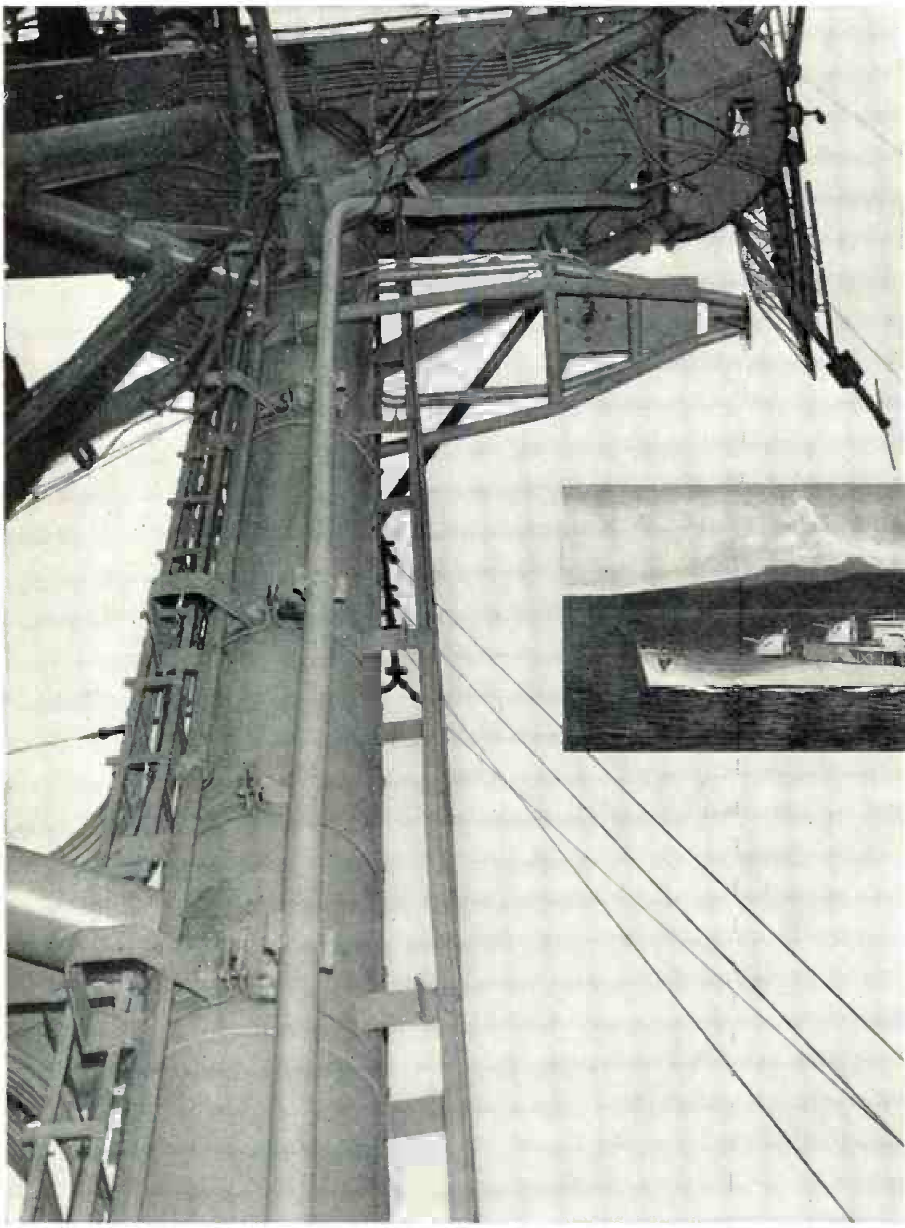


PHOTO COURTESY OF U. S. NAVY

During the overhauling of the U. S. S. Hank, the Navy Department installed 3 1/8" 50 ohm Styroflex coaxial cable as the transmission line in the ship's SRa air search radar system.

Since this installation, results show that positive identification of air targets has been made at *twice the distance* possible before Styroflex was put into service on the ship.

Other Styroflex qualities which helped determine its selection by the Navy include its ease of installation, resistance to shock from gunfire and stable electrical characteristics.

Perhaps Styroflex can answer your particular transmission problem, too. Inquiries are invited by our engineering staff.
See us in Booth 406 at the WESCON Show

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REG U S PAT OFF

PHELPS DODGE COPPER PRODUCTS
CORPORATION

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If you measure "pressure" by the amount of force brought to bear on a specific object, this man is truly a "high pressure" salesman. The problem he is considering is a typical one: how to modify the performance of an electronic component manufactured by a company he represents to meet the special requirements of a customer. Ordinary salesmanship cannot solve this problem. It calls for the combination of engineering thinking and sales-sense that has permitted electronic manufacturers representatives to make significant contributions to the entire electronic industry.

This man is thinking how he can render a service to both his princip and his customer. His credo is: the most important line carried by ar manufacturers representative is his own reputation.

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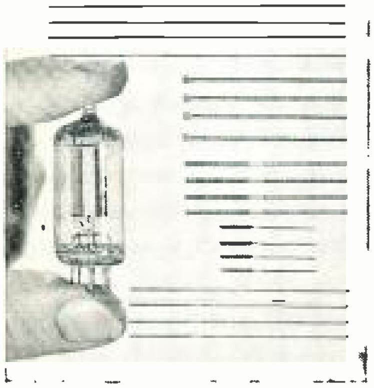
G-E QUALITY IN RADIO AND ELECTRONIC COMPONENTS—AT A PRICE YOU WANT TO PAY!

THE Lamp Leads and Bases Department of General Electric is one of the true pioneers in the electronics industry. We were solving design and production problems at a time when only a handful of companies recognized its potential. Today we stand ready to furnish you with the highest quality radio and electronic components you can buy—as we continue to develop new processes and better materials to insure the best products at the lowest possible price.

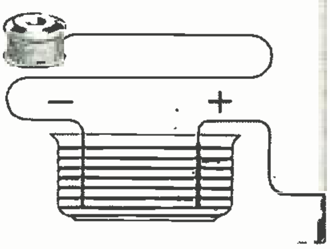


Leads

General Electric is the largest manufacturer of all types of lead-in wires for electronic devices, radio tubes and other applications.

Dumet

To successfully seal lead wire to soft glass, the expansion coefficients must be reasonably close. Dumet, a General Electric development, meets this requirement. It is made of copper tubing, and iron-nickel core rod—and is used for sealing to lead or lime glass.



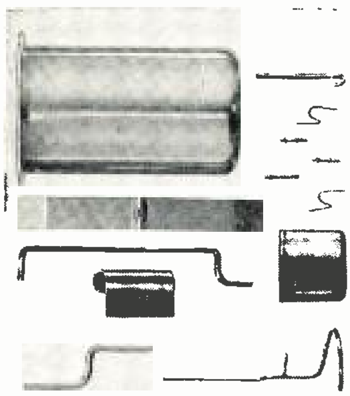
Plated Wire

General Electric produces Nickel Plated Iron Wire and Nickel Plated Copper Wire from low carbon (Armco or Low Basic) iron wire and oxygen-free high conductivity copper wire—in a variety of diameters and plate thickness.

RANGE OF SIZES

Symbol	Base Material	% of Plate	Diameter Range
Cu (NP)	Copper	*	10—50
Fe (NP6)A	Armco	2—8	20—70
Fe (NP6)B	Low Basic	2—8	20—70

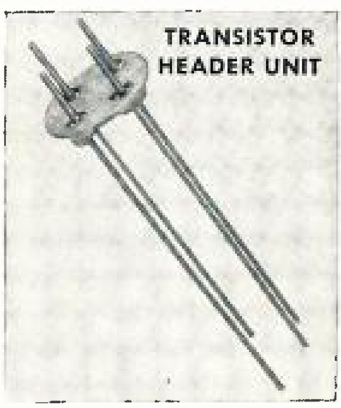
*Plate thickness for all sizes of (CuNP) wire approximates .0001"



Metal Parts

Our development laboratory and fabricating facilities are offered to electronic manufacturers to design, test and produce parts from many types of metals to meet your requirements.

TWO NEW G-E PRODUCTS NOW AVAILABLE!

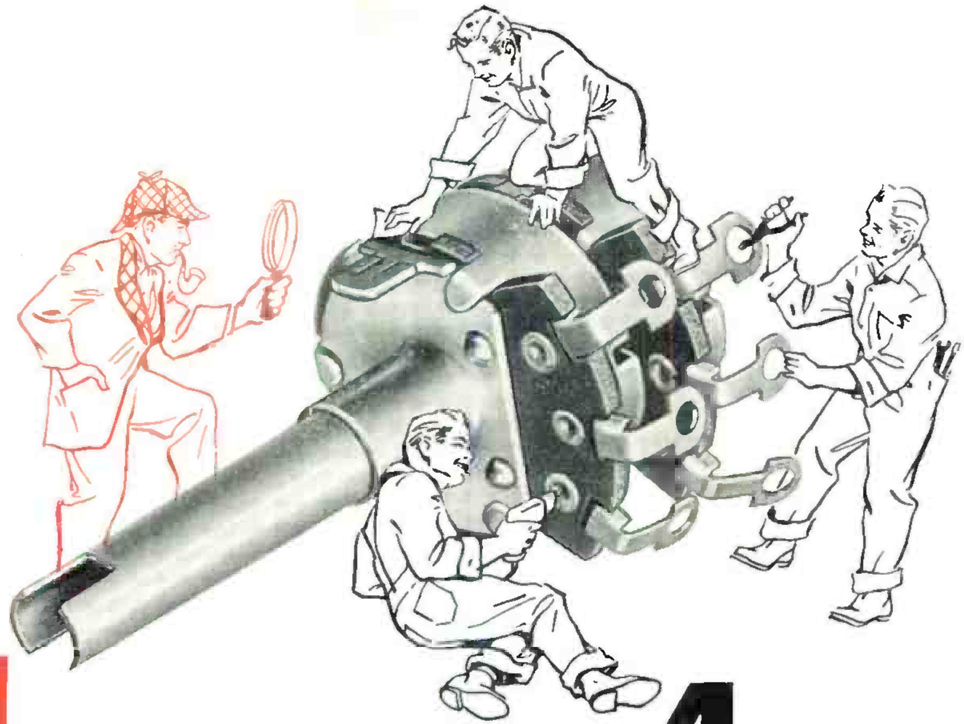


BOTH THESE FINE NEW PRODUCTS are offered with full assurance that quality craftsmanship and precision assembly are used throughout. Both are made to G-E's strict quality standards —and you get all the price benefits of high volume production.

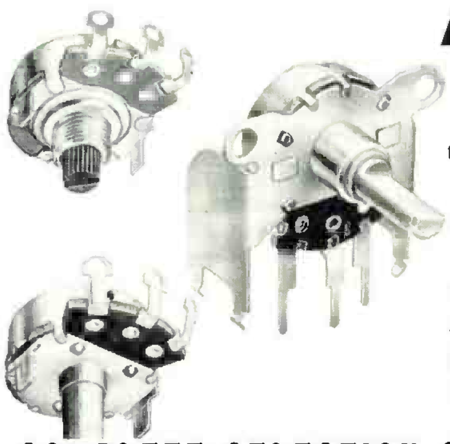
TO GET THE FULL STORY on all our radio, television and electronic components, write: General Electric Company, Lamp Leads and Bases Department, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC



1 OUT OF EVERY 4 WORKERS ON STACKPOLE CONTROLS IS AN *Inspector!*



Few components call for greater manufacturing care and precision than variable resistors.

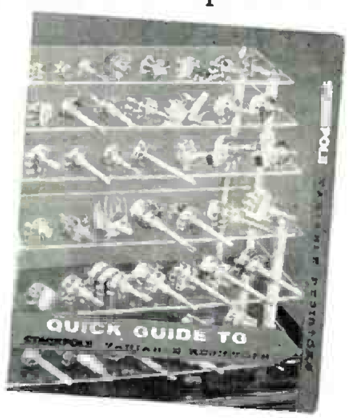
That is why approximately every fourth worker on Stackpole tone and volume controls is an inspector.

This, in turn, is why leading users report that Stackpole Controls not only minimize their incoming inspection problems but reduce subsequent field service as well. Full quality control from raw materials through every step of manufacture, is a feature of *all* Stackpole electronic components.

A COMPLETE SELECTION OF VARIABLE RESISTOR TYPES

write for your copy of this latest QUICK GUIDE to Stackpole variable composition types and adaptations. Provides essential data in handy condensed form for wall, desk or file use.

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



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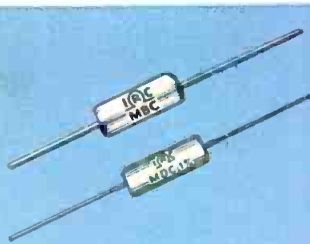
For product information, use inquiry card on last page.

How IRC resistors give added protection

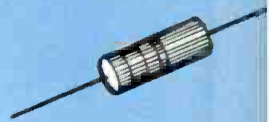
molded resistors

TYPE BT Fixed
Composition Resistors

TYPE PW TYPE BW
Insulated Wire
Wound Resistors



TYPE MB TYPE MD
Molded Deposited and
Boron Carbon Resistors



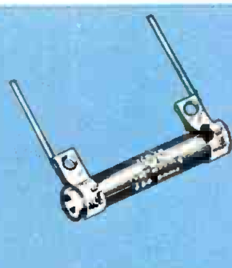
TYPE CL
Insulated
Wire Wound Chokes

Plastic compounds used in IRC molded resistors are all specified by IRC to combine excellent insulating properties, moisture resistance, and impact resistance.

varnish coated resistors

TYPE DC TYPE BO
Deposited and Boron
Carbon Resistors

TYPE MV High
Voltage Resistors

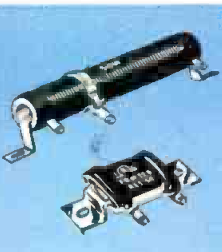


TYPE MP High
Frequency Resistors

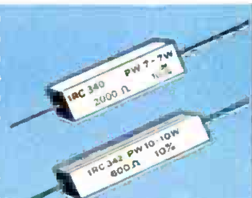
TYPE HFR High
Frequency Resistors

Where mechanical damage isn't a major problem, IRC resistors give excellent protection at lower cost through the use of IRC-developed varnish coatings. Because several layers are applied and cured under specially controlled conditions, these resistors offer superior humidity and temperature characteristics.

cement insulated resistors



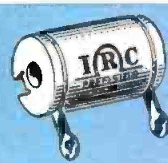
TYPE PWW TYPE FRW
Power Wire
Wound Resistors



TYPES PW-5, 7 and 10
Small Insulated
Power Resistors

The special cement coatings used to insulate IRC power resistors give excellent mechanical protection. Type PWW Resistors, for example, withstand a transverse pressure of 25 pounds. These exclusive IRC cements also permit maximum heat dissipation and give superior moisture protection.

impregnated and encapsulated resistors



TYPE WWJ Precision
Wire Wound Resistors

SERIES "PH"
Encapsulated Precisio
Wire Wound Resistor

Type WWJ Resistors feature a special compound th thoroughly impregnates the winding and remai stable at varying temperatures. This compound n only gives maximum mechanical protection, but al serves as an insulating barrier and minimizes moi ture effects. In IRC encapsulated resistors, the sam epoxy resin is used for both the core and the out housing, thus minimizing the effects of expansi and contraction due to various temperature cond tions. This epoxy resin also imparts excellent insula ing and moisture-resistant properties to the housin

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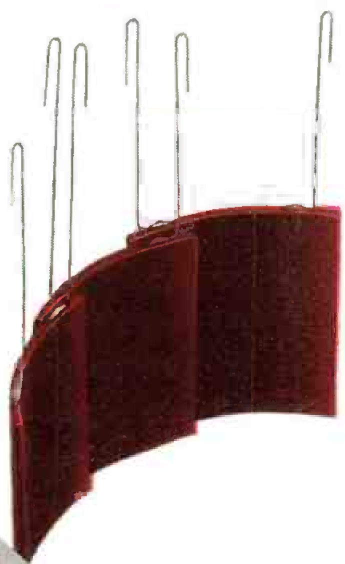

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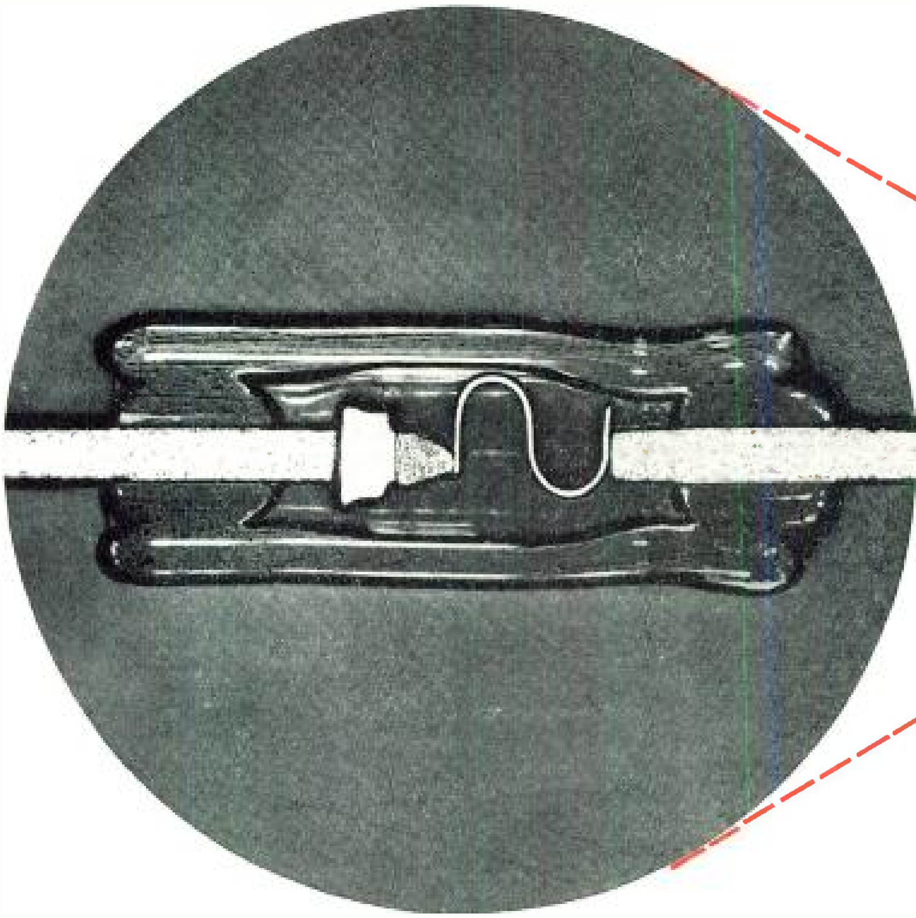
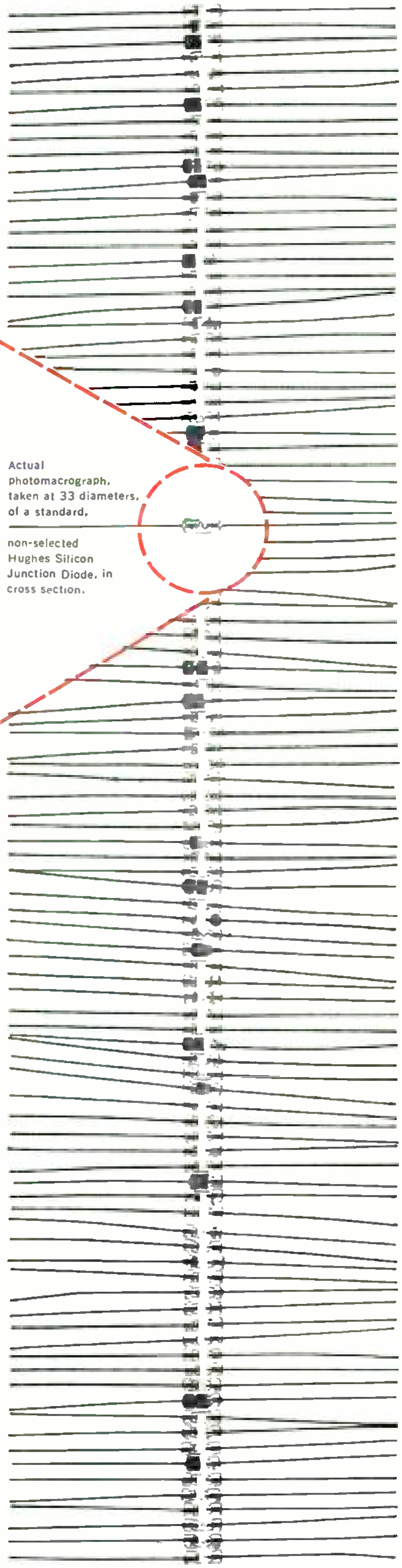
INSIDE, WHERE IT COUNTS, HUGHES DIODES LOOK LIKE THIS





Actual photomacrograph, taken at 33 diameters, of a standard, non-selected Hughes Silicon Junction Diode, in cross section.

With a microscope, you can see many of the physical qualities which distinguish a *Hughes* diode from ordinary types:

- The positive spring contact between the whisker and the aluminum button fused to the silicon crystal. (Our use of a spring contact prevents damage to the crystal at the junction, even if the diode is exposed to extreme shock.)
- The silicon crystal, free from cracks or blemishes.
- The clean, sharp, straight rectifying junction.

Such meticulous physical construction is a vital factor in ensuring the excellence of Hughes diodes' electrical characteristics (which you *can't* see through a microscope!). *All* characteristics—physical and electrical—are protected by a series of thorough, rigorous tests. So, specify Hughes, and make sure that you are using the diodes made First Of All . . . For Reliability!

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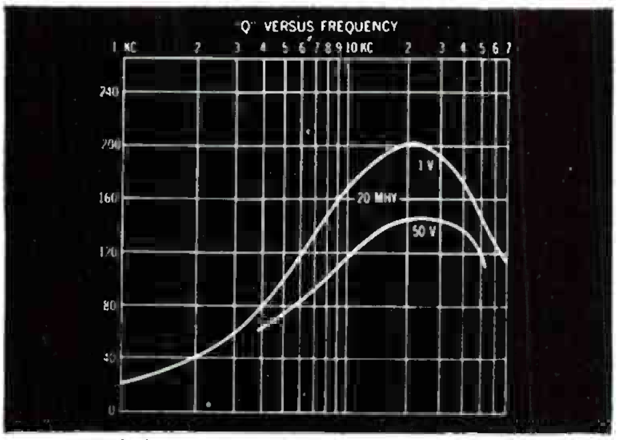
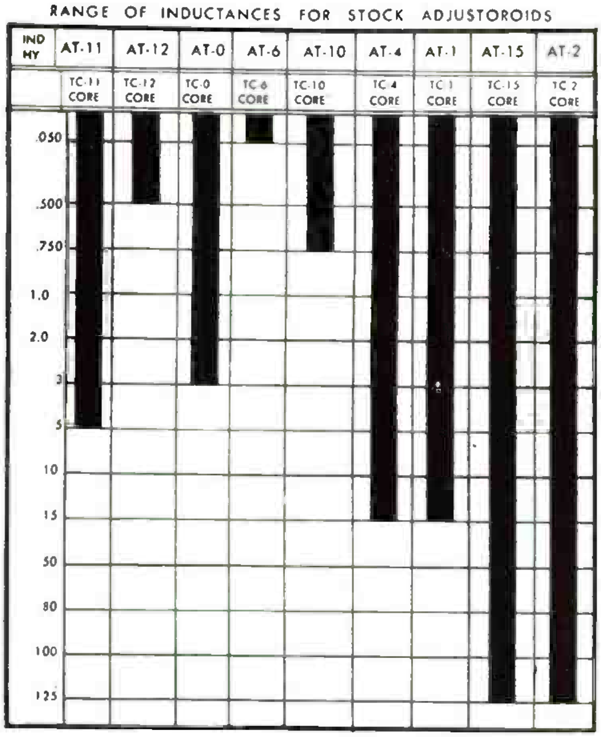


Typical Q vs. frequency characteristics of AT-10.

RANGE OF INDUCTANCES FOR STOCK ADJUSTOROIDS



For nominal D. C. R. values refer to Burnell catalog No. 103.

COMPLETE TECHNICAL INFORMATION UPON REQUEST.
® copyrighted, patent applied for.

ADJUSTOROIDS®

The Adjustoroid, a low cost adjustable toroid, exclusively developed by Burnell & Company, Inc., contains an actual complete toroid which relays all the excellent characteristics of the non-adjustable types. Adjustment is obtained by a completely stepless function with magnetic biasing.

The nominal inductance value for an Adjustoroid is the **maximum** value, and the inductance range is the nominal value minus approximately 10%.

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Intermediate inductance values as well as special taps and extra windings available on special order with minimum delay.

For additional technical data on Adjustoroids, refer to equivalent toroid in catalog.

AT-0, AT-6, AT-10, AT-4

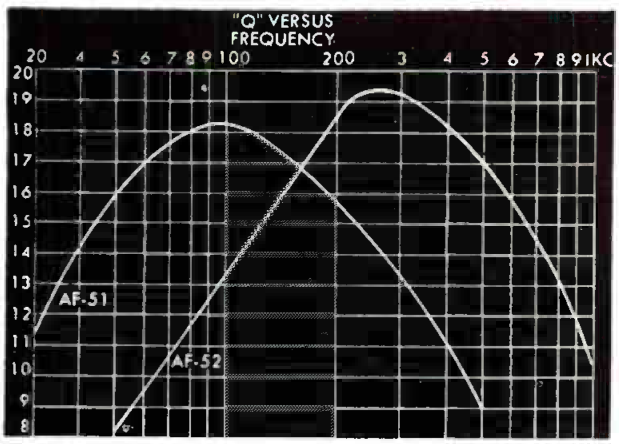
AT-1, AT-2, AT-11, AT-12

You are cordially invited to inspect these and other Burnell products at Booth 1308 at the Wescon Show, and to discuss your network problems with us.

ADJUSTOROID & VARIABLE INDUCTOR DIMENSION CHART

	LENGTH/DIA	WIDTH	HEIGHT
AT-O, AT-6	1-1/16"		1"
AT-10, AT-4	1-19/64"		1-1/4"
AT-15	1-31/32"		1-7/8"
AT-11, AT-12	45/64"	45/64"	3/4"
AT-1	1-3/4"	1-3/4"	1-1/4"
AT-2	2-3/4"	2-3/4"	2-1/4"
AF-51, AF-52	1-19/64"		2"

and now ...



Typical Q vs. frequency characteristics of Variable Inductors.

VARIABLE INDUCTORS

AF-51 AF-52

(30-500 cycles)
Maximum Q at 100 cycles

(50-1000 cycles)
Maximum Q at 250 cycles

Burnell Variable Inductors have the similar characteristics to the Adjustoroid except they are especially designed for low frequency applications or for conditions where high inductance values are required. Variable Inductors are available in all inductance values up to 1000 Hys. With variation of —10% from nominal.

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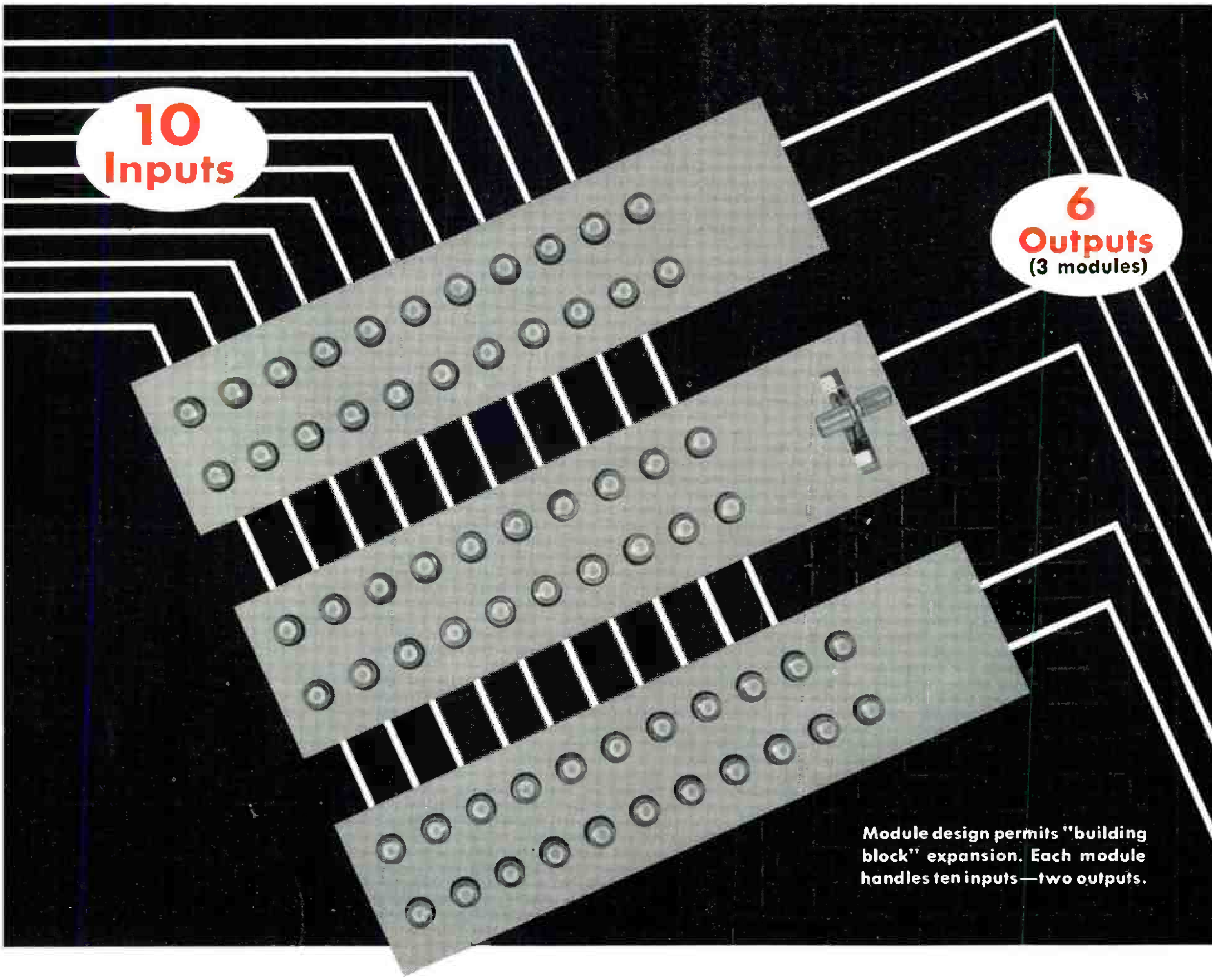

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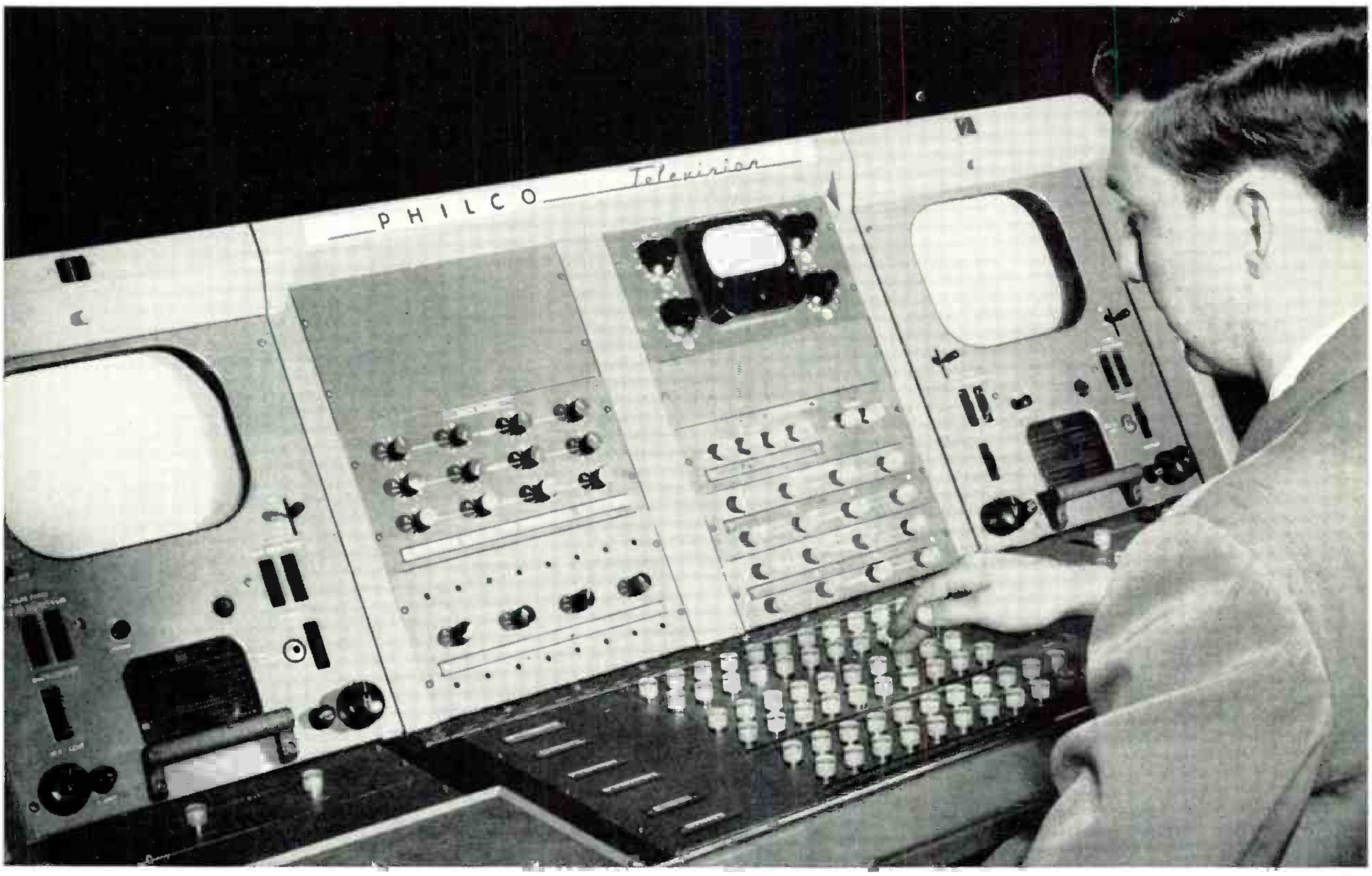

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BOOKS

Transistors Handbook

By William D. Bevitt. Published 1956 by Prentice-Hall, Inc., 70 Fifth Ave., New York 11. 410 pages, price $9.00.

This book sums up, in a practical manner, the most recent information on transistors, their circuits, and their applications in modern industry. The beginning chapters deal with fundamental concepts, and present the characteristics, measurements, circuit properties, and behavior of the different types of transistors. The last half of the book deals with circuits and applications, along with methods for circuit analysis.

Typical values of circuit elements are given wherever possible to exemplify good practice in circuit design. Included among the circuits covered are transistor radio and television receivers, as well as such items as relaxation oscillators, a-f and r-f amplifiers, modulators and demodulators, and many others. The appendix gives standard definitions of semiconductor terms and essential characteristics of the latest transistors.

Mr. Bevitt, himself a transistor application engineer, has done a capable job of presenting transistor information for design and development engineers in a most useful form. The presentation is clear and logical, and the complete index aids in locating desired information with a minimum of delay.

Handbook, Preferred Circuits Navy Aeronautical Equipment NAVAER 16-1-519

By J. H. Muncy. Published 1955 by Government Printing Office, Washington 25. 204 pages, loose-leaf bound. Price $1.75.

The main purpose of this handbook is to encourage reduction of unnecessary circuit variations in military equipment. If standardization of electronic circuits, even in part, is realized, substantial economies will be achieved by both the manufacturer and the military services.

Made available by the National Bureau of Standards and the Navy Bureau of Aeronautics, the book consists of two parts: the Preferred Circuits Manual, and Notes to the Preferred Circuits Manual. The manual presents 32 circuits, complete with schematics, characteristics, and other information. The preferred circuits were derived after experimental measurements had been made on a large number of examples taken from both commercial and military equipment. The Notes, explaining the steps which led to the selection and design of each

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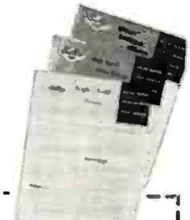

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circuit, should be of particular value to a designer whose interest extends beyond an immediate problem.

Circuits presented include voltage regulators, multivibrators, blocking oscillators, video detectors, and amplifiers. Supplements to the handbook are to be issued from time to time, and will be announced when available.

Germanium Diodes

By Dr. S. D. Boon. Published 1956 by Philips' Technical Library, Eindhoven, Holland. Distributed in U. S. by Elsevier Press, Inc., 155 East 82 St., New York 28. 87 pages, paper bound. Price $1.95.

This book is intended to give the reader enough insight to be able to analyze such germanium diode problems as he is likely to meet, and to enable him to use these semiconductors in practical circuits.

Starting with a historical review of the development of crystal diodes, it goes on to cover the working principles, manufacture, and properties of germanium diodes. Some direct comparisons are made with vacuum diodes, particularly as to properties. The ambient temperature, for example, which is hardly of importance in vacuum diodes, is a factor to be reckoned with in the case of germanium diodes.

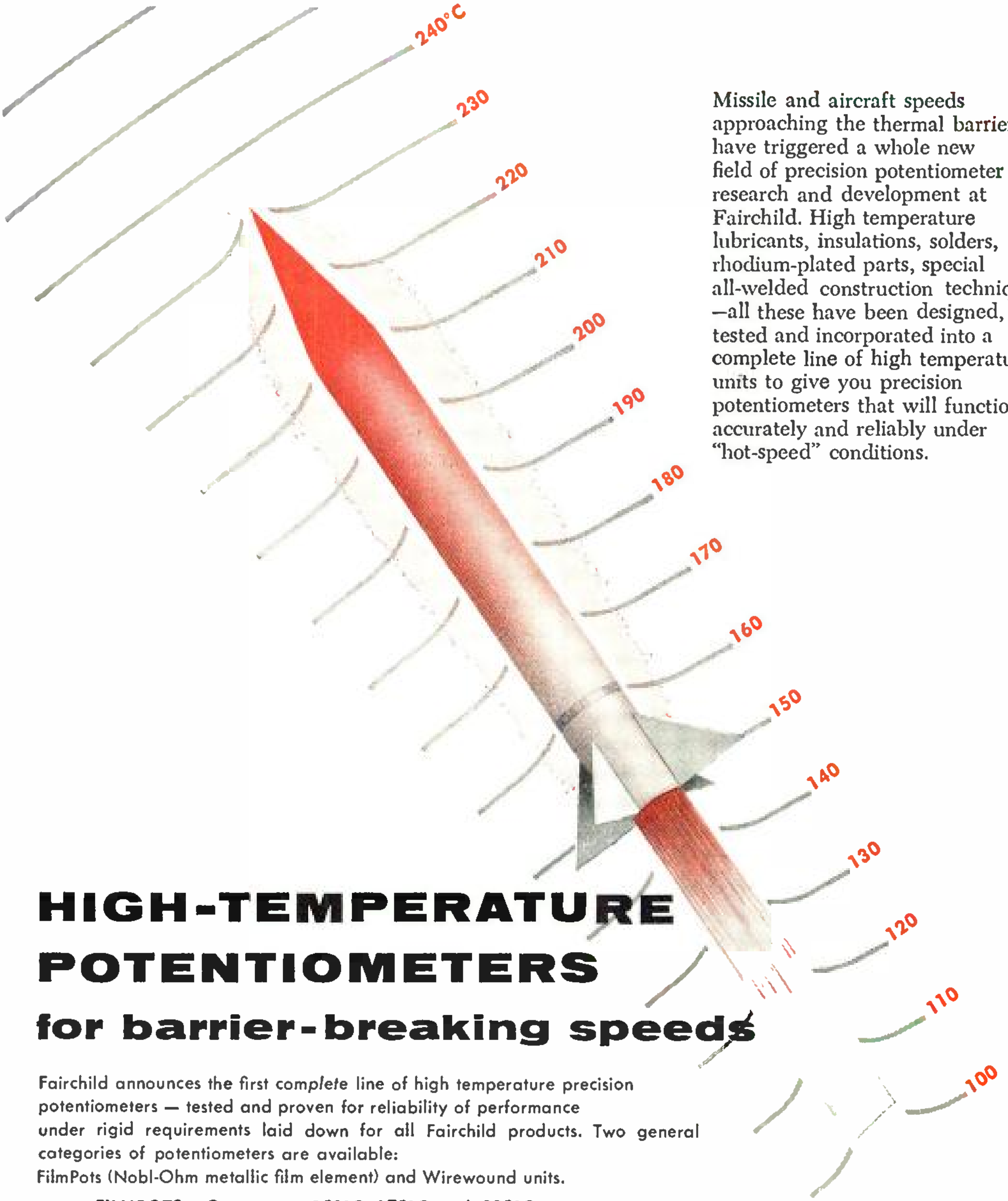
A great many practical examples are given, with the emphasis on the rectification and demodulation characteristics of these units. In all, 27 specific circuits, for use as clippers, video demodulators, pulse shapers, time switches, ring modulators, and the like, are shown, as well as characteristic curves and technical data for some of the latest European diode designs.

Office Automation

By R. Hunt Brown. Published 1955 by Automation Consultants, Inc., 1450 Broadway, New York 18, 283 pages, loose-leaf bound. Price $12.50. Updating service $25 per year.

This is a non-technical work on office electronics, prepared especially for the businessman in loose-leaf form so that it can readily be kept up to date. It is intended as a manual for business executives, Government officials, equipment manufacturers, and others interested in office electronics.

The greater part of the book is devoted to the "hardware" or new office tools. Machines for integrated data processing, including communication services and equipment available, such as telephone, telegraph, facsimile, closed circuit TV, electronic computers, memory systems, and high speed printers, are covered. Throughout the book, existing equipments manufactured by the prominent manufacturers in this field are explained.



Missile and aircraft speeds approaching the thermal barrier have triggered a whole new field of precision potentiometer research and development at Fairchild. High temperature lubricants, insulations, solders, rhodium-plated parts, special all-welded construction techniques —all these have been designed, tested and incorporated into a complete line of high temperature units to give you precision potentiometers that will function accurately and reliably under "hot-speed" conditions.

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FILMPOTS — Operate at 150°C, 175°C and 225°C.

WIREWOUND — To 150°C, single turn and multi-turn types.

A new line of Pressure Transducers which meets all military requirements for humidity, shock, and other environmental conditions, is also available.

Fairchild components research, implemented by critical production techniques and severe testing programs, is continuing to develop units for even higher temperatures and can offer constructive cooperation in guided missile and aircraft control programs. For data sheets, or for assistance on specific problems, write to Fairchild Controls Corporation, Components Division, Dept. 140-72E.

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Transistors and Low-Fidelity Portables

The transistor, which in the years to come is destined to be the heart of nearly all radio, might be getting an undeserved "black-eye" in today's portable radio receivers. Sort of a "guilt by association" condition—because neither the audio volume nor quality is as good on the average as in the vacuum-tube portables. This is the recent finding of the radio testing laboratories of consumer research organizations.

After testing a number of well known makes of transistorized portable receivers, the consumer research laboratories have published reports that, in the majority of sets, the maximum output without intolerable distortion is only about 0.06 watts. Background hiss and noise also cause difficulties. These latter factors are directly chargeable to the transistor, but the audio reproduction limitation is mostly chargeable to the small loudspeakers employed. Transistorized portables can be considered as falling into two groups:

1. MEDIUM-LARGE, weighing over two pounds with speakers of more than three inches in diameter. (Even those in the medium-large group were not equal in fidelity to the average tube equipped portable—not a very high standard.)
2. POCKET-SIZED, weighing under two pounds, equipped with speakers under three inches in diameter.

Such consumer reports can upset public impression of the capabilities of transistorized equipment and even retard future sales. Every effort should be made to improve the deficiencies found in these designs. Further transistor and transistor circuitry developments could improve the hiss and noise problem. However, the invention of a new type of small but efficient sound radiator is sorely needed. Possibly bringing into use some of the newer permanent magnetic materials that can be molded or machined will be of assistance here.

At any rate, while small size and low-energy demands of transistorized portables do interest the public, it is important, too, to realize that performance comparable to vacuum tube design should be the ultimate goal.

Foreign Imports of Radios

The recent newspaper reports describing the spiralling increases in imports of Japanese portable radios for sale in the United States are extremely disturbing.

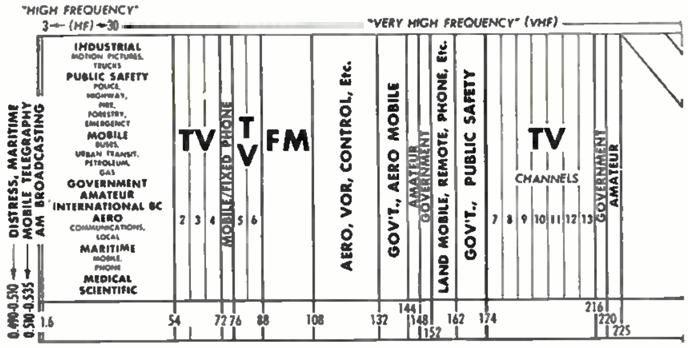
In 1955, for example, total Japanese exports of radio sets is reported at 212,000 units with a value of $1,880,000. About 80 per cent of this total were portable receivers sent to the U. S. For 1956, totals of 25,000 sets in January, 24,000 in February, and 40,000 in March are reported. Japanese industrial leaders are aware of these increases and are said to be considering the possible imposition of a voluntary quota to forestall American complaints. On the other hand, reports also indicate that Japanese manufacturers are now competing with quality products in contrast to the low-cost, low-quality goods produced for the American markets prior to World War II. West European imports are also on a high level, and these, of course, add to the competition that an American manufacturer finds at the market place.

We have attempted to confirm the above-mentioned figures through official U. S. sources, but so far have been unsuccessful. Government statistical figures do not reflect the current conditions. Surprisingly, no RETMA member has yet complained, although their International Department is aware of the situation. This is also a time when several of the larger radio-TV manufacturers are going through major financial retrenchments.

Close watch on future imports of foreign products should be kept, lest we find some of our electronic industries going the way of the American watch manufacturers.

RADARSCOPE

Revealing important developments and trends throughout the spectrum for radio, TV and electronic research, manufacturing and operation



NEW APPROACH to the full utilization of their engineers' abilities goes into force at Sylvania as part of the program for their new Univac Data Processing Center. Full information on their engineers' education, experience, and other pertinent data will be kept on file for emergency situations requiring certain skills. In practice, an immediate need at any one of the 71 Sylvania locations would be flashed to the Processing Center at Camillus, New York, and through the facilities of Univac, the particular Sylvania engineer best qualified to handle the job would immediately by singled out. Company officials are extremely enthusiastic about the added engineering flexibility provided by the service.

FIRST MOVE to establish a new operating council of the West Coast Manufacturers' Association was made recently at a meeting attended by representatives of 12 companies in the San Diego area.

SAGE DISPLAY CONSOLE

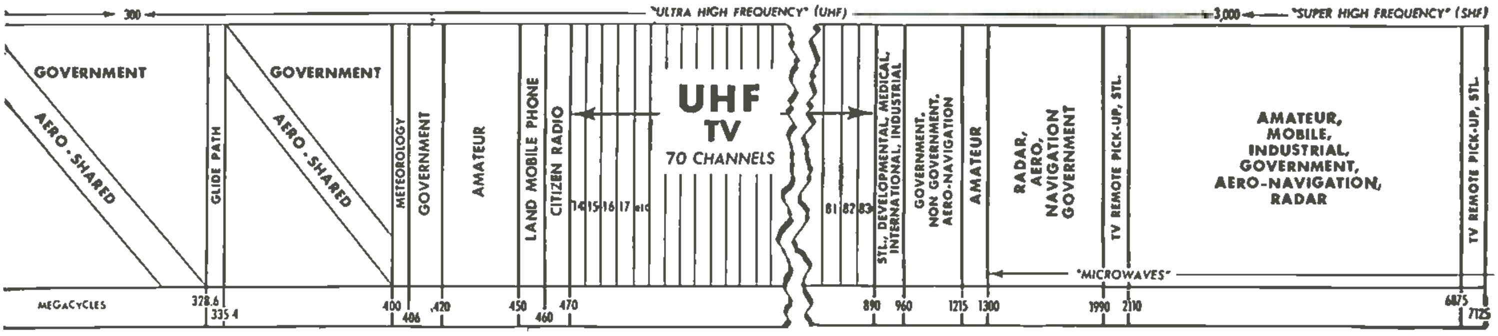
Picture of the air defense situation as picked up by SAGE network and analyzed by IBM computer, is flashed on this screen. With buttons and switches at sides, Air Force personnel make tactical decisions which are in turn carried out by the computer.

PRICE OF SILICON has been reduced $30.00 a pound, bringing the price to $350.00 per pound.

MAJOR BREAKTHROUGH in the field of semi-conductors is in sight as a result of recent investigations at Bell Labs. New intermetallic compounds are now being made which have a wider range of electrical properties than is obtainable with either silicon or germanium, making possible more versatile transistors and other semi-conductor devices. One of the most promising compounds being investigated at the laboratory is indium antimonide.

WOMEN ENGINEERS are getting more and more consideration as a partial answer to the engineer shortage. Dr. Charles J. Jolliffe of RCA recently pointed out that about 20 per cent of all the engineers in Russia are women, compared with less than 1 per cent in the United States. Women, he said, could make a very significant contribution in our life or death struggle for supremacy as laboratory technicians, and as graduate engineers.

INDICATIONS ARE that the long standing barriers to the interchange of technical information between Western and Iron Curtain countries are being removed. Within a few short months after Tele-Tech & ELECTRONIC INDUSTRIES initiated its program of abstracting Russian technical journals, the Russians themselves included in one of their top ranking publications an English language abstract of the editorial content. This would seem to indicate that Russian technical journals are getting increasing dissemination outside the Iron Curtain. A noted German publication has been including for some time both English- and French-language abstracts of their technical articles. And as the latest step in this world wide program the Nation Science Foundation now announces a stepped up program for the translation into English of Russian Research literature. The new journals to be translated will be the Journal of Technical Physics, approximately 4,000 pages per year for which the subscription price will be $90.00; the Acoustics Journal, approximately 500 pages per year, $20.00; and proceedings of the USSR Academy of Sciences (physics articles only), approximately 900 pages per year, $25.00.



RETMA has started a determined drive to collect accurate and timely data on the number of employees in the electronic industry, and their hours and earnings. The lack of information on these items was embarrassing to the RETMA Tax Committee recently in their request for relief from the excise tax, and an emergency survey had to be made within the space of a few days. To avoid a recurrence, and to provide industry in general with timely facts and figures, RETMA's statistical department is now distributing reporting forms which firms are being asked to forward on a regular basis to RETMA.

LABOR MANAGEMENT

FRINGE BENEFITS are increasingly in the news, and are being increasingly misinterpreted. To clear the air, the Bureau of Labor statistics has come up with a list of ten items which are to be considered as fringe benefits. These are as follows:

1. Paid vacations.
2. Holidays and sick leave.
3. Premium pay for overtime.
4. Shift premium.
5. Pension program.
6. Insurance, health and welfare plan.
7. Old age and survivors insurance.
8. Unemployment compensation.
9. Workmen's compensation.
10. State temporary disability insurance.

MILITARY CONTRACTS

THE DEPARTMENT OF DEFENSE is initiating a new program designed to encourage large military prime contractors to subcontract to small business concerns. Semi-annual reports will now be submitted by large business concerns participating in the program to show DOD funds received by these prime contractors and the payments made by them to small concerns for materials or services furnished in connection with the prime contract. The report will include both sub-assemblies fabricated to the prime contractors specification and "off the shelf" items purchased by the prime contractor for use in the performance of the contract.

Each military department will have the responsibility for initiating the procedure with their own prime contractors. The prime contractors will be under cognizance of the military department which has Armed Services Procurement Planning Responsibility for the contractor. The first reports are to be made in February, 1957, to cover the last half of the calendar year 1956.

Military contract awards to small business concerns in the fiscal year 1955 were $3,214,000,000. What is not known is the total value of business reaching small concerns through sub-contracts. There are indications that it may amount to $2,000,000,000. The new reports will furnish information on this important area.

SUPER-MAGNETIC 'WATERFALL'

Highly purified manganese-bismuth powder bursts into a fiery cascade when exposed to air at Westinghouse Research Lab. Magnets made of the new material have more than 10 times the resistance of ordinary magnets to demagnetization.

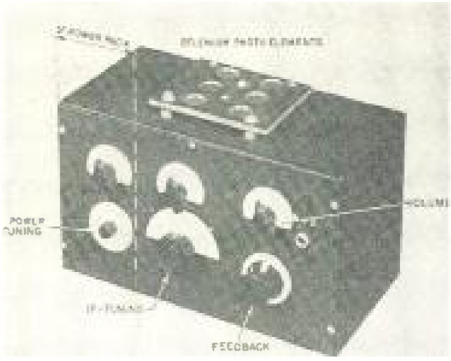


Fig. 2: Lab model of light-powered receiver

Fig. 3: Miniaturized transmitter for 250 kc.

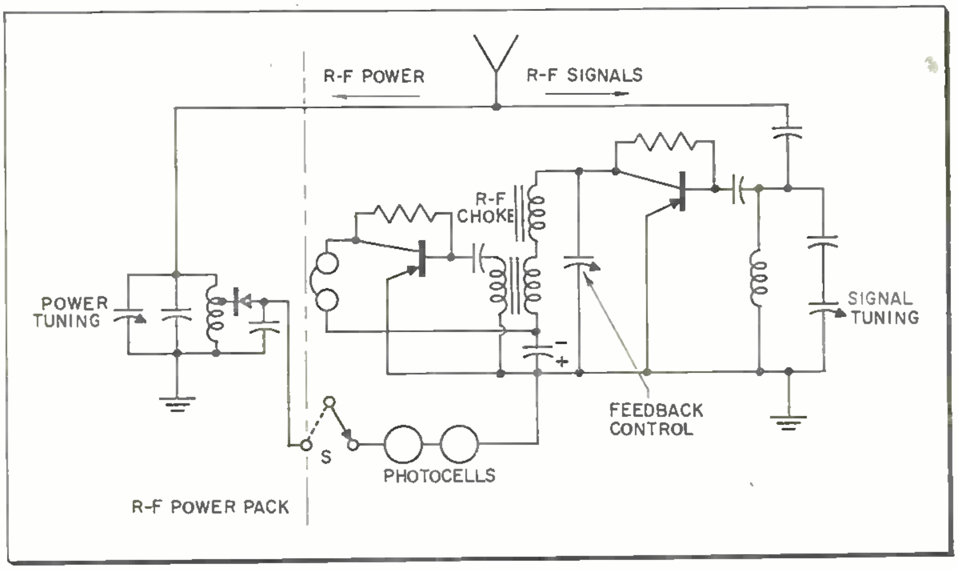


Fig. 1: Schematic of light-powered transistorized regenerative receiver

Designing "Free-Power" Transistor Apparatus

THE first practical applications of the transistor followed fields which until then had been reserved exclusively for the vacuum tube. The competition of both active elements occurs mainly when space, weight, maintenance, and supply energy are limited, as, e.g. in the case of hearing aids which, limited in size and weight, are supposed to guarantee maximum battery efficiency, or as in the case of the giant electronic computers where thousands of tightly packed vacuum tubes require such a large amount of supply power that an extensive and expensive refrigeration system is required to prevent overheating.

In this competition between transistors and vacuum tubes, the transistor art is directed toward the development of improved transistors, with better power handling capacity, frequency response, temperature stability, and the like. On the other hand, it requires a little step to look for applications which, because of their minimum demand for driving energy, have become the sole domain of transistors.

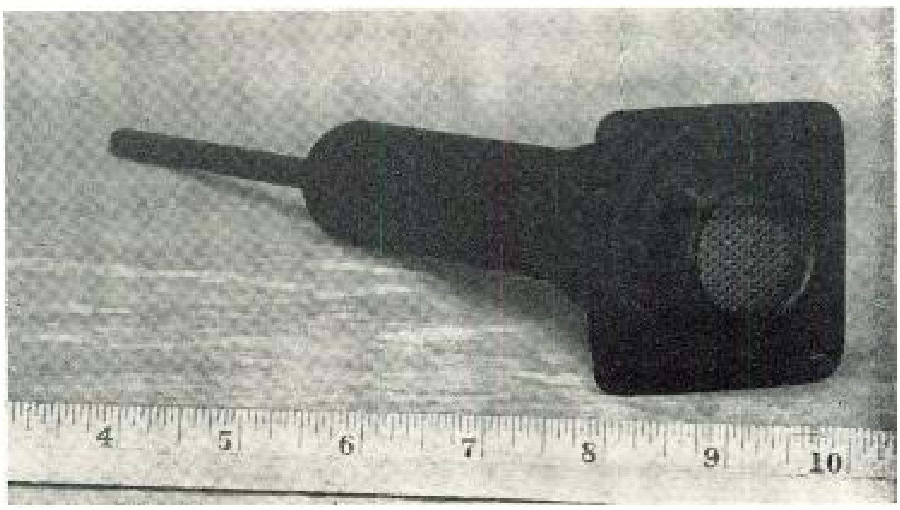
In this direction, one finally arrives at various types of transistor apparatus which require no battery or power supply whatsoever. Naturally, each active element needs some driving energy but this can be derived from natural or artificial energy fields around us and thus is freely available or at least without extra cost. Transistor apparatus fed by free energy, in this meaning of the word, is the topic of this article.

H. E. HOLLMANN, Director of Research, Marvelco Electronics Div., National Aircraft Corp., 3411 Tulare Ave., Burbank, Calif.

Free Energy

Before turning to the transistor apparatus itself, the term "Free Energy" may be defined somewhat more accurately. As is well known, the sun is the most important source of energy for our planet. As an average, the sun's radiation energy totals roughly 1 kw for each sq. yd. of the earth's surface. By the use of ordinary photovoltaic cells or photoelements, less than 1% of this energy is converted into electricity. The new "Solar Battery" developed by the Bell Telephone Co. boosts this poor efficiency up to 15% and more. In conjunction with wet cells which are charged via a rectifier to prevent discharging during the night, twilight, and dim daylight, a continuous supply of driving energy is obtained. In this way, a portable radio receiver may be fed by a

Fig. 5A: Voice-powered phone transmitter, requires no power source



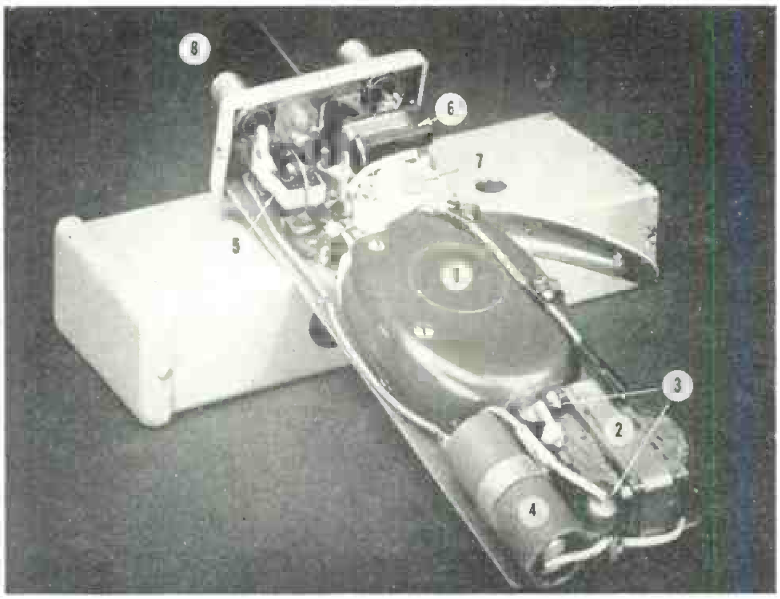
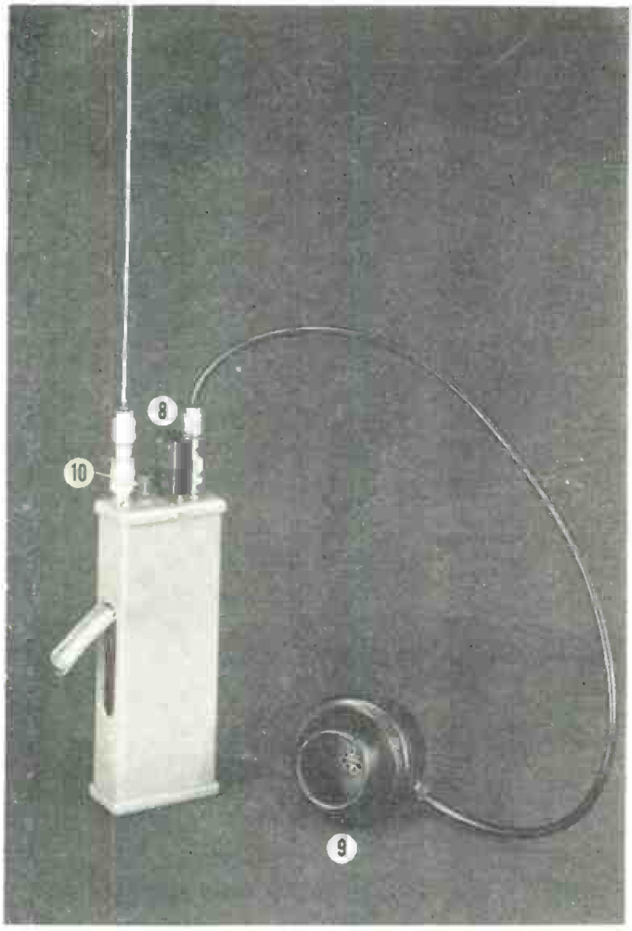


Fig. 4: Hand-powered phone transmitter. Complete unit is at right



Low power requirement of transistors makes possible the design of receivers that utilize the electromagnetic radiation from broadcast stations, or solar energy, as operating voltages. Sound- and hand-powered transmitters are also described.

By H. E. HOLLMANN

multiplicity of silicon cells whereby nothing but the high cost of the solar cells prevents such a receiver from being available on the market.

Another form of energy which surrounds us is sound. Its level, however, is so low that even from the noise of heavy city traffic only a few $\mu w/cm^2$ can be recovered from the intercept area of an electro-acoustic transducer. A more favorable condition is encountered if the sound source is approached immediately without the terrific attenuation of propagation through free space. In this respect, a sound-power microphone when addressed rather loudly is most interesting. Considering the articulation of speech, i.e. the distribution of the low energy consonants and the powerful vowels as well as the intervals between words and sentences, an average energy of approximately 1/10 mw can be produced by talking directly into the mouthpiece of a sound-power mike.

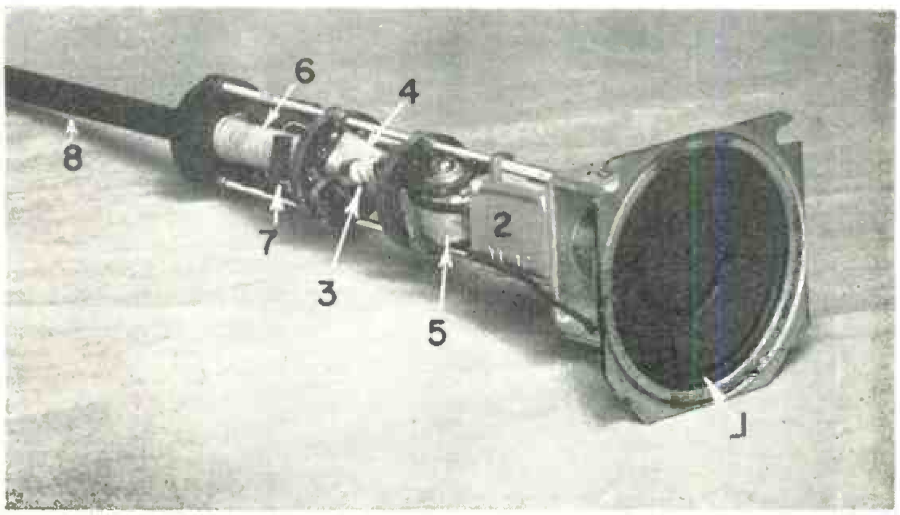
The human voice is the manifestation of the strength of our body which, therefore, has to be included into the realm of "Free Energy." However, in the era of transistors, it is no longer necessary to crank the heavy generator of a tube-type transmitter. A mere touch of a small lever or push-button is sufficient to operate a sensitive transistor oscillator and thus generate short radio pulses.

The philosophy of free power is incomplete without the mentioning of another type, namely the electromagnetic radiation of telegraph, broadcast, TV transmitters and the like as they are found in all civilized countries. Up to now, this radiation energy has been utilized exclusively for the control of active and passive receivers. However, a preliminary study reveals that a powerful transmitter, in particular our local broadcast station, produces an electro magnetic field of sufficient strength to permit an antenna wire to recover enough energy to feed one or more transistors.

Having outlined the general topic, several laboratory models of small transmitters and receivers will be described whose characteristic is that they are fed by the described forms of free energy. Since we enter a new field, it can easily be understood that this first survey has to be confined to rather fundamental characteristics and circuits. In other words, the article discloses *what* can be done rather than *how* it must be done.

(Continued on page 150)

Fig. 5B: Interior of voice-powered unit. PM speaker is driver



Vibrational Stability Tests for

Clapper type relays are evaluated under vibrational conditions of 3 to 2000 cps and accelerations to 35 g. Prime areas of relay improvement are in the design of contact springs, contact supports, and relay mountings

FAILURES of magnetic relays, when subjected to vibration in airborne applications has led to a vibration-evaluation survey of relays. (See Note.)

Based on airborne requirements, 3 to 2000 cps has been established as the frequency range for vibration tests. The low frequency portion of the vibration spectrum (3 cps to about 35 cps) generally includes occasional transient excitations, with a low-damping factor. The low frequency range is overlapped by a higher frequency vibration (from about 20 to 2000 cps) which is interpreted as a continuous complex wave with unpredictable peaks at various frequencies. The effect of such peak excitations on equipment is approximately similar to that of sinusoidal vibrations at discrete frequencies.

Acceleration

The maximum anticipated acceleration level is 15 g for most relays, although some relays are located where accelerations as great as 25 g may be expected. In anticipation of future requirements, acceleration effects beyond the present requirements have also been explored.

Test Methods

Contact chatter during vibration exposure is the first parameter for study. Tests are made to note repetitive contact chatter of 100 μsec or more, duration. The method (Fig. 3) for vibration testing utilizes a low-voltage 60 cycle signal connected through a protective resistance to the series-wired closed contacts. The vertical input of an oscilloscope is connected across the series of closed contacts, and the oscilloscope sweep oscillator is synchronized with the 60 cycle voltage source. Any opening of the closed contacts results in a voltage to the oscilloscope until all contacts are again closed. Contact chatter is evidenced by vertical lines extending above or below the horizontal line.

NOTE: Reported at the 4th National Conference on Electromagnetic Relays.

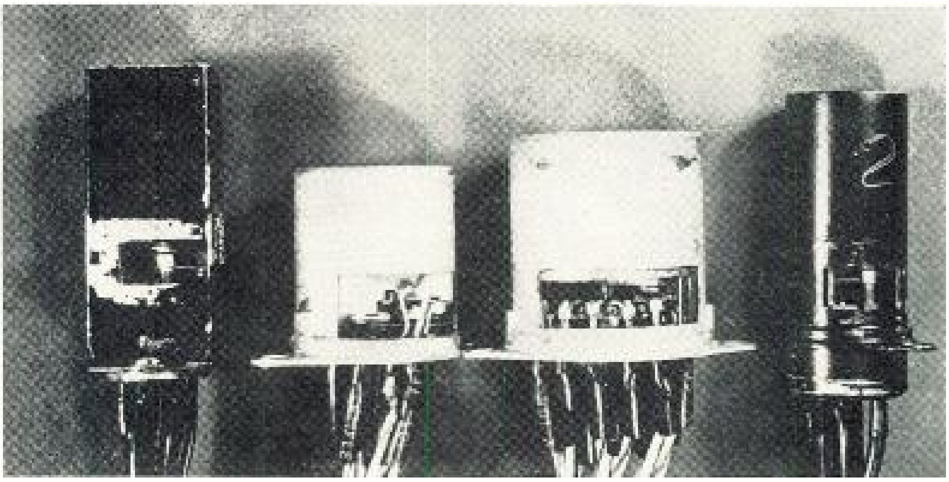


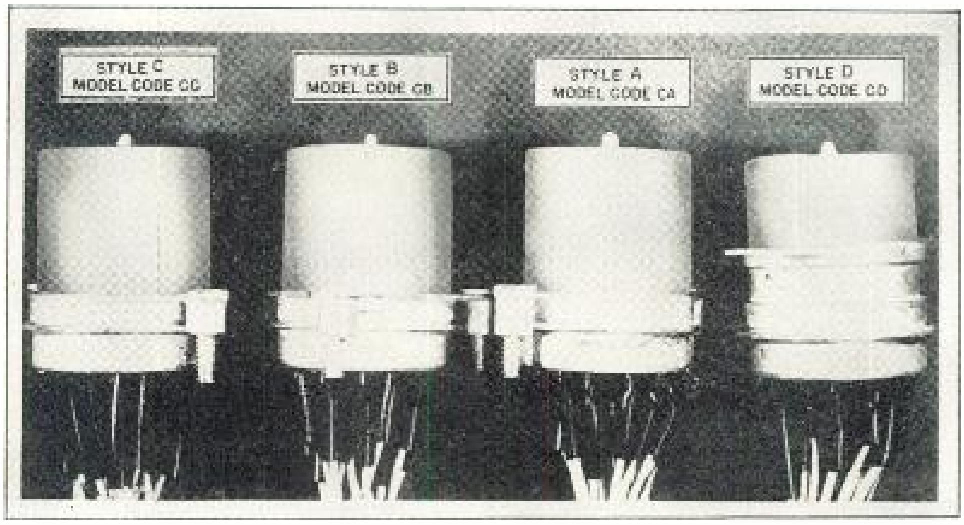
Fig. 1: Windows are cut to permit stroboscopic examination

Vibration Modes

The relay is vibrated in each of its three mutually perpendicular axes with the coil energized to test the normally-open contacts, and with the coil de-energized to test the normally-closed contacts. The frequency (3 to 2000 cps) is changed at the rate of 100 cps per minute. Eight sweeps of the frequency spectrum are made, each at different constant acceleration levels starting with 3 g and increasing to 35 g (Fig. 4). At the low frequencies, the acceleration is limited to maintain a 0.375 in. total constant displacement.

During tests, the frequencies which excite contact chatter are noted and recorded. When chatter is observed during two acceleration level sweeps for an axis and

Fig. 2: Styles CC and CD showed improved operation



Magnetic Relays

By A. H. MASCHMEYER
*Autonetics Division,
North American Aviation, Inc.
Bellflower, Calif.*

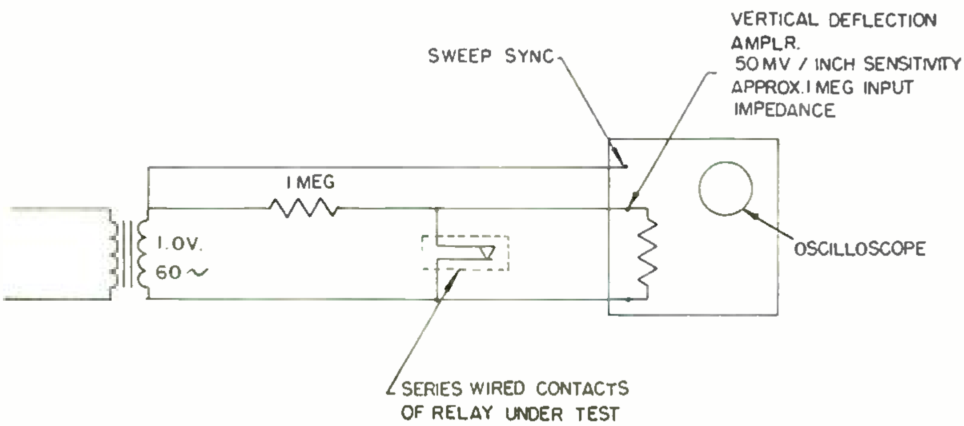


Fig. 3: Contact chatter is evidenced by vertical lines on the oscilloscope

a coil condition (energized or de-energized), the test for that axis and coil condition is concluded.

Monitoring Acceleration

Monitoring the acceleration with the use of three accelerometers mounted in the three mutually perpendicular axes has been found necessary, since any unbalance of the mass on the shake table causes transverse acceleration forces to develop. The output of the accelerometer measuring the acceleration in the direction of the motion of the vibration table is used to maintain the acceleration level within ± 1 g. The remaining two accelerometers are read separately and indicate the magnitude of transverse acceleration vectors occurring in the two axes perpendicular to the motion of the table. The accelerometers are secured as close as possible to the relay attach points to avoid erroneous inputs caused by fixture or shaker resonance.

Transverse Vectors

When chatter is observed, the magnitudes of the transverse acceleration vectors are noted. If the transverse force is greater than 30% of the acceleration in the axis of the motion of the vibration table, the balance of the mass on the table is adjusted to reduce the magnitude of the transverse forces to 30% or less. The 30% limitation is established by the apparent optimum obtainable from present vibration equipment when a resonant free mounting fixture is used.

Dynamic Analysis

For dynamic analysis, sample relays are frequently obtained with observation windows cut into the sides of the relay cases to view the switching mechanism (Fig. 1) during testing. A stroboscopic light source is synchronized with the motion of the shake table to illuminate the switching mechanism, and a 25-power microscope is used to observe the mechanism. By making discreet changes in frequency and acceleration on the relay, contact chatter is produced and analyzed.

Contact Springs

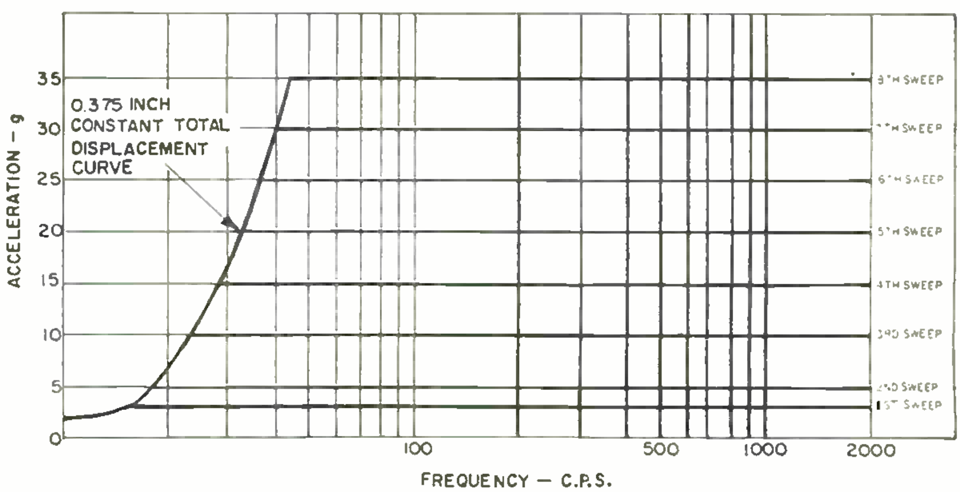
One design, recently observed by the stroboscopic technique, was a mechanism with the normally closed contact mounted on an ear bent from one side of the moving contactor as shown in Fig. 5. During vibration in the "V" axis, the mass of the normally closed contact imparted an off-center loading to the moving contactor and produced a twist which intermittently opened the normally closed contact. The manufacturer has been advised of the design inadequacy, and the resultant improvement is shown in Fig. 6.

Another design which has been studied is the conventional contact springs and arms in the general form of a cantilever beam with the contact at the free end. In such an arrangement, it is noted that rectangular contact springs appear to be more susceptible to vibration than tapered contact springs. The following analysis confirms the susceptibility:

Deflection Force

The force acting to deflect the contact spring during vibration results from the weight of the spring and contact assembly act-

Fig. 4: Vibration caused closed contact to open intermittently



Magnetic Relays *(continued)*

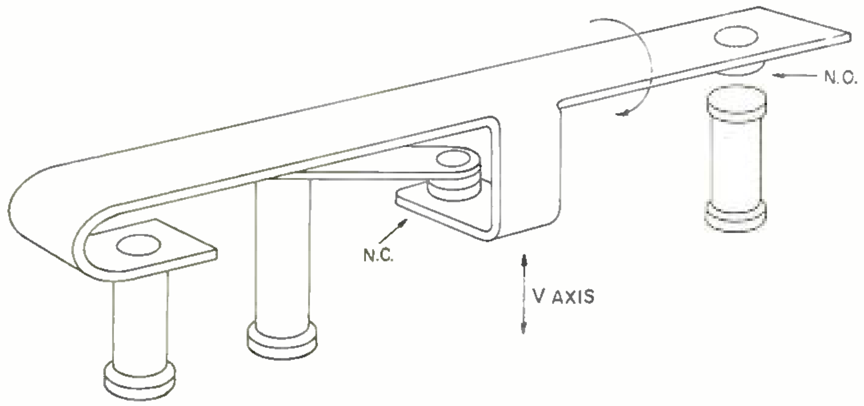


Fig. 5: Redesign eliminated torque of off-center mass

ing on its center of gravity. Accordingly, the energy is applied as a force-moment where the load is a function of the weight of the contact spring assembly, and the moment-arm is the distance from the center of gravity to the point where the contact spring is fixed. The center of gravity of a rectangular contact spring in contrast to a tapered contact spring is shown in Fig. 7.

Spring Shape

Analysis of the deflection from acceleration forces shows that a rectangular spring deflects 2.252 times as much as a tapered contact spring of equal base width. Further analysis shows that the armature force required to deflect the tapered spring is only 2/3 the force required to deflect the rectangular spring. Thus, the tapered contact spring not only has greater resistance to vibrational deflections but also results in decreased coil power requirements. In one instance where this change was made, contact chatter which previously occurred at a 10 g acceleration level did not appear until a 17 g acceleration was applied.

Mountings vs Chatter

The effects of various relay mounting designs contributing to contact chatter are also being evaluated. Among those under consideration are the four different mounting styles shown in Fig. 2.

Style CA — Manufactuers' standard in accordance with MS24115 (USAF) dimensions except shouldered studs are used in place of clearance holes. The relay is supported on the shoulders of the studs only.

Style CB — Manufacturers' standard in accordance with the triangular mounting per MS24115T (USAF) dimensions except shouldered studs are used in place of clearance holes and thru-bolts. The relay is supported on the shoulders of the studs only.

Style CC — Suggested modification of Style CA. This modification is identical to Style CA except the height of the shoulder of the stud is reduced to permit the relay to seat on the annular flange instead of on the two studs.

Style CD — Another modification of Style CA. Here, an annular two hole mounting flange is located near the center of gravity of the relay.

Four relays of each style (selected from a single production lot of the type) have been vibrated. Styles CC and CD (with the modified mounting flanges) did not exhibit contact chatter when tested at accelerations up to and including 35 g through the frequency range of 3 to 2000 cps;

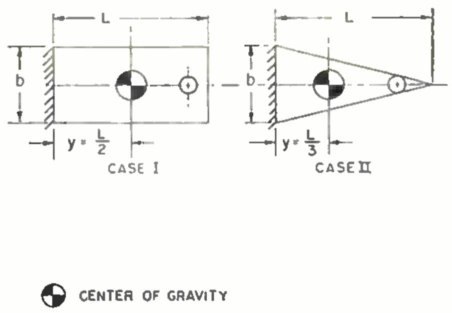


Fig. 7: Center of gravity, rectangular and tapered springs

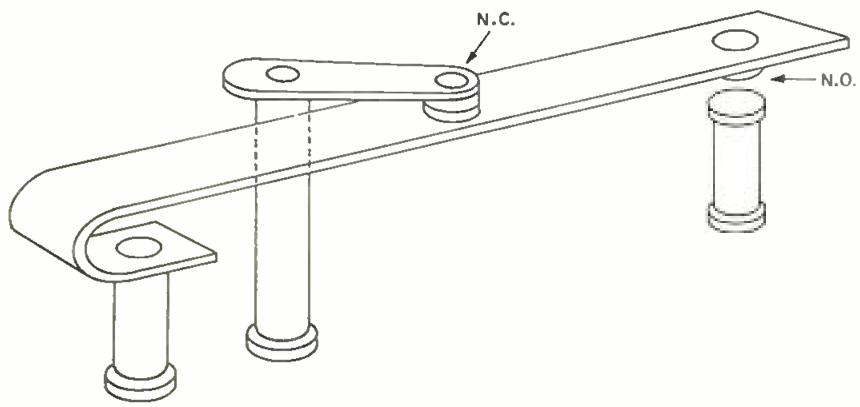
chatter was observed with six of the eight relays tested of type CA and CB relays. These tests indicate that mounting designs may contribute to chatter and, accordingly, further investigation appears warranted.

Proposed Dynamic Testing

Since the majority of relay failures occur in a dynamic environment, instrumentation for evaluating relays under such conditions should be used. The instrumentation should incorporate an adjustable time measure so that only contact chatter with a separation time greater than a pre-

(*Continued on page* 113)

Fig. 6: Contact spring design affects vibrational reliability



Simplified Cascode Design

The characteristics of a given cascode unit can be quickly approximated from the E_b — I_b curves of the triode employed

By F. EVANS
Radiation Laboratory
University of California
Berkeley

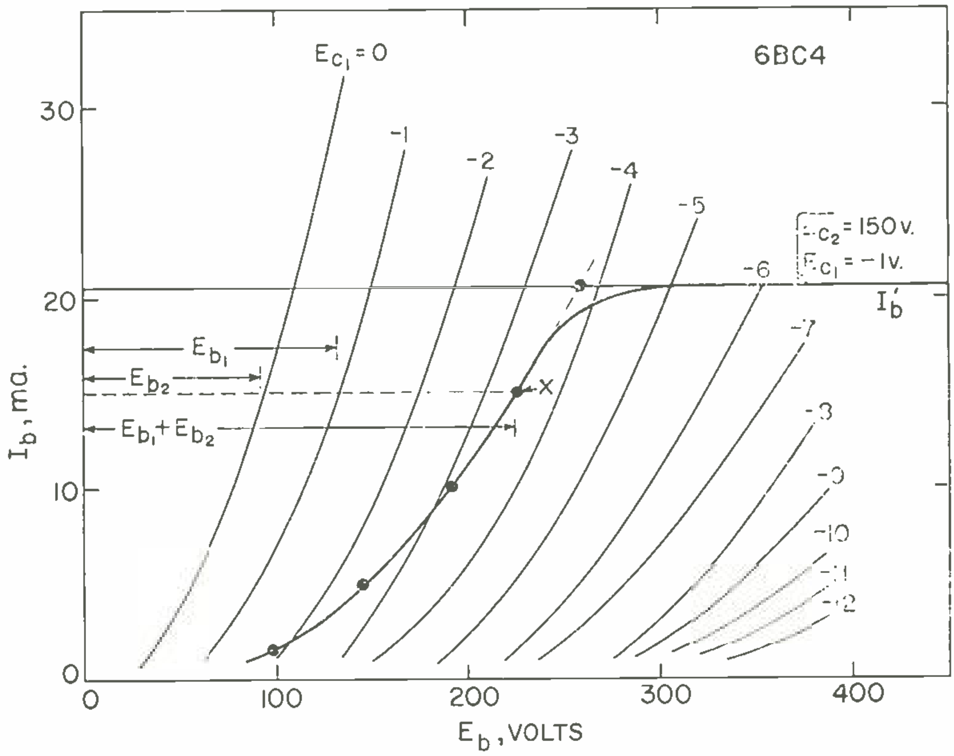


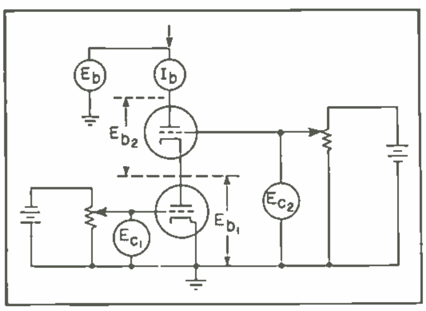
Fig. 2: Cascode characteristics are derived from triode curves

THE test circuit shown in Fig. 1 could be used to obtain equivalent static characteristics of a cascode circuit. Given a value of the upper grid voltage, E_{c2}, a family of E_b-I_b curves could be found with E_{c1}, the bias voltage, as a parameter. It is possible, however, to approximate these curves directly from the triode characteristic curves provided by the manufacturer.

Assume E_{c1} and E_{c2} fixed for the moment. As E_b is increased to sufficiently large values, E_{b1} will increase until it approaches E_{c2}, at which time it will level out to a value very near E_{c2} because of the clamping action of the upper triode. I_b will also level out to a saturation value I_b' corresponding to $E_{b1} = E_{c2}$. As E_b is reduced to sufficiently low values, the upper triode goes into grid conduction and the voltage E_{b2} is determined from the zero bias curve for the particular I_b. Once E_{c2} is set, then the cascode characteristic corresponding to a particular E_{c1} can be derived by determining E_{b1} on the E_{c1} bias triode line, and E_{b2} on the zero bias triode line, both as a function of I_b up to the saturation level I_b'.

An example is given in Fig. 2 for the 6BC4. E_{c2} is given as 150 v. For the particular curve shown in detail $E_{c1} = -1$ v. $I_b' = 20.5$ ma is shown as the value of I_b when $E_{b1} = E_{c2} = 150$ v. The point "x" is obtained for $I_b = 15$ ma. E_{b1} is defined by the triode curve to be 132 v. at this point. Since the upper triode is in grid conduction, E_{b2} from the zero bias curve is 93 v. $E_b = E_{b1} + E_{b2}$ then is shown on the point "x" as 225 v. Other points obtained in the same manner are shown and a continuous line is drawn through these and folded over at the knee to meet the I_b' line. Other curves for the family $E_{c2} = 150$ v. can be drawn but are not shown here.

Fig. 1: A cascode test circuit



Characteristics obtained in this manner are not precise but should be well within the limits of the manufacturer's tolerances on g_m, etc. The upper grid circuit may act as a plate load for the lower tube and tend to shift the lower part of the cascode curve in Fig. 2 to the left. In addition I_b should approach I_b' gradually—more so with low-μ tubes.

Increasing E_{c2} has the effect of spreading out the cascode curves vertically and thus increasing the g_m; however, the knee will be shifted to the right and higher plate-supply voltages are required to get into the "pentode" region.

The I_b' saturation lines are usually the ones of primary interest. These can be found quickly by the intersection of the $E_b = E_{c2}$ line with the triode curves. The knee can be located approximately by assuming grid conduction at I_b' and marking off $E_b = E_{b1} + E_{b2}$ as before. Determining one knee should be sufficient, as the others occur at about the same voltage.

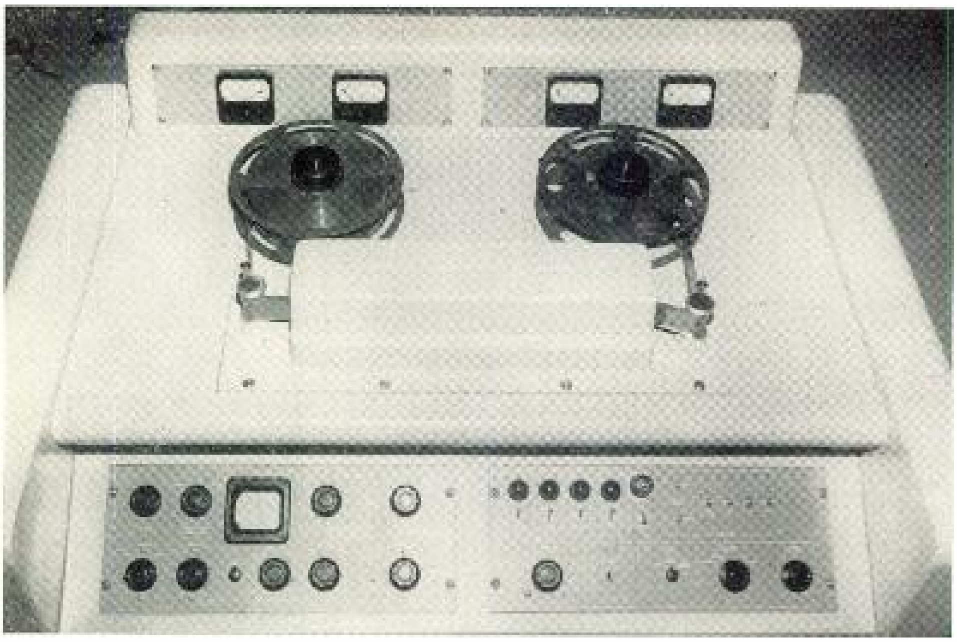


Fig. 1: Top view of video tape recorder. Unit records 1 hr TV show on 14 in. reel of 2 in. tape

By R. Snyder
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Ampex Corporation
Redwood City, Calif.

Ampex's New Video Tape Recorder

Multi-headed disc, spinning at 14,000 rpm, records bandwidths up to 4 mc on a two-inch magnetic tape traveling 15 ips. Immediate application is program delay service for East-West TV; future applications include color TV and high-speed data recording

LOOKING at the advantages which magnetic tape recording had brought to the radio broadcast industry, many engineers visualized its application to TV, when a means might be found of recording the 4 mc video signal.

Several approaches were open to them, and each had its adherents. Basically, the problem involved packing enough information onto a reel of magnetic tape of manageable size to reproduce all the video information in a program of a half-hour or an hour in length. The rate information transmission is proportional to the complex product of the bandwidth and the signal-to-noise ratio. In TV, a satisfactory signal must be at least 4 mc-wide and over 30 decibels "deep."

High-Speed Tape System

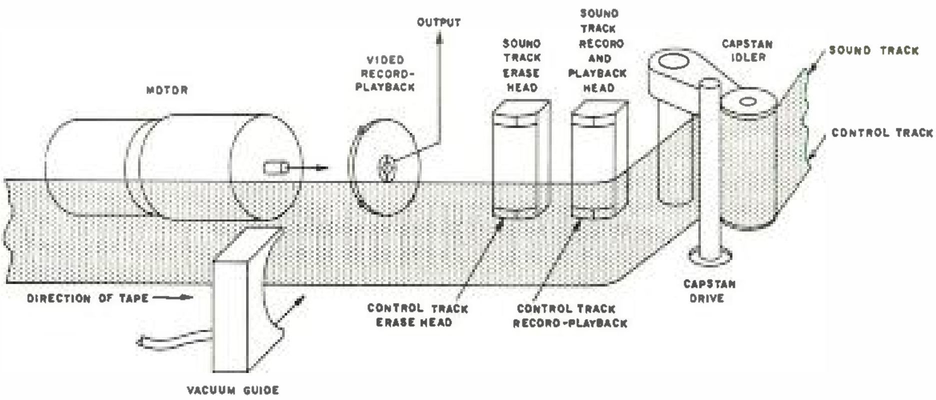
The maximum recordable frequency with a magnetic tape recorder is set by the effective gap width and tape velocity. The magnetic head "sees" substantially only that part of the tape which, at any given instant, is in the head gap. So long as only a small part of a single cycle is in the gap at any moment, the head will "see" a changing flux, and its output will be proportional to the rate of that change.

But when one whole cycle appears in the gap, the average value of the positive and negative half cycles equals zero, and the output of the head is zero. Thus, the narrower the gap, the shorter the wavelength which that head can reproduce effectively, or, the higher the frequency it can reproduce at a given tape speed.

In audio recorders a magnetic head of .005 in. gap width can reproduce a wavelength as short as .001 in. along the tape, or 7,500 cps at 7½ ips. A quarter-mil head, on the other hand, will effectively reproduce a half-mil wavelength, or a 15,000-cycle signal at 7½ ips.

If we used a quarter-mil head gap, then, we might expect that we

Fig. 2: Diagram of multi-function head



would require a tape speed of 2,000 ips to reach an upper frequency limit of 4 mc. At that rate, a reel of magnetic tape 14 inches in diameter and 4800 feet long would record a little less than 29 seconds of program material.

The precision required to manufacture a magnetic head so that the entire length and depth of the two gap faces are separated by exactly .000125 in. is very great. Even so, with utmost care, under conditions of precisely controlled light, temperature, and machinery, heads with this effective gap can be made. Any improvement made in this direction, however, leads not only to exceedingly knotty production problems, but also in the direction of great delicacy of equipment, where ruggedness is greatly to be desired.

Furthermore, substantial reductions in the gap width must be accompanied either by decreased signal, with consequently decreased signal-to-noise ratio, or by decreased head life. This is because signal output is approximately proportional to gap width, and inversely proportional to gap depth. Therefore, if gap width is decreased, the signal must either decline, or the gap depth must be decreased, leaving less and less head material to be worn away in use.

Multi-Channel Systems

This impasse led to experiments with the possibility of "chopping up" the video signal into 2, 4, 6, or more blocks, of proportionately narrower bandwidth, and then recording these on wider tape, using multi-channel heads. There are a number of ways in which this approach might be implemented, either with filters or with a synchronized sampling system. Only an exceedingly complex breakdown system gave any hope of reducing the tape speed to a conventional speed for magnetic recorders.

Transverse Recording

A third approach attains high relative speed between heads and tape by rotating the heads at high speed *across* the tape, and moving the tape itself only fast enough to avoid interference between successive tracks. The longitudinal tape speed required now depends

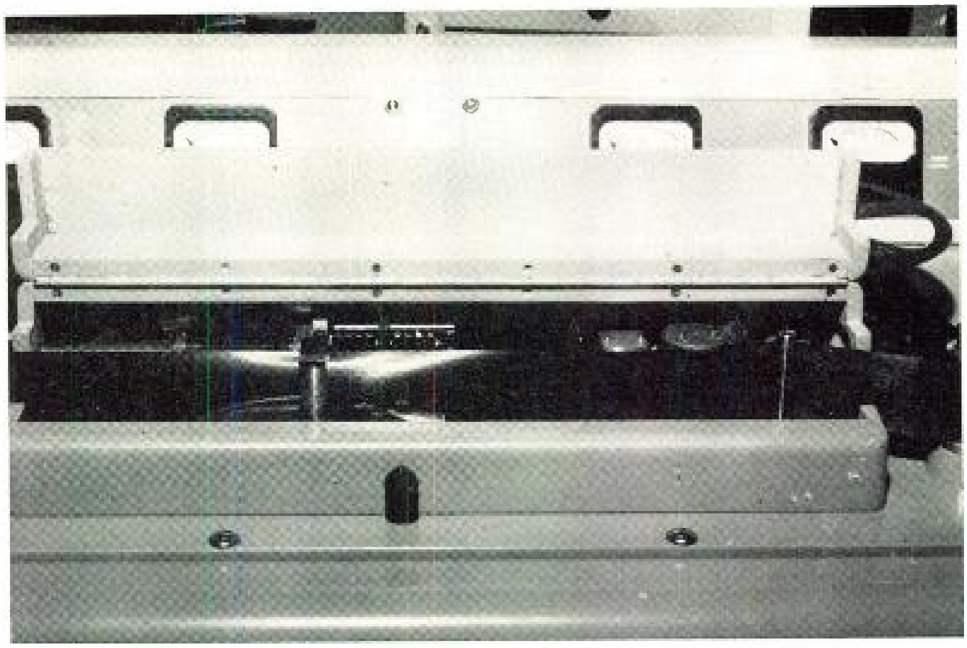


Fig. 3: Vacuum contours the tape to the curved recording head

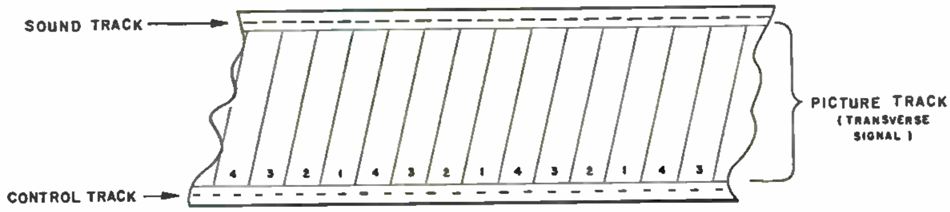


Fig. 4: Transverse video signal gives net 1500 ips for actual 15 ips tape speed

upon the required width of the individual tracks, the rotational speed of the head drum, the minimum spacing between adjacent tracks as determined by the effects of crosstalk, the stability of longitudinal tape speed control, and the effects on the output signal of errors in tracking. It proved possible, by this means to adopt a tape speed of only 15 ips, thus obtaining more than an hour of recorded program on a 14-inch reel of two-inch Mylar polyester based tape.

The equipment developed exceeds the FCC maximum rate of change of information standard of 0.15% per second. It is capable of holding the maximum horizontal line error to 0.1 msec, with only occasional minor adjustment during operation. The 15 ips tape speed is made possible by a special FM carrier system, a precision transport control system, and a unique head construction.

Head Assembly

Four heads are mounted on a drum which rotates at approximately 14,000 rpm and is precisely synchronized with the tape drive capstan. The net resultant speed for the application of video signals is approximately 1500 ips.

The two-inch-wide tape is held in conformity to the circular shape of the head drum by means of a vacuum system. During operation, one head is always in contact with the tape. Each head, in its turn, is connected to the electronic elements of the system by commutation, its timing under strict control. During the play-back process, the relation between the rotational velocity of the head drum and that of the capstan drive is maintained to within very narrow limits through the use of a control track along the lower edge of the tape. A reference signal is recorded on the control track and, during the playback, is amplified and used to control relative speed of the drum and capstan.

Monitor Facility

After the incoming video signal has been amplified and used to modulate the signal to the heads, it

(*Continued on page* 108)

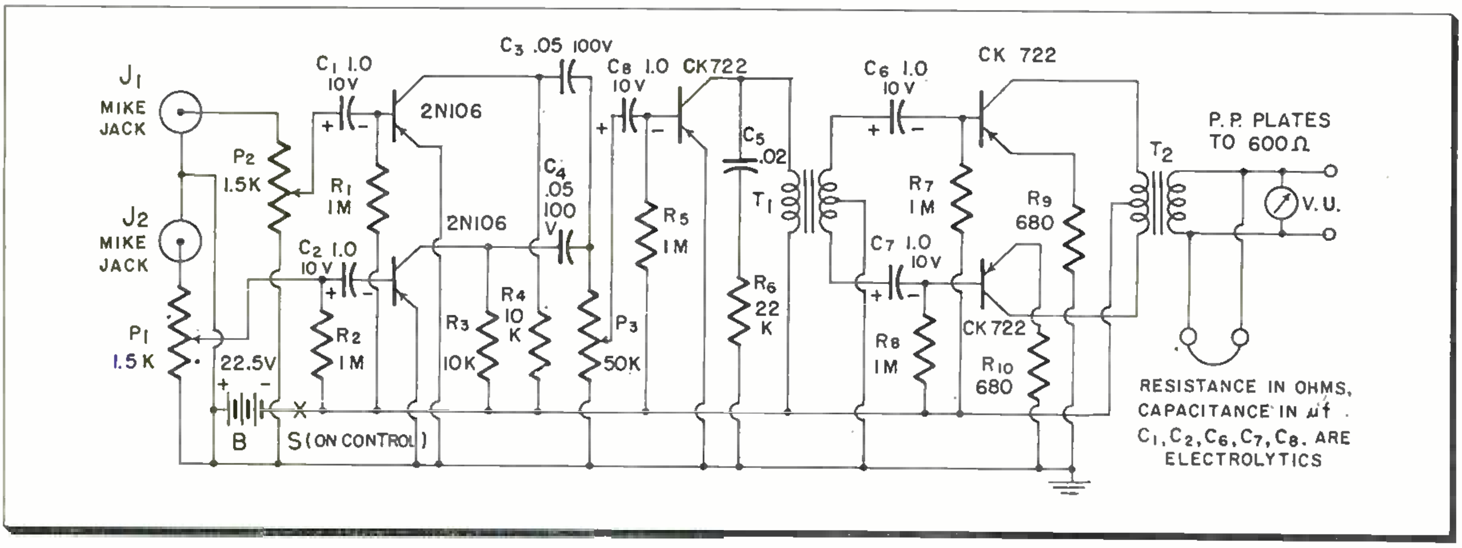


Fig. 1: Schematic of unit. Mikes are connected directly to the inputs of transistor pre-amps through gain controls

Transistor Remote Amplifier

Small, battery-operated 4-transistor channel amplifier has two independently controlled mikes. Low-level mixing is employed. The noise level is 50 db down

By E. C. SMITH

THE small, self-contained transistor amplifier described in this article contains two microphone channels and is used for remote broadcasting of sporting events here at WFIN. Figs. 4 and 5 show the size and appearance of the unit, and Fig. 1 is the circuit diagram.

Two independently controlled mikes were considered necessary. Dynamic mikes with 250 ohms output were available and these are connected directly to the inputs of the transistor preamplifiers through the gain controls. The gain controls contribute very little mismatch, due to the high value of resistance. Low level mixing was decided upon because of the simplicity of the circuit. Two extra transistors or a bulky transformer type mixer would be required for high level mixing. Most

E. C. SMITH
Chief Engineer, Radio Station WFIN, Findlay, Ohio

controls will function very smoothly in the low level mixer.

Design

Miniature transformer coupling was discarded because of poor low frequency response of these units, so the preamplifier transistors are resistance coupled to the second stage. Difficulty was also encountered in trying to use miniature electrolytics for coupling the preamplifiers to the second stage, and we finally decided to use the .05 µf. miniature paper type. Frequency response is corrected by C5 and R7 connected from collector to ground of the second stage.

The second stage is coupled to the push pull output stage by means of T1. This is a plate to 600 ohm line transformer, center tapped. The frequency response of this small transformer is adequate, and performance is very good when used in this way. The 300 ohms each side of the center tap to drive the final stage proved very satisfactory.

For the final stage we decided upon a push pull arrangement with

(Continued on page 125)

Fig. 2: Response—250 Ω input, 600 Ω resistive load, 1000 CPS

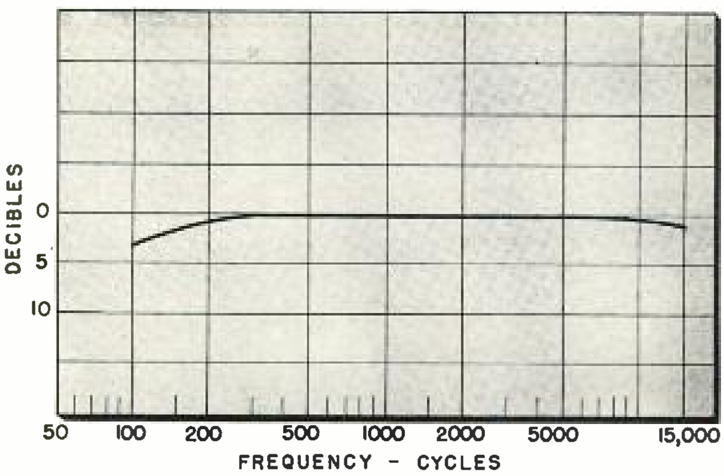
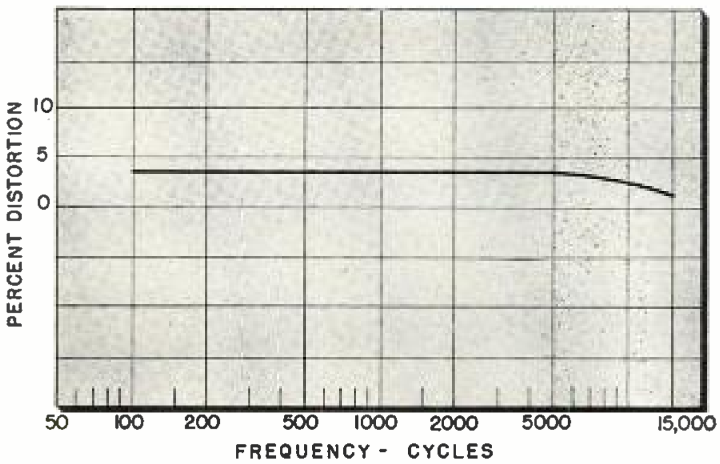


Fig. 3: % distortion—250Ω input, 600Ω res. load, normal level



CUES for BROADCASTERS

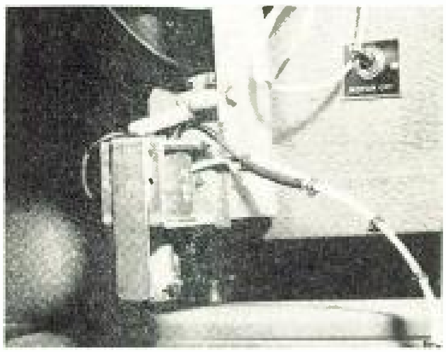
Practical ways of improving station operation and efficiency

Booster Solenoids For Turret Rotation

GEORGE PEPIN
WMT-TV, Cedar Rapids, Iowa

THIS item will be of interest to TV stations listing among their equipment a Gray model 3A or 3B Telojector.

For some time we have had trouble with slide turrets failing to rotate in sequence. The trouble was caused by failure of the release



solenoid to pick-up sufficiently to release the turret allowing the next slide to move into position. Replacement of the solenoid and release pawl did not cure the trouble, but this idea did.

Another pair of solenoids was ordered from the manufacturer and mounted in an inverted position on the case of the original solenoid just below the level of the manual release lever. This is shown in the photograph.

An armature was fashioned out of brass and mounted to connect from the solenoid plunger running along the outside frame and resting just below the manual release lever.

Electrically the two solenoids are in parallel so that, when the slide change button is pushed, both coils are energized and the release lever gets an added kick upward from the second solenoid as well as the downward pull from the original.

This has been in operation for about six months and has yet to fail.

Another addition to the Telojector is the removal of the momentary start switch on the projector and replacing it with a foot switch. This eliminates the necessity of holding the switch, checking copy and pushing the slide change button all at the same time. The switch can be mounted back under the pedestal out of the way to prevent stepping on it accidentally.

Adjusting Spark Gaps

DENNIS C. LONG, Ch. Engr.
WLON, Lincolnton, N. C.

WHEN adjusting several spark gaps that activate an overload relay, such as used in the Collins 20-V, it is usually difficult to determine which one is arcing and causing the overload action. To make this adjustment easy, and to know which spark gap is set correctly, tape a piece of thin porous paper, such as cleansing tissue, in the spark gap areas. When an arc then occurs a hole will be burned through the paper indicating where the arc has occurred. When one gap has been correctly adjusted it may be temporarily blocked by carefully taping a small sheet of good insulating material between the spark gaps. This will make the other adjustments easier. When all adjustments are completed all insulation or paper will, of course, be removed.

Battery Protective Switch

GORDON V. N. WILEY, Ch. Engr.
WGAW, Gardner, Mass.

PROBABLY most engineers and operators have had the unhappy experience of preparing to set up a remote pickup where there is no regular power available, and discovering, when the cover is taken off the remote, that the last operator neglected to turn off the battery switch, and the batteries are either dead or very weak.

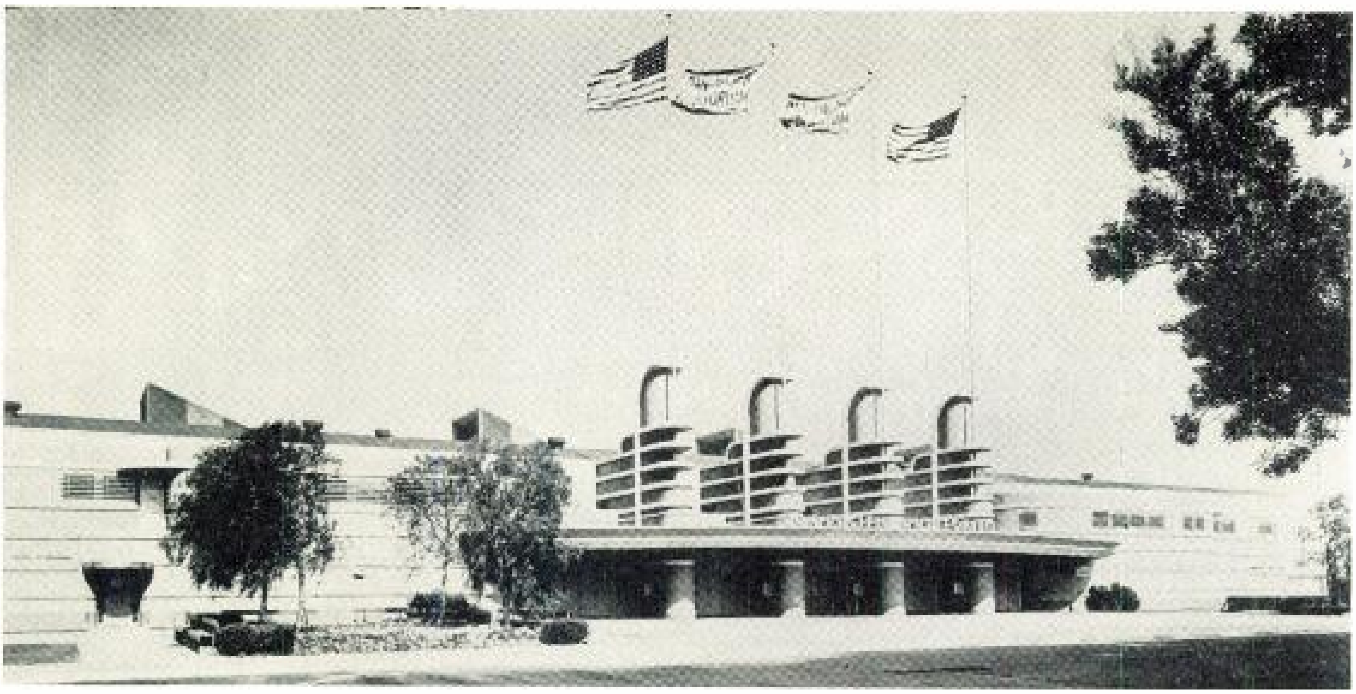
After this happened at WGAW a few times, we decided that something should be done to prevent its happening again. The following method makes it impossible to assemble the cover to the remote unless the switch is OFF, and since making this change we have saved considerable money on batteries as well as a lot of worry.

We use a Collins Remote Amplifier Type 12Z, but the same idea could be used on other types having rotary switches.

The power switch knob was removed from the shaft and a deep groove filed into the back side of the knob, using a round file. This groove should be filed so that it is

at right angles to the edge of the case when the switch is ON, and offset from the hole so that it does not interfere with the shaft. A plastic rod, approximately 2¼ in. long is obtained (we used the pointed handle of a cheap curler type comb bought at the five and ten). The groove should be deep enough so that the rod is flush with, or slightly above the back surface of the knob. The groove was then coated with service cement, the rod positioned in the groove and liberally covered with cement. A washer, having the same or smaller outside diameter than the knob but with a hole large enough to pass the shaft was then cemented to the back of the knob. When replacing the knob on the shaft push the knob back so that the washer is held firmly against the back of the knob by pressing against the switch hub or nut.

If the groove has been located properly the rod will extend over the edge of the case when the switch is ON, as shown in the photo, effectively preventing the cover from being assembled. When OFF the rod swings down out of the way.



Pan Pacific Auditorium, Los Angeles—Site of the 1956 WESCON

WESCON 1956

Over 700 exhibits and more than 150 technical papers will highlight the Los Angeles Show; some 30,000 are expected to attend the event

STARTING its second decade this year, WESCON (Western Electronic Show and Convention) is scheduled for Los Angeles' Pan Pacific Auditorium on August 21, 22, 23 and 24.

Some 30,000 engineers, scientists and business representatives are expected to attend the 1956 WESCON, which will show more than 700 exhibits and present at least 150 technical papers. C. Frederick Wolcott, of Gilfillan & Bros., Inc., Los Angeles, heads this year's eight-man board which administers the event.

The West Coast Electronic Manufacturers' Association and the Los Angeles and San Francisco sections of IRE, representing the 7th Region, are sponsors of WESCON, which is held alternately in Los Angeles and San Francisco.

Five field trips are scheduled for the four-day 1956 WESCON, including a cruise aboard the *USS Bremerton* during which there will be an opportunity to inspect this aircraft carrier's electronic gear. Other trips include: medical electronics facilities at UCLA; a visit to the Pacific Semiconductors plant, where miniature diodes and transistors are made; a tour of the Radio Division of Hoffman Electronics Corp.; and a visit to the color studios of CBS-TV, featuring a special closed-circuit color telecast.

The All-Industry Luncheon is set for August 24 in The Ambassador, the headquarters hotel, which will also be the site of the All-Industry Cocktail Party on opening day, August 21, starting at 5:30 p.m.

Special activities have been planned for wives and other guests of those attending the show and convention, including a get-acquainted tea at the Beverly-Hilton Hotel and various events and tours.

American and Western Air Lines are cooperating in getting WESCON delegates and visitors to Los Angeles via "Operation Airlift." Special attention is being paid to travelers from East of the Rockies, and these airlines have promised priority for WESCON traffic.

TECHNICAL PROGRAM

EARTH SATELLITE

Chairman: Capt. D. P. Tucker, USN. Office of Naval Research.

"The Professional Group on Military Electronics," Capt. C. L. Engleman, USN.

"The U. S. Earth Satellite Program Project Vanguard," M. W. Rosen, Naval Research Lab. D. J. Markcarian, Glenn L. Martin Co.

MICROWAVE THEORY AND TECHNIQUES

Chairman: Charles Chandler, Gilfillan Bros.

"Applications of a Waveguide Slot Coupler with Unity Coupling," R. W. Clapp, Hughes Aircraft Co.

"The Effect of Mode Filters on the Circular Electric Wave Transmission Properties of a Long Multi-mode Circular Waveguide," W. D. Warters, Bell Telephone Labs.

"Equivalent Circuits for Thin Waveguide-Coaxial Junctions," Curt A. Levis, Ohio State Univ.

"Exponential Transmission Lines as Transformers and Cavities," Rabindra N. Ghose, Radio Corp. of America.

ENGINEERING MANAGEMENT

Chairman: E. Finley Carter, Director—Stanford Research Inst.

"Management of Large Research and Development Organizations," N. I. Hall, Vice President, Hughes Aircraft Co.

"People, Things and the Engineer," James F. Gordon, Chief Development Engineer, Helipot Div., Beckman Instruments, Inc.

"Future of Engineers in the Management of Industrial Enterprise," A. C. Fontaine, Vice President, Bendix Aviation Co., Inc.

"Situations that Affect the Productivity of Engineers," M. C. Batsel, Chief Technical Administrator, Defense Electronic Products, RCA.

MEDICAL ELECTRONICS

Chairman: Alexander Kolin, Univ. of Calif, Los Angeles.

"Exposure Hazards from Cosmic Radiation in Flight in Extra-Atmospheric Regions," Hermann J. Schaefer, Naval School of Aviation Medicine, Pensacola, Fla.

"Progress in the Field of Xerography," Speaker from General Electric.

"Methods of Measuring Blood Pressure and Blood Flow," John P. Meehan, Univ. of S. California.

TUBE TECHNIQUES

Chairman: M. C. Long, Hughes Aircraft Co.

"Development of a Line of Microminiature Ceramic Tubes," R. E. Moe, G. E. Co., Owensboro.

"Noise Performance of a Microminiature Triode," J. W. Rush, G. E. Co., Owensboro.

"Flat Display Device with Matrix Display Selection," B. A. Findeisen, G. E. Co., Syracuse.

"A Flash Coding Tube," R. W. Sears, BTL.

"Ceramic Seals for Microwave Tubes," Curtis Ward, Varian Associates.

"New Techniques Used in The Development of a 40 Watt Ceramic UHF Power Tetrode," M. B. Shrader, RCA, Lancaster, Pa.

PROPAGATION

Chairman: R. B. Muchmore, The Ramo-Wooldridge Corp.

"Reflection of a Transient Electromagnetic Wave from a Conducting and Anisotropic Medium," James R. Wait, National Bureau of Standards, Boulder.

"The Prediction of Tropospheric Propagation from Meteorological Data," L. J. Anderson and J. B. Smyth, Smyth Research Associates, San Diego.

"Some Observations of Antenna-Beam Distortion in Trans-Horizon Propagation," A. T. Waterman, Jr., N. H. Bryant, and R. E. Miller, Stanford Univ.

"A Study at 1046 Megacycles of the Reflection Coefficient of Irregular Terrain at Low Angles of Incidence," R. E. McGavin and L. J. Maloney, National Bureau of Standards, Boulder.

"Radar Terrain Return at Near-Vertical Incidence," R. K. Moore and C. S. Williams, Jr., Univ. of New Mexico.

MICROWAVE THEORY AND TECHNIQUES—ACTIVE ELEMENTS

Chairman: Kiyo Tomiyasu, General Electric Microwave Laboratory.

"Recent Developments on Transmit-Receive Switch Tubes," Louis W. Roberts, Bomac Labs.

"Characteristics of Crystal Video Receivers Employing R-F Pre-Amplification," William E. Ayer, Applied Electronics Lab., Stanford University.

"Coupled-Cavity Stabilization of Klystrons," Maurice St. Clair, Varian Associates.

"Burnout Experiments on S-Band and X-Band Crystals," Ben Hecht Bomac Labs., Inc.

CIRCUIT THEORY—FREQUENCY DOMAIN TECHNIQUES

Chairman: Louis Weinberg, Hughes Aircraft Co.

"Realization of Driving Point Impedance Functions Without Mutual Inductance," R. H. Pantell, Stanford Univ.

"RLC Transfer Function Synthesis," E. C. Ho, Logistics Research, Inc. and Univ. of Calif., Los Angeles.

"Synthesis of Grounded Two-Element-Kind Symmetrical Networks," P. M. Lewis, MIT.

"Some Simplifications for Analysis of Linear Circuits," G. L. Matthei, Ramo-Wooldridge Corp.

"Network Design by First Order Predistortion Technique," C. A. Desoer, Bell Telephone Labs.

INSTRUMENTS

Chairman: Carl P. Spaulding, G. M. Giannini & Co.

"A Practical Application of Phase Measuring Techniques to Precision Angle and Distance Measuring Equipments," by William T. Thompson, Cubic Corp., San Diego.

"A Multi-Pressure Measuring and Recording System for Wind Tunnels," M. Bain, Jet Propulsion Lab.

"Electromagnetic Flowmeters — Operating Characteristics and Applications," Eugene Mittelmann, Consulting Engineer, Chicago.

"3-D Magnetic Flux Meter," M. Muller and R. Feldt, Federal Telephone and Radio Co.

TELEVISION RECEIVERS

Chairman: William Milwitt, Industry Service Laboratory, Radio Corp. of America.

"Stagger-Tuned Transistor Video Amplifiers," Victor H. Grinich, Stanford Research Inst.

"Analytical Approaches to Local Oscillator Stabilization," W. Y. Pan and D. J. Carlson, Radio Corp. of America.

"Retrace Driven Deflection Circuit," Walter B. Guggi, Stanford Research Inst.

"Graphic Derivation of the Chromaticity Diagram," Edward L. Michaels, Hughes Aircraft Co.

MILITARY ELECTRONICS

Chairman: J. F. Byrne, Motorola Research Laboratory.

"Electronic Circuit Standardization," J. H. Muncy and G. J. Rogers, National Bureau of Standards.

"Application of Solar Furnaces to High Temperature Research," Lt. Col. R. H. May, Armed Forces Special Weapons Project.

"Nuclear Weapons Efforts on Communication Systems," Jack Eggart, Signal Corps Engineering Labs.

"Silicon Solar Cell," M. B. Prince, National Semiconductors Products, Evanston, Ill.

ANTENNAS I

Chairman: V. R. Rumsey, Univ. of Illinois.

"Radiation and Diffraction Problems Involving Wedges and Cones," L. B. Felson, Polytechnic Inst. of Brooklyn.

"External Fields Produced by a Slot on a Cone," G. Held and G. Hasserdjian, Univ. of Washington.

"A Slot Analog of the Loop-Dipole D-F Antenna," F. D. Clapp and H. Masuda, Univ. of California, Berkeley.

"The Effects of Thin Conductive Coatings on Low-Frequency Aircraft Antenna Performance," C. W. Steele, Stanford Research Inst., Menlo Park.

"The Tacan Antenna," A. Casabona, Radio Navigation Laboratory, Federal Telecommunication Laboratories, Nutley, N. J.

CONTROL THEORY AND METHODS

Chairman: Walter R. Evans, North American Aviation.

"Consideration Regarding Design of Stabilizing Elements for Control Systems," T. H. Chin, Univ. of Pittsburgh.

"Solution of Statistical Problems by Differential Operator Approach, R. L. Cosgriff, Ohio State Univ.

"Describing Function Technique Applied to the Analysis of a Non-Linear Control System Used in Space Stabilizing a Missile In Roll," Leonard Atran, Westinghouse Electric Corp.

"Statistical Theory and Analysis of Multiply-Instrumented Control Systems," R. M. Stewart, Jet Propulsion Lab.

"A Time-Domain Synthesis for Optimum Extrapolators," C. W. Steeg, Dynamic Analysis and Control Lab., MIT.

TRANSISTOR CIRCUITS — LINEAR, LOW AND H-F APPLICATION

Chairman: W. W. Wells, North American Aviation Co.

"Design of Negative Feedback Transistor Amplifiers for Hi Fi Equipment," (with demonstration of equipment). H. R. Lowry, General Electric Co.

"Silicon Transistor Video Amplifier," R. E. Leslie, Sperry Gyroscope Co., New York.

"Stability and Power Gain of Tuned Transistor Amplifiers," A. P. Stern, Electronics Lab., General Electric Co.

"High Frequency Equivalent Circuits for Junction Triodes," R. M. Scarlett, Stanford Univ.

"Some Circuit Applications of Silicon Tetrodes," R. R. Webster and R. F. Stewart, Texas Instruments, Inc.

CYBERNETICS

Chairman: Don Taylor, Univ. of California.

"Spatial Perception," Robert Tschirgi, UCLA.

"The Use of Digital Computers in the Study of Neural Networks Models," Stanley Frankel,

(Continued on page 155)

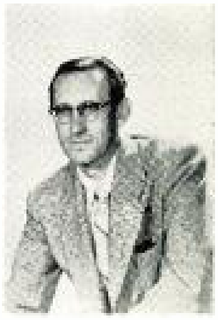
C. Fred'k. Wolcott
WESCON Chairman

Bruce S. Angwin
Vice-Chairman

Gramer Yarbrough
Secy.-Treas.

E. P. Gertsch
Vice-Chairman

Joseph Rodgers
Arrangements



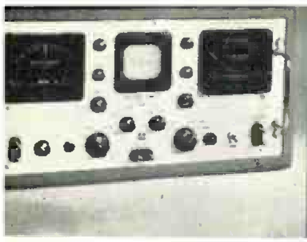
Willard H. Fenn
Technical Program

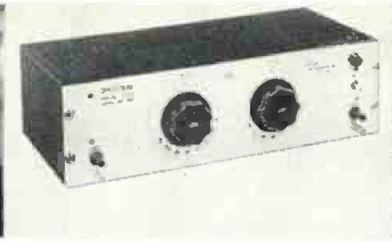
Jeanne W. Jarrett
Recording Secy.

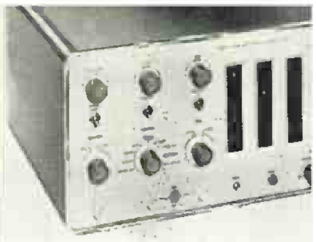
Mrs. F. A. Dunnigan
Women's Activities

Elvin Feige
Advisory Committee

H. W. Jamieson
Field Trips







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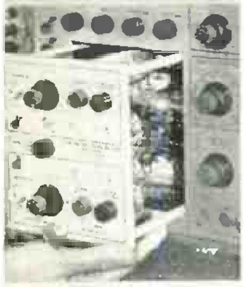
New Components & Equipmen



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1—D & R Ltd.

Model FL-4 Wideband Flutter Meter for studying flutter and wow content of tape transport mechanisms. Carrier frequency 14.5 kc. Internal crystal controlled osc. Booth 344.

2—Baldwin Piano Co.

Compact 13-digit and 16-digit optical encoders generate binary-parallel code signals to ±½ part in 8192 (13-digit) and 65536 (16-digit). Booth 1330.

3—Spectrum Instruments Inc.

Analog Filters for sharp bandpass performance at audio and sub-sonic frequencies. Model BP-160 features independent control of high and low frequency band limits. Booth 1066.

4—Hupp Instrumation Co.

Model 210 Digital Timer, compact, 4 decade, electronic counting instrument. Glow-tube decades and simplified circuitry. Rates as high as 60,000 cps. Booth 403.

5—Computer-Measurements Corp.

Model 225A Universal Counter-Timer, offers direct digital read-out. Features include: 3 direct-coupled inputs, quick time base alignment, 70 mv sensitivity. Booth 1047.

6—Electro-Pulse, Inc.

Model 7240A Preset Counter, utilizing cold cathode glow transfer tubes, counts and indicates the number of input events up to a number (from 1 to 9,999). Booth 1313-1314.

7—Tektronix, Inc.

Type 53/54C is a fast-rise dual-trace unit. Identical channels, operated independently or electronically switched. Sensitivity, 0.05 v/cm to 50 v/cm.

8—Abbott Instru. and Engr. Co.

Edin frequency spectrum analyzer. Continuously analyzes a broad band of frequencies, and integrates the individual bands, which may be as many as 24. Booth 307.

9—Burroughs Corp.

Magnetic Core Tester (BCT 301), designed expressly for testing tape wound bobbin cores. Allows accurate measurement of core switching time. Booth 133-134.

10—John Fluke Mfg. Co., Inc.

Model 801 precision potentiometric DC VTVM is substantially impossible to damage by overload. Voltage range is from 500 v. down into the microvolt region. Booth 603.

11—Non-Linear Systems, Inc.

New Digital Voltmeter, Model 1500, has mercury wetted contact relays that assure life expectancy of more than 1 billion accurate readings. Booth 941.

12—Electronic Control Systems, Inc.

"Digimatic" computer, consisting of a planning desk, high-speed decimal computer and tape recorder, and a machine control unit. Booth 136-137.

13—Shasta Div., Beckman Instruments

Model 605 wide range resistance bridge checks resistance to an accuracy of ±0.15% full scale. Seven ranges from 100 ohms to 100 megohms full scale. Booth 747.

14—Electronic Specialty Co.

RY-426 series of voltage sensors provide reliable, exact sensing of the 400 cycle systems. Uses magnetic amplifier to actuate the output relay. Booth 103.

15—Perkin Engineering Corp.

Light weight Model MR532-15A magnetic amplifier regulated, 2 to 36 v. at 15 amp. power supply. Ranges—2-36 volts, and 5-32 volts. Booth 1409-1410.

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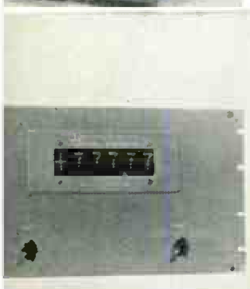



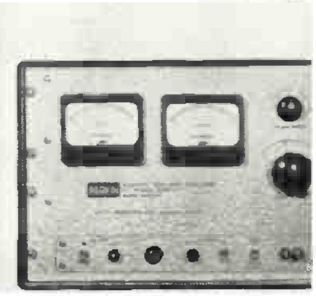

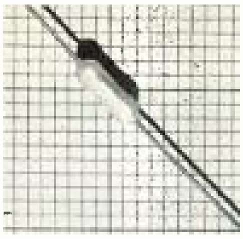

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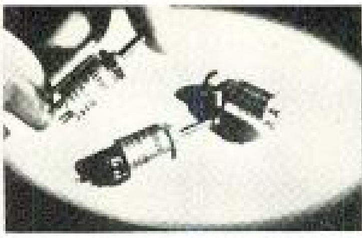

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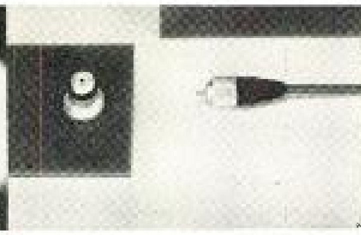

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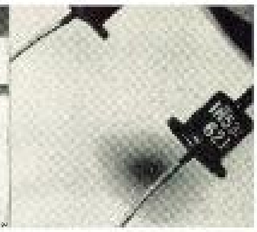

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To See At WESCON

21

16—Ward Leonard Electric Co.

Miniature 3-watt power type resistor, AXI-OHM, for printed circuits and advanced miniaturization designs. Special alloy resistance wire of low temperature coefficient. Booth 727.

17—American Phenolic Corp.

Miniaturized connectors 'ribbon' contact design with self-wiping, self-cleaning, double-contact action. Booth 1019-1020.

18—Ace Electronics Assoc.

High temperature X-500 ACEPOT, sub-miniature precision wire-wound potentiometer, which operates from —55°C. to 150°C. 200 ohms to 250K ohms. Booth 1364.

19—Microdot, Inc.

Miniature printed circuit receptacles, and mating plugs, for all printed circuit boards from 1/16 in. to 3/16 in. thick, provide coaxial or shielded cable connections. Booth 1327.

20—General Electric

New silicon rectifiers, types 1N537 and 1N538, occupying a total volume of 0.03 cubic in. and weighs 0.07 oz. Axial leads. Booth 1218-1219.

21—Litton Industries

Model LA-09 10-turn potentiometer. All metal external construction, metal-to-metal stops, stainless steel ball bearings, and glass sealed terminals. Booth 1256-1257.

22—H. H. Buggie, Inc.

Miniature BNC type connectors for new type miniature coax. Quick "pressure correct" connect and disconnect, and complete moisture and dustproof sealing. Booth 104.

23—Burgess Battery Co.

New "wafer cell" smaller than a fingertip yet ⅓ more powerful than conventional cells, made entirely by machine and sealed in airtight envelope. Booth 1009.

24—Control Products, Inc.

Light-weight Thermal Switch, sensitive and fast-acting. Made in single-wire and 2-wire designs. The single-wire unit weighs less than 1 ounce. Booth 1346.

25—National Vulcanized Fibre Co.

Printed circuits made from copper-clad phenolite in standard grades, new G-10-365 epoxy grade and circuits made by the new HNP (Houghton National) process. Booth 1052-1053.

26—Phillips Control Corp.

Phil-trol Type 8QA relay, available with multiple wound coils over a wide range of resistance values, features fast response time, unexcelled reliability. Booth 1039.

27—Alden Products Co.

New indicator light; tiny bulb, 1/6 the size of "miniature" bayonet bulbs. Filament is sealed high in lens, keeping all of the light in front of panel. Booth 1165.

28—Bowmar Instrument Corp.

Universal precision gear train, 107U, featuring 20 common lab. ratios from 20:1 to 1600:1. Single universal housing of anodized aluminum and 20 stainless steel gear clusters. Booth 824.

29—American Lava Corp.

AlSiMag metal-ceramic seals for high temperature applications. Close dimensional tolerances, low dielectric loss, high insulation resistance. Dependable bonding. Booth 926.

30—Indiana Steel Products Co.

Indiana Hyflux "One-Piece" Cores, used for the same wide range of applications as two-piece cores, and made of the finest, Armco oriented silicon steel. Booth 339-340.

31—Erie Resistor Corp.

Packaged Assembly Circuit module, PAC, for packaging electronic components consists of "pin" type resistors and capacitors ⅛ in. x ⅝ in. mounted in clips. Booth 1325.

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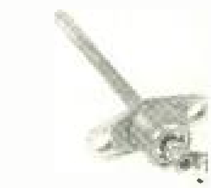

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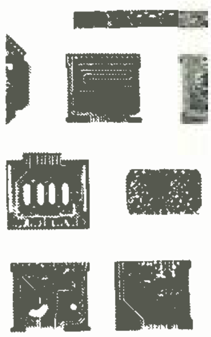

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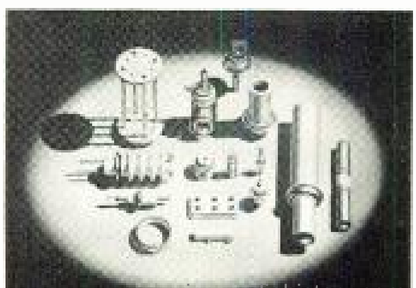

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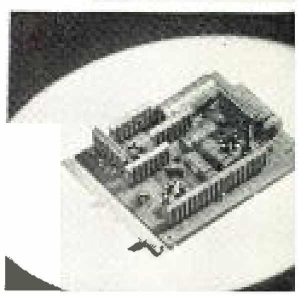


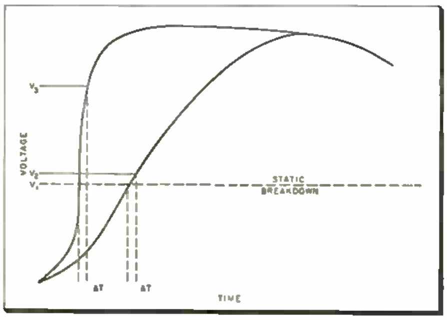


Fig. 1: Fast rise rates lead to higher breakdown voltages because of the avalanche effect

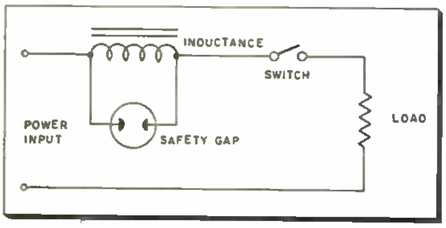


Fig. 2: Safety gap protects coil from surge damage

Fig. 3: Gap protects pulse transformer from damage in case of load failure

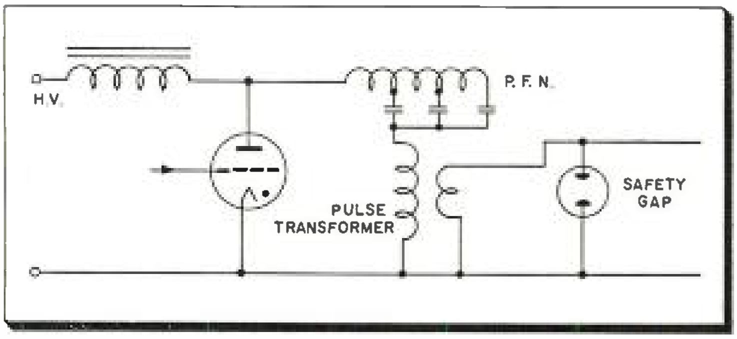
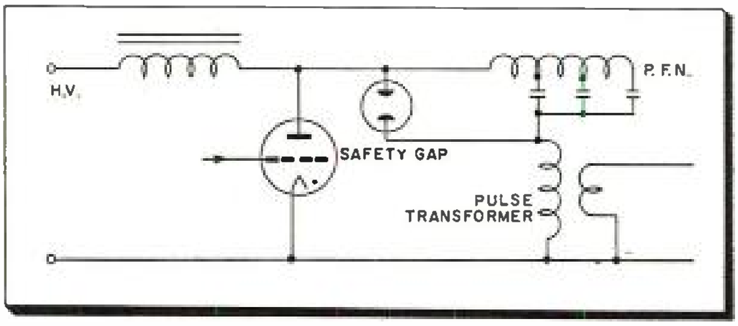


Fig. 4: Safety gap limits surge voltages across pulse forming network



The Spark Gap—New Circuit Component

By J. H. JOHNSTONE
Bendix Aviation Corp.
Electron Tube Plant
Eatontown, N. J.

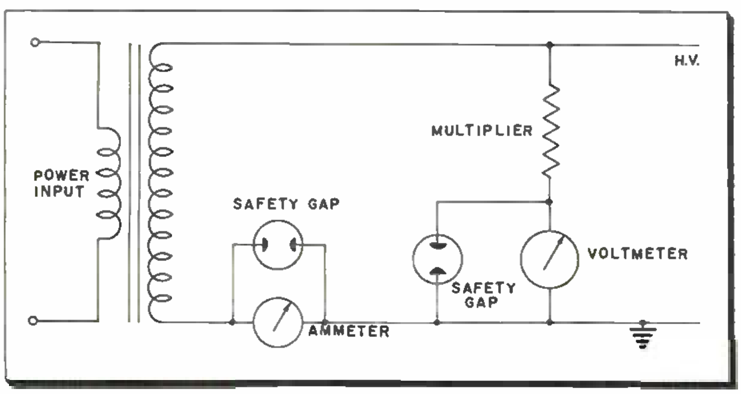
Spark gaps used as voltage-sensitive switches can handle extremely high currents with low voltage drop. Requiring small space, units can be made insensitive to ambient temperature, pressure, altitude, and humidity

ALTHOUGH the spark gap as an individual electronic device has been known longer than any other electronic item, little is known by equipment engineers about its uses. If the spark gap is considered to have the same characteristics as a voltage sensitive switch its use as a circuit element can be more readily understood. As a switch, spark gaps are able to pass extremely high currents with a relatively low voltage drop, can handle high voltages in a small space, and can be made insensitive to wide variations in ambient temperature. They are also normally not affected by changes in pressure, altitude, or humidity. They can be used in either stand-by or safety circuit service or as an operational circuit element.

The voltage at which the gap will break down can be easily specified if it is under dc or low frequency ac conditions. However, if the gap is subjected either to high frequency, pulse, or sharp wave front conditions the breakdown voltage is not as predictable. Passage of current through the gap requires the formation of a conductive path. Formation of the path requires creation of an "avalanche" of electrons from one electrode to another. Any statistical delay in creation of the avalanche will result in overvoltage being applied to the gap and a resultant increase in the voltage at which breakdown occurs. In general the pulse or high frequency ac breakdown will be higher than the static or dc breakdown although this increase can be minimized for most applications by changes in the design of the gap.

Referring to Fig. 1, two pulse

Fig. 5: Meter voltages are limited by shunt gaps



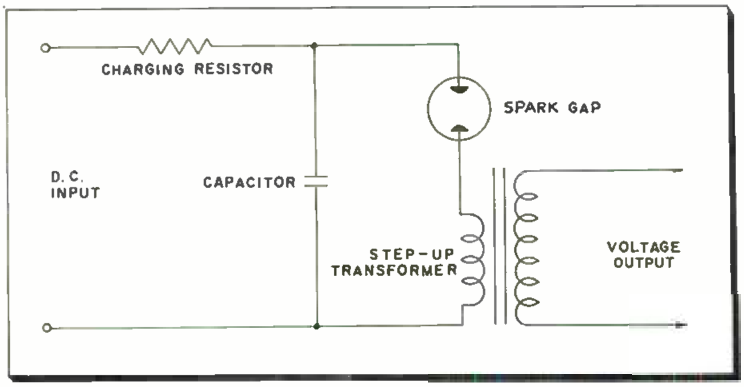


Fig. 6: Spark gap pulse-forming circuit

shapes are shown, one with a slow rate of rise and a second with a much faster rate of rise on the leading edge. If V_1 represents the static breakdown of a spark gap and T represents the delay in formation of the avalanche, the graph shows how, with a slow rate of rise the voltage, V_2, at the breakdown is but slightly higher than the static breakdown, but with a rapid rate of rise, the voltage, V_3, at breakdown is much higher than the static breakdown.

In case of repetitive pulses, this rise is not as pronounced. Specified applications of spark gaps in typical circuits will serve to indicate the areas in which a spark gap can be used to advantage.

In protection service, spark gaps are designed to protect circuit components against damaging high voltage surges. Present operational and environmental requirements of modern electronic equipment do not always allow for a suitable safety factor in the design of components. As a result, transformers, capacitors, and other parts are often overstressed by unavoidable transients in the circuit. To protect operationally rated circuit elements from these transients, a safety spark gap should be included in the circuit.

The gap is designed to discharge at some point between the normal operating voltage to the circuit and the breakdown voltage of the component. The safety gap must have a stable voltage breakdown over a long period of time and a breakdown tolerance narrow enough to prevent firing during normal circuit voltage fluctuations, and yet allow the gap to fire before the voltage surge becomes damagingly high.

If the current through a choke or inductance is interrupted or changes rapidly, the collapse or rapid change in the magnetic field can cause excessively high voltages to appear across the winding. Insulation rupture may occur causing either a short to core, to case, or shorted windings. A safety gap as shown in Fig. 2, across the coil terminals can protect against the surge and maintain operation of the equipment.

Pulse transformers, modulation transformers, and other similar

(*Continued on page* 123)

The Selenium Diode in TV Design

By J. T. CATALDO
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WITH the advent of the selenium diode, the electronic design engineer has available a new series of semiconductor components that offer exceptional benefits for future circuit design. These selenium diodes are very rugged components, and offer many advantages over the conventional thermionic diodes. Selenium diodes are the smallest units in the selenium rectifier family. For example, the Types 1S1 and 1T1 measure only 0.120 in. in diameter x 0.210 in. long and are provided with pig-tail leads. Their small size makes them ideal for use where space is limited or where no vibration problems are encountered; no additional support is required because of their exceptionally light weight. They are particularly suited for electronic applications[1*] where low to medium voltage is required at low current.

The most recent commercial application for selenium diodes has been in various television circuits, such as the horizontal AFC circuits. Of the three horizontal AFC circuits in general use today, the balanced phase detector type is the most common. Such a phase detector, Fig. 1, consists of two series-connected diodes. Positive horizontal sync pulses are applied to the free anode, negative horizontal sync pulses are applied to the

(*Continued on page* 149)

Fig. 1: Thermionic diode phase detector

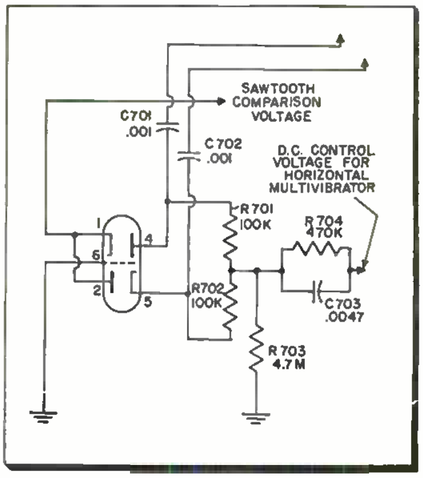
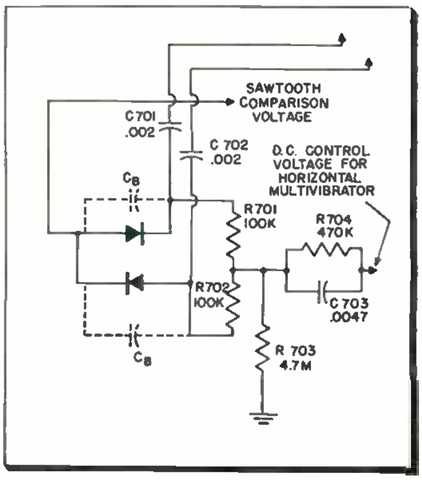


Fig. 2: Selenium diode phase detector



High-Powered C-Band Klystron Amplifiers

By R. W. Haegele
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Integral-cavity klystron amplifier delivers 50 to 100 watts with high efficiency and wide frequency range by use of ceramics in seals, fittings, and tuner

THE rapid growth of microwave relay communication systems has brought with it the need for new microwave tubes to meet the demands of longer station to station hops, improved fade margins, and less critical antenna alignment for mobile units.

While remarkable success has been achieved with receiver type reflex oscillators in the transmitters of many existing relay systems, one or more of the above demands have now become a 'must' in newer systems. The answer to these demands, of course, is greater power. But the increase in power must be obtained economically and simply; and it must be enough times greater than existing 0.1 to 1.0 watt systems to make substantial improvements in one or more of the urgent areas of need.

The most economical method of achieving these ends would appear to be an efficient amplifier which could use existing equipment as a driver. Why not just a more powerful reflex oscillator instead of an amplifier? Huskier reflex tubes have already been used to raise the power level from 0.1 watt to 1.0 watt. However, with a beam efficiency of 1 or 2%, the reflex types have nearly reached their practical limit at 100 watts input and 1 or 2 watts output.

The tubes to be described here have been designed to deliver 50 to 100 watts CW power output with a beam efficiency of 25% yet require only 10 MW of driving signal. They are linear 4-cavity klystron amplifiers for C-Band requirements from 5300 to 8000 MC. This frequency range has been covered with the three tubes pictured in Fig. 1.

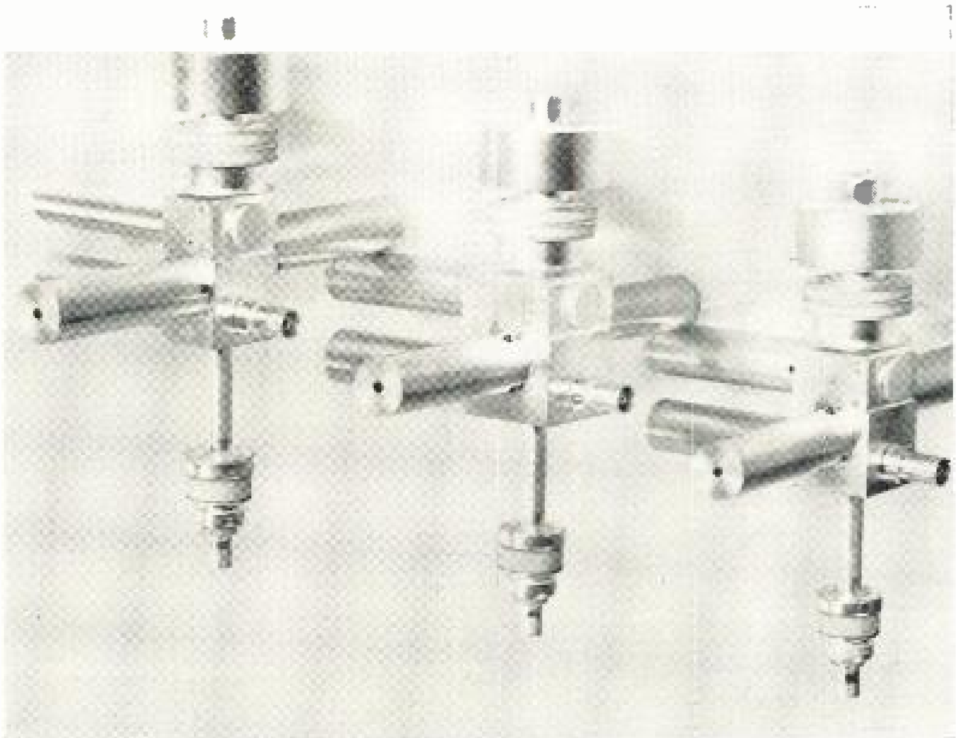
Tube Description

The Eimac X563 series are integral cavity, magnetically focused klystrons having ceramic insulation throughout for the cathode and collector seals as well as for the r-f coaxial input and waveguide output fittings. The use of ceramic materials has been one of the keys to the success of the tube. The rugged, high temperature vacuum seals at the ceramic-to-metal joints permit simplified assembly techniques not possible with glass, and allow improved processing methods which insure cleaner, harder, longer-life tubes. In addition, the use of ceramic in the tuner mechanism has provided a novel method of tuning the tube which gives a much wider frequency range per tube than is usually found in integral cavity microwave tubes of this power level.

The tuner has no contacts within the cavity (the bearing surfaces are all outside the cavity) and hence it is free of noise or similar problems arising from contact plungers. Neither the walls of the cavities nor the gridless reaction gaps are moved or distorted by the tuning action, thus permitting them to be ruggedly built for excellent frequency stability.

The tuning rate of the ceramic tuner is low enough to insure ease in tuning the klystron to any desired frequency within the band covered. For example, the X563H

Fig. 1: C-band klystron amplifiers cover 6500-8000, 53-5800, and 5900-6500 mc



	300 Watts Beam Power Input	400 Watts Beam Power Input	
Frequency	6400	6400	(MC)
Beam Voltage	2700	3050	(V.)
Beam Current	111	131	(ma)
Beam Transmission (with RF drive)	82	84	(%)
Bias Voltage	—16	—18	(V.)
Top Magnet Current	2.5	2.8	(Amp.)
Bottom Magnet Current	3.4	3.5	(Amp.)
RF Input Power	10	10	(mw.)
RF Output Power	67	101	(watts)
Gain	38.2	40.0	(db)
Beam Efficiency	22.3	25.2	(%)
Bandwidth (—3 db)	12	14	(MC)

covers the range from 5900 to 6500 MC in 13 revolutions of the tuning knob. By using high quality ceramic material for the tuner, relatively high cavity Q can be maintained over the entire tuning range. Values from 2500 to 3500 are typical for the X563 series with high alumina ceramics having a dielectric constant of 9.5 and a loss factor of 0.005 or less at these frequencies. Tuning curves in terms of ceramic plunger displacement are shown in Fig. 2 for the X563G, X563H, and X563F.

The cavities of the X563 contain gridless reaction gaps through which is focused a high density electron beam approximately .060 in. in diameter. This beam is initially formed by a Pierce-type electron gun and is confined within the drift tubes of the cavities by a magnetic field. The field is excited by two tape-wound aluminum foil electromagnets which are particularly economical both in space and power requirements. Approximately 80 watts to each coil will supply the required 850 gauss for proper beam focusing.

Tube Performance

The X563 series of tubes are rated for a maximum continuous beam input of 400 watts. Typical operating characteristics for the 300 and 400 watt input levels are tabulated above.

The above conditions represent the tube tuned for optimum power output. By stagger tuning the four cavities, the bandwidth may be substantially increased with a corresponding reduction of gain. For typical broadband operation, the drive requirement is increased to 40 or 50 MW and the —3 db bandwidth obtained is about 17 MC. At 1 db down, the bandwidth is 13 to 14 MC which is adequate for most TV and communication relay systems using an FM signal.

In addition to CW operation, the X563 series may be pulsed up to about 10 times the normal CW rating. Fig. 3 illustrates the performance of a typical type X563H at voltages up to 6000 v. with a 1% duty cycle. Pulsed power output in excess of 600 watts may easily be obtained with these tubes.

Besides the large increase in power afforded to microwave systems by these tubes, there are other advantages offered by the use of an amplifier. The troublesome effects of load variations on the frequency and output of a reflex oscillator are well known. The amplifier, which isolates the driver completely from load changes, is as stable as the input signal itself, and power changes due to load variations are small compared to those encountered with reflex oscillators. The high gain of the amplifier permits the use of a low power reflex tube as a

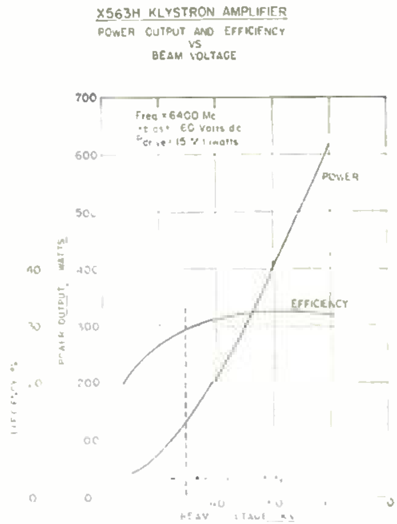
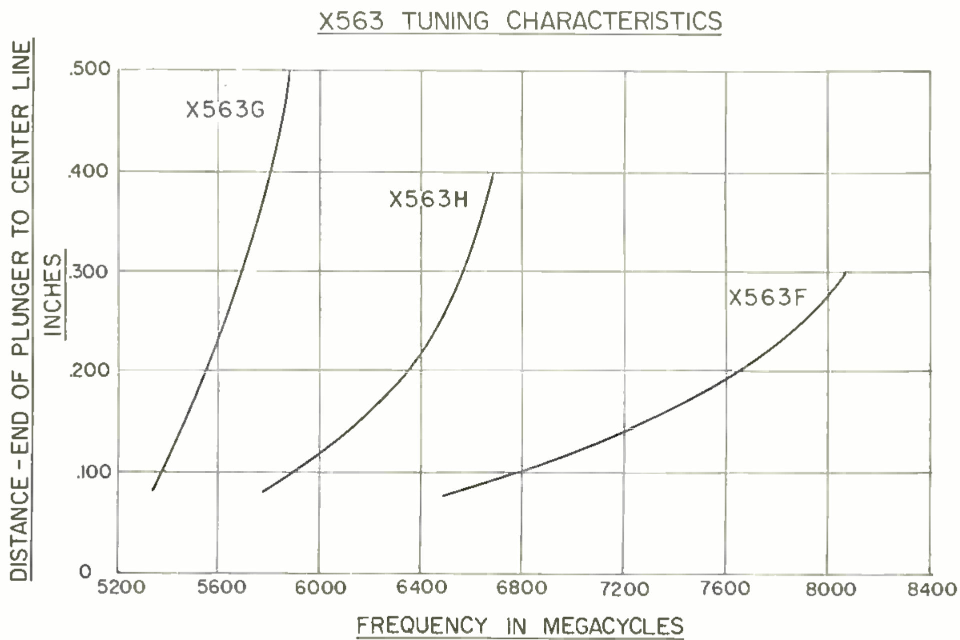


Fig. 3: CW and pulse performance of the X563H klystron

driver in which a higher numbered repeller mode (having too low a power output for use as a transmitter by itself) may be used for greater linearity of frequency modulation.

Fig. 2: Tuning curves for X563 klystron amplifiers



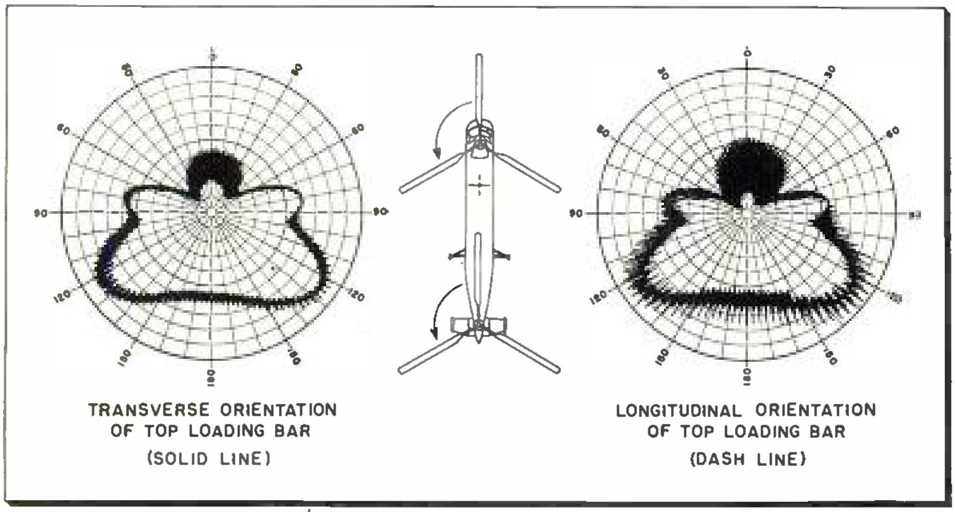


Fig. 1: Rotor modulation on H-21

By A. R. ELLIS

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Stanford Research Institute,
Stanford, California

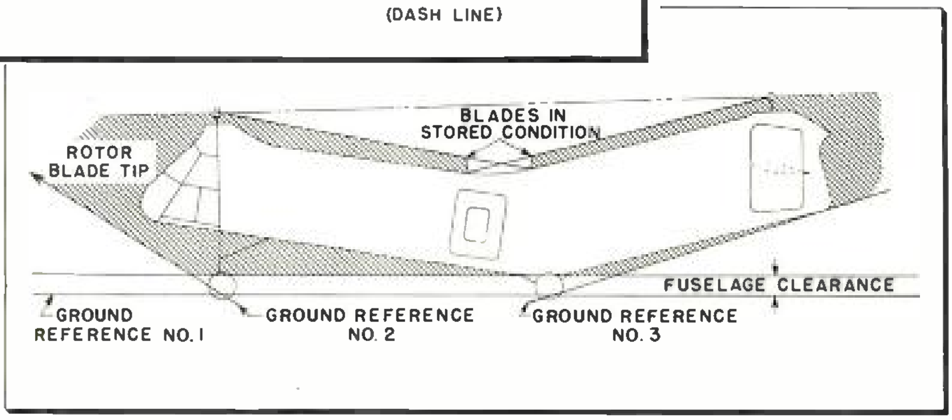

Fig. 2: (R) Location limits on H-21

Helicopter Antenna Design

Unique problems have arisen from the configuration and function of helicopters. New methods and equipment have been designed to study radiation shielding, rotor modulation and harmonic ratios, and airframe resonance.

ANTENNA design problems for helicopters differ in many respects from those for fixed-wing aircraft. Helicopters generally have slow speed, low ceiling, and short range. Typical design cruising speeds of today's rotary wing transports are in the order of 100 knots, 5,000 ft. altitudes, and operating radii of 100 nautical miles. Hence altitude, icing, and drag problems are not as serious as with fixed-wing airframes. As a consequence, flush-mounted antennas are not necessary and, in fact, may not be desirable on helicopters because of the associated weight penalty. One ton is a typical payload of a helicopter today and any increase in weight required to strengthen the aircraft structure for insertion of flush mounted antennas would result in degradation of the helicopter utility.

Height Limitations

Although zero-drag antennas are not required, the permissible vertical height of antennas is limited by factors peculiar to this type of aircraft. The space occupied by the moving rotor blades restricts the location and size of antennas on the top of helicopters. (See Fig. 2.) Further restraints on antenna positions on the upper surface are imposed by the requirement for folding and tying down the blades when storing the aircraft. Ground clearance is important also. Antennas located in some areas on the bottom of the fuselage will be subjected to extremely high forces if they contact the ground or other objects while operating from landing strips in rough terrain. Hence the antennas should be sufficiently small and mounted in those areas on the aircraft which are least vulnerable to this type of damage. Antennas can also be mounted on the side of the fuselage if they do not cause unnecessary inconvenience or compromise the operation or ground-handling of the aircraft by being susceptible to damage.

Location

For UHF and VHF communication antennas, the major problems are those of location. The requirement for omnidirectional patterns in the horizontal plane are the same as those for fixed-wing aircraft with the additional limitations imposed by the restricted clearances. Although a location under the cockpit may be satisfactory, the non-retractable wheels and associated struts may cause serious lobing in area of interest. (See Fig. 4.) In discussing operational problems with helicopter pilots, shielding of

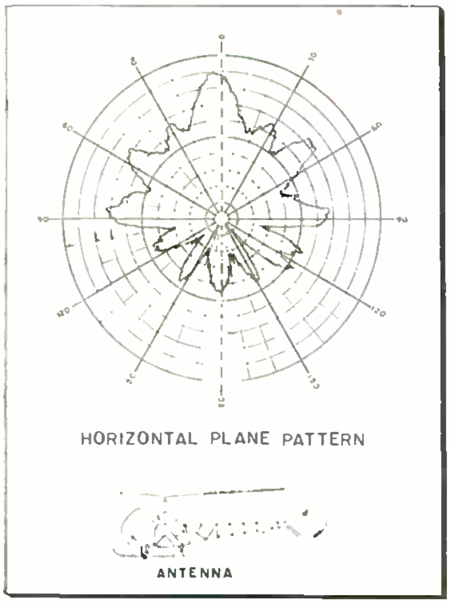

Fig. 4: Struts cause lobing

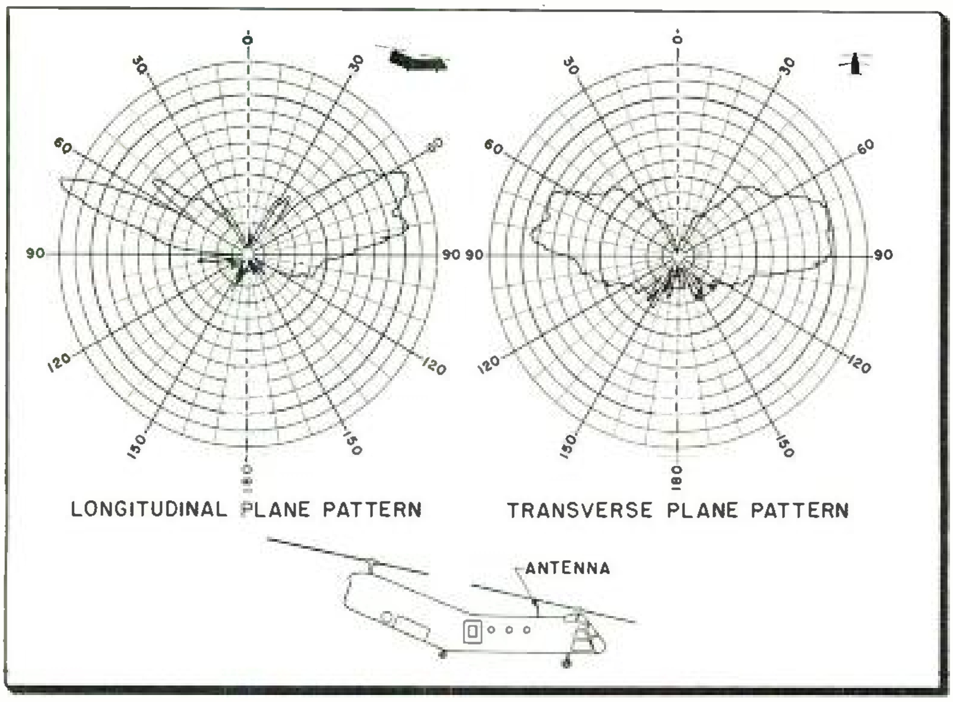

Fig. 3: Structural shielding of UHF

the UHF radiation by the aircraft structure frequently resulted in serious communication deficiencies. Sometimes this required flying the helicopter backwards while communicating. Although this was accepted more or less as a routine matter, it does leave something to be desired. Fig. 3 shows a typical example of shielding to the rear.

Although the small size of UHF stubs permit mounting in many positions where the clearance is restricted, the larger VHF antennas require additional consideration. One type of design which has proven satisfactory where the available vertical height is limited is the "L" or bent stub antenna. Pattern measurements show that the Eϕ polarized radiation from the horizontal portion of the antenna reduces the Eθ signal in the horizontal plane by a maximum of about 1 db.

For lower frequencies (24-52 MC.), vertically polarized antenna design and location is more troublesome. Step impedance matching or ultimately automatic matching appears to be necessary for the required low-silhouette radiators to operate through this band, with efficiency, size, and weight being very important factors. In this frequency range, omniazimuthal vertically polarized patterns are difficult to obtain, since many of the fuselages and rotor blades are of resonant lengths and therefore will carry high radiation current densities, causing considerable power to be wasted in Eϕ polarization. This same effect occurs with larger fixed-wing aircraft at the lower hf frequencies but in that range the random polarization obtained from sky wave propagation permits utilization of both Eθ and Eϕ components. The ionospheric reflection is a negligible factor in the 24-52 MC. range, however, and so any energy in horizontal polarization can be considered wasted energy.

For radiation resistances which permit step matching over 2 MC. steps, stub heights of at least ⅛ wavelength are required. At the low frequency limit (24 MC.) this re-

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Fig. 5: Bearing error on H-21

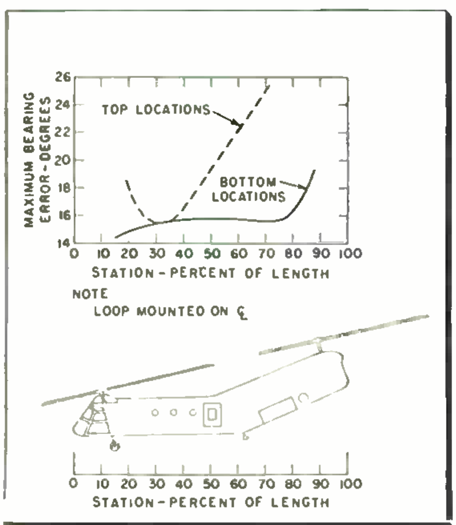
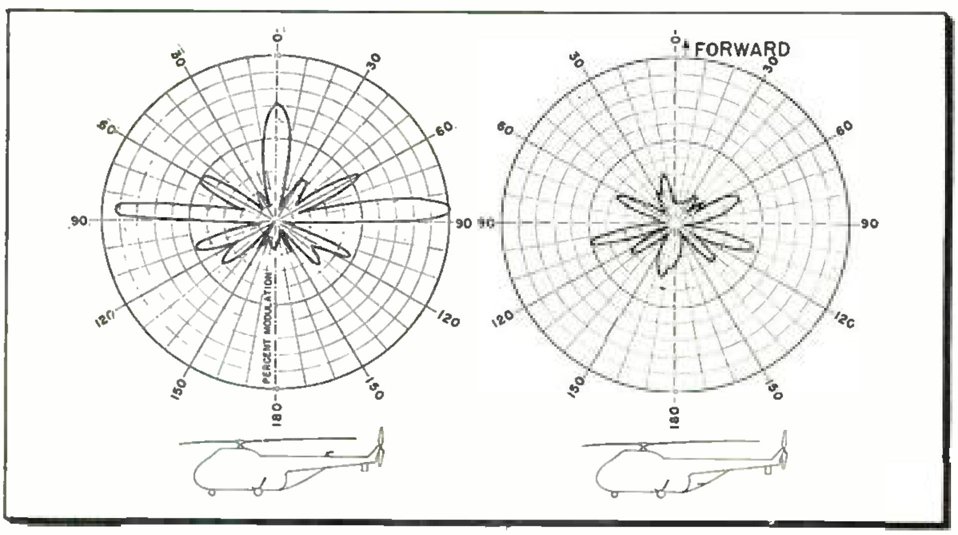


Fig. 6: H-19 rotor modulation – VOR



New Discriminator-Output

Analysis of FM information is facilitated by triggered-pulse, frequency-to-voltage conversion system. New discriminator-output frequency meter measures 3 cps to 100 kc

By **DUANE MARSHALL,**
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Hewlett-Packard Co.,
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Fig. 1: Discriminator-output frequency meter measures 3 cps to 100 kc

WHEN information is recorded or transmitted in the form of frequency, transmission path configuration, path length, cable length, and frequency response all have diminished importance because amplitude changes which are likely to occur during handling become relatively unimportant. Partially for these reasons, many physical data such as airspeed, fuel flow, acceleration and control movement are commonly being converted into frequency variations for transmission purposes in FM/FM telemetering systems. In other cases it is often desirable to measure the magnitude of residual and incidental f-m in signals.

Analysis of such information is facilitated by a new electronic frequency meter which, in addition to indicating a measured frequency directly on a panel meter, converts the frequency into a proportional output current and voltage. This frequency-voltage conversion is accomplished in the instrument by using each cycle of the input frequency to trigger a pulse-forming circuit. Since the resulting pulses are of standard length and amplitude, an average voltage is produced which is proportional to the input frequency. Variations in the frequency are then easily observed or recorded as variations in voltage or current. Frequency modulation on an input signal, for example, is converted to an a-c voltage whose amplitude is proportional to the peak-to-peak frequency excursion of the input signal and whose frequency is equal to the deviation rate of the input signal.

Fig. 1 shows the new discriminator-output frequency meter. The instrument measures frequencies in nine ranges from 3 cps to 100 kc to a full-scale accuracy of within ±2%. Its ability to measure f-m can be extended well into the microwave range through use of standard auxiliary equipment. An output for operating a strip chart recorder is also provided.

Frequency Shift Measurements

In addition to its discriminator output, the instrument has the ability to expand its scale readings by a factor of 3 or 10 times, i.e., the pointer movement caused by a change in input frequency can be magnified up to 10 times. This feature permits frequency shifts to be measured with increased accuracy.

Fig. 2: Shadow shows normal deflection for 600 cps downward shift of 8 kc signal

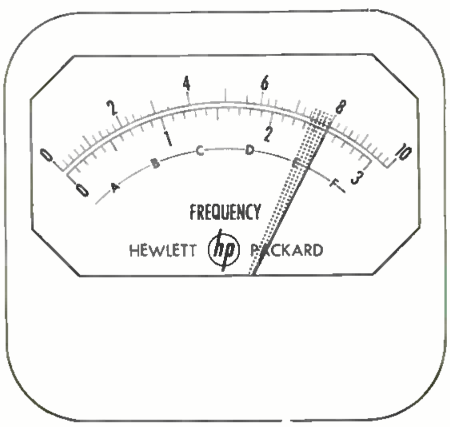
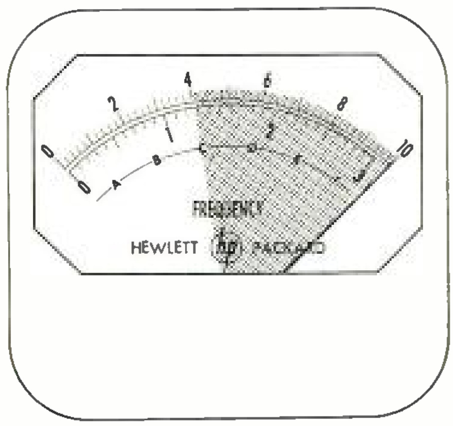


Fig. 3: Expanded operation gives movement over shaded area for conditions of Fig. 2



Frequency Meter

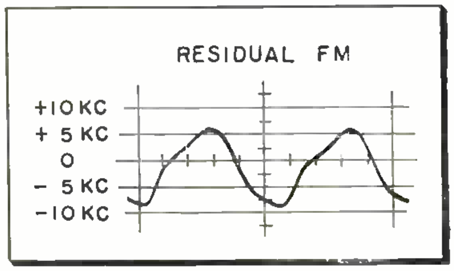


Fig. 4: Oscillogram of residual fm in klystron oscillator output

When the expanded scale feature is used, the meter is still direct-reading as far as the change in frequency is concerned. Expanded operation involves the use of a panel control that permits the meter pointer to be positioned to any desired point on the meter scale for the initial reference reading.

The expanded scale feature can perhaps best be illustrated by an example. If a 600 cps downward shift of an 8 kc frequency were to be measured in normal operation on the most suitable range (10 kc) of the instrument, the meter pointer would move through the shaded area shown in Fig. 2.

When such a measurement is made in expanded operation, the meter pointer would be positioned with a panel control to full scale in this example, since the shift is known to be downward. The meter pointer would then appear as shown in Fig. 3. When the frequency being measured now changes as before, the meter pointer will move through the 10 times larger shaded area indicated in Fig. 3. Since 10 times expansion is used with the 10 kc range, the full swing of the meter represents 1 kc. Since the pointer has dropped 60% of full scale, the frequency has dropped 600 cps.

Three times expansion operates in a similar fashion.

Expanded operation has two advantages over conventional operation for the measurement of frequency shifts. In addition to reducing parallax errors by having a magnified motion of the meter pointer for the frequency shift, the measurement itself has increased accuracy. Instead of a possible 4% error (the maximum possible difference between two ±2% measurements), 3 times expansion gives an accuracy within ±1.4% and 10 times expansion gives an accuracy within ±0.7% of the full scale frequency.

Expanded operation does not affect the discriminator output but does expand the recorder output in the same manner that the meter reading is expanded. More detailed information can thus be recorded.

Microwave Measurements

Although the frequency meter itself has a maximum upper limit of 100 kc, this limit can be extended well into the microwave region by the use of standard auxiliary devices such as a transfer oscillator using the heterodyne method. Such an oscillator converts a signal anywhere in the range from 100 mc to 12.4 kmc into a low (below 100 kc) intermediate frequency which contains the same frequency excursion magnitude contained in the original signal. These excursions can then be extracted for external analysis directly by the new frequency meter.

A typical example of the use of this feature of the frequency meter is shown in Fig. 4. This illustration is an oscillogram of the residual frequency modulation in a klystron oscillator caused by the use of a-c in its heater circuit. In making this oscillogram the oscilloscope gain was set so that each major vertical division on the graticule was equal to 5 kc of deviation. The peak deviation is thus seen to be equal to 15 kc. The fundamental component of this demodulated f-m is 60 cycles but there also exists a large amount of second harmonic. An accurate analysis of these components could be obtained by applying this waveform to a harmonic wave analyzer.

Fig. 5 shows the equipment arrangement used to view the modu-

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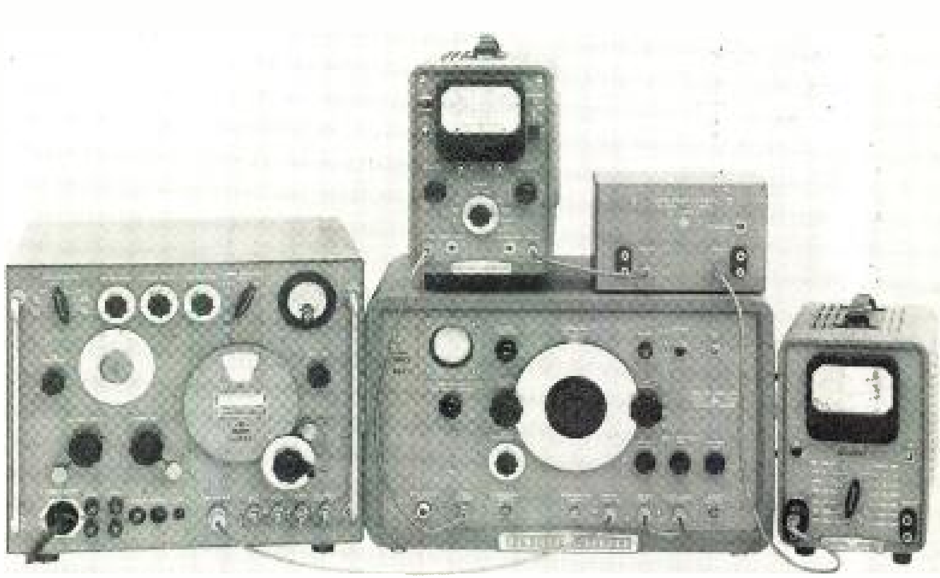
Fig. 5: Test set-up using heterodyne oscillator to extend range of frequency meter



Designing Microwave Equipment

The requirements of a medium-route microwave system—handling up to 300 telephone channels—are examined with respect to installation costs, transmission quality and performance, reliability and compatability. Includes average installation costs and typical system characteristics

A microwave system for use in the telephone industry must be designed to permit its engineering, ordering, installation, and maintenance like any other telephone transmission system. This requires the incorporation of features and the provision of services which are often unfamiliar to the radio industry, but which are based on long established telephone engineering practices.

Medium-route microwave is the type of facility that is most applicable to the average telephone plant. (See Fig. 1.) There is no distinct division between medium- and heavy-route, or medium- and thin-route microwave; however, it is expected that the capacity of medium-route systems will eventually reach several hundred telephone channels. At least one system now in use can be expanded, in groups of 12 channels, to an ultimate capacity of more than 350 channels.

Frequencies

Two frequency bands are most commonly used for common carrier service. These are from 890 to 940 MC and 5925 to 6425 MC. A distinct advantage of the former is the ability to use relatively inexpensive flexible r-f transmission lines. This permits physical separation of the antenna and the microwave equipment and the resultant versatility with regard to installation of the transmitter and receiver. The 900-MC equipment can always be installed indoors, and consequently gets the advantage of routine maintenance at the system terminals. An advantage of the 6000 MC band is the wider available bandwidth, which permits larger numbers of channels to be transmitted without interference.

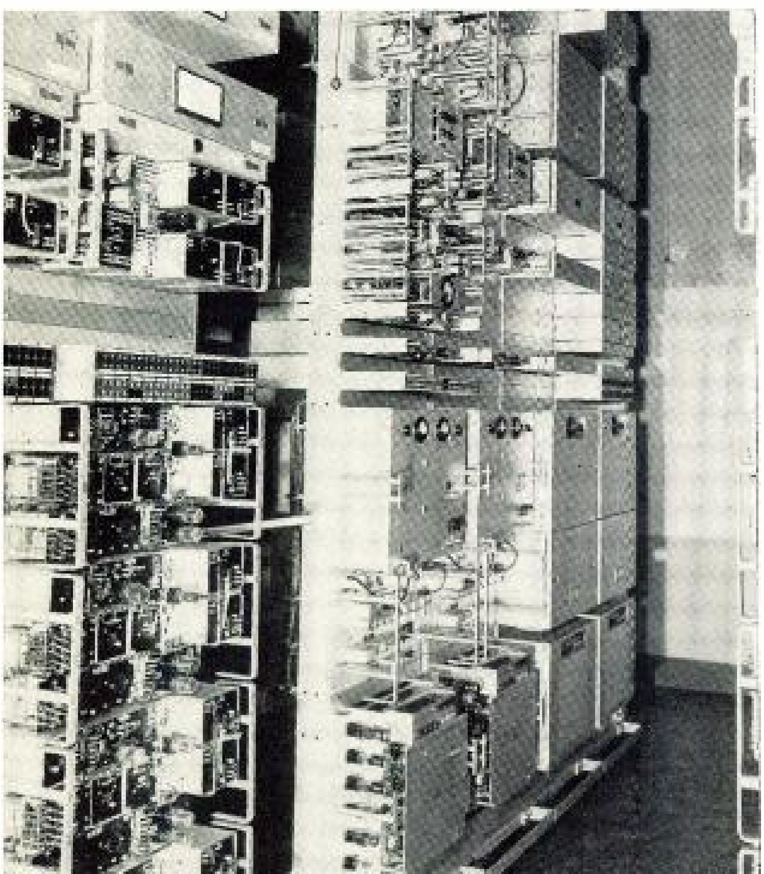


Fig. 1: Typical telephone office installation of medium-route microwave equipment.

Basic Requirements

Telephone companies are usually operated by men with long experience in the techniques of communication by open-wire and cable. Consequently, to prove-in and be accepted, medium-route microwave must meet the majority of the following requirements:

1. Installation cost should be below that of an open-wire or cable system capable of providing the same number of channels. Installation costs include all costs incurred up to the lineup of the microwave system.
2. Quality of transmission should be equal to or exceed that of an equivalent open-wire or cable system.
3. Reliability and life-expectancy should be comparable to that of other electronic equipment in the telephone toll plant, such as carrier telephone and telegraph equipment.
4. The microwave equipment must be mechanically and electrically compatible with other telephone equipment.
5. Maintenance cost should be equal to, or less than, that of an equivalent open-wire or cable system. Maintenance procedures should be simple enough that little extra training of maintenance personnel is required.

A microwave manufacturer, in attempting to meet these five requirements, must realize that the provision of microwave equipment is only the beginning in fulfilling a telephone company's needs. Many other factors concerned with the installation, operation, and maintenance of the system take on as much significance as the char-

For Telephone Companies

W. C. FISHER
Lenkurt Electric Co.
San Carlos, Calif.

acteristics of the basic radio equipment itself.

Installation Costs

Installation cost is one of the most important of the five basic requirements of microwave for the telephone industry. An important part of the total installation cost may be the cost of the microwave equipment. This is especially true for relatively simple installations. In many cases however, particularly where large antenna structures, emergency power supplies, power lines, access roads, and buildings are involved, the cost of the radio and carrier equipment may be only of incidental importance. Fig. 2 shows a typical remote repeater station in which the cost of the transmitting and receiving equipment was only a small part of the total installation cost. Fig. 3 shows a simple pipe-mounted antenna for a relatively inexpensive microwave installation.

Of the many items contributing to the initial cost of a microwave installation, several factors under the control of the manufacturer are important in keeping the first cost as low as possible. These factors include the design of equipment especially for telephone use, the construction of equipment to promote ease of installation, and the provision of information and instruction material for telephone personnel.

Another factor which reduces initial cost is the availability of a completely engineered microwave system instead of component parts which then require expensive engineering coordination. Also, accurate and up-to-date engineering and ordering information supplied by the manufacturer saves time in writing specifications and requisitions, and assures complete delivery of the equipment.

An important reason for keeping the first cost of a microwave system to a minimum is to improve its competitive position with respect to open-wire and cable facilities. At present, the prove-in distance of a single-section microwave system may be as short as

Fig. 3: Simple pipe-mounted installation

15 miles. For distances less than this, cable and cable carrier still appears to be the most appropriate facility. In the future, however, improved and more economical microwave techniques can be expected to reduce the prove-in distance to even less than 15 miles.

An instance is known where a single-section 48-channel system was installed over a 17.5 mile path between two cities. At each end of the system antennas were mounted on pipe masts on top of the telephone company office buildings. In engineering the system, a comparison was made between the cost of the 48-channel microwave and an equivalent cable installation. It was determined that cable would have cost about $4500 more than the radio and multiplexing equipment, installed and ready for service. In this particular case, the difference in cost was important; but the deciding factors were the expandability, reliability, and the ease and simplicity of installation of the microwave. Table 1 gives a comparison between the installation costs of an expensive and a simple installation.

Medium-route microwave usually is expected to provide transmission facilities for part of, or

Fig. 2: Typical remote repeater station. Cost of transmitting and receiving equipment is only small part of total cost.

Microwave (cont.)

all of, one link in the nation-wide toll network. It is therefore necessary that the microwave system have characteristics which maintain satisfactory toll-quality performance.

The four most important transmission characteristics of a microwave system are flat frequency response, level stability, frequency stability, and adequate signal-to-noise ratio. The first three usually are the least troublesome to the microwave manufacturer because they represent areas in which conventional radio engineering techniques are applicable.

The operational characteristic which gets the closest scrutiny by telephone engineers is the capability of the microwave to provide a transmission medium in which all carrier channels are within the noise limits prescribed by accepted toll standards. The noise contribution of the microwave is the factor which limits, more than any other single characteristic, the system's length and channel capacity.

In the engineering of links (toll trunks) for the nation-wide toll dialing system, a frequently quoted objective is the maintenance of total long-term[1] average noise below +31 dba;[2] The noise level per link may rise above this for small percentages of the time.

A link may be made up of combinations of cable, wire-line, and microwave in tandem. Therefore, the microwave system's noise contribution will be limited to a value which is the difference between the accepted standard and the added noise power contribution by the cable, wire-line, and channelizing equipment. Since each application of microwave involves different factors, it is necessary that the manufacturer provide accurate noise performance data to the telephone transmission engineer.

The noise contributed by the microwave system comes from three main sources:

1. The modulator of the transmitter (modulator noise).

TABLE 1: Comparison of Costs Between an Expensive and a Simple Installation

Expensive Repeater Installation		Simple Terminal Installation	
Land and Building	$25,000	Antenna Support	$ 500
Access Road	$18,000	Installation and Accessory Equip.	$1,000
Antenna Supports	$ 6,000	Radio Equipment	$8,000
Installation and Accessory Equip.	$90,000		$9,500
Radio Equipment	$20,000		
	$149,000	Radio Equipment Cost is 84% of Total Cost	

Radio Equipment Cost is 13.5% of Total Cost

In an average installation, the microwave equipment cost amounts to less than 50% of the total installation first cost.

2. Intermodulation distortion due to nonlinearities in the microwave equipment.
3. The head-end of the receiver (receiver thermal noise—of principal interest during fading).

The importance of the noise contributions from these sources depends upon the number of repeater sections in a system, the section lengths, and the propagation path clearances. The noise produced by each source must be kept as small as design and manufacturing techniques will allow because individual noise contributions are additive on a power basis.

Modulator noise can be minimized by good equipment design, but can never be eliminated. A typical microwave transmitter for telephone use will generate about +14 to +16 dba of such noise.

Intermodulation distortion is a more complex noise source. The linearity of the modulator, demodulator, and wideband amplifiers under peak load conditions determines the amount of noise contributed as intermodulation distortion. Loading depends upon the type of carrier system, the peak number of channels in use at one time, and the talker levels.

(1) Long term is considered to be more than 50% of the time.

(2) All noise measurements quoted are at a zero level transmission point with F1A weighting.

Complete and accurate information on the performance of the

(*Continued on page* 126)

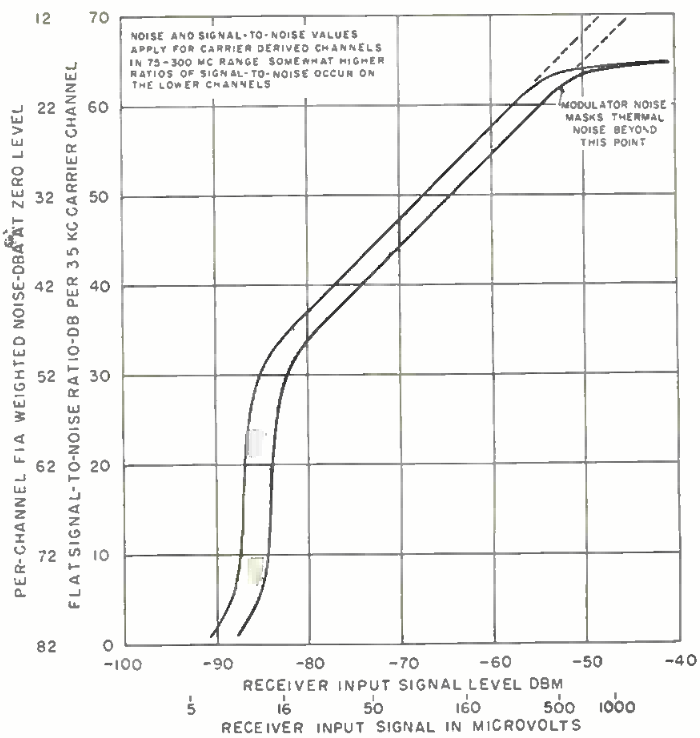


Fig. 4: Thermal noise characteristic of a Lenkurt Type 72B 900 MC FM microwave receiver.

No. 37—VTVM High-Frequency Error

By J. F. SODARO

Nomograph provides a quick calculation of the error introduced by the transit-time effect in the input diode

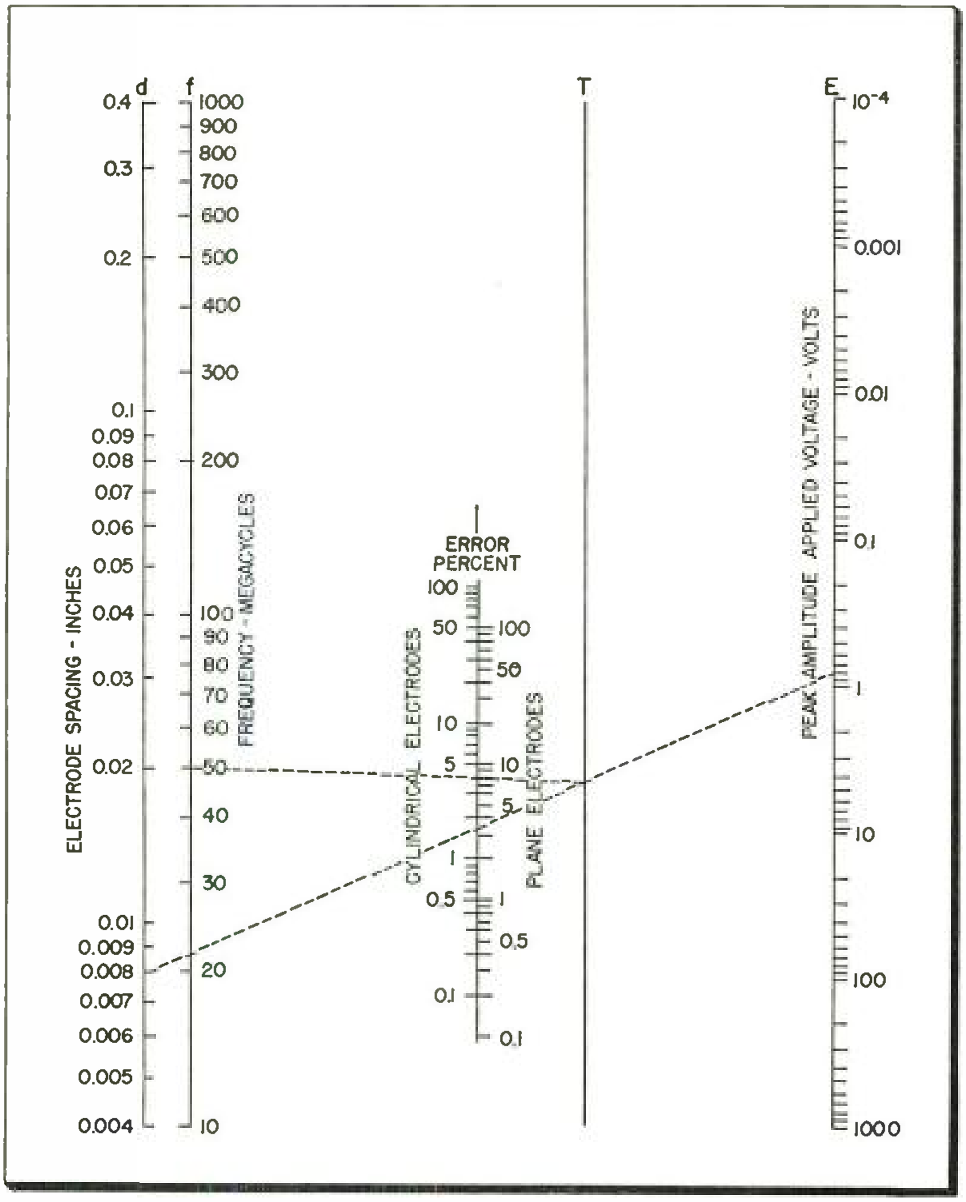
At very high frequencies the VTVM indicates less than the peak applied voltage because of electron transit-time effect within the input diode. When travel time is a large percentage of the input-voltage cycle-duration, some electrons may not pass from cathode to plate before plate potential falls below the value required to attract these electrons. The transit-time is proportional to the cathode plate spacing and to the shape of these elements. Furthermore, the error is inversely proportional to the square root of the applied peak voltage. For moderate to small errors the following relation applies[1,2]

$$\text{Error} = \frac{0.847\ fKd}{\sqrt{E \times 10^{10}}} \qquad (1)$$

in which f is in CPS, K is approximately 1050 for cylindrical electrodes and 2100 for plane electrodes, d is the cathode-plate spacing in inches, and E is peak applied volts.

Engineers designing or using diode-voltmeters for high-frequency measurements may find it desirable to estimate measurement error for such instruments. This error depends upon applied voltage, frequency, and diode characteristics as shown by Eq.1. Repetitive evaluation of Eq.1 is simplified by the use of the nomograph shown in Fig. 1. To use this nomograph, select the electrode spacing in inches on the d scale and peak applied voltage in volts on the E scale. Connect these points with a straight line and locate a turning point where this line intersects the T scale. Locate frequency in MC on the f scale and connect this point with the turning point by a second straight line. Where this line crosses the ERROR scale, read the error in per cent using left side for diodes with cylindrical electrodes and right side for diodes with plane electrodes.

As an example, assume that the input diode has cylindrical electrodes spaced .008 in. For an input of .8 v. peak at 50 MC estimate the instrument error. Draw a straight line from .008 on d to .8 on E and locate turning point where this line crosses T. From this turning point to 50 on f draw another line which crosses the left side of the ERROR scale slightly below 4%.



J. F. SODARO, Registered Engineer, 2924 Selby Ave., Los Angeles 64, Calif.

References

[1] F. E. Terman and J. M. Pettit, *"Electronic Measurements,"* p. 25-28, McGraw-Hill, New York, 1952.

[2] L. S. Negaard, "Electrical Measurements at Wave Lengths Less than Two Meters," *Proc. I.R.E.*, p. 1207, Sept. 1936.

Design For A

Shock-Resistant Graphic Milliameter

Reliable operation under shock conditions up to 30 g. such as exist in aircraft, is achieved by using transistorized servo amplifiers and heated ball point pens.

By G. WALTERS
Director of Research
Dalmo Victor Co.,
San Carlos, Calif.

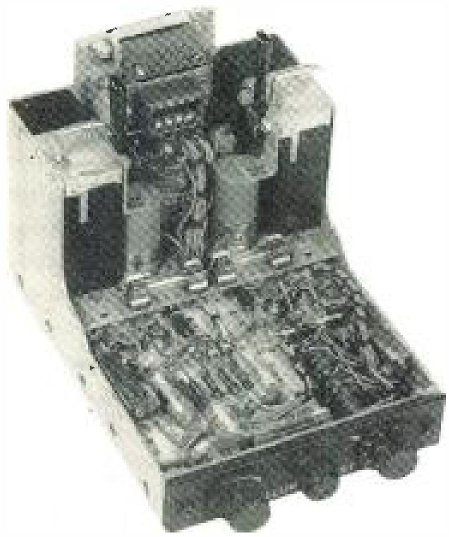


Fig. 1: Switch at right gives on-off and 6 test positions

THE increasing complexity of modern aircraft brings with it an ever increasing need to record numerous functions while in flight. Attempts to utilize existing lab type recorders have had only limited success because of the excessive bulk, weight, and vulnerability to shock and vibration usually exhibited by such instruments.

It has become evident that a successful airborne recorder needs to be designed specifically for such a purpose, and must combine accuracy, reliability, simplicity of operation, and small physical size with ability to operate under widely varying conditions of vibration and shock.

Electronic Section

Fig. 1 shows the electronic section of a recording milliammeter designed for airborne applications. Designed for a full scale range of .5 ma, the unit is composed of a regulated power supply, the circuitry required to provide internal test

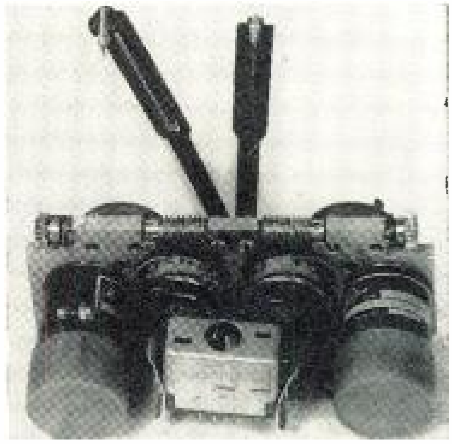


Fig. 2: Ball point pens are electrically heated at low temperatures

TABLE I

Sensitivity	±0.5 ma for full scale deflection
Input Impedance	15,000 ohms
Frequency Response	Full scale to 3 cps 1/10 scale to 15 cps
Dual Pen Recording	Red and green channels completely isolated one from the other and from chassis ground
Paper Width	4.25 in. total 4 in. writing width
Paper Supply	1-15/16 in. diameter roll. 1,000 in. in length
Paper Speed	Manually set to 12, 3, or ¾ ipm
Case Size	5¾ in. wide x 7 in. high x 7 in. deep
Weight	8 lb.
Vibration	10-55 cycles—±0.030 in. excursion
Shock	30 g for 15 msec duration, 3 directions
Temperature	—50° to +71°C.
Writing Time	5.5 hr (at 3 ipm paper speed)
Power Input	115 v. 400 cps at .4 a. 28 v. dc at .25 a.

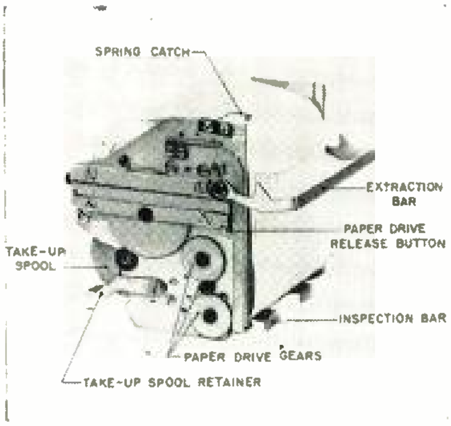


Fig. 3: Chart drive roller adjusts to prevent sideward "creep"

signals, and two plug-in transistor servo amplifiers.

Circuit

A circuit diagram of one-half of the unit is shown in Fig. 4. The power supply is a standard, full wave rectifier utilizing 1N256 silicon diodes with voltage stabilization by a type 5787WA regulator tube. Each plug-in transistor amplifier contains cascaded 903 and 952 silicon transistors driving a pair of 2N57 germanium power transistors.

Stabilization

The gain of the circuit is stabilized by means of negative feedback through a 100K resistor between the base of the 952 transistor and the collector output circuit of the 2N57. The introduction of negative feedback along with the degeneration introduced by the 2 ohm resistors in the emitter circuits of the 2N57 provides adequate stabilization over a temperature range of −55 to +71°C. Each amplifier assembly is approximately the size of a package of cigarettes. The gain of each amplifier is 60 db; the input impedance is 60,000 ohms, and the output impedance is 200 ohms. A maximum average output of 3 watts is supplied to the control winding of the servo motor.

Pen Assembly

A photograph of the pen assembly is shown in Fig. 2. Each pen is driven by a two-phase servo motor through two stages of precision spur gearing. Servo followup voltages are obtained from individual potentiometers which are coupled into the gear train so as to rotate 225° for full-scale pen travel. The pens are zeroed by rotating the potentiometer bodies relative to the recorder frame.

As can be seen from Fig. 2, sturdy pen arms and rugged drive units have been provided to prevent malfunction due to vibration and shock. The design is such that vibrations of 10-55 cps produce no more than ±.030 in. excursion of the pen.

Chart Drive

The third subassembly, the chart drive unit, is shown in Fig. 3, and the complete unit in Fig. 5. Important mechanical considerations in the design of this recorder were provision of self-testing and calibration features, unit construction to facilitate accessibility and service, and a self-centering, sprocketless chart transport unit. Table 1 lists important characteristics of the unit.

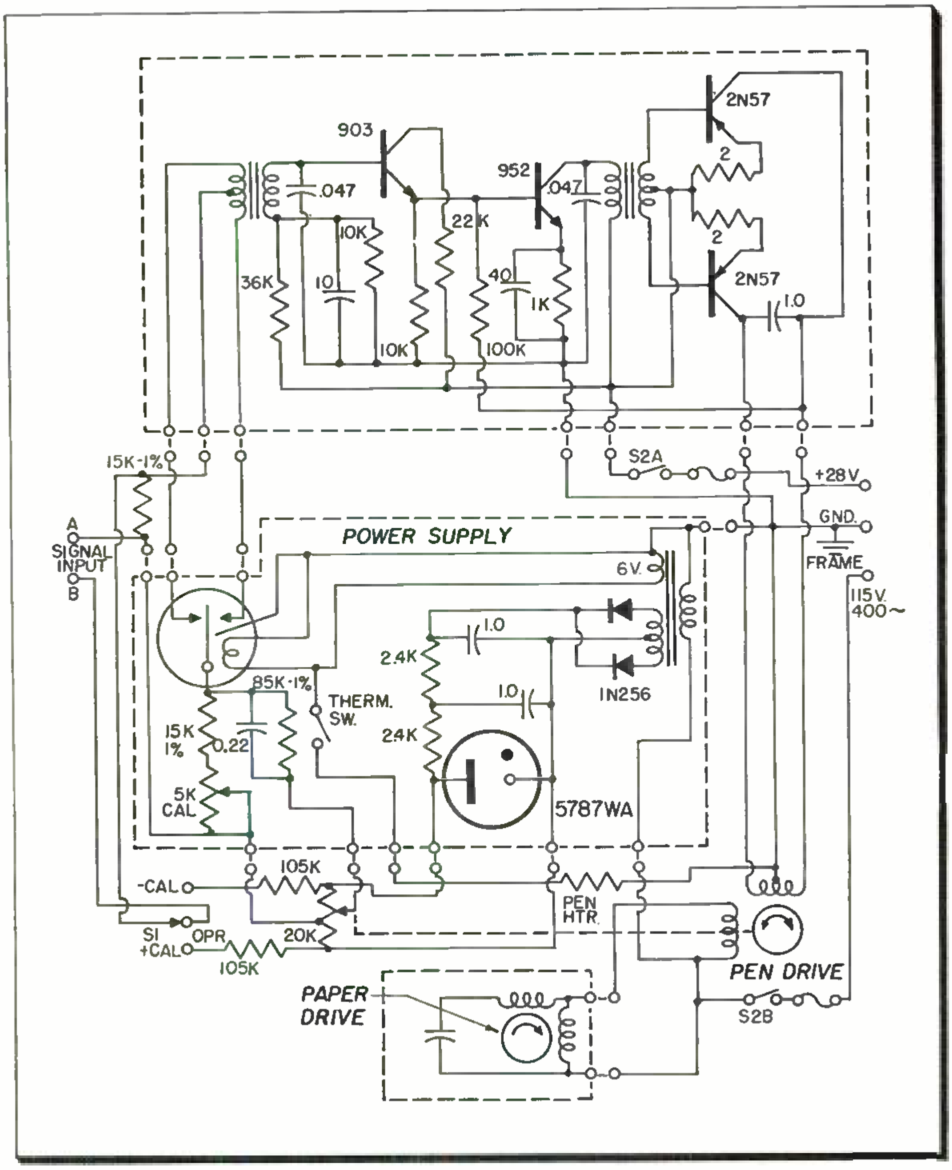
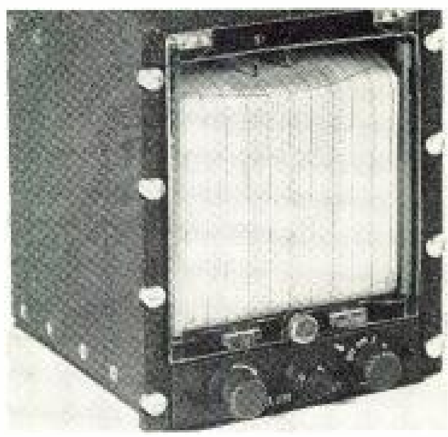


Fig. 4: Gain is stabilized by negative feedback through 100 K resistor

Fig. 5: No shock or vibration isolators are required



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Featherstone Radio & TV 1010 E St 81-1306
General Elec Supply 485 S "I" St 5135
Gough Industries PO Box 222 Hdqrs Los Angeles
Graybar Elec 655 S "H" St ST 9-1051
*Inland Electronic Supply 843 Colton Ave 6-5571
Kierulff & Co Hdqrs Maywood
SAN DIEGO
Electric Supplies Dist 435 2 Ave
Electronic Equip Dist 1228 2 Ave BE 2-3155
General Elec Supply 450 2 Ave BE 9-0271
Gough Industries 3255 5 Ave Hdqrs Los Angeles
Graybar Electric 720 State St BE 3-1361
Radio Parts Co 2060 India BE 9-9361
Radio Specialties Hdqrs Los Angeles
Shanks & Wright 2045 Kettner BE 9-0176
Western Radio & TV 1415 India St BE 9-0361
SAN FRANCISCO
*Assoc Radio Distr 1929 Market St HE 1-0212
Basford Co H R 235 15 St MA 1-8545
*Brown Co C C 61 9 St MA 1-7000
Edwards Co Frank 382 6 St MA 1-9700
Ets-Hokin & Galvan 551 Mission St EX 2-0432
General Electric Supply 1201 Bryant St UN 3-4000
Graybar Electric 1750 Alameda St MA 1-5131
Hauer Radio Parts Karl 281 9 St MA 1-0552
Kaemoer & Barrett 1850 Miss UN 3-3080
*Meyberg Co L J 33 Gough St MA 1-3400
Offenbach & Remus 1564 Market St KL 2-2100
*Pacific Whsle 1850 Mission St UN 1-4843
*San Francisco Radio 1284 Market UN 3-6000
*Smith & Crawford 789 Stevenson St UN 3-2045
*Television Radio Supply 326 Market St EX 2-2898
Westinghouse Elec 201 Potrero UN 1-5051
*Wholesale Radio 140 9 St HE 1-3680
*Zack Radio Supply 1424 Market MA 1-1424
SAN JOSE
Peninsula TV & Radio 881 S 1 St CY 4-8781
*Quement Frank 161 W San Fernando St CY 4-0464
San Jose TV Supply 999 S 1 St CY 4-7900
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Abbett Co E B 345 Francisco GL 3-1130
SANTA ANA
Electronic Supply Hdqrs Pasadena
Graybar Electric 301 French St KI 3-8309
Hurley Electronics 1434 S Main KI 3-9237
Radio & TV 207 Oak KI 2-6741
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Dealers Wholesale 209 W Canon Perdido Hdqrs Ventura
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Santa Monica Radio 117 Santa Monica EX 3-8231
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Mac's Radio Supply 8320 Long Beach LU 8-4111
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*Dunlap Radio & TV 27 N Grant HO 6-7907
General Electric Supply 24 N Aurora St HO 5-7231
Kemo Co E M 50 N Wilson Way Hdqrs Sacramento
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*United Radio Supply Hdqrs Portland
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R F Supply 2367 S 6 St 6572
MEDFORD
General Electric Supply 121 W 4 St 3-2423
United Radio Supply Hdqrs Portland
*Walker Co V G 205 W Jackson 2-4558
PORTLAND
Appliance Whole 600 N W 14 AT 6584
*Central Distrs 1131 NW Couch CA 8-0146
Connelly Co F B 905 NW 12th Ave CA 1755
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General Electric Supply 300 NW 14 Ave BR 0651
Graybar Electric Park & Flanders BR 6641
Home Makers Supply 824 S W 18 St CA 9385
H & R Radio Sup 5210 NE Sacramento AT 7-0057
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North Pacific Supply 2950 NW 29 Ave CA 8-9576
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*Portland Radio 1234 W Stark St AT 8647
Saelens Radio 1605 NW Everett CA 8-6395
*Stubbs Electric 33 NW Park Ave BR 5404
*Tracey & Co 937 NW Glisan St CA 3-6263
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SEATTLE
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Coast Radio 110 University St MA 9133

(Continued on page 155)

New West Coast Products

OSCILLOSCOPE

Model 627R rack mounting 3 in. Oscilloscope, 5¼ x 11 x 19 in., responds from DC to 300 kc and is flat from DC to 150 kc. Horizontal and vertical amplifiers are

identical and balanced. All operating controls are grouped for maximum efficiency and flexible performance. The 3 in. CRT is flat-faced and a tight tolerance type with recurrent or triggered sweep. It expands 8 times tube diameter. **Hycon Electronics, Inc., Pasadena, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-6).

READOUT INDICATORS

Three new in-line readout indicators, the 5910 Series, for counting instruments, feature all numbers in one plane to reduce operator fatigue and reading errors. Indicators retain the reading while the counter accumulates new data, permitting more samples per unit time. Each digit consists of a plug-in module formed

by a p-c board, 2 tubes, 4 p-c relays and a printed display panel. **Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond 3, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-22).

A-D CONVERTER

New eight-bit sine-cosine analog-to-digital converter consists of two disc-type commutators with pick-off brushes. The double-brush V-scan system is used to avoid

ambiguity. The input shaft is scaled at 360° rev. full-scale input. Coding is in continuous serial binary form in increments of 2-8 for values of the functions from zero to one. A ninth bit is included to enable the encoding of the value one. **Librascope, Inc., Glendale, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-3).

TRIMMER POT

Sealed trimming potentiometer, Trimpot Model 230, subminiature in size, meets or exceeds Military Humidity Specifications (MIL-E-5272A). Furnished with wire-wound or carbon resistance element. Wire-wound unit operates at 135°C, and dissipate 0.4 watts

at 50°C. Screwdriver adjusted over 25 turns, with a self-locking shaft for stable settings. **Allen, Dorsey & Hatfield, Inc., 5010 Sunset Blvd., Los Angeles 27.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-25).

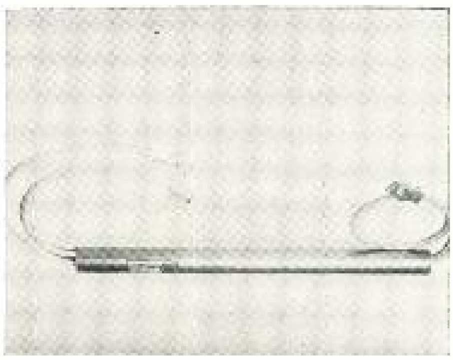
BACKWARD WAVE OSC.

Model VA-161 miniature backward wave oscillator is designed for modern, miniaturized equipment. It is instantaneously tuned by changing voltage. Operates

over the normal 8.5 to 9.6 KMC radar band on less than 300 v. making possible the use of existing radar system power supplies. Contains a permanent magnet which weighs less than 5 lbs. Tube is approximately 4 x ¾ in. Metal and ceramic construction. **Varian Associates, 611 Hansen Way, Palo Alto, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-19).

TRAVELING WAVE TUBES

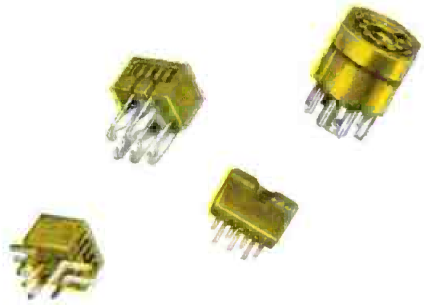
HA-12 S-Band and HA-13 X Band traveling wave tubes feature broadband operation. Primary use for their pulsed power characteristics is in microwave measurements and in medium power driver applications. Positive grid control is provided for amplitude modulation and AGC. Characteristics (HA-12): power out—1 w.;



helix volts—950 v.; cathode current—35 ma.; grid volt—100 v.; magnetic field 600 gauss. **Huggins Labs., Inc., 711 Hamilton Ave., Menlo Park, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-31)

CINCH ☆ STANDARD COMPONENTS

AUTOMATION... automatically made, therefore made with precision metal and electrical components. CINCH automatically assembled parts assure the uniformity and quality mandatory for use in AUTOMATION in the end users equipment.



CINCH SUB-MINIATURE SOCKETS insure positive electrical control, hold tubes securely in place, permit easy maintenance replacement, yield maximum insulation and minimum high frequency loss.

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CINCH MANUFACTURING CORPORATION
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C-R TUBE
CRYSTAL
ELECTROLYTIC
GLASS TYPE; 4 TO 7 PRONG LAMINATED
INFRA-RED RAY TUBE
HIGH ALTITUDE AIRBORNE TYPES
KINESCOPE; MAGNAL, DUODECAL, DIHEPTAL
LOKTAL-MINIATURE-MULTIPLUG-NOVAL-OCTAL (MOLDED BAKELITE, STEATITE, TEFLON, KEL-F AND LAMINATED)
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PRINTED CIRCUIT
SPECIAL SOCKETS TO SPECS
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TV; 110V CIRCUIT BREAKAWAY
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Centrally located plants at Chicago, Shelbyville, Pasadena and St. Louis.

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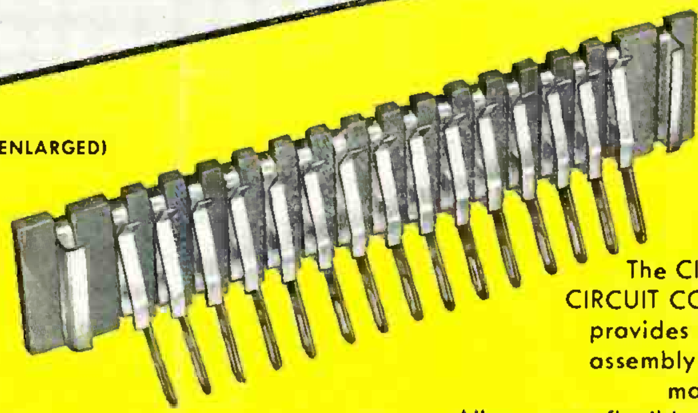
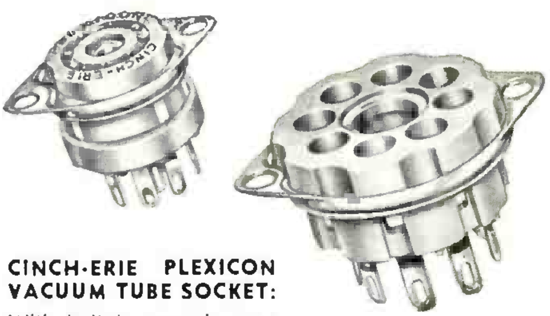


Quantity production of low loss Mica components. Finest molding machines and equipment operated under most experienced guidance and engineering supervision with adequate and unequaled facilities has advanced CINCH to the foremost in production of low loss Mica components in quantity.



CINCH-ERIE PLEXICON VACUUM TUBE SOCKET:
With built-in ceramic condensers, Plexicon Tube Sockets, no larger than standard receiver socket, provide the most effective method of by-passing . . . with condenser close to tube element providing shortest path to the ground . . . capacity up to 1,000 MMF — the tube element may be coupled or by-passed as desired.

The CINCH EDGE CIRCUIT CONNECTOR provides quick, easy assembly. Eliminates moisture trap. Allows more flexible tolerances. Lower cost. Available in materials for both Military and Commercial use.

☆ CINCH metal plastic assemblies fully perform the service for which they were designed and often have anticipated the engineering needs of the future. So that today, judged by demand and usage, CINCH components are "the standard".

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Cinch ELECTRONIC COMPONENTS

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NEW Polystyrene Decade Capacitor

Range:
0.001 µf to 1.11 µf in steps of 0.001 µµf

Accuracy:
within ±1% for any setting

Dissipation Factor:
less than 0.0002

Insulation Resistance:
greater than 1 MMΩ

Dielectric Absorption: *or voltage recovery, 0.1%*

Capacitance Constancy:
values at dc and 1 kc within 0.1%

Voltage Rating: *500v, dc or peak*

Zero Capacitance:
less than 35 µµf

Type 1419-A Polystyrene Decade Capacitor $195

The new Type 1419-A Polystyrene Decade Capacitor combines the best in materials with years of G-R experience in the manufacture of precision electrical components. This is a superb general-purpose laboratory capacitance standard. Extremely low dielectric absorption and loss, high constancy of capacitance and dissipation factor with frequency, and high insulation resistance make this a particularly suitable component for computer and integrator circuits. It is a nearly *ideal* capacitor for d-c work.

Each Type 1419-A Polystyrene Decade Capacitor contains three Type 980 Decade Capacitor Units. These basic Units are constructed to rigid electrical and mechanical specifications. They feature:

- Highest Grade, Polystyrene-Wound Capacitors built around an eleven-point switch; all mounted on heavy aluminum frame.
- Excellent Long-Time Stability . . . individual capacitor units heat-stabilized to obtain performance approaching that of best silvered-mica capacitors.
- Newly Developed Switch Has Very Low Capacitance and Loss . . . is rigidly constructed; supporting columns, shaft and other switch insulation are all of heat-resistant polystyrene; whole structure silver plated; positive positioning provided by cams bearing on phosphor bronze springs. (980-P1 switch available separately at $11.)
- Complete Hermetic Sealing . . . teflon beads used for terminal lead outs . . . all insulation is of highest available quality.

Type 980 Decade Capacitor Units may be bought separately to be built into tuned circuits, wave filters, oscillators, amplifiers, and other apparatus. Similar Units, with paper or mica dielectric for use where dissipation-factor requirements are not critical, are also available at lower cost.

Prices range from $26 to $128.

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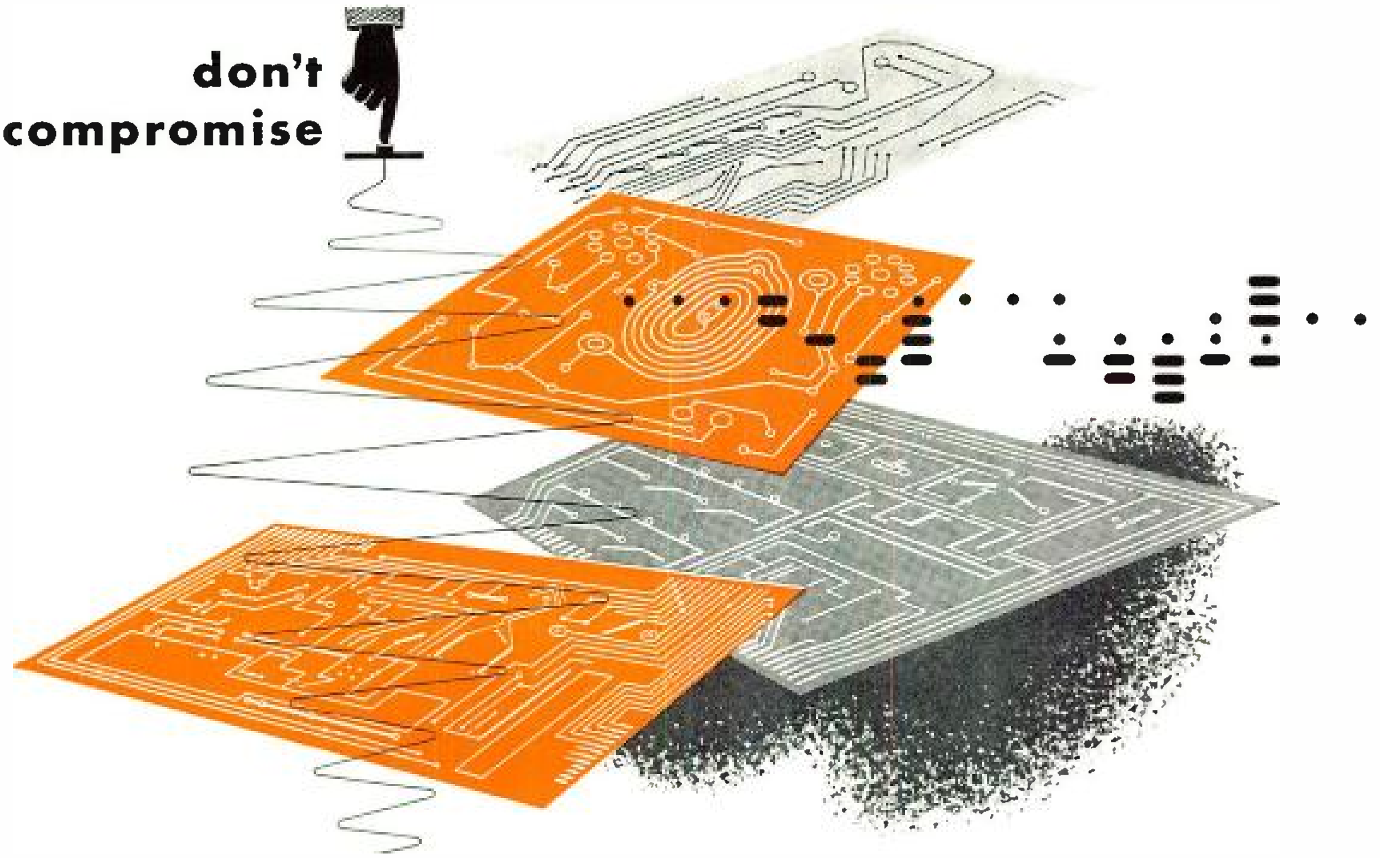

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HERE'S HELP FOR YOU—*our fact-filled, 12 page bulletin entitled "Mechanize Your Wiring with Copper-Clad* PHENOLITE" *contains full information on Copper-Clad* PHENOLITE. *Write for it today! Address Dept. F-8.*

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ARE YOU, LIKE SYLVANIA,

Pushing to Higher Frequencies?

Dr. R. G. Hutter, manager of Sylvania's Physics Research Laboratories, under whose direction basic research in traveling wave tubes is carried on, discussing problems with engineer R. I. Harrison. Dr. Hutter is holding a Sylvania low level 2000-4000 mc amplifier tube in his hands.

When Sylvania started out on a traveling wave tube program, their research engineers specified PRD test equipment. High quality was an important factor in their choice. In addition, they wanted a line of test equipment covering a wide frequency range to take care of future developments in higher frequencies.

If you, like Sylvania, are pushing to higher frequencies, you will be interested in PRD's full coverage and especally in the —

PRD MILLIMETER WAVEGUIDE TEST EQUIPMENT

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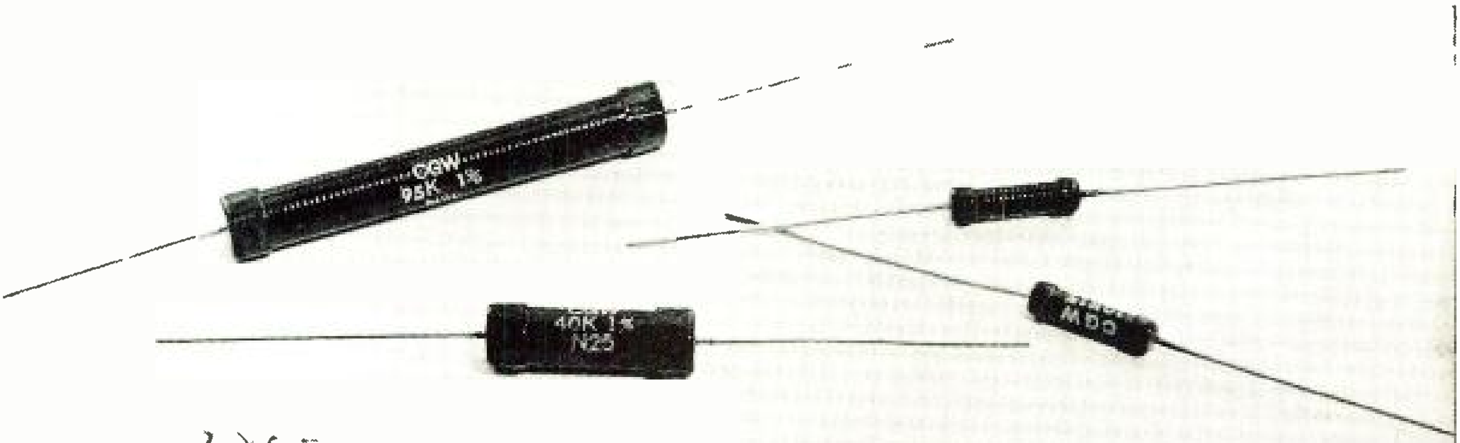

TYPE	POWER RATING	RES (MAX)	RES. (*CRITICAL)	VOLTAGE
N20	½ W	10 K		
N25	1W	400 K	10 K	350
N30	2W	1 MEG.	250 K	500
			281 K	750

* Full rated power

New film multiplies Corning Type N resistance range 10 times on N 25 - N 30 types . . . closer tolerance TC now available

Now you can use rugged, stable Corning Accurate Grade Resistors of high resistivity in your critical circuits.

Corning scientists have developed a new 600 ohms per square resistive film. This new film, which is integrally bonded to the glass core, increases the resistance values for each Type N size as noted above. This table shows you the new ratings.

With this development, you also get a much improved temperature coefficient. It can be guaranteed to ±300 ppm/° C. over the temperature range of −55° C. to ±105° C. referenced to 25° C.

You get these noninductive resistors in standard tolerances of 1%, or closer if you wish. They are stable, have low voltage coefficients and noise levels so low they are difficult to measure. The film and the core are impervious to moisture. Even rough production handling and thermal shock of soldering will not alter values. Corning Type N Resistors meet or exceed MIL-R-10509A specifications.

You can use them in circuits where other precision resistors are unsuitable or in the place of costly wire-wound resistors. With their stable, noninductive, low-noise characteristics, you can use them in test equipment, high-frequency circuits—wherever you're working with low-signal, high-gain amplifier stages.

Our catalog sheet details complete information. We'll send it to you with samples and very interesting price lists at your request. Write us or circle this publication's reader service number.

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Low-Power 3-, 4-, 5-, and 7-watt sizes. Highest resistance range of any low-power resistor.

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Type WC-5—5 KW water-cooled. Range —35 to 300 ohms. Versatile, adaptable.

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Components Department, Electrical Products Division

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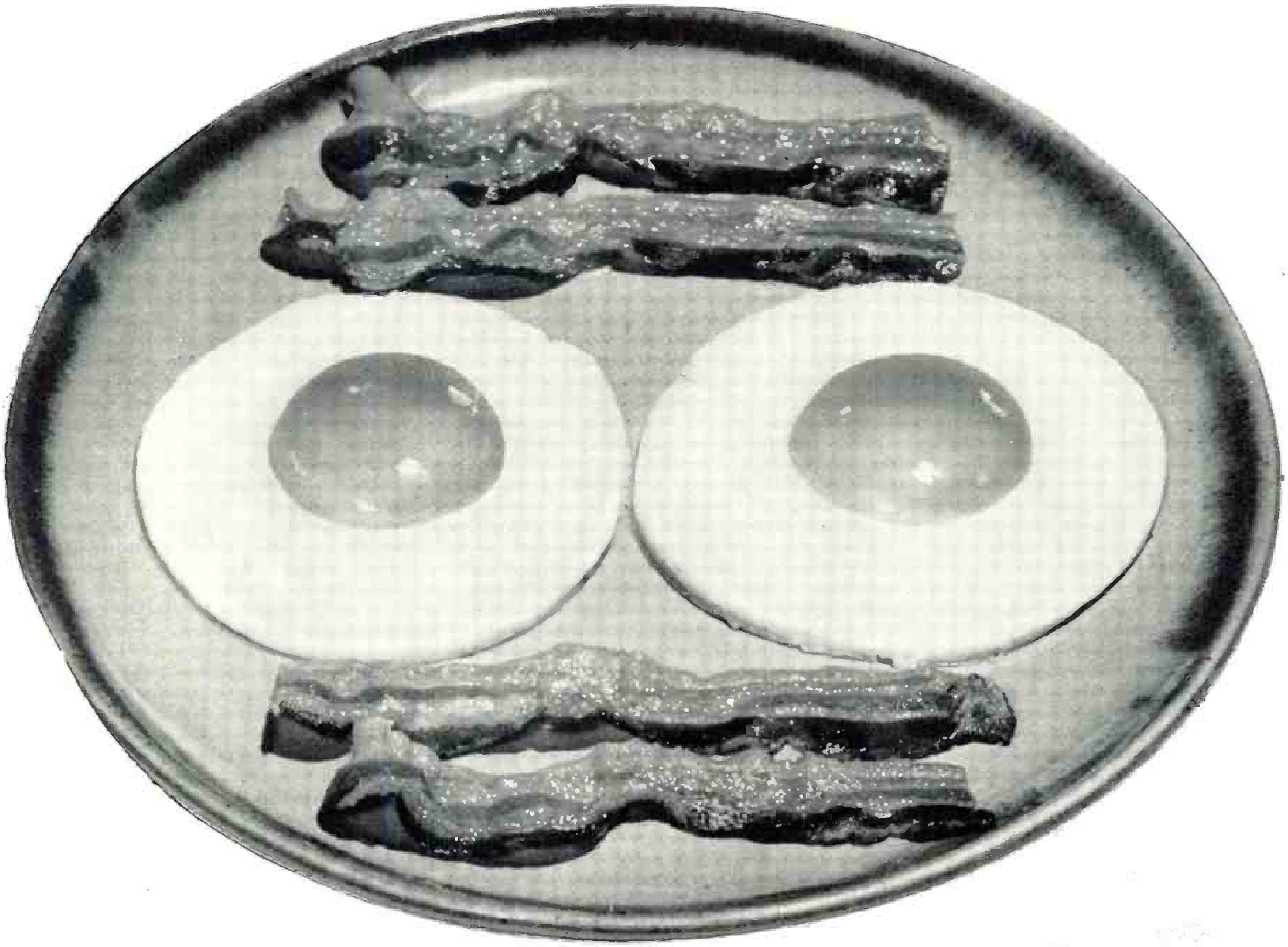

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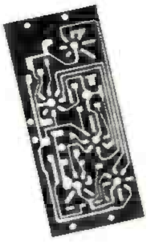

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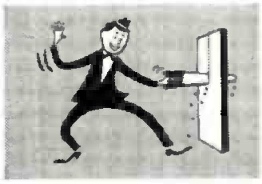

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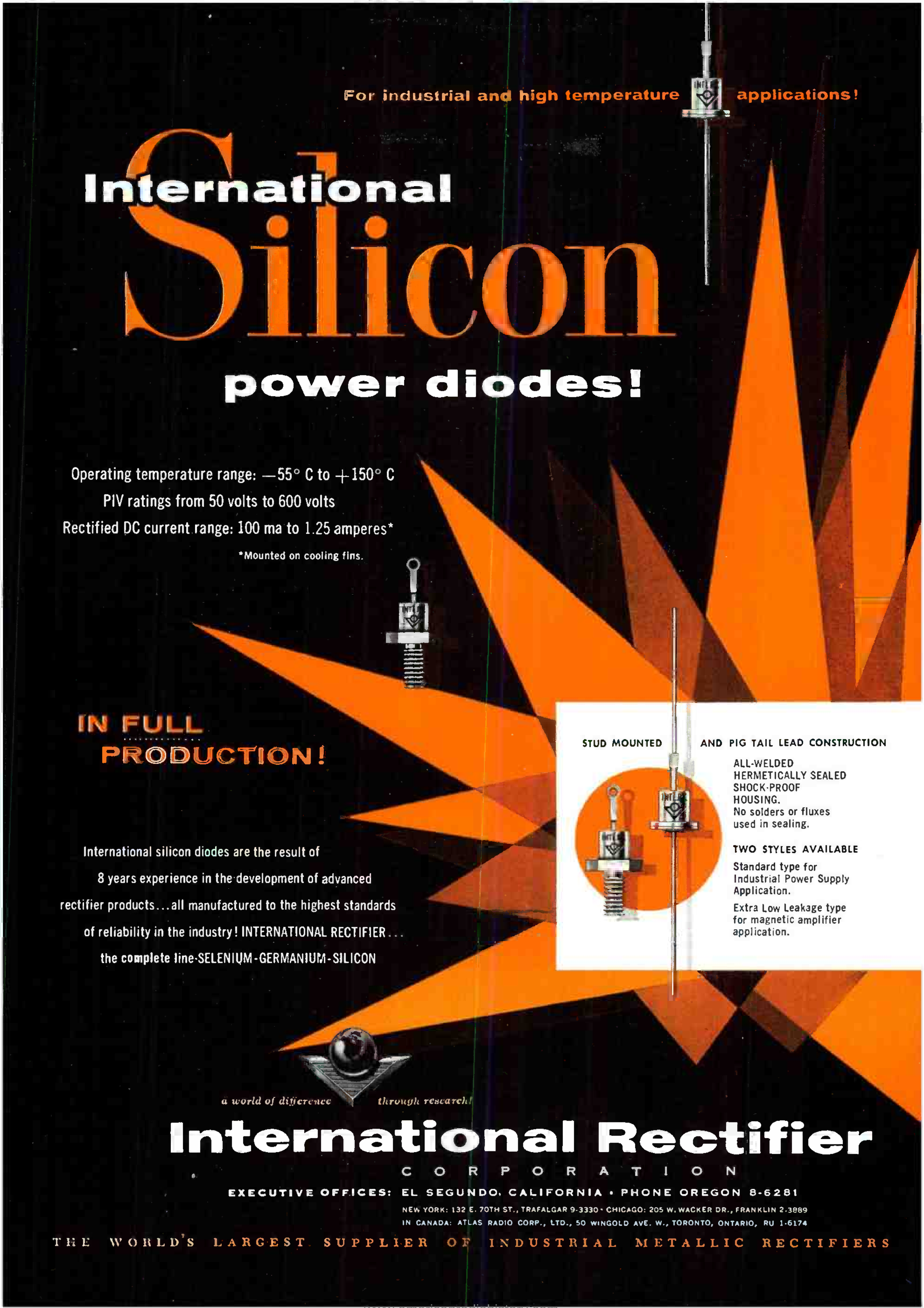
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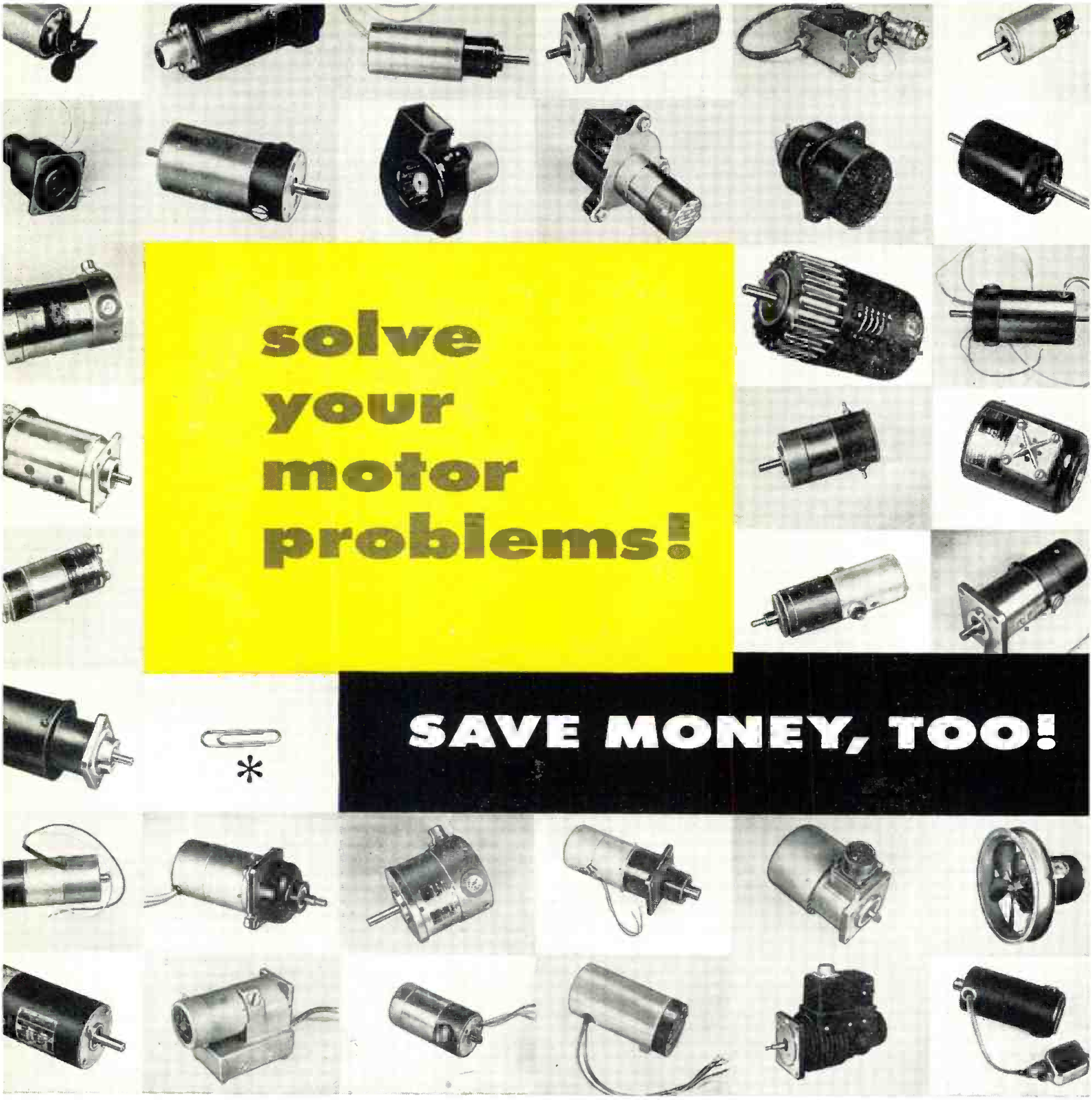

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* Motors are shown at same reduction as this photo of standard paper clip.

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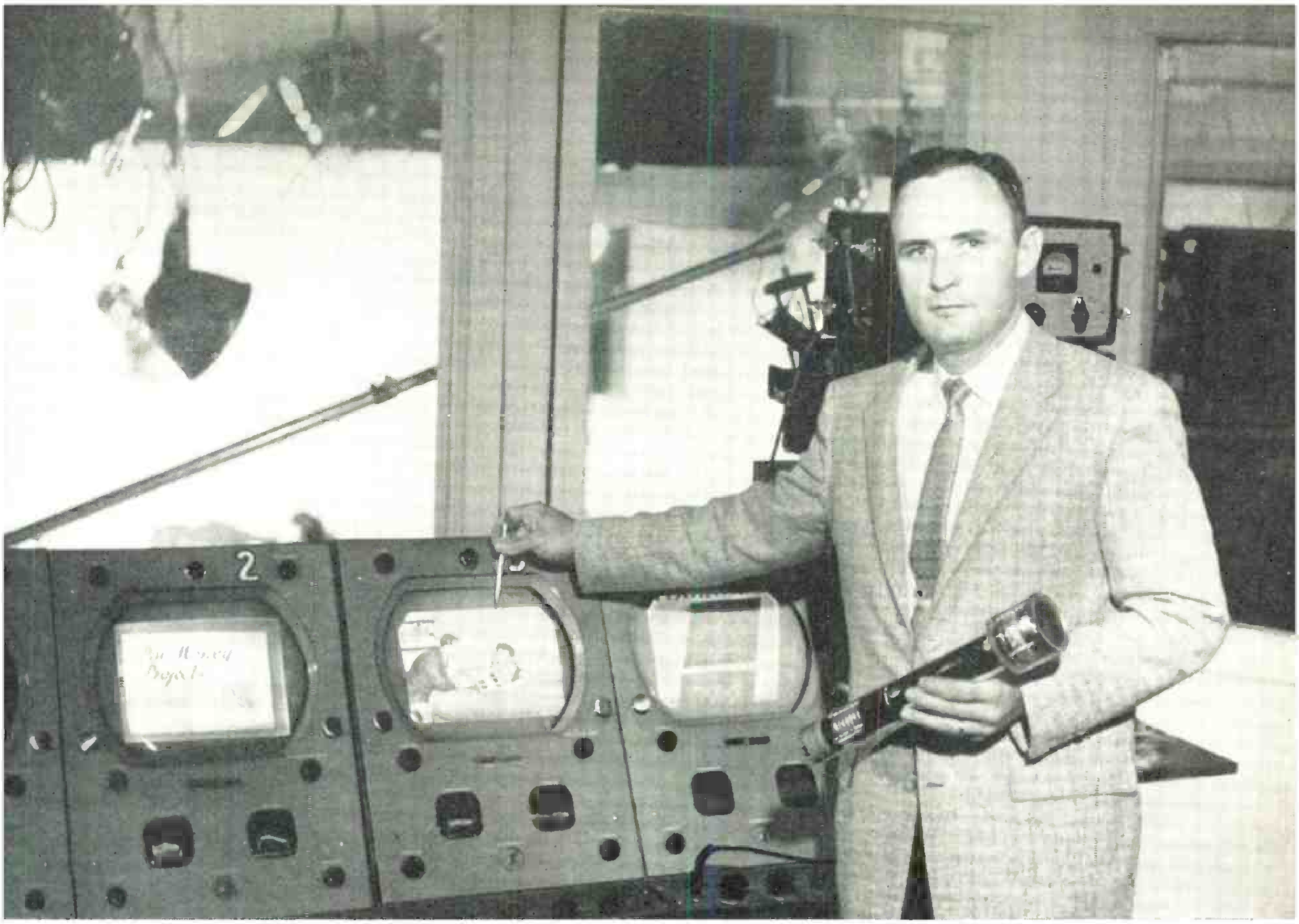

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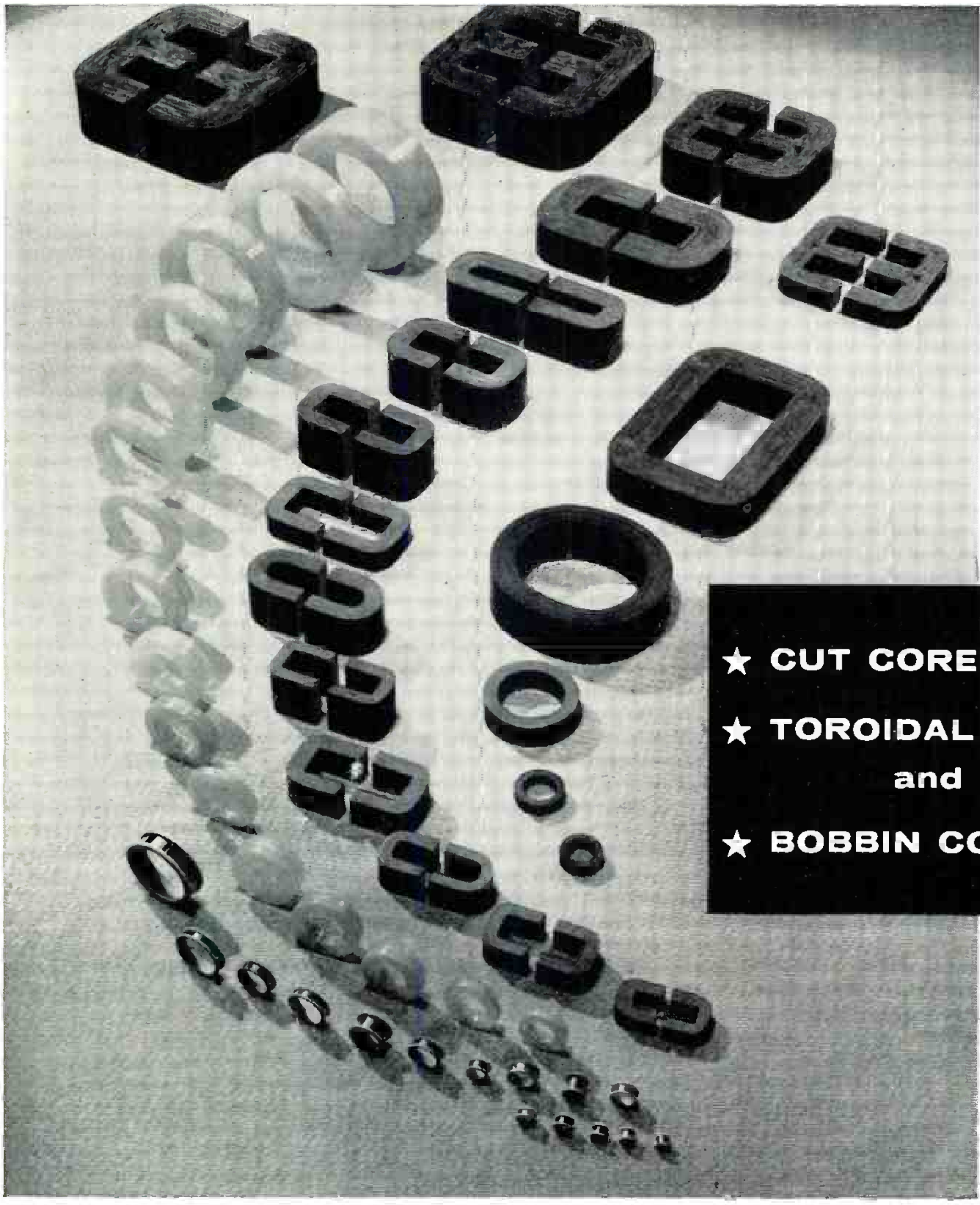

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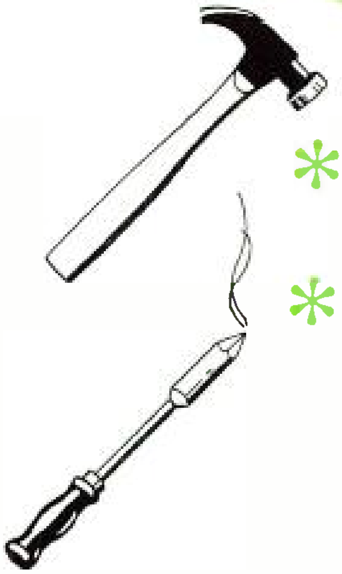

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Video Recorder

(*Continued from page 73*)

is passed through the necessary electronics to provide a video monitor circuit. The picture appearing on the monitor is thus derived from the same FM signals which feed the heads. Actual current in the record heads is indicated by a meter on the control panel. Positive assurance that normal recording is in process is thus always visible.

Sound Track

The sound track is recorded directly along the upper edge of the two-inch tape in a conventional manner. The circuitry and performance of the sound system are comparable in every way to those of a professional audio recorder. Frequency response and signal-to-noise ratio make the fullest possible use of the FM television sound transmission medium. Preservation of high fidelity sound, long unavailable in delayed television broadcasts, is an inherent advantage of this magnetic recording method.

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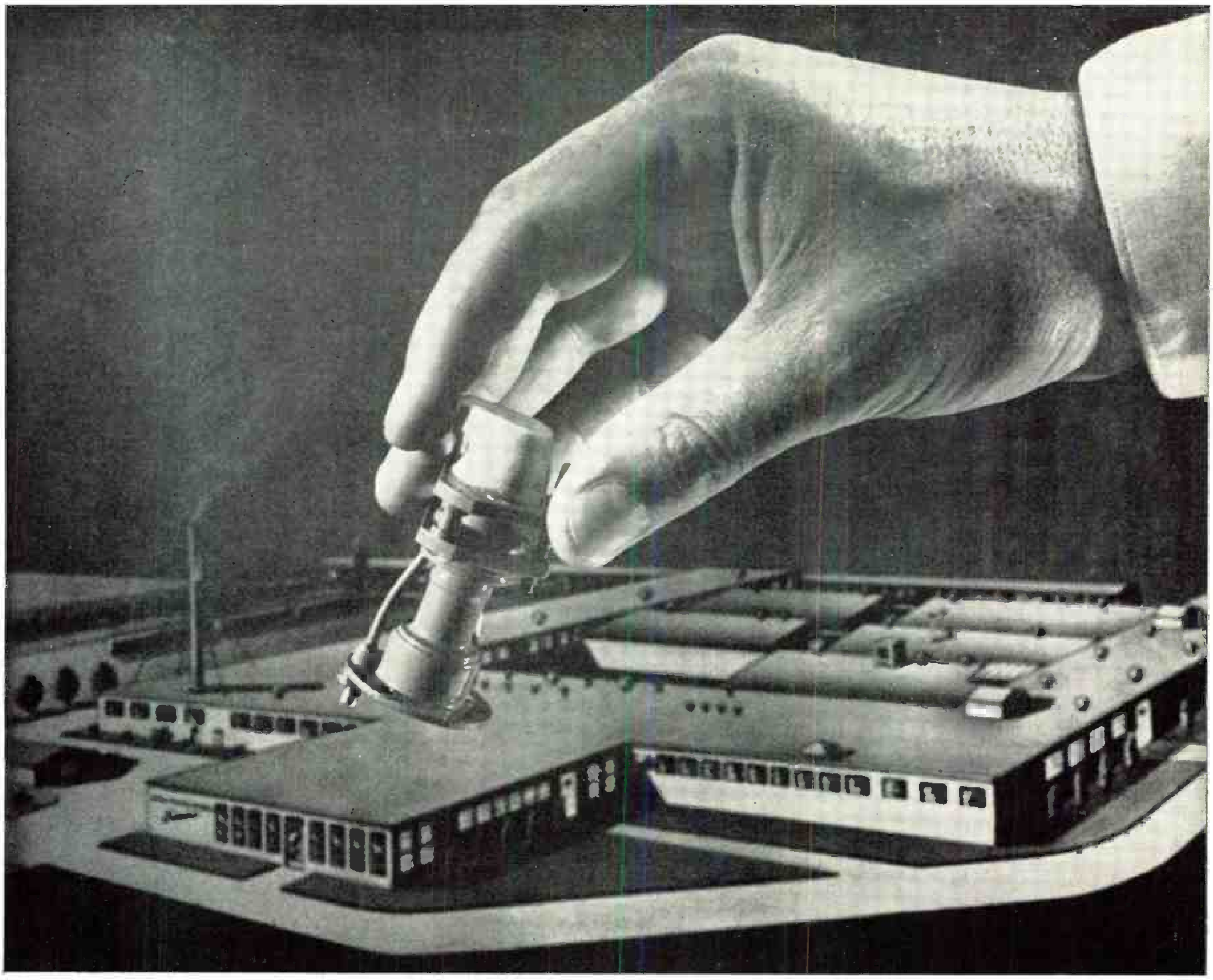
Multiplexed on the control track is a narrow-band audio channel, on which may be recorded instructions for later playback, information concerning the "take," or any other spoken cues which the user may desire. Its presence in no way influences the function of the control, video, or sound tracks.

Performance

The "live" quality of the video tape playback is due mainly to two inherent advantages over fast photographic delay systems. The electrical transfer-characteristic of the special FM recording process is inherently very nearly linear, giving faithful reproduction of the full gray scale. The resolution capability of the video tape recorder considerably exceeds that of the average TV receiver.

Thus, when a tape recorded program is telecast, the limitation of picture quality will be in the home receiver rather than in the transmission. Horizontal resolution, de-



Hand holds Eimac 1K015CA local oscillator C Band Klystron, 5300-6000mc

New EIMAC Microwave Center Opens at Salt Lake City, Utah for Research and Production of Local Oscillator Klystrons

A new microwave facility for Eimac local oscillator reflex klystron research and production opened last month at our Salt Lake City, Utah plant. For 13 of the 22 year history of Eitel-McCullough, Inc., the production excellence of the Salt Lake City installation has been instrumental in establishing Eimac as the world's largest manufacturer of transmitting tubes.

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termined by the bandpass and by the constants of American TV broadcast standards, is 320 lines.

Operation

In function, the video tape recorder is a logical extension of present day audio recording practices. In common with audio tape recorders, it has push-button control, re-usability of tape, immediate playback, and excellent relation of original versus reproduced quality. It can, therefore, perform for the TV industry something like the same revolution which the audio magnetic recorder has already performed for the radio and recording industries.

Other Applications

Since the video tape recorder is basically a long-playing, wide-band recording device which presents at

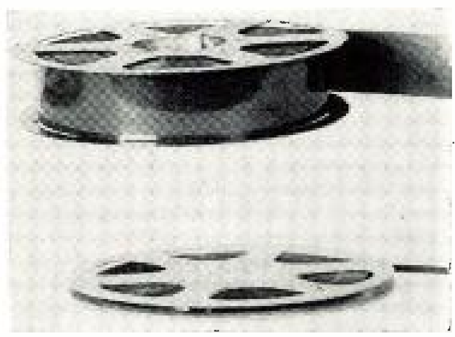

Fig. 5: Two-in. video tape compared to conventional ¼-in. audio tape

its output all of the information in a signal 4 mc wide with a signal-to-noise ratio in excess of 30 db, it is clear that the unit is adaptable for color TV, radar signals, computer information, and other high-speed data. Engineers are already approaching the solution to the problem of color TV recording, with the eventual aim of producing a machine handling either monochrome or color.

10% Price Cut on Germanium Rectifiers

A price reduction averaging 10 per cent on 5 to 10 amp germanium rectifiers has been announced by GE. The new prices of the rectifiers bring them within the price range of other equivalent dry rectifiers.

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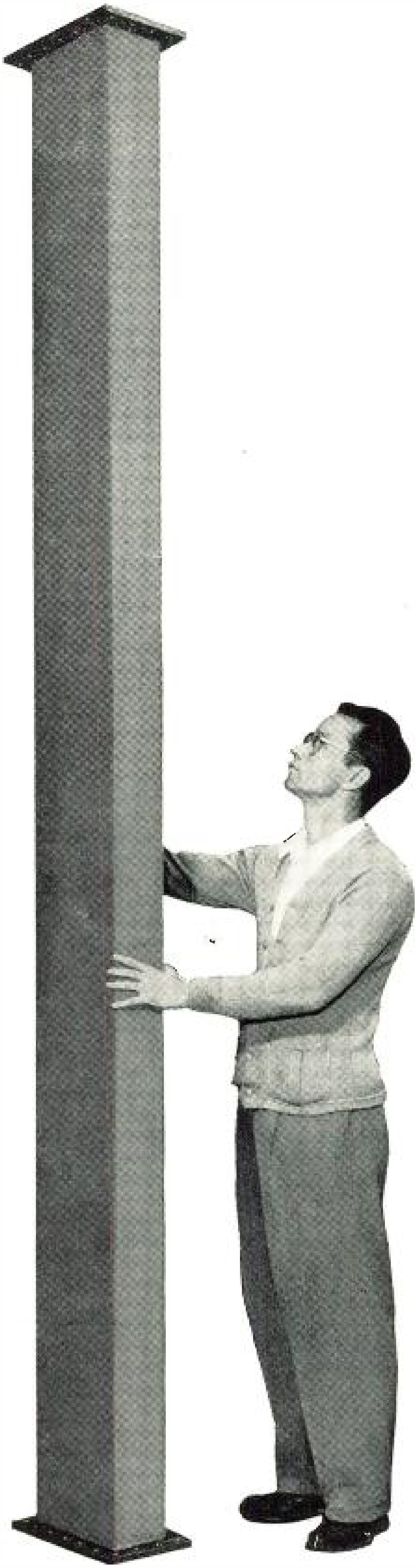

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Relay Tests

(Continued from page 70)

selected duration will indicate failure. The range of contact separation time should be between 5 to 1000 µsec. For convenience, it should be possible to select any value as the reject level within this range. In addition, the instrumentation should measure contact resistance, insulation resistance, pull-in and drop-out voltage (or current), and other characteristics which may be critical under vibratory conditions representative of the actual operating life of the relay. Even though the measurements are not a requirement of any current military specifications, relays must be appraised in environments closely simulating the expected service conditions to attain the magnitude of reliability required in airborne equipment.

New Designs

Relay engineers are recognizing shortcomings of the clapper type armatures. This recognition is evidenced by the increasing number of relay designs with plunger or balanced rotating-type armatures. The results are that recent designs, such as balanced rotating-armature relays, have been vibrated as high as 35 g acceleration through a frequency spectrum from 3 to 2000 cps without evidence of chatter. Plunger type relays are also being successfully vibrated at 25 g. A limiting factor still seems to be contact springs. It is hoped that the information presented here demonstrates the simplicity of some measures which can be used successfully toward improving relay reliability under airborne operating conditions.

Factory Service For GE Mobile Equip.

A new sales policy, under which the factory will accept mobile radio service contracts, has been announced by G. A. Svitek, newly-appointed national service manager for General Electric Communication Equipment.

Antenna Design

(*Continued from page* 85)

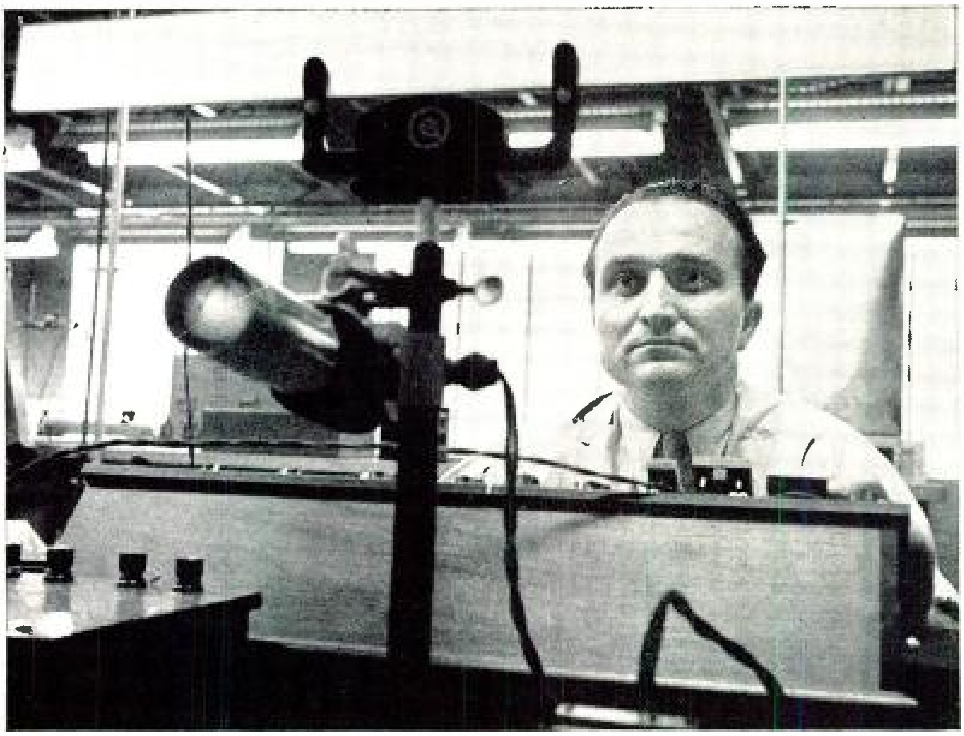
quires a length of about 5 ft.—much too great for top or bottom locations. Several possibilities are indicated and their relative merits are being investigated at the present time. One location which appears attractive from the pattern standpoint is a vertical dipole in front of the helicopter, but this type of installation will cause some inconvenience for engine maintenance crews. Possibly a better alternative is two elements, one on each side of the aircraft fed in phase. The spacing between each element and the side of the aircraft must be sufficiently large so that a satisfactory radiation resistance can be obtained and yet not too large so that lobing in the horizontal plane occurs.

Vertical Whip

Another possibility appears attractive with some aircraft which have hollow rotor shafts. Acceptable patterns have been obtained with a vertical whip projecting through the top of the rotor drive mechanism. With this arrangement, the clearance problem is eliminated except when storing the helicopter in space with limited vertical clearance. Possibly a simple disconnect device would suffice, however. If all of these approaches are found to be impractical, automatic matching may be the only remaining alternative. The weight penalties attached to this solution have not yet been assessed.

The location of ADF loops follows accepted practice. Fig. 5 shows the results of electrolytic tank measurements on a H-21 helicopter. As can be seen, there is considerable freedom in location of a loop antenna assuming a possible compensation in the ADF set of 20°.

For sense antennas, a zero tilt angle (null directly downward) is very desirable. With single rotor helicopters the best location is usually near the axis of the rotor which may necessitate a bottom mounting. With restricted clearances, the standard "T" antenna may be undesirable. One possible solution is a faired-in top loading plate for a vertical antenna. A 17 in. square plate spaced about



Scientist at control box of a Sanford-Bennett High-H-Permeameter measures hysteresis loop of Indox ceramic magnet.

How temperature affects magnets

An interview with Dr. Rudolf K. Tenzer, scientist, The Indiana Steel Products Company

BECAUSE PERMANENT MAGNET remanence changes, resulting from varying temperatures, often necessitate corrections, compensations, or allowances, Dr. Tenzer undertook a series of studies on the subject. Some of the data used by him in answering the questions posed below resulted from work sponsored by the Wright Air Development Center of the U. S. Air Force. Reprints of an article by Dr. Tenzer on the subject are available by writing The Indiana Steel Products Co., Dept. N-8, Valparaiso, Ind.

Question: How does the remanence of permanent magnets vary with temperature?

Answer: Normally, remanence decreases with an increase in temperature . . . becoming zero at the Curie point, where all ferromagnetic properties vanish.

Question: Does a change in temperature result in a permanent change in remanence?

Answer: Not necessarily. Investigations which we have conducted show that temperature effects on ferromagnetic materials reveal both non-reversible and reversible variations.

Question: Can the result of these influences be evaluated?

Answer: Proper measuring techniques will evaluate the non-reversible variations as well as the reversible variations.

Question: Are non-reversible variations permanent changes in the remanence of a magnet?

Answer: Non-reversible variations are permanent until the initial remanence is restored by remagnetizing. This effect is not the same as irreversible metallurgical changes which prevent restoration of initial remanence by remagnetizing.

Question: What are reversible variations in remanence?

Answer: When a magnet has been stabilized for a certain temperature range, remanence variations within this temperature range are reversible.

Question: How are magnets stabilized for a given temperature range?

Answer: The magnet is exposed to repeated temperature cycling over a given range until the non-reversible variation becomes zero and remanence at room temperature remains the same for each additional cycle.

Question: Can the amount of remanence variation with temperature be predicted?

Answer: Our experiments in this field have produced quantitative results which can be used in predicting both the reversible and the non-reversible variations in remanence resulting from temperature change.

Question: Over what temperature range can these measurements be applied?

Answer: Our initial work in this field has been carried out in the temperature range from —60°C to 350°C.

Indiana expands research and production facilities

Currently under construction at Valparaiso, Ind., is a half-million dollar addition to the main plant of The Indiana Steel Products Co. The new structure will provide facilities for expanded research of magnetic materials, and increased production of Indox ceramic permanent magnets.

"Cattle Magnets" protect Bossie from stomach-aches

Cows often consume nails, staples and wire with their food. This causes a disorder called "hardware disease." To prevent it, you can feed Bossie an Indiana "Cattle Magnet." The magnet remains in her first stomach, gathering the stray metal. This keeps it from passing to her other stomachs (she has four, you know) where it can cause great distress.

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INDIANA PERMANENT MAGNETS

3 in. from the skin appears adequate.

For marker beacon reception on small helicopters, a factor is encountered which with larger aircraft need not be considered. The antenna on the aircraft is polarized with the electric vector along the line of flight. In other words, it is parallel to the fore and aft axis of the helicopter. At 75 MC. a wavelength is about 13 ft. With the smaller helicopters this means an over-all length of 2 or 3 wavelengths. Pattern measurements show that the signal downward will, in general, not be single lobed but will have several lobes with depressions between in the order of three to six db deep. The resulting effect on the marker beacon operation has not yet been determined.

Rotor Modulation

An even greater departure from conventional fixed-wing antenna design techniques is caused by the movement of the rotor blades. Rotor modulation adds another factor to the basic variables of pattern and impedance characteristics which must be considered by the antenna development engineer.

Fig. 1 shows the amplitude modulation produced with a short vertical stub top loaded with a horizontal bar with two different orientations. Fortunately, laboratory measurements indicate that the effect of rotor modulation of this magnitude on present day FM receivers and transmitters is negligible. Operational experience confirms these measurements. Even amplitude modulated VHF and UHF communication does not seem to be greatly affected by the rotor movements.

Modulation Plotting

Although in most instances, rotor modulation does not seriously degrade communication system performance, some navigational systems are adversely affected. Stanford Research Institute has developed equipment for automatically plotting both the modulation envelope and the harmonic components.

The modulation envelope is plotted by rotating the rotor blades while recording a pattern in the normal fashion. The model itself is rotated slowly and the rotor is rotated, by a small motor within the model, at a speed sufficiently slow so that the recorder pen will follow the maximum excursions caused by the modulation. The maximum usable model rotor speed will, of course, depend upon the modulation amplitude encountered with a given antenna installation.

Harmonic Modulation

The percentage of modulation contributed by the fundamental frequency and each of its harmonics can be measured by the use of special equipment in conjunction with the polar recorder. This additional equipment consists basically of: (1) a synchronous motor which drives the rotor at a constant speed; (2) a high gain amplifier which contains an automatic gain control circuit and (3) a series of narrow-band filters by which the fundamental modulation frequency of any of its various harmonics can be selected. The automatic gain control circuit removes the effect of the pattern. In other words, it becomes a circle; hence, by selecting the desired filter the relative level of the fundamental harmonics can be plotted automatically as the model is rotated.

A noteworthy example of a system which is degraded by rotor modulation is the VOR, where the standard receiver compares the relative phase of 30-cps FM and 30-cps AM components to obtain directional information. Any 30-cps modulation introduced by the rotor blades will cause an error in the indicated bearing. The H-19 helicopter is particularly susceptible to VOR rotor modulation interference (See Fig 6), because its three-bladed rotor is driven at speeds near 200 rpm when cruising, thereby leading to a third-harmonic component of rotor modulation near 30 cps. A standard VOR antenna installation for this aircraft utilizes a "ram's horn" antenna mounted on top of the tail boom. Radiation pattern measurements for this installation indicated that good omnidirectional coverage was provided, since the gain on the horizon was, on the average, only slightly less than an isotrope and never dropped to less than 6 db below isotropic gain. However, the critical third-

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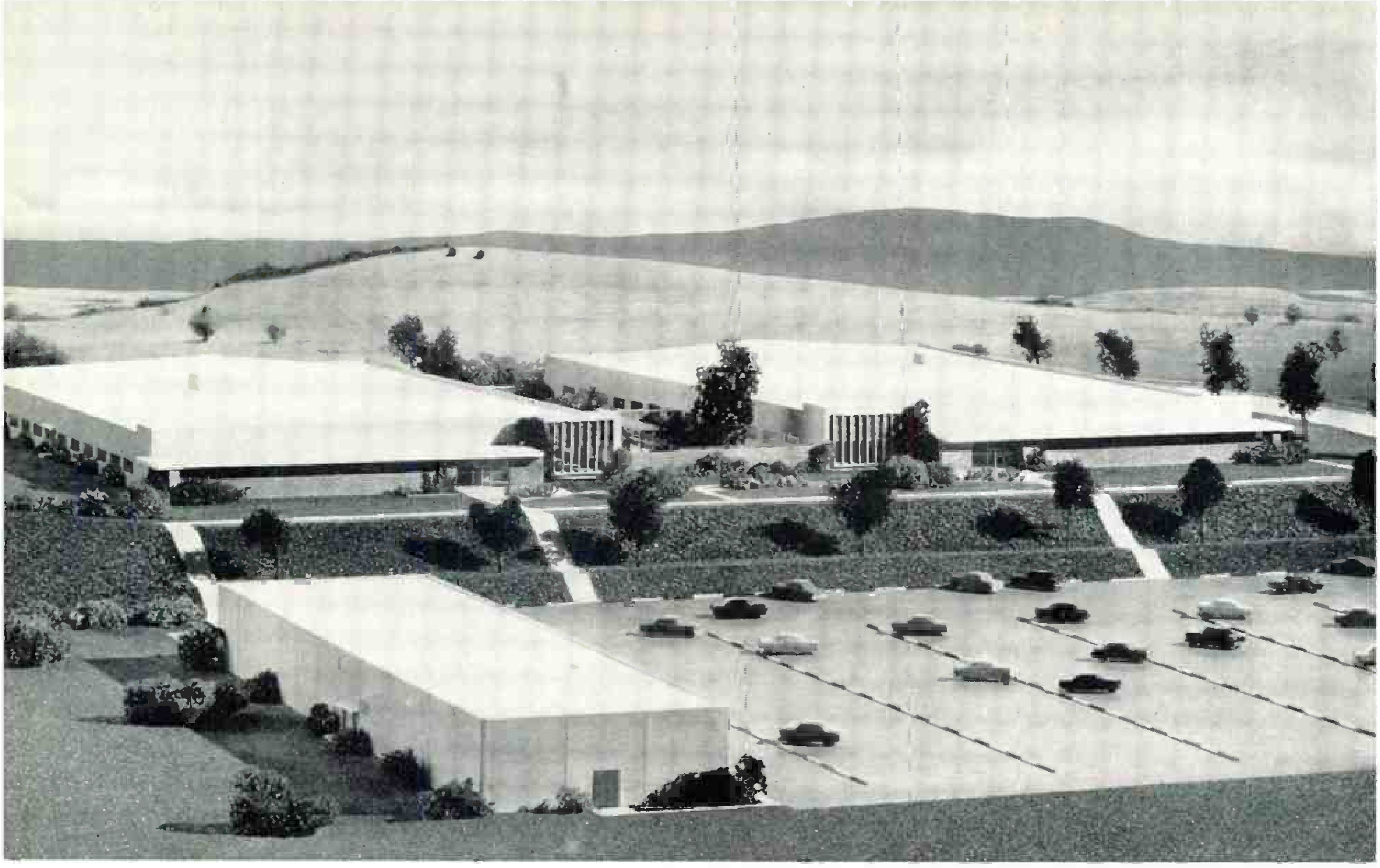

SCALE MODEL, NEW LOCKHEED RESEARCH CENTE

LOCKHEED MISSILE RESEARCH CENTER NEARS COMPLETION AT PALO ALTO

Scientists and engineers soon will transfer research and development on a number of highly significant projects to new laboratories on Stanford University's Industrial Park in Palo Alto, California. They are the first step in a $20,000,000 expansion program.

Advanced research and development will be carried on in more than 40 areas of endeavor, including upper atmosphere problems, nuclear physics, ultrasonic aerodynamics, heat problems, applications of new and rare materials, propulsion, advanced electronics and outer space theory.

The ideal academic and technical environment and living conditions weighed heavily in the selection of Palo Alto as the site for the new laboratories.

The expansion program has created a number of new positions for scientists and engineers of exceptional ability in virtually every field of endeavor. Inquiries are invited.

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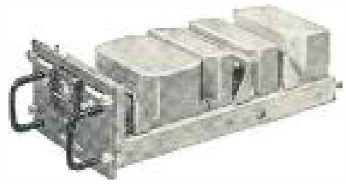

TDI Type 2201A Miniature Subcarrier Discriminator—compact, twin-tee feedback type designed for separation of all subcarrier signals in the RDB band. Basic chassis accommodates any frequency. Features outstanding stability, linearity and sensitivity. Width 5¾", Depth 11⅝", Height 3¾", Weight 7½ lbs.

TDI Type 2201C Miniature Subcarrier Discriminator—same design features as 2201A with meter on front panel, connector in rear, plug-in subminiature tubes, no dust cover. Width 5¾", Depth 15", Height 3¾", Weight 7½ lbs.

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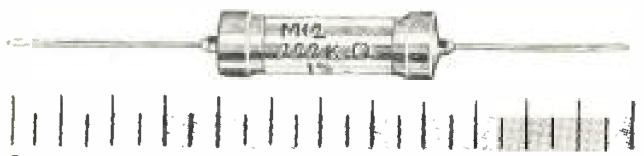

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Stability . . . The resistance value will not change more than 0.05% over a period of six months.

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Temperature Coefficient:
The temperature coefficient depends on resistance value, and lies between 300 and 360 parts per million per degree centigrade. The coefficient is positive in all cases, and in general the lower ohmic values have the higher temperature coefficient in the stated range.

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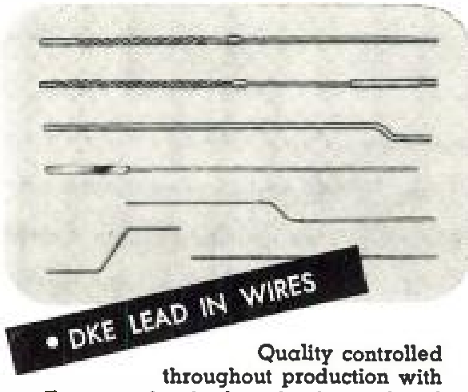

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Antenna Design

(Continued from page 117)

harmonic component contributed over 10 per cent modulation at some azimuth angles. This modulation percentage will produce a ± 8° to 12° swing of the OBS and OBI indicators with engine speeds from 193 to 207 rpm. With balanced half loops mounted on each side of the fin behind the cockpit and below the tail boom, this modulation can be reduced to less than 5%. This reduction, together with simple circuit modifications to the OBS and OBI indicator circuits, results in a maximum swing of ± 8° over the more limited range of engine speeds of 198 to 202 rpm.

With ADF systems, a corresponding critical frequency is the modulation employed in the receiver that is used to drive the loop servo motor. If sufficient modulation is introduced on the sense antenna at this frequency by the rotor blade rotation a serious bearing error can result. However, the modulation frequencies used in presently available equipment are sufficiently high so that the rotor modulation does not degrade the performance appreciably. If the number of blades or the rotor speeds are increased, or if new equipment is designed using lower modulation frequencies, this factor may be of importance.

Freq. Meter

(Continued from page 87)

lation waveform of Fig. 4. The microwave output from the klystron was applied to the transfer oscillator. That instrument was then tuned so that the microwave signal was heterodyned down to 70 kc. This frequency contained the same frequency excursions present in the original microwave signal.

The 70 kc frequency was then applied to the new frequency meter, which measured the average frequency. In addition, for each cycle of the 70 kc frequency, the meter produced a standard voltage pulse. Since the 70 kc frequency contained a frequency excursion, these pulses appeared in time as shown in Fig 6 (b). The original deviation waveform can thus be recovered by averaging the pulses with a suitable low-pass filter, as indicated in Fig. 6 (c).

The amount of deviation can be determined readily, since the peak-to-peak amplitude of the variations in the short-time average level will be exactly proportional to the deviation. The amplitude and width of the pulses is such as to give a d-c output level of —10 volts at the filter output for a full-scale reading on the meter. The applied frequency of 70 kc results

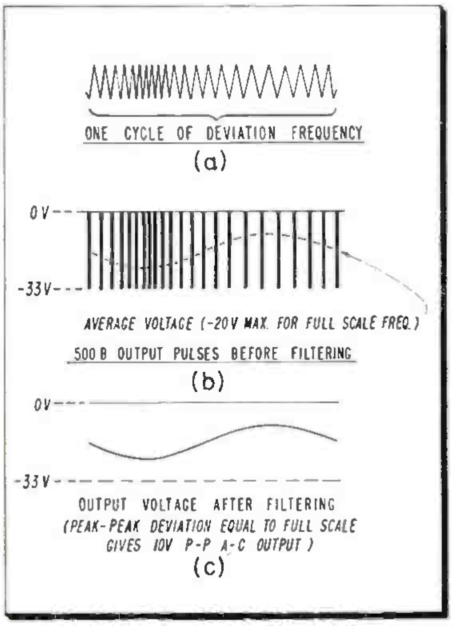


Fig. 6: Waveforms at (a) input, (b) pulse conversion stage, and (c) output of frequency meter

in a 7/10 full-scale reading on the 100 kc range or an output voltage of 0.1 volt d-c/kc. By measuring the peak-to-peak amplitude of the varying component of the d-c output with an oscilloscope, the deviation of 15 kc was obtained.

While the above approach to f-m measurements is not new, the versatility of the setup and the ease with which measurements are made are considerable. The lowest carrier on which f-m could be detected is fixed in the vicinity of 10 cps by the lowest range of the frequency meter. The highest carrier frequency can be above 12 kmc when a transfer oscillator is used. Readout is also simple since an oscilloscope or voltmeter can be made to read directly in kc per division. Non-technical personnel can thus make rapid measurements in production work, since the only judgment required is to determine whether the deviation exceeds a pre-determined level. If an oscilloscope is used, any unusual patterns will be seen and can be investigated.

For laboratory work simplicity may not be the most valued feature of an f-m measurement setup, but flexibility is very important. The ability to measure small f-m deviations directly on almost any carrier frequency with ease and accuracy is valuable indeed. Further, the arrangement has the advantage over a peak-reading modulation meter that waveform and frequency components can be determined.

Spark Gap

(*Continued from page 81*)

impedance matching transformers can also develop high secondary or primary voltages if the load fails or is removed for any reason. Protection against this type of damage is shown in Fig. 3.

Capacitors, pulse forming networks, and by-pass units may be protected against surges as shown in Fig. 4.

Instrument failure in high voltage circuits can cause dangerously high voltages to appear at unexpected points. In the circuit of Fig. 5, should the ammeter or the voltmeter develop an open, the total circuit voltage will appear across the meter terminals. This hazard can be controlled by safety gaps placed as shown.

In all cases of protection of components by safety gaps, the effect of the gap discharge on the circuit and the resultant fault current on the gap must be considered. In the case where the normal circuit operating voltage is below the extinguishing voltage of the gap, the circuit will probably recover after the surge has passed. This would be the condition normally encountered in Fig. 2, choke or inductance protection. The safety gap in this case need carry only the surge energy. In the case where a heavy follow through current will continue after the surge has passed, as might occur in Fig. 4, or a continuous fault current as in Figs. 3 and 4, the continuous dissipation rating of the gap must sustain this current long enough to permit a circuit breaker or a fuse to operate.

As a switch in an operation circuit, a spark gap can provide repeated operations with relatively little change in characteristics if it is run within its ratings. The circuit of Fig. 6 shows a method of

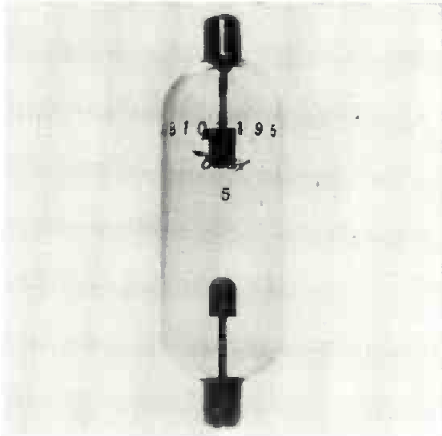


Fig. 7: Commercial spark gap unit

producing high voltage pulses. The capacitor charges through the resistance and periodically discharges through the spark gap. The pulse thus formed is stepped up through the transformer.

The addition of a third electrode to the spark gap produces a unit which can be triggered and becomes more like the conventional thyratron although capable of carrying much higher peak currents.

Sealed spark gaps are presently capable of withstanding operation between +600°F and —100°F temperature range. Static breakdown voltage tolerances can be held as close as those commonly associated with panel type instruments although a 10% tolerance is generally suitable for most applications.

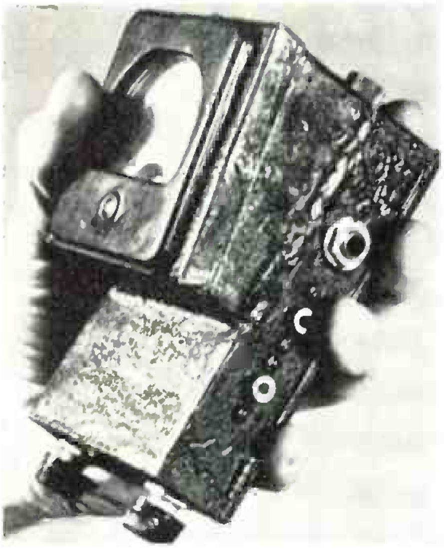
New RETMA President

Dr. W. R. G. Baker, vice president of GE, was elected RETMA president at the annual RETMA Convention in Chicago. Dr. Baker has headed the Association's engineering activities since 1934.

Remote Amplifier

(*Continued from page 74*)

a 22 v. battery to get sufficient output with T2. A load line drawn for a 15,000 ohm load, for a CK722 transistor, shows a wide excursion of collector voltage with a relatively small base current and collector current change, indicating a small driving voltage is required and a very low collector current needed at the operating point. Also, operating voltage is not critical. Thus battery aging should not have much of an effect on distortion. The operating point for the collector of each transistor in the last stage is 2 ma at 22 v. Total amplifier drain, all stages, is about 5 ma. A program output of +4 v.u. is easily obtained under these conditions.



Completed hand-size transistor amplifier

Frequency response of the amplifier is shown in Fig. 2. Measurement was made with 250 ohms input and the output loaded at 600 ohms. Distortion is shown in Fig. 3. Measurements were made at normal program output. Noise is very close to 50 db below normal program output.

Temperature changes in the transistors during operation under the above conditions are very small and the collector current remains sufficiently stable. Collector dissipation is well within limits. Also, the feedback resistors R9 and R10 have a stabilizing effect.

The amplifier described is a high quality, rugged and dependable piece of equipment. It is hoped it will contribute to better, more dependable, and less complicated remote broadcasts.

 For product information, use inquiry card on last page.

Microwave

(*Continued from page 90*)

microwave equipment with respect to intermodulation distortion must be provided by the microwave manufacturer. This data is needed by the transmission engineer before he can design a system consistent with the established transmission standards. A typical microwave system loaded with 120 telephone channels, operating in accordance with accepted loading statistics, will contribute intermodulation noise of about +16 dba to each carrier channel during 1% of the busy hour.

Thermal Noise

Thermal noise in the head-end of the receiver is caused by random motion of electrons in the input resistance and in components of the receiver located before the first amplifier stage. For an adequately designed microwave system, thermal noise will have no significance during normal propagation conditions. Thermal noise has to be taken into account only during the time that fading occurs. The thermal noise data for a receiver should be provided by the manufacturer. A set of curves such as that illustrated in Fig. 4 will give complete information.

When the noise characteristics of the channelizing equipment, the modulator noise, the intermodulation distortion, and the thermal noise characteristics of the microwave equipment are known, the noise performance of the overall system can be calculated for both normal and faded propagation conditions.

With noise factors of the magnitudes described, microwave toll systems employing single-sideband suppressed-carrier channelizing can be extended to 10 or 15 repeater sections without resorting to the use of compandors or heterodyne repeaters. Section lengths up to at least 55 mi. are possible, depending upon the type of terrain to be traversed and the clearance which can be obtained.

Heterodyne repeaters, while capable of reducing noise in long systems, lack flexibility for dropping and inserting channels at repeater and branching points. Such flexibility has proved advantageous in many medium-route installations. Furthermore, maintenance is standardized when back-to-back microwave terminals are used as repeaters.

Reliability

To provide the high degree of reliability required by the telephone industry, the microwave equipment must utilize the highest quality components. Adequate metering must be provided, power supplies should be conservatively rated and adequately fused, and the entire system provided with monitoring and alarm circuits so that troubles can be localized immediately. Equipment arrangements should be such that all components and panels are easily replaceable.

Where equipment is installed at unattended locations, and particularly where the need for exceptional reliability is important, a suitable remote control and supervision system should be installed. The remote control and supervision system should operate over a facility independent of the system it supervises. In the Bell system, the supervisory and control signals of many TD-2 routes are carried over paralleling open-wire, cable, or radio systems.

Frequently, medium-route systems do not have adequate paralleling facilities, and may be required to carry their own remote control and alarm tones. Since a working system is needed to convey supervisory information and, since the most important information concerns unserviceable equipment, standby microwave becomes essential. In fact, for maximum reliability of service, standby microwave equipment and an adequate remote control and supervision system go hand-in-hand. Fig. 5 shows an array of microwave equipment and its associated remote control and supervisory equipment for use in the telephone network of the Hawaiian Islands.

Reliability is also dependent upon freedom from fading. The results of extensive operating experience, particularly in the vicinity of 900 MC, has made it possible

For product information, use inquiry card on last page.

to engineer systems with conservative repeater section lengths up to 55 mi. which are almost completely free of fades.

Performance records of 99.80% for single-section systems without standby, and 99.98% for multisection systems with standby are being achieved by operating companies using routine maintenance procedures.

The requirement for long life of microwave equipment is related to the requirement of reliability. A telephone company should expect its microwave equipment to serve in the toll plant for at least as long as its associated carrier telephone and telegraph equipment. This imposes an obligation upon the microwave manufacturer to design and supply quality equipment, and then be ready and willing to stock spare parts and to provide spare panels for an indefinite number of years even if manufacture of the equipment has been discontinued.

Compatibility

Microwave equipment specifically designed for use in the telephone industry must include features not normally found in radio equipment used for other types of service. These features include:

1. Same general mechanical characteristics as other telephone equipment.
2. Circuit design and layout in accordance with conventional telephone practices.
3. Electrical characteristics coordinated with other telephone equipment.

The physical arrangement of microwave equipment should be such that it can be used anywhere in the toll plant. The advantages of housing microwave equipment without restrictions in any convenient location are immediately apparent. One of the hurdles which radio has had to overcome in the highly standardized telephone industry is its "special" nature. Special equipment, installed on a roof or in a hut, does not take advantage of the constant routine checking and maintenance procedures long established as standard telephone practice.

(*Continued on page* 146)

ABSTRACTS & REVIEWS of WORLDWIDE ELECTRONIC ENGINEERING

TELE-TECH & ELECTRONIC INDUSTRIES

International ELECTRONIC SOURCES

PUBLICATIONS REVIEWED IN THIS ISSUE

Abbreviation	Publication Name	Abbreviation	Publication Name	Abbreviation	Publication Name
Aero D	Aero Digest	El. Rund.	Electronische Rundschau	Nach. Z	Nachrichtentechnische Zeitschrift
Arc. El. Uber.	Archiv der elektrischen Ubertragung	Freq.	Frequenz	Radiotek.	Radiotekhnika
Auto. Con.	Automatic Control	Hochfreq.	Hochfrequentz-technik und Elektroakustik	Rev. Sci.	Review of Scientific Instruments
BC News	Broadcast News	ISA J	ISA Journal	Rev. Tech.	Revue Technique
Bell Rec.	Bell Laboratories Record	Inst. & Auto.	Instruments & Automation	T-T & El. Ind.	Tele-Tech & ELECTRONIC INDUSTRIES
Con. Eng.	Control Engineering	Insul.	Insulation	Wirel. Eng.	Wireless Engineer
El.	Electronics	Int. Proj.	International Projectionist		
El. Des.	Electronic Design	J BIRE	Journal of the British Institution of Radio Engineers		
El. Eng.	Electronic Engineering				

Also see government reports and patents under "U. S. Government."

ANTENNAS, PROPAGATION

Interference Due to Reflections in Multi-Channel FM Radio Systems, by G. Bosse and M. Wagner. "Freq." May 1956. 6 pp. The effect of different maximum frequency deviation on different FM channels to compensate for expected variations in interference due to reflections is studied by the method suggested by W. R. Bennett et al in Bell Tech. J. (1955). The results are graphically represented.

Problems of Aerophysics in the Hypersonic Region, by J. Bond, Jr. "Aero D." June 1956. 5 pp. At high hypersonic speeds, the dissociation and ionization of air in the immediate vicinity of a vehicle may influence its design. The transmission of radio signals through the shock layer becomes increasingly difficult as the velocity of the object increases. The determination of the power required to transmit a radio signal through the shock layer depends upon the signal frequency and on the distribution of electrons in the shock layer.

An Antenna System With a Reflecting Mirror, by V. D. Kuznetsov. "Radiotek." March 1956. 12 pp. The paper analyzes the operation of an antenna system with a reflecting mirror. It discusses the problems of the optimum shape for the surfaces of the antenna and mirror, the efficiency of the energy transfer from the antenna to the reflecting mirror, the utilization of the surface of the upper mirror, the gain coefficient. the shape of the directivity pattern and the shielding action of the reflector. Formulas are derived which permit design of the system.

Helicopter Antenna Design, by A. Ellis. "T-T & El. Ind." Aug. 1956. 4 pp. Unique problems arising from the configuration and function of helicopters are discussed. New methods and equipment have been designed to study radiation shielding, rotor modulation, harmonic ratios, and airframe resonance.

Systematic Investigation of the Effect of the Geomagnetic Activity on the Nocturnal Critical Frequencies of the F_2-Layer, by G. Lange-Hesse. "Arc. El. Uber." April 1956. 6 pp. A statistical examination of the deviation of the nocturnal critical frequencies of the F_2-layer establish its dependence on geomagnetic activity, sunspot cycle and season. Figures indicating the reliability of predictions of nocturnal disturbances in HF radio transmission are derived.

AUDIO

Ampex's New Video Tape Recorder, by R. Snyder. "T-T & El. Ind." Aug. 1956. 3 pp. Describes a new tv recorder using a multi-headed disc, spinning at 14,000 rpm to record 4 mc video signals on a 2-in. magnetic tape traveling 15 ips. Immediate application is program delay service for East-West tv; future applications include color tv and high-speed data recording.

Tape Doubles Response of Disk Recorders, by W. Gilson. "El." July 1956. 1 pp. A method is described for circumventing limited high frequency response of ordinary cutting heads of disk recorders. Essentially, a tape recording is fed into the cutting head, both tape and disk units being run at half speed.

Wide Range Meter Measures Flutter and Wow, by H. Wirth. "El." July 1956. 2 pp. A test instrument is described which measures speed variations in tape recorder transport mechanisms. A simple system using an fm discriminator detects changes in the recorded signal.

Coupled Oscillations in Cavity Resonators having a Grid, by E. Kohlsdorf. "Hochfreq." April 1956. 3 pp. Sound absorbing structures comprising a grid, acting as a mass, and an air cushion between the grid and a wall, acting as a spring, are considered. The effect of mechanical oscillations of the grid structure which couples to the oscillations of the grid-air cushion combination is investigated.

On the Sound Level at Corners, at Edges and on the Walls of Closed Rooms in the Presence of Noise, by W. Woehle. "Hochfreq." April 1956. 3 pp. It is shown that, for specified assumptions, elementary calculations yield the differences in the sound levels at the corners, at the edges and along the walls of closed rectangular walls. Measurements show good agreement for a noise spectrum between 37.5 and 75 cycles in a room of approximately 60 m^3.

The Acoustics of the Berlin Opera, by W. Reichardt. "Hochfreq." April 1956. 11 pp. A model of the opera (1:20) to be rebuilt has been studied. The results of diffusion, clarity, and echo measurements are reported; the reasons for unsatisfactory results pointed out and measures taken to improve such results are described. Results of measurements taken in the rebuilt building are compared to the model measurements.

FOR MORE INFORMATION ON SUBJECTS REVIEWED HERE

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To obtain copies of any articles or complete magazines reviewed here, contact the respective publishers directly. Names and addresses of publishers may be obtained upon request, stating publications of interest, by writing to: "Electronic Sources" Editors, Tele-Tech & ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Philadelphia 39. The editors can recommend translation agencies.

To obtain copies of U.S. patents, and research reports on military and government projects reviewed here, send payment indicated directly to federal agency as instructed in section entitled "U.S. Government."

The Amount of Sound Absorption of Cavities and its Dependence on the Arrangement, by E. Kohlsdorf. "Hochfreq." April 1956. 3 pp. The behavior of sound-absorbing cavities, i.e., a grid structure arranged in front of an air cushion, is studied. Particular attention is given to the incidence of the sound, at right angles or diffuse, and of the arrangement of the cavities as it affects the sound absorption.

Intelligibility of Amplitude-Limited Speech, by H. Schneider. "Freq." May 1956. 10 pp. A comparison of the various methods of limiting the amplitude of a speech signal, such as tilting of the spectrum peak clipping, multi-band transmission, and frequency shift, is presented. Extensive measurements have been carried out and are reported.

CIRCUITS

Minimizing Noise in Electronic Systems, by R. Wendt. "T-T & El. Ind." Aug. 1956. 4 pp. Internally generated noise is a constant problem to equipment designers. Discussed in this article are some causes of capacitive, leakage, conductive, and inductive noise pickup, and practical preventive measures.

Simplified Cascode Design, by F. Evans. "T-T & El. Ind." Aug. 1956. 1 pp. A method is presented for approximating the characteristics of a cascode unit, using the published E_b—I_b curves of the triode type employed.

Selective 1 CPS Bandwidth Amplifier, by W. Nonnenmacher. "El. Rund." May 1956. 4 pp. A high selectivity if-amplifier has been developed as part of a measuring amplifier for noise voltage spectroscopy. The high selectivity is produced by disattenuation of the resonance circuit by means of a feed-back cathode amplifier (Q multiplier). Bandwidth can be altered by adjustment of the feed-back factor. The required stability is achieved by the intense counter coupling of the cathode amplifier.

Remote Control of Electro-Acoustic Equipment, by H. Petzoldt. "El. Rund." May 1956. 3 pp. Remote control of switching operations in electro-acoustic main control centers is required owing to number and scope of simultaneous switching operations, to remoteness of operator, on account of mutual functional coupling or dependence of a plurality of switching operations. A new remote control equipment for the switching of 6 loudspeakers from a remote microphone speaker location under precedence order conditions is described with reference to a circuit diagram.

Amplitude Limitation in LC-Oscillators Using Two Biased Diodes, by Z. Akcasu. "Wirel. Eng." June 1956. 5 pp. An LC-oscillator which includes two biased diodes in the grid circuit to limit oscillation amplitude is analyzed. Amplitude of oscillation and harmonic distortion are calculated and represented by curves. From these curves it is observed that oscillations can be modulated linearly; no frequency modulation occurs during amplitude modulation and harmonic distortion is very low.

Mathematical Treatment of Nonlinear Keying Operations, by F. Weitzsch. "El. Rund." May 1956. 4 pp. Networks exert electronic keying functions if the passage of a rectangular pulse involves a time function of certain electric magnitudes. Their determination gives rise to some difficulty caused by the presence of such nonlinear elements as hysteresis-affected inductivities, etc., in the circuit. Normalized orthogonal systems are established and means of approximating their integrals are discussed.

Decade Counter Tube Circuitry, Part II, by J. Adams. "El. Des." June 1, 1956. Continuing a discussion of the basic operation of decade counter tubes (Part 1, "El. Des." May 15, 1956), the author presents a complete counter circuit for applications involving high speed counting.

Analytical Method for Complex Transistor Circuits, by Ya. K. Trokhimenko. "Radiotek." March 1956. 7 pp. The paper briefly discusses the admittance matrix of a transistor and describes a method of analysis for complex circuits, which is based upon reducing the complex circuit to an equivalent fourpole and conducting the design according to the parameters of the fourpole.

Amplitude Stabilization of Self-Oscillations by an Inertial Nonlinearity, by E. O. Saakov. "Radiotek." March 1956. 11 pp. The paper analyzes the operation of the simplest circuits with nonlinear resistors having a thermal inertia, when such resistors are used to stabilize the amplitude of sinusoidal self-oscillations. Relationships are derived for the calculation of the steady-state amplitude of the oscillator output.

A Wide Range Photo-electric Automatic Gain Control, by C. Riddle. "El. Eng." July 1956. 5 pp. A photocell and tube are arranged in such a way that the output voltage is proportional to the light modulation, and independent of the value of the steady light flux. The circuit is extremely simple, and the range over which the light flux may vary is very large (100.000:1).

An Improved Type of Differential Amplifier, by J. Richards. "El. Eng." July 1956. 3 pp. A differential amplifier stage capable of giving a high rejection ratio with unselected tubes and components and without a balance control is analyzed, and a particular amplifier is described in some detail. The stage is particularly suitable for converting balanced to unbalanced signals.

A Variable Multiple Pulse-Stream Generator, by W. Woods-Hill. "El. Eng." July 1956. 2 pp. During the development of circuits intended for use in electronic computers there is a need for checking, with a minimum of apparatus, the logic of circuits which require numerous pulse streams for their operation. An apparatus for such checking is described.

A Less-Than-Minimum Phase Shift Network, R. Destebelle, C. Savant, and C. Savant, Jr. "T-T & El. Ind." Aug. 1956. 3 pp. A combination of a tuned amplifier and a phase sensitive demodulator is described which allows high Q without instability.

Synchronization of an Oscillator by Means of Radio-Frequency Pulses, by E. S. Voronin and G. N. Berestovsky. "Radiotek." March 1956. 7 pp. The paper theoretically and experimentally investigates the process of synchronizing a harmonic oscillator by means of rectangular radio-frequency pulses. Calculations are conducted for the process of establishing the phase and amplitude of the oscillations. The results are experimentally verified at 1 mc. It is shown that the time for establishing a steady state depends heavily upon the initial phase.

Interaction Between Signal and Noise in an Inertial Detector, by L. S. Gutkin. (Continuation of paper in Feb. Issue.) "Radiotek." March 1956. 12 pp. Detailed qualitative and quantitative analysis including thorough mathematical derivations. This second part of a two-part paper deals with the signal-to-noise ratio at the output of the detector. It includes: 1) evaluation of the internal resistance of the detector, 2) evaluation of the current from the equivalent low-frequency current generator, 3) evaluation of the noise voltage across the detector load.

The Frequency Dependence of Self-Excited Microwave Generators with Complex Load, by H. Paul. "El. Rund." June 1956. 4 pp. In this final section of a previous article, the changes in the Rieke diagram resulting from a load positioned several wavelengths from the plane containing the plate slot are treated. Mismatching is discussed, and a measuring method suggested.

Trailing Edge (Decay) of a Pulse in a Cathode Follower with a Capacitive Load, by M. L. Volin. "Radiotek." March 1956. 7 pp. The paper discusses the causes of the extended decay of the trailing edge of a pulse when it passes through a heavily loaded cathode follower. An experimentally verified method is given for calculating the decay time for the trailing edge. Circuits for increasing the slope of the trailing edge are analyzed.

The Origin of the Six-Terminal Network Curve, Its Graphical Evaluation and Its Application to Determine the Transformation Properties of Loss-Less Six-Terminal and Eight-Terminal Networks, by H. Lueg. "Arc. El. Uber." April 1956. 12 pp. The formulas for a six-terminal network are coordinated with a set of vectors rotating in the complex plane. It is shown how the curve for the six-terminal network permits the determination of the input impedance for any terminating impedance.

Bridge Stabilized Oscillators and Their Derivatives, by E. J. Post and J. van der Scheer. "J BIRE." June 1956. 6 pp. The bridge stabilized oscillator with unspecified amplifying section can be regarded as a source of a wide class of feedback oscillators. Simple operations such as crosswise interchange of bridge elements, as well as suitable unbalancing of the bridge, will lead to most of the available feedback oscillator circuits as the derivatives of the bridge device. Principles involved are studied.

The Impedance Concept, Part 2, by C. Mayo and J. Head. "Wirel. Eng." May 1956. 8 pp. In Part One it was shown how useful information on circuit behavior would be obtained within the 'p-world,' p being a variable closely associated with time differentiation which can be manipulated algebraically. A general condition for a polynominal P_n of degree n in p to be free from zeros with positive real parts was obtained, and applied to the case of a three-stage RC feedback amplifier. Part 2 determines the effect of adding extra "step-circuit" elements on the gain and maximum feedback obtainable.

Design Chart for Selective Cathode Traps, by K. Hillman. "El." July 1956. 2 pp. Equations are discussed for determining attenuation introduced at trap frequency and at other desired frequencies. A graph is presented for determination of values of R, L, and C for cathode traps.

Telemetering Demodulator for Wide-Band F-M Data, by T. Warzecha. "El." July 1956. 3 pp. The demodulator described converts fm to pfm for pulse averaging recovery of the signal. Also described is a means of recording the fm signal.

Regulator Stabilizes Infrared Detector, by H. Weisbecker. "El." July 1956. 2 pp. Bolometer-type infrared detectors used on aircraft give ambiguous indication at intensity variation rates up to 25 cps unless the power supply is well regulated. A chopper-derived ac loop is described which can supplement more conventional dc regulation and cut variations to less than a millivolt.

Automatic Tuning for High-Power Transmitter, by V. DeLong. "El." July 1956. 4 pp. A system is described by which a frequency-selecting dial operates a servo system which tunes transmitter stages and adjusts the loading of the final stage. A combination of wide and narrow band discriminator circuits pulls the servos into critical tuning positions over a wide range.

COMMUNICATIONS

Designing Microwave Equipment for Telephone Companies, by W. Fisher. "T-T & El. Ind." Aug. 1956. 5 pp. The requirements of a medium-route microwave system—handling up to 300 telephone channels—are examined with respect to installation costs, transmission quality and performance, reliability, and compatibility. Data includes average installation costs and typical system statistics.

Transistor Remote Amplifier, by E. Smith. "T-T & El. Ind." Aug. 1956. 2 pp. A small, battery-operated 4-transistor channel amplifier using low-level mixing and having two independently controlled mikes is described. Complete circuitry and response-test results are presented.

Reducing Noise in Communications Systems, Part V. by W. Bennett. "El." July 1956. 4 pp. Transmitting information through noise can be accomplished by exchanging excess bandwidth for improved signal-to-noise ratio. Pulse-code modulation does this efficiently and permits regenerating pulses that have become distorted. Error detecting and correcting codes offer additional advantages.

Regulating Amplifier Corrects Slope and Level, by W. Chaskin and H. Kimball. "El." July 1956. 3 pp. A servo-control which automatically adjusts gain to accommodate changes in attenuation in long open-wire telephone lines is described. Pilot-tone pairs of 40 and 80 kc with 99 and 150 kc are employed to control gain.

Multipath Simulator Tests Communications, by A. Deuth, H. Ressler, J. Smith, and G. Stamps. "El." July 1956. 3 pp. The authors describe a system using an ultrasonic artificial ionosphere and crystal transducers operating at 150 kc in air to simulate radio fading.

Arcing at Telephone Relay Contacts, by P. Kisliuk. "Bell Rec." June 1956. 5 pp. Research now in progress is aimed at extending the useful lifetimes of relay contacts. Oscilloscopic studies are in agreement with earlier work, that arcs occur before there is any metallic contact. This article presents results of extensive investigation and experimentation with arcing.

Balanced Revertive-Pulsing Circuits, by E. Spack. "Bell Rec." July 1956. 4 pp. Revertive pulsing is the signaling method used to control motor-driven switches at a terminating office in the panel type of automatic switching system. When crossbar systems were designed, they included revertive pulsing for compatibility with existing offices, using relays to simulate the action of the mechanical switches. No. 5 crossbar has grown rapidly in suburban areas, and it has been found that ac interference in these areas can adversely affect the revertive-pulsing circuits. To prevent this, new balanced arrangements have been designed for both panel and crossbar incoming circuits.

Distortion of the Duration of Telegraph Pulses Due to the Effect of Fluctuating Interference in a Frequency-Modulated System, by A. M. Zingerenko. "Radiotek." March 1956. 11 pp. The paper derives a formula for the frequency variation which results when fm signals are transmitted in the presence of fluctuating interference. The mean-square distortion of the duration of the telegraph pulses is determined.

Application of Magnetic Null Devices to Telemetering and Registering Units, by A. M. Pschenichnikov. "Elek." Jan. 1956. 6 pp. A primarily qualitative analysis of the use of magnetic amplifiers as null devices. The paper describes their principle of operation, their chief properties and characteristics and the possibilities for their extensive use. Their use as inverters, in polyphase and bridge systems, and the use of second-harmonic induction are discussed. The lower sensitivity threshold is made a minimum.

Simultaneous Tuning of Tuned Circuits in Superheterodyne Receivers, by W. Rotkiewicz. "Hochfreq." April 1956. 11 pp. The difficulties encountered in simultaneously tuning two capacitively-tuned circuits in a receiver are studied. Equations for the tuned h.f. circuits and the associated oscillators are given. The errors are evaluated for tuning curves identical at two or at three points.

Visual Detectability of Signals in Noise, by J. Griffiths. "Wirel. Eng." May 1956. 3 pp. The effect of 'contrast' (in the form of a bias) on the detectability of signals displayed for visual observation in a noise background is very controversial, as many different considerations arise in different applications. This article is concerned with the effect of such contrast on a particular derived signal-to-noise-ratio criterion, and it is shown that the results obtained agree, at least qualitatively, with experimental results on probability of detection in very simple systems.

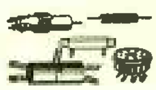
Repeaters for Twelve-Channel Military Telephone, by J. Barstow, Jr. "Bel Rec." June 1956. 4 pp. A recently developed light-weight system permits transmitting twelve telephone conversations over a single four-conductor cable. Both attended and unattended repeaters have been developed which permit the terminals to be placed as much as 200 miles apart.

Effective Capacitance in Modulated Power Amplifiers, by R. Lee. "El. Des." June 1, 1956. 3 pp. Incidental capacitance has a marked influence on the electrical performance of high-level AM power amplifiers, particularly in the modulator. Several components of incidental capacitance are analyzed and their effects discussed.

Voice-Controlled Blocking Circuits in Telephone Signal Transmission by Radio, by K. Fischer. "El. Rund." June 1956. 5 pp. A voice-controlled blocking circuit is required at the junction of the radio transmission and the two-wire line, provided the radio link cannot be stabilized. Various such blocking circuits are compared and their fields of application indicated.

The Reciprocity of Time and Frequency in Communication Engineering, by H. Marko. "Nach Z." May 1956. 7 pp. The Fourier transformation is applied to stationary phenomena, statistically known phenomena, and to nonlinear systems, such as modulators. Electrical phenomena and mathematical formulas are closely interrelated to facilitate understanding.

Radio Set AN/TRC-24: Exciter and Frequency Control, by G. Rodwin and N. Lund. "Bell Rec." July 1956. 4 pp. The radio portions of a compact and portable multi-channel telephone system are described. The exciter, with its associated frequency-control circuit, enables the radio transmitter to operate on any one of a large number of stabilized frequencies.



COMPONENTS

Nonlinear Ceramic Dielectrics, by N. Rudnick and G. Howatt. "Con. Eng." July 1956. 7 pp. The ceramic dielectrics have been put to many uses in the control field, chiefly as transducers that make use of their piezoelectric properties. They have still another, far less exploited characteristic. They are nonlinear in the same way as are ferromagnetic materials: they display a hysteresis loop. Because of this analogy they are called ferroelectrics. Nonlinear dielectrics can amplify electrical signals somewhat as magnetic amplifiers. Such dielectric amplifiers have several inherent potential advantages over magnetic amplifiers for voltage and moderate power amplifier applications.

Spark Gap—New Circuit Component, by J. Johnstone. "T-T & El. Ind." Aug. 1956. 2 pp. Use of spark gap units as voltage-sensitive switches handling extremely high currents with low voltage drop is described. Units can be small and can be made relatively insensitive to temperature, pressure, altitude, and humidity. A spark gap pulse generator circuit is illustrated.

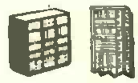
Specifying Toroidal Reactors, by R. Edgar. "El. Des." June 15, 1956. 2 pp. Molybdenum permalloy powder toroidal cores have been used extensively in recent years because of high Q stability over a wide range of voltages and good stability with respect to dc magnetization. However, it is often desirable to know just how a toroidal reactor is affected by the core used in order to specify these reactors correctly. The article describes a typical toroid and points the way to improved design.

A Guide to Applying Resistance Pots, by H. Gray, Jr. "Con. Eng." July 1956. 14 pp. Since the potentiometer used often spells the difference between a workable and unworkable system, or between a complex and greatly simplified one, the selection procedure is important. The author presents information in the form of a guide to selection of pots for specific uses.

Ultrasonic Delay Lines, by J. May, Jr. "Bell Rec." June 1956. 5 pp. As modern electronic equipment is called upon to perform increasingly intricate operations, electrical signals must frequently be delayed within a circuit. Most methods of providing such delay require considerable space or equipment. This article describes ultrasonic delay lines which occupy a relatively small space, and can provide time intervals ranging from a fraction of a μsec to several thousand μsec.

Factors Affecting Resistor Tolerances, by F. Paul. "El. Des." June 1, 1956. 1 pp. Minimum circuit design tolerances for resistors must often be much greater than the rated resistor tolerances specified by manufacturers. Recommended minimum design tolerances are given.

Transit-Time Accelerometer, by L. Jones. "Rev. Sci." June 1956. 4 pp. An omnidirectional transit-time accelerometer, developed for measuring the drag acceleration of spheres dropped from rockets, is described.



COMPUTERS

Binary Conversion for A-D Converters, by I. Resnick. "El. Des." June 15, 1956. 2 pp. Serialization of parallel data may be desirable or necessary for minimization of the number of recording channels required, telemetering on a single channel, and preparation of data for further processing. This article describes a shift-register system used to convert data coming in parallel form into serial form, and a means of converting cyclical-binary code into conventionary-binary code.

Factors in Selecting Data Handling Systems, by A. Hix. "ISA J" June 1956. 4 pp. This is a discussion of industrial data handling systems from the standpoint of operational control, cost-accounting and inventory control, preparation of operating and managerial reports, and engineering studies.

Mechanized Memory and Logic—What Electronics Can Do, by J. Felker. "Bell Rec." June 1956. 6 pp. Despite its seeming complexity, electronic switching promises a wholesale simplification of telephony and, it is believed, more economical telephone service. This article presents simplified definitions of the basic concepts of such systems.

Practical Analog-Digital Converters, by M. Klein, F. Williams, and H. Morgan. "Inst. & Auto." June 1956. 9 pp. The authors present a list and descriptions showing the state of the art and the types of commercially available converters designed for shaft position conversion with binary output, shaft position conversion with uncoded output, shaft position conversion for direct data printing, data loggers with all-electronic conversion, and all-electronic high-speed conversion.

Designing Analogy Circuits from Test Data, by G. D. McCann. "ISA J" June 1956. 5 pp. The author discusses direct synthesis of analogous circuits from tests such as influence coefficient or normal mode shake tests.

What's Inside Transac—I, by A. Cavalieri, Jr. "El. Des." July 1, 1956. 3 pp. A transistorized automatic computer using surface barrier transistors is described. It is capable of performing about 416,000 additions per sec, and can multiply two six-digit numbers in about 48 μsec. Typical circuit units are illustrated and described.

Optimizing with a Computer, by J. Strong. "Auto. Con." June 1956. 3 pp. Combining advanced mathematical techniques with a careful analysis of the controlling factors and objectives in scientific, industrial, or business situations, Operations Research can sometimes produce new answers or viewpoints in what were previously considered unsolvable problem areas. Several mathematical tools, such as linear programming and queueing theory are discussed.

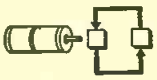
New Computer Method for Obtaining Optimum Area, by J. Tyroler and C. Smith. "Rev. Sci." June 1956. 2 pp. An automatic computer method for obtaining the optimum area for any fixed interval under a transient is described and discussed. This method automatically chooses the point on the transient where integration of the area is initiated and a preset timer stops the integrator after the selected time interval has elapsed.

Electronic Methods of Analogue Multiplication, by Z. Czajowski. "El. Eng." July 1956. 5 pp. The author presents a general survey of the principles used in analog multiplication. An attempt has been made to classify the different methods of approach to the problem and to compare all systems as to accuracy, speed, and complexity. This article deals with those devices which perform multiplication directly by application of some mathematical or physical formula.

The Simple Bridge Can Solve Equations, by W. Pease. "Com. Eng." July 1956. 1 p. By properly including the variables in the arms of a self-balancing bridge circuit, a single amplifier can serve to solve an entire equation. With precision components the overall accuracy can be as high as .01 per cent. The solution of a slant range equation is used for illustration.

Digital Storage Using Neon Tubes, by M. Raphael and A. Robinson. "El." July 1956. 4 pp. A means of providing inexpensive storage for digital data using a neon-tube matrix is described. The memory uses multiplier-phototube read out.

How to Design Reliable Computers, by F. A. Ordemann. "El Eq." June 1956. 4 pp. Reliability, a major consideration in the design of all electronic equipment, assumes extreme importance in computer development. This article outlines the steps taken by one major computer manufacturer to enhance the dependability of his product.



CONTROLS

Electronic Step Actuated Integrative Control Equipment with Approximately Continuous Performance, by G. Weitner. "El. Rund." May 1956. 3 pp. Control equipment with approximately continuous integrative performance permits adjusting motor control via conventional mains contacts and control button adjustment of the adjusting velocity and the permanent deviation. Its temporal performance and basic design circuits are discussed with reference to an actual equipment example using a thyratron in combination with a relay.

Photoelectric Amplifier for Flame Guards, by E. Suchel. "El. Rund." June 1956. 2 pp. The flame guard photocell controls an alarm which sounds when the flame of an oilburner dies down. Circuit requirements are stated and a specially designed circuit is illustrated and discussed.

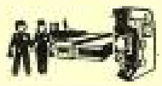
Control Techniques for Nuclear Reactors, by W. Whitehead and H. Lamonds. "Auto. Con." June 1956. 3 pp. The accelerated rate at which nuclear power reactors are being developed has led to the evolution of many new reactor types, but, as this article points out, the control systems for all these are based on a few fundamental principles and employ familiar hydraulic, pneumatic, and electronic control elements.

Relays for Control Applications, by W. Lockwood. "Auto. Con." June 1956. 2 pp. A general discussion of types and suitability of relays for a variety of applications.

Cascade Control Systems, by N. Gollin. "Con. Eng." July 1956. 5 pp. Proper choice of the control arrangement improves the performance of the control system. If this arrangement involves the adjustment of the set-point of the controller in a control loop by means of another measured variable, it is called Cascade Control. The type of cascade control system considered here is one where the two measured variables are related through the process. By block diagrams and transfer functions of the system's elements, cascade control systems can be analyzed to show how much they improve control of the process.

Capacitor Type Fuel Gages and Controls, by S. Solarez. "Aero D." June 1956. 4 pp. Modern aircraft fuel gage systems can allow for disposable fuel tanks, fuel programming to maintain aircraft stability, and indicators to show tank-full during in-flight refueling.

Structural Constant for Magnetic Amplifiers, by S. Ya. Dunayevsky. "Elek." Feb. 1956. 6 pp. The paper develops an approach to designing magnetic amplifiers, which is intended for those cases when the amplification factor is one of the main indices of the amplifier. The output power and the control power are included in the specified data. Complete design procedure is analyzed.



INDUSTRIAL ELECTRONICS

Application of Magnetic Amplifiers to Electric Drives, by A. G. Efanov, B. M. Gutkin, Yu. R. Reingold. "Elek." Feb. 1956. 6 pp. Paper discusses the use of magnetic amplifiers as intermediate amplifiers for the purpose of raising the gain of rotary amplifiers whose characteristics have been stabilized by negative feedback. Coupling circuits between the magnetic and rotary amplifiers are analyzed, static and dynamic characteristics are given, coil data is specified for the magnetic amplifiers and specific industrial examples are given.

Experimental Investigation of the Dynamic Properties of a Rotary Amplifier and the Design of Its Parameters, by E. L. Ettinger and Yu. R. Reingold. "Elek." March 1956. 9 pp. Experimental frequency responses of a rotary amplifier are used to analyze the effect of internal feedback, mutual inductance between the control coils, the degree of compensation and the load upon the dynamic properties of the amplifier. All of the basic parameters are then found for both no-load and load conditions. A simplified transfer function is derived, and the coefficients of the transfer function are calculated for various conditions. The method is generalized to include other typical elements of an automatic drive. It is shown that complex systems can be reduced to combinations of elementary members.

The Short-Interval Timer, by G. Hitchcox. "El. Eng." July 1956. 4 pp. Many industrial devices operate so rapidly that electronic time measurement is required, both in designing and in testing them. Examples are: fuses and contact-breakers, high speed relays, camera shutters, and explosive caps. This article describes the factors which govern the specification and design of a modern short interval timer intended for general purpose uses.

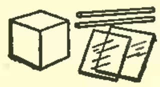
Gear Gage Controls Automatic Hobber, by R. Miles. "El." July 1956. 5 pp. An electronic inspector uses probes attached to the cores of linear variable-differential transformers to measure the pitch diameter and the root fillet of gears. Dimensional deviation signals are stored and compared electronically to determine corrective measures based on trends, ignoring individual variation. Corrective signals cause automatic readjustment of the gear-cutting machine.

Voltage Control of a Hydraulic Alternator of 36,000 KVA by Magnetic Amplifiers, by J. Fourner. "Hochfreq." April 1956. 16 pp. The circuit diagram is shown and explained; performance data are given in great detail. Good stability and rapid control have been obtained.

Application of Magnetic Amplifiers to an Automatic DC Motor Drive, by S. S. Royzen and K. Ya. Goasen. "Elek." March 1956. 8 pp. Theoretical discussion of the use of a magnetic amplifier in place of the rotary amplifier which is in the feedback loop of a dc motor speed regulator. The amplifier provides the necessary gain needed to maintain sufficiently accurate speed regulation with less bulk, less complexity and less loss. Systems with generator and rectifier supplies are analyzed, and experimental results are cited.

A New Circuit for Regulating the Load on an Electric Blooming-Mill Drive, by V. I. Arkhangelsky. "Elek." March 1956. 8 pp. The present device used for regulating the armature current of the drive motor is a rotary amplifier that suffers from the following disadvantages: a) there is no continuous control of the acceleration of the loaded motor during start, b) the regulator does not affect the field of the motor properly when the motor is slowed down from its maximum speed, c) the regulator has an unsatisfactory law of variation for the reference voltage as a function of exciting current. The new circuit overcomes these drawbacks. The loaded motor can be operated so that optimum characteristics are obtained with full utilization of overload capacity.

Vapor-Pressure Analyzer Computes Liquid Concentration, by L. Griffith. "Con. Eng." July 1956. 2 pp. A simple analyzer detects a liquid's vapor pressure and temperature and performs a computation on these two process variables to yield a continuous direct reading of concentration.

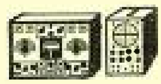


MATERIALS

Basic Insulating Materials, by G. Moses. "Insul." June 1956. 4 pp. A number of basic material components are used either separately or as combinations in composite insulation products. This article contains a general description of solid, non-resinous materials including asbestos, fiber glass, synthetic textiles, and mica; and reviews the peculiar characteristics of each which fit it to specific uses and limit its use in other applications.

Cathode Ray Tube Phosphors, by R. Millet. "El. Des." June 15, 1956. 2 pp. Specification of the correct CRT screen phosphor for a particular design application is often difficult. A design analysis of phosphors, including characteristics and suggested applications is presented.

A New Method of Electric Welding of Copper Cable Joints, by W. Ruecker and P. Raphael. "Nach. Z" May 1956. 3 pp. A 6-volt battery is applied to the carbon electrodes spaced 0.1 mm apart. A series of conical openings is provided in the circumference of the two circular electrodes, each electrode having half-conical recesses. The wire ends are placed into these openings and the weld is shaped like a small cone.



MEASURING & TESTING

Discriminator-Output Frequency Meter, by D. Marshall. "T-T & El. Ind." Aug. 1956. 3 pp. Circuitry and performance of a discriminator-output frequency meter for 3 cps to 100 kc are described. The meter analyzes fm information by use of a triggered-pulse, frequency-to-voltage conversion system.

The "Frequency-Microscope," a Registering Frequency Meter of High Sensitivity, by G. Ohl. "Arc. El. Uber." April 1956. 6 pp. A comparison of two frequencies is accomplished by heterodyning the two frequencies and recording the difference frequency. The recorder consists of a synchronous motor controlled by an adjustable frequency derived from a quartz crystal and a chronograph. Graphical and numerical methods to evaluate the frequency difference from the direction of the traced lines are given.

Vibrational Stability Tests for Magnetic Relays, by A. Maschmeyer. "T-T & El. Ind." Aug. 1956. 4 pp. Clapper type relays are evaluated under vibrational conditions of 3 to 2000 cps and accelerations to 35 g. Prime areas of relay improvement are found to be design of contact springs, contact supports, and relay mountings.

A Ruggedized Graphic Milliameter, by G. Walters. "T-T & El. Ind." Aug. 1956. 3 pp. Considerable difficulty has been experienced in using existing graphic recorders in airborne installations due to improper operation in the presence of shock or vibration forces. This article describes the techniques employed in designing a ruggedized instrument suitable for operation under the extreme environmental conditions specified by the military.

Method for Eliminating Omegatron Radial Field Errors or for Direct Measurement of Mass Ratios, by H. Woodford and J. Gardner. "Rev. Sci." June 1956. 4 pp. An omegatron having two pairs of ion-accelerating plates instead of one and using resonance absorption detection has been used successfully to obtain simultaneous cyclotron resonances of two different ion species in the same field. When used in conjunction with a nuclear resonance probe, the method effectively eliminates errors due to perturbing radial electric fields in the omegatron; alternatively, if radial electric fields are considered negligible, the method permits the direct measurement of mass ratios.

An AC Potentiometer for Measurement of Amplitude and Phase, by M. J. Somerville. "El. Eng." July 1956. 2 pp. A simple ac potentiometer circuit using ac coupled amplifiers is described. The design utilized enables the generation of in-phase and quadrature components which remain accurately in quadrature with one another, even though substantial phase shifts will occur in the ac couplings involved.

Fast Timing of Scintillation Pulses, by H. Ticho and J. Gauger. "Rev. Sci." June 1956. 6 pp. Some modifications of the conventional chronotron circuit are discussed. Using such a modified chronotron, time interval distributions due to two liquid scintillation counters have been studied under various experimental conditions. These studies suggest that even when counters with sensitive areas of approximately 300 cm^2 are used, a precision of ± 0.25 µsec in an individual time interval measurement can be achieved if the distance between the particle trajectory and the photosensitive surface is known.

An Electronic Timing Unit, by N. B. Acred and G. Bishop. "El. Eng." July 1956. 7 pp. This article describes in some detail the design and construction of equipment for measuring the time intervals encountered in determining the speed of an aircraft flying over a straight course of known length. The primary requirement was that the timing unit should measure and display time intervals between 1 and 99.999 sec with an accuracy of 1 part in 10^4. This, and other factors which influenced the design are discussed.

Photoelectric-Optical and Thermoelectric-Optical Amplifiers, by B. P. Kozyrev. "Elek." Feb. 1956. 8 pp. The paper analyzes the design and construction of photoelectric-optical and thermoelectric-optical amplifiers used with galvanometers for high-sensitivity measurements. Detailed design parameters and dimensions are given for existing standard amplifiers, and design equations are derived. The transformation of a photoelectric-optical amplifier into a thermoelectric-optical one is discussed.

Aural Electrocardiograms, by A. Gemant and D. Burch. "Rev. Sci." June 1956. 2 pp. In heart surgery the need arises for electrocardiograms that do not require visual attention. This has been achieved by converting the voltage wave pattern into a sound pattern of varying pitch; the latter is an exact reproduction of the voltage wave. The apparatus used for the conversion is described.

Extending the Limits of Resistance Measurement Using Electronic Techniques, by G. Hitchcox. "J BIRE" June 1956. 11 pp. In general, the article is confined to a discussion of devices and techniques which are suitable for inclusion in commercial instruments, rather than of those which, by their complication, delicacy, or specialization, are restricted to the laboratory. It opens with a description of the basic ohmmeter in its two dual forms, refers to three low resistance systems, two using direct and one alternating test currents, and then goes on to describe what is thought to be a novel instrument which can measure very low resistance using pulsed test currents to reduce thermal dissipation in the test sample.

Diamond, a Practical Radiation Counter, by W. Cotty. "J BIRE" June 1956. 15 pp. The properties which make diamond an attractive material for a practical conduction counter are discussed and the general theory of conduction counting is outlined. The counting property is thought to be a structural property and this also is responsible for the ill effects of polarization; diamonds, however, have been found which have the natural ability to maintain a steady counting rate for long periods and a method for selecting them is given. The principles of amplification are described in detail.

A Phase Meter for 50 Cycles to 30 MC, by O. Macek. "Freq." May 1956. 6 pp. The phase meter consists of two identical amplifiers and a CR tube displaying an elipse. Alternatively the signal to be compared may be mixed with an oscillation between 1 mc and 30 mc to result in a suitable beat frequency. A phase difference of 1° can still be read. Various methods are discussed.

Determination of the Amplitude Distribution on Plane Surfaces from the Directional Distribution of Their Radiation Fields, by K. Feher. "Arc. El. Uber" April 1956. 10 pp. This continuation of a previous article describes the experimental set-up and the evaluation methods. The results for an aluminum plate vibrated by a piezoelectric crystal and for a plate vibrated by waves incident at a specified angle are reported.

Four-Place Timer Codes Oscillograph Recordings, by S. Dorsey. "El." July 1956. 3 pp. A timing generator is described which creates a pattern indicating time in increments of .001 seconds.

Group-Delay Measurements, by C. Heuvelman and A. van Weel. "Wirel. Eng." May 1956. 7 pp. A description is given of a simple group-delay meter which, in combination with any conventional wobbulator generator, gives the group-delay characteristic directly on an oscilloscope.

A Five-Band Recording Spectroradiometer, by C. McCamy. "NBS J" May 1956. 7 pp. An accidental fire in an aircraft engine compartment can be dealt with successfully only if the fire is detected within a few seconds after it starts. Devices that respond to the radiant energy from flames have received considerable attention because a single unit can detect fires anywhere within a large space. Such detectors must be able to discriminate between flame and sun or hot engine parts. To accomplish this discrimination, the use of two characteristics of flame radiation has been proposed: the spectral distribution of energy and the fluctuations in the radiant intensity known as "flicker." In order to explore some of the possibilities, the instrument described in this article was built to record the radiant intensity of flames in several broad regions of the spectrum and to determine the frequency distribution of flicker.

A Mechanical-Electronic Transducer for Low Range Pressure and Force, by B. McKay. "ISA J" June 1956. 3 pp. Article gives circuitry, construction, application, and performance details of the RCA type 5734 transducer tube for measurement of pressures and force or weight, with particular mention of specific applications in the biological field. Past work is cited and new applications suggested.

Advances in the Design and Application of the Radio-Frequency Permeameter, by A. Rasmussen, A. Enfield, and A. Hess. "NBS J." May 1956. 8 pp. Improvements are described for increasing the frequency coverage, accuracy, and ease of application of the r-f permeameter developed at NBS to measure initial complex permeability of toroidally shaped ferromagnetic materials of low conductivity.

Slideback Electrometer, by N. Doctor and P. Franklin. "Inst. & Auto." June 1956. 3 pp. Low-leakage resistance paths in terminal boards, in laminates which bear etched wiring circuits, and in potted assemblies can seriously alter operation of electronic systems. An instrument is described for measuring resistances between 10^{10} and 10^{15} ohms. The instrument is in part a slideback voltmeter employing an electrometer tetrode.

Low Distortion and Low Noise in Small-Amplitude Motions, by B. McFadden. "Con. Eng." July 1956. 2 pp. Distortionless, noise-free mechanical motion at sinusoidal double amplitude of .01 deg is produced by a table designed to simulate aircraft motions for instrument testing. The table has a noise threshold below one second of arc.

Balloon-Borne System for Tracking the Sun, by H. Edwards, A. Goddard, Jr., M. Juza, T. Maher, and F. Speck. "Rev. Sci." June 1956. 5 pp. A balloon-borne system for tracking the sun both in elevation and azimuth is described.

Phase-Angle Measurement, by C. Vincent. "Wirel. Eng." May 1956. 5 pp. This article discusses the method of phase-angle measurement due to Fleming, in which X and Y deflections are adjusted for equality, and the phase difference is deduced from the proportions of the resulting ellipse. A thorough analysis is made of the geometrical factors which might lead to error in this method.

CAMA—Automatic Trunk-Test Circuit, by R. Dusenberry. "Bell Rec." June 1956. 4 pp. In a Centralized Automatic Message Accounting installation, trunks from local telephone offices are periodically tested by a circuit which can automatically test 2,000 incoming trunk circuits, without interrupting busy circuits. The author discusses necessary test functions and describes the operation of the tester.

Electrostatic Particle Size Analyzer, by H. Yoshikawa, G. Swartz, J. MacWaters, and W. Fite. "Rev. Sci." June 1956. 4 pp. This article comprises the theoretical analysis and physical description of an Electrostatic Particle Size Analyzer (EPSA) for determining the particle size distribution of aerosols in the 1- to 20-micron size range.

Wide Amplitude String Galvanometer for Direct Recording, by L. Browder. "Rev. Sci." June 1956. 5 pp. By employing an Einthoven or string galvanometer rather than the usual D'Arsonval galvanometer in a direct-writing oscillograph a considerable reduction in inertia of the moving element is obtained. The use of compliant end supports makes possible very large deflections so that a 10-cm long string having a resonant frequency of 230 cps can be made to move through an amplitude of 2.5 cm.

Automatic Scanning Device, by L. Holm. "Rev. Sci." June 1956. 5 pp. The driving mechanism and the control and recording circuits of an automatic device for repeated, continuous, unidimensional scanning of radioactive objects are described. The scanner can run at several different speeds from $4.10X10^{-3}$ up to 1.32 mm/sec. It is shown theoretically and illustrated with actual examples that it is possible to construct "equilibrium curves", i.e., curves corresponding to an infinitely low scanning speed, from those recorded with finite scanning speeds.

RADAR, NAVIGATION

Radar Doppler-Frequency Nomograph, by G. Baker. "El. Des." May 15, 1956. A design tool relating doppler frequency, radial velocity, and transmitted wavelength.

Three-Dimensional Radar Video Simulator, by P. Pielich. "El." July 1956. 3 pp. Terrain-clearance radar data is presented as three-dimensional oscilloscope display by using simulated-video generator and conventional flying-spot scanner. The mechanization of such a display was found to be a relatively simple matter.

Electrical Altimeters for Airplanes, by E. Roessler. "El. Rund." May 1956. 3 pp. Diverse kinds of electrical altimeters, especially capacitive, pulse echo, and frequency modulation types, are described in detail with reference to the historical development. The combination of weather radar, a collision warning radar, and a pulse altimeter finally is regarded as a possible technical solution of the pertinent problems of aeronautical engineering.

Transmission of Radar PPI Pictures with Reduced Bandwidth, by H. Meinke and H. Groll. "Nach. Z" May 1956. 8 pp. The received Radar signals are fed to a linear electronic memory by a modulated electron beam. The electronic memory is based on the charging principle and will be additive. A slower moving scanning beam transfers the added signal to an output resistor via a collector and transmitted. This system is discussed and radar pictures are shown.

Designing a Simulated Rate of Climb Indicator, by R. Neunes and P. Stein. "ISA J" June 1956. 4 pp. Instrumentation of an altitude test facility led to the development of an equivalent rate of climb indicator comprising a completely self-contained, portable unit containing a transistorized dc amplifier, built-in calibration device, and zero-suppression for extended range use. The design employs commercially available transducers and measuring instruments.

The Distant Field of a Paraboloid Having Rotational Symmetry in Combination with a Dipole at Right Angles to the Plane of the Opening, by F. Mueller. "Hochfreq." April 1956. 4 pp. The surface currents in the reflectors are computed from the distant field of the dipole; this leads to a computation of the distant field of the assembly. The result indicates a split direction for the main beam; the field is similar to the distant field of the E_{01}-wave of a circular wave guide.

The Night-Effect on Direction Finders, by P. Miram. "El. Rund." June 1956. 4 pp. Fluctuations of this effect and possibilities for its remedies are considered. The various pictures received are discussed and a table is included in an effort to systematically correlate the disturbances and their cause.

SEMICONDUCTORS

Intermetallic Semiconductors, by H. Hrostowski. "Bell Rec." July 1956. 5 pp. There is a class of semiconductors other than silicon and germanium about which our knowledge is as yet incomplete. Recent investigations show that we can make intermetallic compounds with a wider range of electrical properties than is obtainable with silicon and germanium, and thus it may be possible to produce more versatile transistors and other semiconductor devices.

What Type of Degenerative Feedback for Transistors? by R. Hurley. "El. Des." June 15, 1956. 3 pp. The greater the number of stages per feedback loop, the greater is the predictability of the transistor amplifier gain at mid-frequencies for given overall gain. However, for more than two transistor stages per loop, instability results, the suppression of which reduces bandwidth. Experimental data is presented: results show that a two-stage transistor amplifier using current feedback is "some sort of optimum," as to midband gain predictability and bandwidth.

Superregenerative Transistor Oscillator, by R. Kircher and I. Kaminow. "El." July 1956. 2 pp. Equal on-off intervals of 500 cps audio frequency are obtained at a rate of 7 cps using a junction transistor in a basic self-quenching oscillator circuit. Effects of circuit parameter variation on the performance of the oscillator are given.

Transistor Circuitry in Japan. "El." July 1956. 5 pp. Japanese transistorized products including four different types of broadcast receivers, a portable tape recorder, and a hearing aid are reviewed.

Transistors Telemeter Small Missiles, by C. Kortman. "El." July 1956. 3 pp. Spin information is placed on a subcarrier channel of an fm/fm system, using a germanium photocell and transistors.

Automatic Curve Tracing Aids Transistor Circuit Design, by N. Goldich. "El Des." July 1, 1956. 2 pp. Curve tracers can be effectively used to evaluate transistors in circuit design. They are particularly useful in analyzing changes in transistor characteristics with load, operating time, and environmental conditions. This article is a delineation of a typical curve tracer and explains how it can be used as a design tool.

Transistor Circuit Design with Intermediate Connections Terminal, by A. Jorysz. "El Des." July 1, 1956. 3 pp. Recently, a new class of transistor circuits has been developed, which exhibits interesting and quite useful properties. The new circuits are more general and allow better control of impedances and amplification properties of the transistor. The most general form of the new circuit may be considered as a parallel-series or series-parallel combination of a transistor and an impedance bridge. The author discusses a group of three simple circuits: the "intermediate emitter-base," the "intermediate emitter-collector," and the "intermediate base-collector."

Designing "Free-Power" Transistor Apparatus, by H. Hoffmann. "T-T & El. Ind." Aug. 1956. 3 pp. A discussion of equipment deriving its power from natural or artificial energy fields is given. Transistor equipment using light, sound, and rf energy for power is described.

Designing Transistorized Test Equipment, by T. Lommasson and K. Hardin. "El. Des." July 1, 1956. 2 pp. Replacing vacuum tubes with transistors requires particular consideration of temperature effects, drive and impedance matching requirements, and frequency response. Some of the design problems encountered in the design of a small transistorized test set are discussed in this article.

TELEVISION

Designing Storage-Tube Equipment, by J. Buckbee and A. Luftman. "El." July 1956. 5 pp. Special cathode-ray tubes for storing information are useful in frequency-bandwidth conversion, mti radar, and data storage and analysis. High-voltage power supply, video amplifiers, sweep and blanking generator, focus-current regulator and staircase raster generator used with storage tube are described. Typical use is tv transmission over telephone lines.

Color Television on the L1 Coaxial Carrier System, by H. Hey. "Bell Rec." July 1956. 4 pp. The advent of color tv with its more stringent transmission requirements, made it necessary to modify existing L1 tv channels. To fill this need, existing B2 and C2 tv terminals have been integrated into B3 and C3 color tv terminals by the addition of new equipment.

Eidophor May Revive Lagging Theatre-TV Operations, by N. Wasserman. "Int. Proj." June 1956. 3 pp. A new closed-circuit TV system, capable of producing a wide-screen color picture with a high degree of clarity was originally developed by the Swiss and is now undergoing final development. An arc lamp projects a beam through a condenser to a schlieren lens. The light which is deflected strikes a reflector which is coated with an oily Eidophor liquid. When agitated by the scanning beam of an electron gun, this oily liquid forms tiny ridges or prisms which alter the reflective pattern of the light in such a way as to form an image. Only that light which is diverted by electron-agitated portions of the Eidophor liquid is reflected so as to pass through the schlieren lens and through the projection system to the screen.

Raising the Selectivity of Television Receivers, by Ya. I. Efrussi. "Radiotek." March 1956. 10 pp. The paper analyzes circuits for the intermediate amplifier stages in television receivers. These circuits permit an increase in selectivity and a simultaneous decrease in the number of tuned circuits. It is shown that in order to retain high video quality the selectivity must not exceed a specified value.

The Selenium Diode in TV Design, by J. Cataldo. "T-T & El. Ind." Aug. 1956. 2 pp. Applications for semi-conductor components, particularly selenium diodes, in tv receiver design are described. The horizontal phase detector circuit is analyzed, with both selenium diode and conventional vacuum tubes and comparative performance figures are given.

On the Theory of Mertz and Gray, by H. Schoenfelder. "Freq." May 1956. 6 pp. An analysis of the pulses in the frequency spectrum of a television signal is presented to illustrate the results of the theory of Mertz and Gray (Bell Tech. J. 1934).

Color Television Transmission Systems, by K. Teer. "Nach. Z" May 1956. 3 pp. The Philips system is compared with the N.T.S.C. system. The Philips two AM-sub-carrier system (T.S.C.-system) transmits a 3.6 mc carrier (2 mc wide) for the red color component and a 4.6 mc carrier (1 mc wide) for the blue color component. A control signal to adjust the amplitude relationship between the signals, corresponding to the burst signal, is also transmitted.

Design Project for a Television and Radio City in Bogota, Colombia, by W. Duschinsky. "BC News" June 1956. 14 pp. How to build proper centralized radio and television facilities in a growing city like Bogota is a problem which is all too familiar to broadcasting and television enterprises in many parts of the world. The Government of Colombia has formally approved the project described in this article, and is proceeding with extensive streamlining of its communications facilities, including radiotelephone and radiotelegraph, as well as broadcast and television.

Chrominance Circuits for Colour Television Receivers (Part 2), by B. Osborne. "El. Eng." July 1956. 5 pp. This article is a brief review of circuit techniques applicable to the chrominance section of a color tv receiver designed to receive an N.T.S.C. type signal.

Design of Industrial Television Equipment, by W. Mayer. "El. Rund." May 1956. 4 pp. Resistron and Vidicon-tubes, owing to their simple design, have been adopted generally as camera tubes for industrial tv equipment. Circuit design depends on due consideration of special qualities of the camera tube resistance screen. Conditions are discussed determining the production of inertia-free images (small signal plate voltage and adequate electron jet current values), also problems of resolution power, noise, focusing, and aperture loss.

International ELECTRONIC SOURCES

TRANSMISSION LINES

Ferrites in Waveguides, by G. Thompson. "J BIRE" June 1956. 18 pp. The gyromagnetic mechanism which controls the permeability of a ferrite at microwave frequencies is investigated theoretically in several simple cases, and the tensor form of the permeability in the general case is indicated. The theory is first applied to circular waveguides containing a ferrite magnetized along the axis. Applications of the effects in the construction of isolators and circulators are described. These include resonance and reflection isolators for circularly polarized modes, and also devices which make use of Faraday rotation. The effects of transverse magnetization of the ferrite is then discussed. Applications in rectangular guide in the form of resonance isolators, non-reciprocal phase circulators, and field displacement devices are described.

The Frequency Dependence of Self-Excited Micro-Wave Generators Under Complex Load, by H. Paul. "El. Rund." May 1956. 4 pp. The influence of frequency alterations due to a complex load on the operation of a transmitter, especially a magnetron transmitter, is examined with reference to the Rieke-frequency diagram. In the present paper, instability regions for certain kinds of load and their origin are discussed. Maximum admissible misadaption for certain cable lengths is calculated, also the frequency operation of the transmitter near stability limits.

TUBES

Klystron Control System, by R. Reeves. "Wirel. Eng." June 1956. 9 pp. The concept of a "control plane" is introduced to illustrate klystron properties, and the automatic tuning problem is recast as one in two dimensions. Provision of afc for primary radar is described in detail. The article describes test equipment which presents the control plane on the face of a crt and maps either klystron mode areas and frequency contours or servo-trajectories onto the plane. The afc system described takes cognizance of oscillation strength while searching for, or tracking the required frequency. A sampling technique for mode centering is introduced which affords minimum disturbance to the controls and provides a slightly better error criterion.

Modern Reflex Klystrons, by R. Hechtel. "Arc. El. Uber." April 1956. 6 pp. An introduction on the design considerations for reflex Klystrons is followed by a description of the Raytheon RK 5976, (6250 to 7425 mc), the Western Electric 431 (3700 to 4200 mc) and the experimental Telefunken reflex Klystron (3600 to 4200 mc). Tables and charts facilitate the presentation of tube characteristics.

Ceramics in Electronic Tubes, by G. Gallet. "Rev. Tech." April 1956. 13 pp. This article gives an account of the development possibilities of electronic tubes through the use of ceramics. Different cases are listed where the use of ceramic products brings about an improvement either in the manufacture or in the characteristics of the tube. A review of the mechanical, electrical, and thermal qualities which govern the choice of ceramic is included.

Hydrogen Thyratrons, by J. Chantereau and P. Leduc. "Rev. Tech." April 1956. 20 pp. A detailed description of the manufacture and testing of thyratrons is given, together with a review of the advantages of hydrogen thyratrons and the characteristics of TH-6345, 6435, 6522, and 6907 tubes.

Reliability as a Design and Maintenance Problem, by R. Matthews. "El. Eng." July 1956. 3 pp. Attention is drawn to the critical importance of reliability in complex electronic equipment. Tube performance is suggested as being largely responsible, and an estimate is made of this factor in equipment failure. A design philosophy is proposed which could improve operational reliability, provided it was backed by the appropriate maintenance system. Tube by tube negative feedback and marginal checking techniques are then examined as related solutions to the problem.

Experimental Verification of the Theory of Reflex Klystrons, by R. Musson-Genon. "Rev. Tech." April 1956. 92 pp. The theoretical determination of the characteristics of the circuit with localized constants equivalent to a resonant cavity is reviewed. A description is given of different experimental methods with or without electronic beam. A review is presented of the theoretical determination of the different parameters arising in the expression of the second order of the admittance of the electronic beam: finite transit times in the H.F. space, non-uniform retarding field, multiple paths, phase aberration. Description is given of the various experimental methods defining these parameters.

High-Powered C-Band Klystron Amplifiers, by R. Haegele. "T-T & El. Ind." Aug. 1956. 3 pp. Need for increased power in microwave is met by a line of linear four-cavity Klystron amplifiers for 5300 to 8000 mc. Described here are the designing highlights: ceramic-to-metal techniques, novel tuning methods, and unique input and output fittings.

Very High Frequency Triode TH 021, by F. Hulster. "Rev. Tech." April 1956. 18 pp. Beginning with the phenomenon of power drop in triodes with an increase in frequency, the physical principles to be observed in the construction of vhf triodes are then more generally set forth, and in particular the principles which result from the phenomena of transit time and of interaction of the tube with the resonant circuit.

U. S. GOVERNMENT

Total Cross Sections for 14-MEV Neutrons—Comparison of Measured Values with Values Calculated From the Complex Square-Well Model (PB 111853), by W. McGarry, J. Elliot, and W. Faust, NRL. Dec. 1955. 5 pp. 50¢. (OTS) A comparison was made between measured 14-Mev neutron total cross sections and theoretical values calculated from the complex square-well model of the nuclear interaction. The theoretical parameters used in the calculations were obtained from previous work on 14-Mev neutron differential elastic cross sections. The comparison shows that the calculated cross sections are low, indicating either that a greater nuclear radius parameter is required (in contradiction to the differential elastic scattering data) or that the theoretical model utilizing a square well is an oversimplification.

Systems Engineering (PB 111801), by J. Warfield, Pennsylvania State U. Aug. 1955. 30 pp. 75¢. (OTS) To provide useful material for the systems engineer in any industry, technical considerations are eliminated and only material common to most systems problems is included in the book. An introduction to systems engineering is given, the factors surrounding a typical systems-engineering problem are enumerated, and the systems design process is outlined.

Units and Systems of Weights and Measures (NBS Circular 570), by L. Judson, NBS. April 1956. 29 pp. 25¢. (Govt. Printing Office, Washington 25, D. C.) This circular brings together much of the information previously available in separate mimeographed leaflets.

Monte Carlo Reactor Calculation (PB 111865), by S. Podgor and L. Beach, NRL. Dec. 1955. 10 pp. 50¢. (OTS) The Monte Carlo method was used to estimate the slowing down of fast neutrons in a spherical homogeneous mixture of U^{235} and H_2O. The estimated probability distribution of thermalization was compared favorably with those of other calculational methods and with experimental measurements. These probability distributions were used to calculate the critical ratio of U^{235} to H_2O for both bare and reflected core reactors.

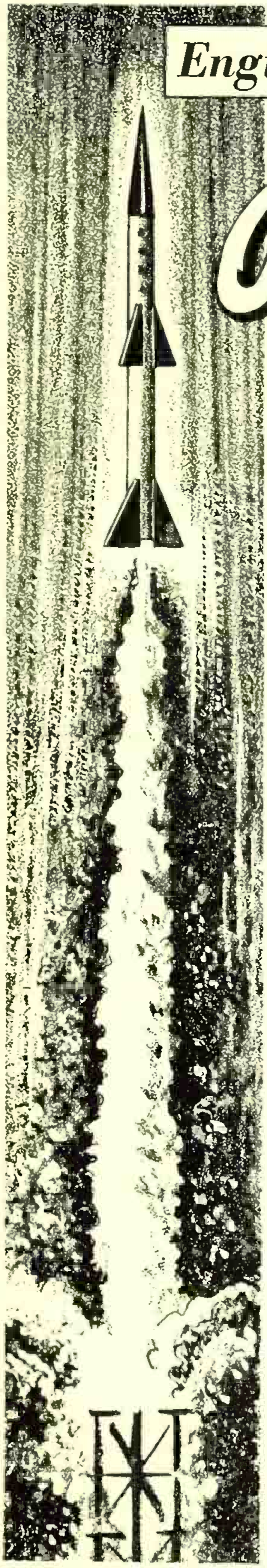
Debunching in UHF Velocity-Modulated High Density Electron Beams (PB 111799), by M. Weinstein, U. of Illinois. April 1955. 112 pp. $3. (OTS) The role of space charge of large beam current densities in field free drift regions of a velocity modulated electron beam is investigated, with particular attention to space charge "debunching." A beam analyzing system, enabling the observer to see the velocity distribution of electrons during the complete cycle at a point of interest along the beam, was employed to obtain experimental knowledge about the velocities in each phase increment of a complete modulation cycle.

Behavior of Brittle-State Materials, Part 1 (PB 111987), Part 2 (PB 121002), by O. Salmassy and others, Batelle Memorial Institute. June 1955. Part 1, 153 pp. $4; Part 2, 161 pp. $4.25. (OTS) Part 1 investigates the factors influencing the fracture of brittle ceramic materials with emphasis primarily on the effects of size and stress state, as well as the effects of strain rate and temperature. Part 2 sets forth principles for the selection, evaluation, and design of brittle materials from a statistical and probability viewpoint. The entire distribution curve of fracture stresses was indicated to be a function of size and stress state of a brittle body. All materials investigated showed the same qualitative effect of size and stress state.

Industrial Preparedness Study: Transistors and Transistor Manufacturing Equipment, RCA May 1955. Vol. 1 (PB 111822), 200 pp. $5. Vol. 2 (PB 111820), 42 pp. $1.25. (OTS) Necessary manufacturing equipment and facilities for a point-contact switching transistor and a general purpose junction transistor were designed, built, and operated in a pilot run. Vol. 1 reviews engineering development and summarizes design features. Pilot production problems are discussed, and complete manufacturing instructions are included. Vol. 2 contains descriptions and photographs of the mechanized equipment developed for point-contact production.

Energy Distribution in Luminescence Spectra of Organic Compounds (PB 111872), by F. Germann, Colorado U. Nov. 1954. 163 pp. $4.25. (OTS) As a result of the frequent use of solutions of fluorescent materials in scintillation counters, interest in the phenomenon of energy transfer in phosphor systems has been greatly stimulated. A new system for the detection of infrared radiation (7,000 A-20,000 A) is described. It uses a lead sulfide photoconductive cell and a high gain AC amplifier. With this new detector, infrared phosphorescence of a number of different substances was studied. Phosphorescent emission was found for a series of cadmium sulfide-zinc sulfide phosphors up to a wavelength of 9,000 A.

Evaluation of Antistatic Agents on Nylon Parachute Cloth (PB 121141), by J. Sweeney, Lowell Technological Institute Research Foundation. Sept. 1955. 71 pp. $2. (OTS) Justification was found for the utilization of fabric surface resistance as the measurable parameter. Special instrumentation was developed to provide the desired test conditions of —30° F and 10 percent RH and permit the required range of resistance measurements. No permanent antistatic agent was found to be effective at low temperatures, but specific non-permanent agents gave the treated material a surface resistance at test conditions which was comparable to the resistance of untreated nylon fabric at standard test conditions of 70° F and 65 percent RH.



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PATENTS

Phase Shift Oscillator, No. 2,749,441. Inv. D. A. Kelly. Iss. June 5, 1956. A voltage feedback is applied to a multistage phase inverting amplifier. Series-connected L-sections are used as a phase-shift tuner in the feed-back path reversing the phase at the operating frequency. Degenerative feedback is also supplied.

Direct-Reading Frequency Meter, No. 2,749,515. Inv. P. G. Hansel. Assigned Servo Corp. of America. Iss. June 5, 1956. The output frequency of a wide-range continuously-tuned oscillator is compared to the harmonics of a crystal-controlled oscillator, each frequency coincidence being counted for each tuning sweep. The unknown frequency is similarly compared to the output of the continuously-tuned oscillator and applied to the same counter. The counter being stopped at simultaneous counts, giving an indication of the particular harmonic frequency swept just before attainment of the unknown frequency.

Electromagnetic Horn, No. 2,749,545. Inv. J. A. Kostriza. Assigned International Telephone and Telegraph Corp. Iss. June 5, 1956. Dielectric material is positioned between two parallel conductors of a transmission line. The conductors having a first section of uniform width leading to a terminating section flaring outwardly to provide an impedance transition between the uniform-width transmission line section and free space.

Transistor Oscillator with Current Transformer Feedback Network, No. 2,748,274. Inv. A. R. Pearlman. Assigned Clevite Corp. Iss. May 29, 1956. Two transistors are coupled in push-pull and their output fed to a transformer coupling to a load. The primary of a feedback transformer is supplied by the load, and the secondary of the feedback transformer serves as input to the transistors.

Intercarrier Wave Translation Circuits, No. 2,-745,954. Inv. G. F. Devine and R. F. Foster. Assigned General Electric Co. Iss. May 15, 1956. The different carrier frequency AM and FM waves received in a TV receiver are intermodulated in a two-control grid tube. The AM wave is derived and detected from the first-electrode cathode circuit. A filter circuit between the plate and the cathode derives the intermodulatel wave for limiting and demodulation.

Semi-Conductor Signal Generator, No. 2,745,-960. Inv. B. D. Griffith. Assigned RCA. Iss. May 15, 1956. A resistor and capacitor in series are connected between the collector and emitter electrodes of a point-contact type semi-conductor. Another capacitor and variable resistor are connected in parallel between the emitter and the base electrode. The variable resistor controls the current of the emitter and thus the oscillation frequency. Suitable bias voltages are provided.

Vacuum Tube Shield and Heat Radiator, No. 2,-745,895. Inv. E. J. Lideen. Iss. May 15, 1956. The shield and heat radiator is a grounded corrugated metal cylinder closely surrounding the tube. At the bottom, where it rests on the socket, small openings are provided for the entrance of cooling air which then progresses along the vertical corrugations. The shield can be mounted by sliding it over the tube.

Television Receiver Circuit, No. 2,745,899. Inv. R. A. Maher and Ch. C. Pfitzer. Assigned Avco Manufacturing Corp. Iss. May 15, 1956. In a color television receiver the phase of the color subcarrier oscillator output is compared with a received color burst signal for synchronization of the oscillator. This oscillator controls the elements of a color grid aligned with the horizontal strips of phosphors of different color. At least one low harmonic of this oscillator output is applied to a beam intensity modulating electrode.

T-Connected Stub Filters for Use on Very High Frequencies, No. 2,751,557. Inv. B. M. Sosin. Assigned Marconi's Wireless Telegraph Co., Ltd. Iss. June 19, 1956. The connecting arm of a T-connected stub is not a multiple of a quarter wavelength at any operating frequency. This connecting arm is connected in parallel to the two other arms; one arm is open-circuited at its other end and an odd multiple of a quarter wavelength, while the other arm is short-circuited at its other end and shorter than a quarter wavelength.

High Frequency Capacitor, No. 2,751,560. Inv. E. F. Brinker. Assigned Lavoie Labs, Inc. Iss. June 19, 1956. Two sets of stator blades are mounted respectively at the end of two spaced rectangular conductors of a transmission line and extend in the direction of the line. Two electrically connected groups of rotor blades, interleaving respectively with the two sets of stator blades, are rotatably mounted.

Color Television Synchronizing Apparatus, No. 2,748,188. Inv. R. J. Stahl and N. L. Heikes. Assigned Color Television Inc. Iss. May 29, 1956. A tunable synchronizing frequency oscillator is controlled by a voltage derived from a phase comparison of a subharmonic of its output with another voltage. This comparison voltage is derived from a frequency stabilized oscillator tuned to a harmonic of the half-line frequency.

Television Color Synchronization, No. 2,751,430. Inv. G. E. Kelly. Assigned RCA. Iss. June 19, 1956. The color synchronizer comprises a color sampler driven by a crystal-controlled oscillator. The phase of the received burst signal is compared with the phase of the oscillator output to derive a control signal which is applied to the piezoelectric crystal controlling the oscillator.

Signal Translation System, No. 2,751,437. Inv. C. H. Hoeppner. Assigned Raytheon Manufacturing Co. Iss. June 19, 1956. The receiving antenna of a communication system supplies a plurality of frequency signals, the frequencies representing the intelligence. These frequencies are converted into pulses, divided and recorded. A reproducer feeds a magnetic string oscillograph.

Automatic Gain Control Circuit for Transistor Amplifiers, No. 2,751,446. Inv. C. C. Bopp. Assigned Avco Manufacturing Corp. Iss. June 19, 1956. The gain control circuit for a main transistor amplifier is a direct current transistor amplifier. The bias voltage source of the collector electrode of the main transistor amplifier is connected in series with the collector electrode to transmitter electrode path of the direct current transistor amplifier. The collector electrode to transistor electrode impedance of the direct current transistor amplifier is variable.

Superregenerative Transistor Broadcast Receiver, No. 2,751,497. Inv. R. S. Duncan. Assigned Bell Tel. Labs., Inc. Iss. June 19, 1956. A transistor oscillator with a regenerative feedback is used. This feedback is controlled to compensate for the current gain factor of the transistor which decreases with frequency over the operating band so that the oscillator will alternately start and stop oscillating.

Cathode-Ray Tube, No. 2,750,525. Inv. R. C. Palmer. Assigned Allen B. Du Mont Labs. Iss. June 12, 1956. The face plate of a cathode-ray tube is made of light-sensitive glass which may assume different colors. This plate is photographically fixed to provide a series of strips effective as color filters for different color. These filter strips can be arranged to provide, for instance, alternating blue and red filters.

Intercarrier Sound System, No. 2,750,441. Inv. K. Schlesinger. Assigned Motorola, Inc. Iss. June 12, 1956. An intercarrier 4.5 MC wave is frequency-modulated by the audio signal and amplitude-modulated by low-frequency pulses of the video signal. This wave is limited and mixed to produce a 300 kc to 600 kc FM wave which is fed to a blocking oscillator. The blocking oscillator output is demodulated by a filter supplying the audio output.

Superregenerative Superheterodyne Wave-Signal Receiver, No. 2,748,267. Inv. D. Richman. Assigned Hazeltine Research, Inc. Iss. May 29, 1956. The heterodyned wave is supplied to a regenerative oscillator having a quench circuit. Further, the regenerative circuit supplies another heterodyne signal in response to the heterodyne signal and the signal supplied by the regenerative oscillator. This signal is fed to a frequency-selective circuit.

Direct Current Amplifier, No. 2,750,453. Inv. R. L. Pritchard. Assigned General Electric Co. Iss. June 12, 1956. A varying resistance which is to be measured is connected to the base electrode of a transistor having a current amplification factor less than unity. A dc voltage source and an output resistor, having a resistance which is small compared to the one to be measured, are connected between the collector and the emitter, the free end of the varying resistance being connected to the common terminal of the voltage source and the collector electrode.

Device for the Amplification of Both Voice and Signalling Voltages, No. 2,749,394. Inv. L. B. Person et al. Assigned Telefonaktiebolaget L. M. Ericsson. Iss. June 5, 1956. In a device for the amplification of voltages above a given frequency, a feedback low-pass filter, passing frequencies lower than voice frequency, is connected to the cathode of a tube. A high negative voltage is applied over a large resistor to the other terminal of the network. A grounded voice by-pass capacitor is also connected to this terminal, while a biasing voltage is applied thereto over a diode.

Trigger Circuit, No. 2,749,437. Inv. W. G. Parr. Assigned Pye Ltd. Iss. June 5, 1956. A plurality of flip-flop connected double tubes is arranged in series. A resistor is interposed between the grids of one of the tubes and ground. The control grid of another tube is connected to a resistor and grounded rectifier in series, resetting pulses being applied to the junction of the resistor and rectifier. The input is applied to a cathode and the output taken from a plate.

Multivibrator Trigger Circuit, No. 2,745,955. Inv. B. L. Havens. Assigned International Business Machines Corp. Iss. May 15, 1956. Each grid of the two multivibrator trigger tubes is connected to a rectifier and a resistor having their other terminals at a constant potential. This limits the negative voltage excursion on the grids, whereby the recovery time is reduced. A rectifier is connected to the grids in such a manner that the control pulse will trigger only the more positive grid.

Trigger Circuits, No. 2,745,959. Inv. A. R. Kilbey and G. E. Tucker. Assigned Raytheon Manufacturing Co. Iss. May 15, 1956. A reactive impedance is inserted into the cathode lead of an electron tube and another reactive impedance is placed in the plate circuit. During conduction of the tube, the two impedances will resonate. The control signal is applied to the grid of the tube.

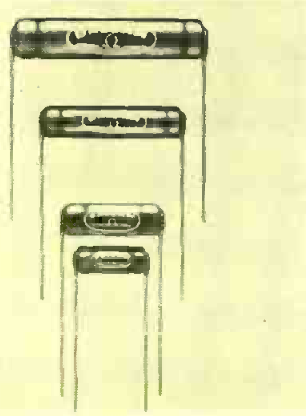
Radio-Frequency Controlled Plasmatron, No. 2,-750,455. Inv. H. J. Geisler. Assigned International Business Machines Corp. Iss. June 12, 1956. Two pairs of opposing electrodes enclosing a common space are mounted in a gaseous discharge tube. An ionizing dc potential is applied to one pair of electrodes through a choke coil filter grounded over an output resistor. An amplitude-modulated high-frequency oscillation is fed to the other pair of electrodes which are balanced with respect to ground.

Color Television Transmitter, No. 2,750,439. Inv. R. D. Kell. Assigned RCA. Iss. June 12, 1956. A full band-width panchromatic signal and two color component signal trains are developed. The low-frequency component of each of the color signals is combined with the low-frequency panchromatic signal. This combination signal and the low-frequency components of the two color signals are consecutively and cyclically sampled at a comparatively high frequency and the resulting signal is mixed with the panchromatic signal to produce a composite signal for transmission.

New Printed Circuit Components

MINIATURE RESISTORS

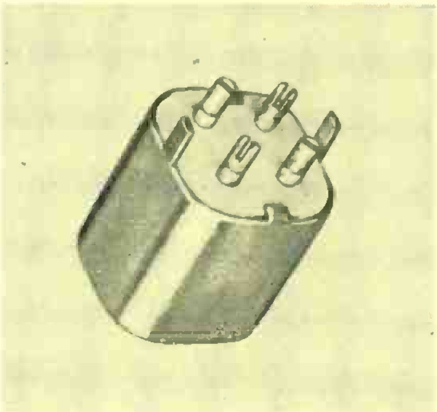
The new Dalohm Type RLS miniature power resistors, designed for printed circuit applications, are basically the same as the Type RS resistors, except that



they have radial instead of axial leads. They come in 6 sizes and 4 wattages, 2, 5, 7, and 10 w. Max. resistance values are 4.4K, 15.5K, 22K, and 55K, respectively. Temperature coefficient: 0.00002/Deg. C; di-electric strength of 1000 VAC, V block test; tolerances: 0.05% to 3%. **Dale Products, Inc., Columbus, Neb.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-1)

COIL FORM

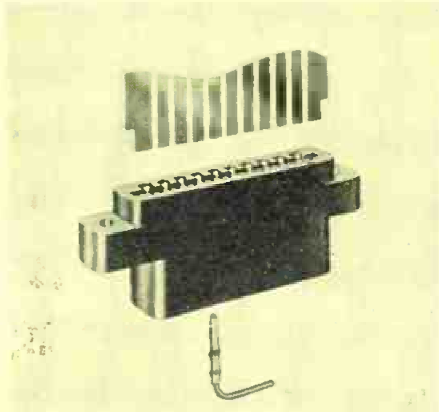
Shielded coil form for printed circuits, designed as LS-12, has a square shaped plated brass housing, whose dimensions are ½ x ½ x ½ in. Inside the housing is



a coil form with an internally adjustable powdered iron core, tunable from top or bottom. The LS-12 mounts by two tabs that can be inserted through a printed circuit board and can be dip-soldered from one side of the board to complete installation. **Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-20)

CARD RECEPTACLE

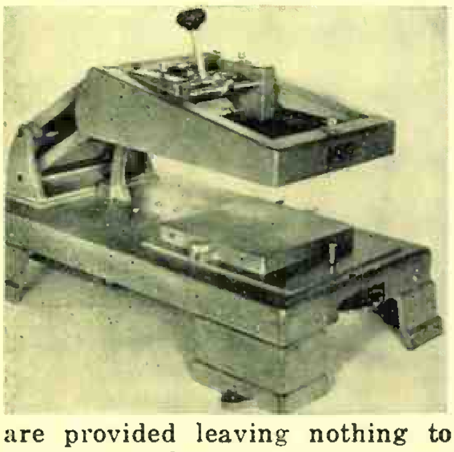
Line of double-row, printed card receptacles, designated as Series UPCR-DTP, feature beryllium copper contacts with taper-pin terminals embodied within a



high-compression solid molding. Available in 6, 10, 15, 18 and 22 contacts per row, for 1/16 in. and 3/32 in. printed cards, receptacles have an insulation resistance of over 100,000 megohms and voltage capacity of 2200 v ac (RMS) at sea level, and 600 v ac (RMS) at 60,000 ft. **Components, Inc., 454 E. 148th St., N. Y. 55, N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-31)

SCREEN PRINTER

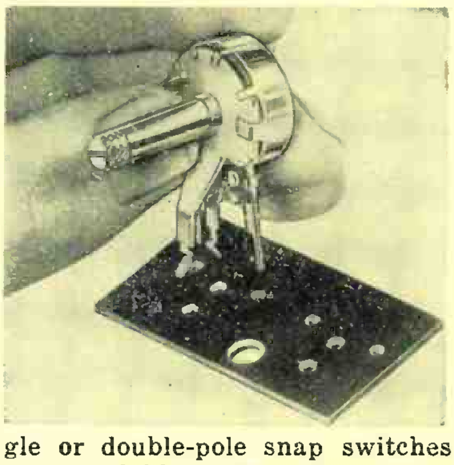
Screen Process Printer for printed circuits will print an actual area of up to 6 x 6 in. on copper clad laminates of any thickness. The screen is closed to the work by an air cylinder, while the squeegee is operated by a simple hand motion. Pressure, angle of squeegee, and registration locks



are provided leaving nothing to operator judgment. 200 impressions per hr. are readily achieved. **Mech-Tronic Equipment Co., P.O. Box 510, Silver Spring, Md.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-143)

SNAP-IN CONTROL

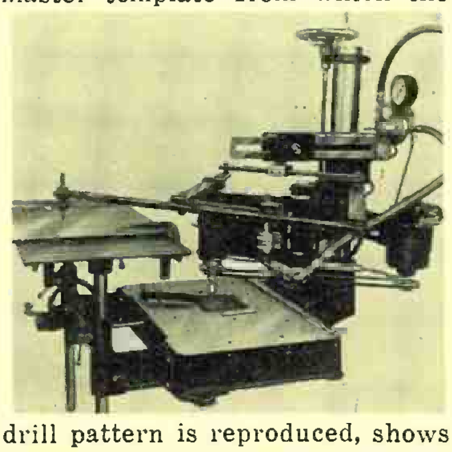
Self-supporting, snap-in variable resistor for printed wiring known as the Stackpole Type LR-70, measures 57/64 in. dia. and stands ⅞ in. off the mounting board. It is supported by four legs —the three regular voltage taps, and a larger, case ground leg. Sin-



gle or double-pole snap switches are available with ratings from 15 a., 15 v. dc; to 6 a. at 125 v. ac-dc. **Electric Component Div. of Stackpole Carbon Co., St. Marys, Pa.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-90)

CIRCUIT DRILLING

Speed-up in the drilling of printed circuit plates is now possible with a newly-developed pneumatic attachment to the New Hermes pantograph. Machine enables an unskilled operator to increase the drilling operation to more than 100 holes per min. A master template from which the

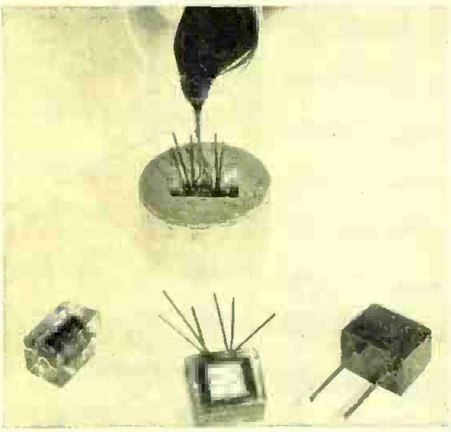


drill pattern is reproduced, shows a number of dots representing the amount of holes to be drilled. **New Hermes Engraving Machine Corp., 13-19 University Place, N. Y. 3, N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-26)

New Microwave Products

EPOXY RESINS

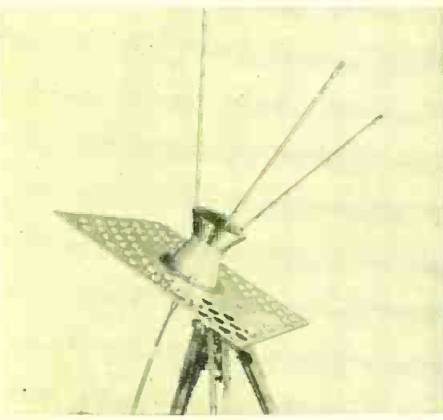
"Family" of epoxy resin systems are marketed under the trade name "Randac." Randac R-4060 exhibits nearly constant values for volume resistivity, loss or dissipa-



tion factor, and dielectric constant from room temperature to 130° C. R-4059 is a 100% reactive, mineral-filled, thermosetting liquid designed for room-temp. application which, in the cured state, is semi-flexible. R-4053 a 100% solid resin is thermoplastic until cured. **Mitchell-Rand Insulation Company, Inc., 55-A Murray St., New York 7, N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES (7-72)

ANTENNA

Patterned after a Signal Corps design, the new 91280-1 Discone Antenna fully meets the requirements of specifications MIL-I-11683A and MIL-S-10379A. Used in conjunction with the Stoddart NM-30A Radio Interference-Field Intensity measuring equipment, it is suitable for making broad-band



interference measurements within the frequency range of 40 to 400 MC. **Stoddart Aircraft Radio Co., Inc., 6644 Santa Monica Blvd., Hollywood 28, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-98)

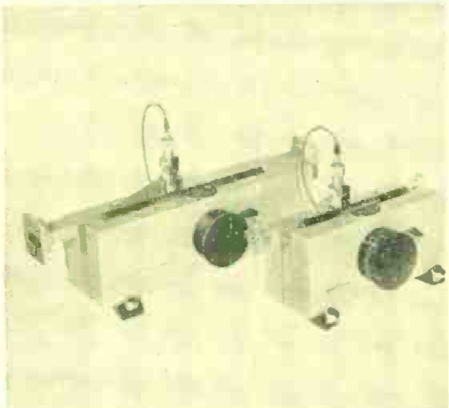
MICROWAVE SYSTEM

This new and compact 2,000 MC microwave relay system for TV combines for the first time outputs of separate aural and visual transmitters into a common antenna.

The complete system weighs less than 200 lbs. and comprises 2 transmitting and 2 receiving units, and 2 parabolic antennas or "dishes." The system will be available in 2 models; the TL-3-A, including both aural and visual equipment; and model TL-3-D, visual equipment only. **General Electric Co., Electronics Park, Syracuse, N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-12)

STANDING WAVE DETECTOR

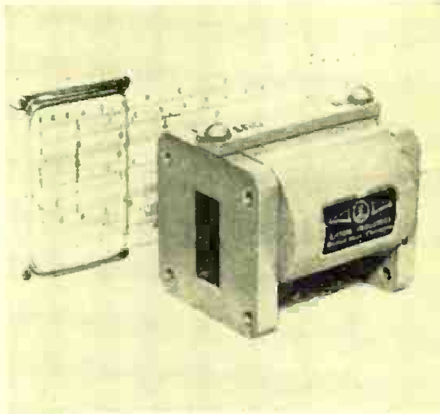
Consisting of only three basic units—the carriage and drive section, the block, and the probe, Type DB-825 can measure all standard microwave and ultramicrowave frequencies, from 5.8 KMC to 90 KMC. The slot is built



perfectly parallel to the waveguide axis, and probe travel is held parallel to the waveguide axis. **DeMornay-Bonardi, 780 S. Arroyo Pkway., Pasadena, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-159)

FERRITE ISOLATOR

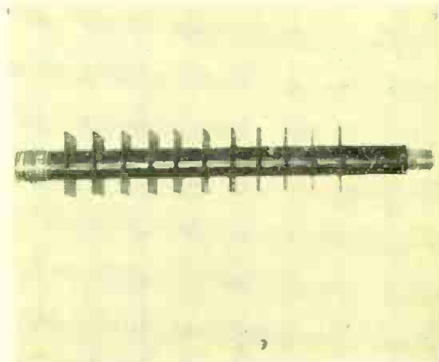
The new Model X110 Ferrite Load Isolator is designed for use in X-Band systems where space and weight are at a premium. Unit weighs 1 lb. and is 2 in. long



and 2 in. wide. Nine db isolation is provided at 100 kw peak power over a bandwidth of 8600 to 9600 mc. It provides a compact solution to "long-line" effects and other loading problems caused by lengthy transmission lines or excessive VSWR's. **Litton Industries, Components Div., 336 North Foothill Road, Beverly Hills, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-18)

COAXIAL TERMINATION

New high power coaxial termination for the 900 to 10,000 mc range, Model 369, has a power rating of 200 w. average and 50,000 w. peak. Capable of withstanding temperatures in excess of 500°F., it is useful for terminating directional couplers and other devices in high power sys-



tems in actual operation or for test purposes. The unit is 11 in. long and is available with a type N female connector. **Narda Corp., Mineola, L. I., N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-8)

Western Manufacturers Offer Technical Data . . .

(Ask for WC-1)
Diodes, transistors and deposited carbon resistors are shown on catalog sheets. Engineering data sheets, and catalogs showing wire-wound resistors, precision carbon-coated resistors and copper oxide rectifiers, also available. (Nucleonic Products)

(Ask for WC-2)
Motor brochure on rotating electrical equipment, including data sheets and photos, and a performance specification on a new instrumentation camera (35mm type—MPSC35-100) are offered. Engineering drawings included in both brochures. (Bill Jack Scientific Instrument)

(Ask for WC-3)
Etched circuitry and related electronic components and assemblies are described in a four-page brochure. Material includes photos and brief descriptions of components; back cover has graphs relating to current carrying capacity and voltage drops expected for various weights of copper used in printed circuitry. Charts have been incorporated in the Standards Manual at North American Aviation. (Graphik-Circuits Div., Cinch Mfg.)

(Ask for WC-4)
Data sheets offered are: special cathode ray tubes, vacuum gage tubes, vacuum measuring equipment, spot and seam welders, and fractional cycle timers. Engineering bulletins available include: phosphor characteristics, and welders. (Vacuum Tube Products)

(Ask for WC-5)
Pulse handling instruments line is described in eight catalog sheets and specification sheets. Items include: two time delay generators, a digital time delay generator, pulse generators, a marker generator, and a pulse forming unit. (Rutherford Electronics)

(Ask for WC-6)
Fluoroplastics Kelon-T (Teflon) and Kelon-F (Kel-F, Fluorothene) are described in engineering bulletins. Kelon-T and Kelon-F are used to make back-up rings, standard O-rings, piston-rings, scraper rings, valve packings and stand-off and feed-through insulators. Wide variety of applications for these fluoroplastics is listed, and bulletins include specs and drawings. (W. S. Shamban)

(Ask for WC-7)
Cinema encapsulated resistors, wire-wound fixed, are described in a bulletin which includes scaled drawings and specifications for each type. Military types and series for printed circuits are included among the available resistors. (Cinema Engineering)

(Ask for WC-8)
Plug-in catalog includes a special section on plug-in units and an application chart for quick reference in applying plug-in units. Special section of plug-in units involves: counting and frequency division (digital counting and analog counting); pulse and sweep generators; time selection; squaring circuits; pulse amplifiers; and linear amplifiers. For systems designers, the catalog is concerned with standard plug-in units for military and commercial users, as well as special plug-in units fabricated to customer drawings. Catalog has photos, engineering drawings, specs and price list. (Eeco Production)

(Ask for WC-9)
Application case history No. 113, describing use of rubberized abrasive for deburring and polishing component metal electronic tube parts, and industrial catalog and price list are offered. Case history gives details of problem and its solution. Catalog, illustrated, gives specs, uses and operating suggestions on wheels, points, blocks, sticks and cones, for burring, smoothing and polishing. (Cratex Mfg.)

(Ask for WC-10)
Engineering-drawing aids are available for three specifications: free space attenuation nomograph, thermal noise nomograph, and noise figure vs. frequency for high frequency triodes. (Interstate Electronics)

(Ask for WC-11)
Digitizer data are included in Data File 661, which contains technical bulletins with application data, specs, photos, and schematic diagrams used in building up digital readout systems. (Coleman Engineering)

(Ask for WC-12)
Dictionary of carrier and microwave terms, and monthly company magazine, The Demodulator, are available upon request. Dictionary contains charts and nomographs especially for communications engineers. Magazine features factual information on carrier telephone, carrier telegraph and microwave communications; material is slanted for both non-technical management and the experienced communications engineer. (Lenkurt Electric)

(Ask for WC-13)
Monthly technical publication discussing major technical developments and new catalog is offered upon request. Called The Tracerlog, magazine recently announced a new catalog of technical services and radioactive chemicals, which is available upon request without charge. (Tracerlab)

(Ask for WC-14)
Fluorescent paints, inks and dyes are among the products described in a brochure which lists daylight materials and black light materials. Wide variety of luminous materials and products such as phosphorescent paints for signs are offered. Price list is offered for paints and crayons; black light lamps and fixtures and filters; Hi-Brite oil base color and Ultra-Brite signal color; inks and textile colors; and miscellaneous non-packaged items, such as luminous paper, penetrant fluids, magnetic powder and luminous pigments. (Shannon Luminous Materials)

(Ask for WC-15)
Major television chassis components are listed in a chart which includes all chassis made by the company. Correct replacement part stock numbers are provided, for quick reference, under component headings and chassis numbers are given in both right and left margins. A model-chassis index is also provided to help locate chassis number if only model number of receiver is known. (Radio Div., Hoffman Electronics)

(Ask for WC-16)
A circuit designer (Model C-38) and stack-up connecting leads are described in two flyers. Material on the circuit designer is illustrated, gives specs and lists accessories. Leads are illustrated and features and model details are given. (Pomona Electronics)

(Ask for WC-17)
Micaply Epoxy-Glass, a laminate, is described in detail in a booklet. Product applications include etched circuits, commutators, binary code discs and lighted panels, for clad material; for unclad material, applications include electrical insulation, mock-up boards, gaskets and high R-F grounding insulation (copper or aluminum sandwiched in laminate). Micaply Epoxy-Glass is made in three grades—military, industrial and punching. Price lists are given in booklet. (Mica Corp.)

(Ask for WC-18)
Sub-miniature and other switches are described in data sheets. Products covered in detail include: sub-miniature, snap-action basic switch; auxiliary actuators for sub-miniature switches; push button and toggle switches; and a subminature high amperage switch. A description sheet, price list and definitions of technical terms are also available. (Milli-Switch Corp)

(Ask for WC-19)
Technical bulletins are offered as engineering aids and include engineering drawings in some instances. Subjects include: triax and double shielded coax; index of engineering data drawings; cellular polyethylene cables; hermetic seal connectors; pressurized connectors; color coding connectors; pricing of cable assemblies; "terminals" for cable center conductors; "locking terminals" for Microdot receptacles; cable specifications; cross index of Microdot coaxial connectors; and printed circuit receptacles and connectors. (Microdot, Inc.)

(Ask for WC-20)
Infrared spectroscopy reprints may be obtained in a handy package which serves as an introduction to the field. Thirteen articles, including a basic introductory article, are in the package, plus a bulletin on the Beckman IR-4 Infrared Spectrophotometer, a copy of Infrared Notes, and an index of all infrared reprints now available. (Scientific Instruments Div., Beckman Instruments)

(Ask for WC-21)
Precision instrument hardware, connectors, connector application notes, micro-miniature terminal lugs and rivets, and a miniature indicator lamp are among the subjects described, with illustrations and detailed specs, in a series of flyers. Features, ratings and specs are included. (Circon Component)

(Ask for WC-22)
Catalog of index books for accumulation of reports, technical information, specs, background data and clippings is available. These visible index books provide quick reference and portability, and may also be used for personal lists, sales contracts, cataloging references, sales control or follow-up, and inventory. (Recordplate Co.)

(Ask for WC-23)
Magnetic servo amplifiers and miniature power type DC voltage references are two items of descriptive literature for standard products. Amplifier 400 cycle MS series literature features a selection chart in selecting a standard magnetic amplifier to drive a standard 400-cycle servo motor. Both products are described in detail; charts and photos are included. (Timely Instruments & Controls)

(Ask for WC-24)
Antennas, antenna systems and transmission line are described in a 100-page catalog which contains the product description and engineering data of over 500 products. Twenty pages are concerned with system engineering data, and related information, especially for engineers working in this field of electronics. Catalog, available upon request, is fully illustrated with charts, photos and engineering drawings, plus specs. (Andrew California Corp.)

(Ask for WC-25)
Data files, catalogs and spec sheets, describing methods of using various instruments, are offered. Data files include: electronic timing, frequency measurement, electronic control, pressure measurement, programming operational equations for analog computers, and an introduction for operation of analog computers. A short form catalog describes the full line available, and another booklet discusses industrial systems engineering. New data files are in preparation. (Berkeley Div., Beckman Instruments)

(Ask for WC-26)
A summary data sheet, reprints of nine technical papers read or published, and an external house organ are available upon request. Data sheet lists and compares the entire line of precision potentiometers, and the house organ carries certain technical information and miscellaneous information. Reprints include these from Tele-Tech & ELECTRONIC INDUSTRIES: "Computing with Servo-Driven Potentiometers, Bradley & McCoy (Sept., 1952); and, "Accuracy of Potentiometer Linearity Measurements," McDonald & Hogan (Aug., 1953). (Helipot Corp., Div. of Beckman Instruments)

(Ask for WC-27)
"What's New with the Electron . . . 1956" is the title of an illustrated brochure, which discusses vacuum tubes, stacked ceramic tubes,

Selected publications, bulletins and catalogs, that are both useful and that have a permanent reference value for engineers, scientists and technicians, may be obtained from West Coast manufacturers upon request

To obtain this literature use the postage-paid Inquiry Card in the back of this issue—opposite page 176. List the number of each item of literature you want and mail the card. We shall refer your request to the manufacturers concerned. Unless otherwise noted, publications are available to interested persons without charge.

and new ceramic receiving tubes. New ceramic power transmitting tubes are also described. (Eitel-McCullough)

(Ask for WC-28)
"Ultra-Violet Lamp in Scientific Research," by Jack DeMent, research chemist of Portland, Ore., is offered as one of a series of bulletins. Catalog sheets on various ultra-violet lamps and equipment, illustrated and giving specs, also available upon request. (Ultra-Violet Products)

(Ask for WC-29)
Data sheets on scopes and meters, plus a small photographic reference handbook, will be sent upon request. Data sheets include: Digital vacuum tube volt-ohmmeter, oscilloscope (several types), digital printout systems, digital radiometer and an oscilloscope instruction sheet. (Hycon Mfg.)

(Ask for WC-30)
A technical bulletin and an external information bulletin are available. Tech. bulletin 3010A, 8 pages, describes an electronic data processing system; the No. 5 information bulletin tells about computer applications, company facilities and personnel. (ElectroData Corp.)

(Ask for WC-31)
Electric power drives and electric motors are described in product catalogs. Multi-mount reducers, slow-speed geared electric power drives, and explosion-proof motors are among the products described in available catalogs. Photos, darwings and specs are included. (Sterling Electric Motors)

(Ask for WC-32)
Long life L. M. Ericsson miniature electronic tubes are described in an illustrated brochure that includes graphs, charts and engineering drawings of various tube types. Features and tube quality tests are described, as are more than a score of different tubes. (State Labs)

(Ask for WC-33)
A report entitled "Project Datum, an Integrated Data Collecting and Processing System for Air Force Flight Test Center, Edwards AF Base. Calif." has been issued containing illustrations and drawings. The 58-page brochure includes these sections: central data processing system, airborne data acquisition system, rocket engine test station data acquisition system, high-speed track data acquisition system, and ground data acquisition system for radar photheodolite. Report is based on a completed Air Force contract. (Electronic Engineering Co.)

(Ask for WC-34)
Four engineering bulletins discuss various electronic developments and products. Theoretical Analysis of Accuracy of Ratio Transformers points out that theoretical analysis of a perfect autotransformer used for stepdown purposes shows that if leakage inductance and winding resistance are uniformly distributed and the turns can be accurately tapped, the accuracy as a voltage divider for no load is perfect. Bulletin No. 2, Use of Gertsch Standard Ratio Transformers for Low Impedance Voltmeter Calibration, discusses the PT Series Standard Ratio Transformers that are useful for AC voltmeter calibrations. The system, basically, consists of a standard voltage source driving the RatioTran which in turn drives the meter to be calibrated. Accuracy Calculations for Gertsch Standard Ratio Transformers (Bulletin No. 3) states that these Standard Ratio Transformers have accuracy specified by a formula which gives the maximum error which could be expected in the indicated ratio; this would give the error as a percentage of the output if the input is perfectly known. This accuracy is applicable to a bridge circuit, since the source voltage is common to both branches of the bridge circuit and variations of source voltage cause no error. The accuracy specification is given as a formula. Bulletin No. 4 shows the Use of Standard Ratio Transformers in Bridge Circuits, and discusses the use of a shielded bridge transformer. All bulletins are illustrated with engineering drawings or charts. (Kertsch Products, Inc.)

(Ask for WC-35)
Free subscriptions are available for the Audio-Record, a house organ published quarterly and containing news and information about sound recording materials. New products and uses of products are described in feature articles which are illustrated with photos. Each issue carries a technical discussion, illustrated, on recording problems and solutions. (Audio Devices, Inc.)

(Ask for WC-36)
Major developments, new products and other pertinent information, are included in Ampex Playback, a house organ published monthly. Material is illustrated with photographs. (Ampex Corp.)

(Ask for WC-37)
Electric generating plants are described in an 8-page, 3-color catalog which has been designed to simplify the selection of the proper type of generating plant and appropriate accessories. Full details are given with each illustration of various electric plants. Individual spec sheets for all models are listed as being available. (D. W. Onan)

(Ask for WC-38)
The Experimenter, published monthly, gives information on new products, technical information, and development news. Illustrated with photos and engineering drawings, the publication is sent to interested individuals upon request. (General Radio)

(Ask for WC-39)
An illustrated bulletin (No. 1000) in color describes and lists industrial shock and vibration mountings for all types of electronic controls and machine tool protection. Detailed specs are included. (Robinson Aviation)

(Ask for WC-40)
"Tubes That Can Take It" is the title of a brochure, based on a new motion picture describing a stacked ceramic receiving tube—a small electronic tube that can withstand environments found in airborne and missile applications. A flyer in color is also available, giving illustrations, drawings and specs on four different ceramic receiving tubes. (Eitel-McCullough)

(Ask for WC-41)
Bulletins, illustrated, describing various products and equipment are available. Materials include specs and illustration of an antenna kit, a standard frequency comparator, and an article discussing standard time and frequency broadcasts. (Specific Products)

(Ask for WC-42)
Synchros available for electronic applications are described in a 16-page illustrated brochure which includes drawings and specs. Specific applications and detailed descriptions are included. (Clifton Precision Products)

(Ask for WC-43)
Bulletin M562 describes the M562 Strain Gauge Power Supply, 5 v at 1 amp continuous. Unit is illustrated in bulletin and specs and applications are included. (Perkin)

(Ask for WC-44)
"It Pays to Specify 'Mylar'" is the title of an 8-page booklet (MB-8) available upon request. Material details experiences of manufacturers in using Mylar. (duPont)

(Ask for WC-45)
Technical descriptions in brief of the portable Series 3000 DC overpotential testers are included in the reprint of "Resume of DC Overpotential Testing," available upon request. (Beta Electric)

(Ask for WC-46)
Catalog sheets of four products are offered. Products are: Transconductance Analyzer and Circuit Designer, Transistorized Voltohmmeter, Frequency Modulation Monitor, and FM Signal Generator. (New London Instrument)

(Ask for WC-47)
Printed Circuit Connectors are described in a new bulletin (No. 101). (Elco Corp.)

(Ask for WC-48)
Printed circuit tube-sockets are described and mounting dimensions given in Bulletin 102. (Elco Corp.)

(Ask for WC-49)
A new 6-page bulletin, "Microwave Noise Sources," describes noise tubes, waveguide mounts and attentuators. (Waveline Inc.)

(Ask for WC-50)
Bulletin No. T-505 gives specifications and operating characteristics of thermal time delay relays. (Curtiss-Wright)

(Ask for WC-51)
A 4-page bulletin (No. B-5) lists comprehensive data, tolerances, dimensions and temperature coefficients of insulated wire wound resistors. (International Resistance Co.)

(Ask for WC-52)
A new 12-page booklet describes materials handling methods and equipment, including descriptions of 28 different containers. (National Vulcanized Fibre Co.)

(Ask for WC-53)
"Multi-Track Magnetic Recording/Reproducing Heads" is the title of a new bulletin (No. 55-B) describing magnetic tape data recording and reproducing heads. Specifications and operating characteristics are included. (Davies Laboratories)

(Ask for WC-54)
TV transmitting antennas for low power TV stations are described in bulletin 432. (Prodelin Inc.)

(Ask for WC-55)
Tubeless high voltage airborne radar power supplies are discussed in a recent bulletin. (Perkins Engineering Corp.)

(Ask for WC-56)
An 8-page catalog (No. 257) describes a wide variety of antenna accessories for TV antenna intercom, etc. (Javex)

(Ask for WC-57)
Commutation switches for telemetering and similar applications are described in an 8-page illustrated booklet. (Mycalex Electronics)

(Ask for WC-58)
A general discussion of the properties of Nickel and Nickel Alloys is included in a new 20-page catalog of Nickel and Nickel Alloy tubing. (Superior Tube)

(Ask for WC-59)
Infrared radiometry is the general topic of a booklet now available. In addition to technical discussions, a line of infrared systems and components is described. (Barnes Engineering Co.)

(Ask for WC-60)
Solid tantalum capacitors are described in a new bulletin (No. 6.110). The bulletin lists 24 standard ratings from 1 mfd at 35 working volts dc to 350 mfd at 2 working volts. (Fansteel Metallurgical Corp.)

WASHINGTON

News Letter

Latest Radio and Communication News, from The National Capital, and Previews of Things to Come

EXCELLENT SUCCESSOR—The succession of Commissioner T. A. M. Craven, who had been on the FCC from 1937 to 1944 and had previously been its chief engineer, to veteran Commissioner E. M. Webster, also a leading Government radio engineer and "father" of Coast Guard communications, was heartening to the communications and radio industries under FCC jurisdiction. Commissioner Craven is recognized particularly as an authority in frequency allocations and has specialized knowledge of broadcasting and television engineering. Commissioner Webster, who holds the retired rank of Commodore in the Coast Guard, ended 47 years of service in the Government.

STRENGTHEN TV SERVICE—In its long-range plan ultimately to shift all or a major portion of TV operation to the UHF band in the next ten years, the FCC has presented a blueprint for television to promote more competitive operations to strengthen and expand TV service throughout the Nation. The television industry has been asked to submit comments on the plan by Oct. 1. It is estimated that the FCC will need possibly two years to reach a final decision. For the immediate implementation of UHF television service, the Commission increased maximum power of UHF stations from 1000 to 5000 kilowatts, effective Aug. 1, and plans interim considerations for eliminating in 13 different areas of the nation of VHF channel assignments to create improved opportunities for UHF TV broadcasting.

BIG ENGINEERING TASK—The FCC plan on UHF television presents a substantial task for radio engineers and research scientists. The Commission expressed the belief that a program of expedited research and development should be launched at once to achieve the maximum possible increase in the range, and the reduction of shadow areas, of UHF stations. The research and engineering development, the FCC advised, should be concentrated upon UHF transmitters with emphasis on increased transmitting power and feasibility of use of such techniques as UHF boosters and satellites, and upon receivers and receiving antennas with the aim of increasing the sensitivity of and reducing the noise factors of receivers as well as improving their selectivity to permit reassignment of UHF channels with a minimum number of restrictions on station separations.

TV ANNIVERSARIES—The first of July marked the 15th anniversary of the birth of regular television broadcast service and the fourth anniversary of the lifting of the TV "freeze." The Nation has 647 video stations currently authorized, of which 477 are on the air—457 commercial and 20 educational TV stations. More than 90% of the Nation's population is within range of at least one TV station, and over 75% are in service areas of two or more stations. Three out of every four American households have TV sets. So, the television industry can be proud of the tremendous progress made in serving the American people in this short span of time.

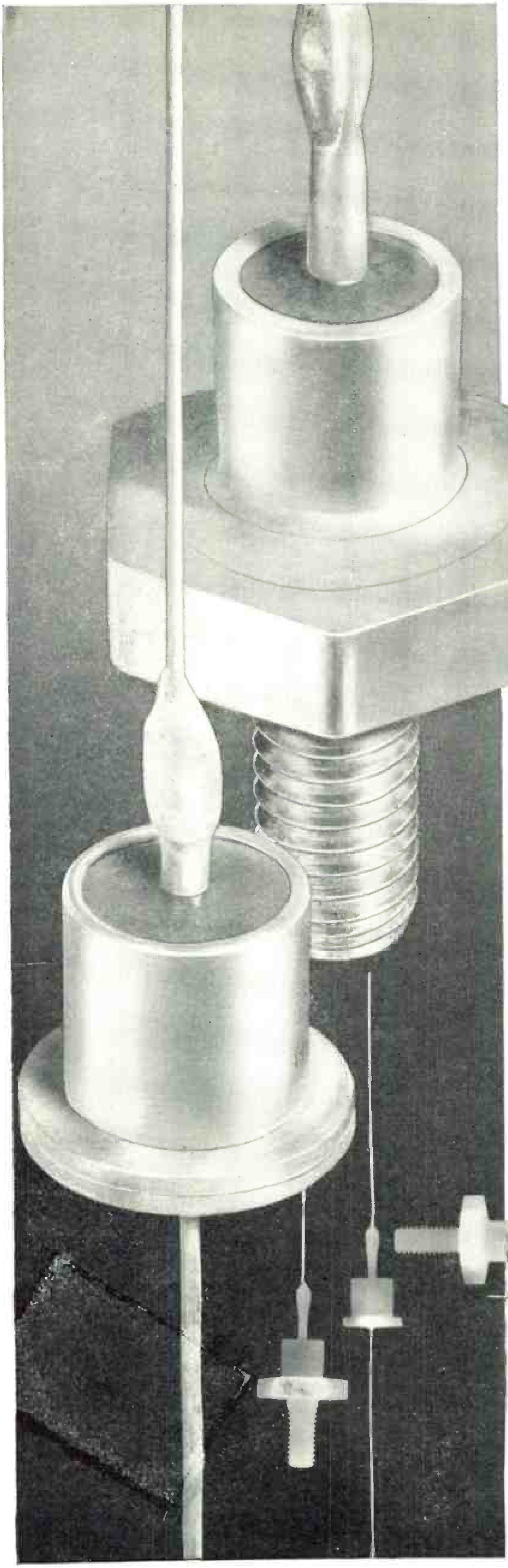
MOBILE RADIO PROSPECTS—The UHF television plan of the FCC holds out prospects for more frequency space for the important and continuously growing land mobile radio services. In fact, the Commission UHF report mentioned land mobile radio as a possible beneficiary of any VHF television frequency space to be abandoned in a switch to all-UHF. The FCC report also cited the possibility of the use of ionospheric scatter transmission in portions of the 30-60 MC frequency band, portions of which are being heavily used by present land mobile services. The Commission noted that the need and demand of land mobile radio for more space promises to increase further as the industrial uses of radio continue to develop.

HUGE VOLUME—The tremendous volume of operations in the safety and special radio services was depicted by FCC Chairman George C. McConnaughey in a recent letter to a Congressman. The FCC during this fiscal year, which ended June 30, had a total receipt of applications of 172,000 for the year, compared to 88,000 in 1949. As of the beginning of July, there were 340,000 stations authorized—more than double the 153,000 in 1949.

COMMUNITY TV—The most pressing question in the community television antenna field—whether the CATV operators are violating property rights of telecasters when they circulate to their subscribers programs received from TV broadcast stations—may soon be the subject of a "friendly suit" filed by the National Association of Radio & Television Broadcasters against the National Community Television Association, which represents most of the community TV systems.

National Press Building
Washington 4

ROLAND C. DAVIES
Washington Editor



WESTINGHOUSE
SILICON DIODE

High peak inverse voltages . . . extremely low reverse current

The Westinghouse XP-5052 fused-junction silicon diode can handle 500 ma continuous d-c current at peak inverse voltages from 50 to 600 volts.

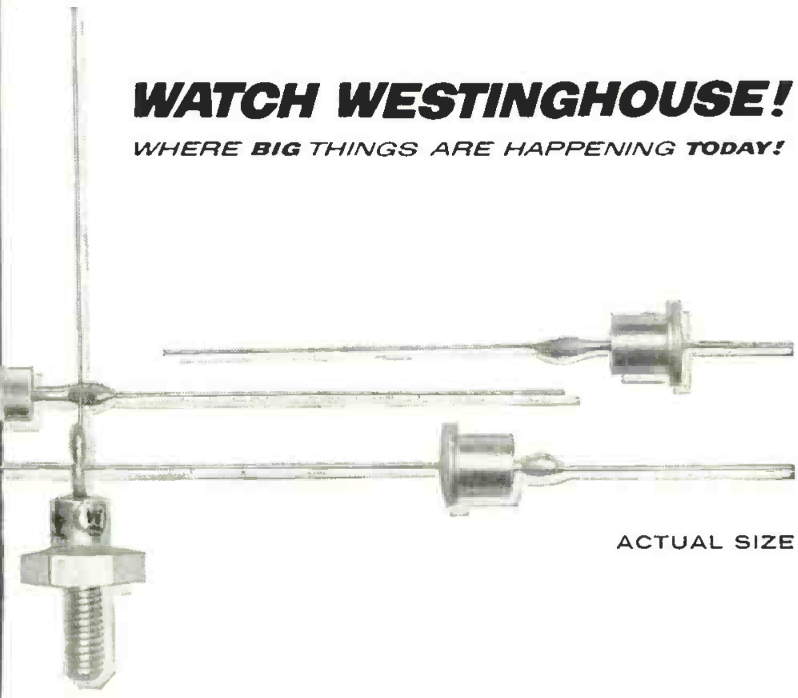
Leakage at rated voltage is extremely low . . . result is increased efficiency and temperature ranges never before attainable.

This diode is suitable for use in radio and TV, radar, aircraft, magnetic amplifiers, voltage regulators, computers, precipitators, and other industrial applications. Two case designs are immediately available . . . pigtail (XP-5052) and threaded stud (XP-5053).

For more information on the XP-5052, or any other silicon rectifier requirements, regardless of voltage and current, call your nearest Westinghouse apparatus sales office, or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-09001

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING **TODAY!***



ACTUAL SIZE

For product information, use inquiry card on last page.

Microwave

(Continued from page 128)

Experience is proving that microwave equipment, easily accessible in the central office and simply tested, is maintained as easily and performs as reliably as its associated carrier equipment. To make such routine maintenance possible drawings, engineering information, and maintenance practices along lines standardized by the telephone industry must be made available by the microwave manufacturer.

Conventional telephone engineering practices should be followed in the design and construction of the radio equipment to facilitate installation, troubleshooting, and maintenance. Also, the equipment should incorporate all necessary safety practices to protect personnel from the risk of shock.

Electrical coordination requires the impedances and levels, particularly on the drop side of the microwave equipment, to be identical to those encountered in the connecting carrier equipment. The microwave supplier should provide, on a coordinated basis, the necessary junction filters, amplifiers, equalizers, pads, impedance-matching transformers, and other accessory items that permit the telephone company to achieve the utmost flexibility in the use of the microwave equipment. Also, some means should be provided to monitor the microwave circuits, to switch automatically to standby microwave equipment, and to provide alarms to indicate that the equipment has failed.

Apart from reliability, the actual cost of maintaining the microwave system must be kept as small as possible. This requires equipment that can be checked and adjusted by telephone craftsmen as part of their routine duties. Maintenance practices should be provided which enable nonspecialist craftsmen to localize troubles and make repairs. Here again, it is extremely important that any changes in design be coordinated with changes in instruction material so that the equipment and the drawings agree in every detail.

Engineering and Installation Services

In the telephone industry, the engineering load on operating companies is often relieved by placing orders with the supplier for entire communication links. The supplier then takes on the responsibility for engineering the system into the telephone company's plant, ordering all items of equipment, and installing and lining-up the system. After completion of line-up, the working system together with suitable technical data is turned over to the telephone company. At least two suppliers are currently involved in providing such service to the telephone industry.

Typical Microwave Systems

It is possible here to provide statistics only on Lenkurt microwave systems. These statistics should be of some interest however, because they account for more than 40% of the medium-route microwaves systems in use by the telephone industry.

Table 1 gives statistics for the Lenkurt microwave systems installed or under construction at this time. Of 31 Lenkurt systems, 18 have been for Independent companies and 13 have been installed by the Bell System operating companies. The average section length is 23 mi. with the maximum length at 56 mi. and the minimum at 5.5 mi. The average system consists of two sections and requires one repeater. Almost 40% of the repeaters have branching or drop-off arrangements—a provision not conveniently obtained with heterodyne repeaters. The cost of the microwave equipment may range from about 10% to over 80% of the total cost of the installation. Most systems thus far installed use separate antennas for transmitting and receiving, but several have been equipped with r-f directional filters to permit transmission and reception on a common antenna.

References

1. "Load Rating Theory for Multichannel Amplifiers," Holbrook and Dixon: *Bell System Tech. Jour.*, Oct. 1939.
2. "A Speech Volume Survey on Telephone Message Circuits," V. Subrizi; *Bell Lab. Record*, Aug. 1953.

PERSONAL

Dr. Rudolfo M. Soria was named Vice President of Engineering by Amphenol Electronics Corp., Chicago (formerly American Phenolic Corp.).

Dr. Carlo L. Calosi has been elected a Vice President of Raytheon Mfg. Co., Waltham, Mass., and will participate in the management of the company's microwave and power tube operations.

G. Lupton Broomell, Jr., is now Assistant Director of Engineering at Leeds & Northrup Co., Philadelphia. He is also Acting Head of Engineering and Inspection.

John E. Meade is the new Director of Engineering, Electronics Div., American Machine & Foundry Co., Boston.


Henry F. McKenney


John E. Meade

Henry F. McKenney has been appointed Vice President for Engineering at Electronics Corp. of America, Cambridge, Mass.

Albert A. Chesnes has been named Technical Director of Chromatic Television Laboratories, Inc., New York, responsible for color development and military electronics activities. Other appointments: **Sy Krinsky,** to Chief Engineer; **Paul Neuwirth,** to Department Chief, Color TV Dept.; and **Albert Jacobs,** Department Chief of Government Research and Development.

Charles D. Branson is now Asst. Director of Research at the Research Center, Robertshaw-Fulton Controls Co., Irwin, Pa.

James Van Horne Lawrence is in the newly-created post of Director of Engineering Orientation, and **George A. Crowther** is Chief Engineer, at Ford Instrument Co., Div. of Sperry Rand Corp., Long Island City, N. Y.

(*Continued on page* 162)

Diode Design

(*Continued from page* 81)

free cathode and a sawtooth waveform from the horizontal output with the polarity shown (Fig. 1) is applied to the anode-cathode junction. The control voltage for the horizontal oscillator is obtained from the center tap of a high resistance load between the free anode and free cathode. In this circuit a 6AL5 duo-diode is normally used as the detector.

The circuit of Fig. 1 offers an ideal application for selenium diodes. For example, a pair of International Type 1U1 selenium diodes, series connected, can be readily used as replacements for the 6AL5 tube, as shown in Fig. 2. A dual

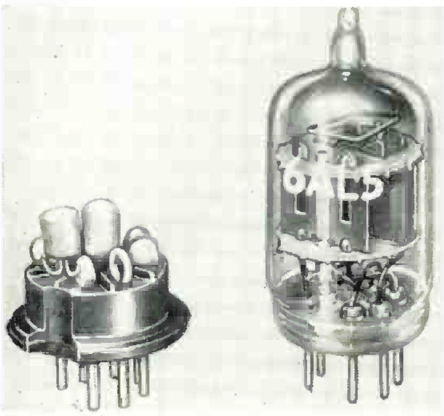


Fig. 3: Selenium diode circuit replaces 6AL5

unit Int'l. Type D-3086, which is essentially a doubler, can also be used as a replacement.

Due to the relatively high short capacity of a selenium diode compared to a thermionic diode, low-impedance sources must be used for the sync pulses and referenced sawtooth. Such a source for the sawtooth waveform is best obtained across a low value resistor in the low potential side of the horizontal deflection coil.

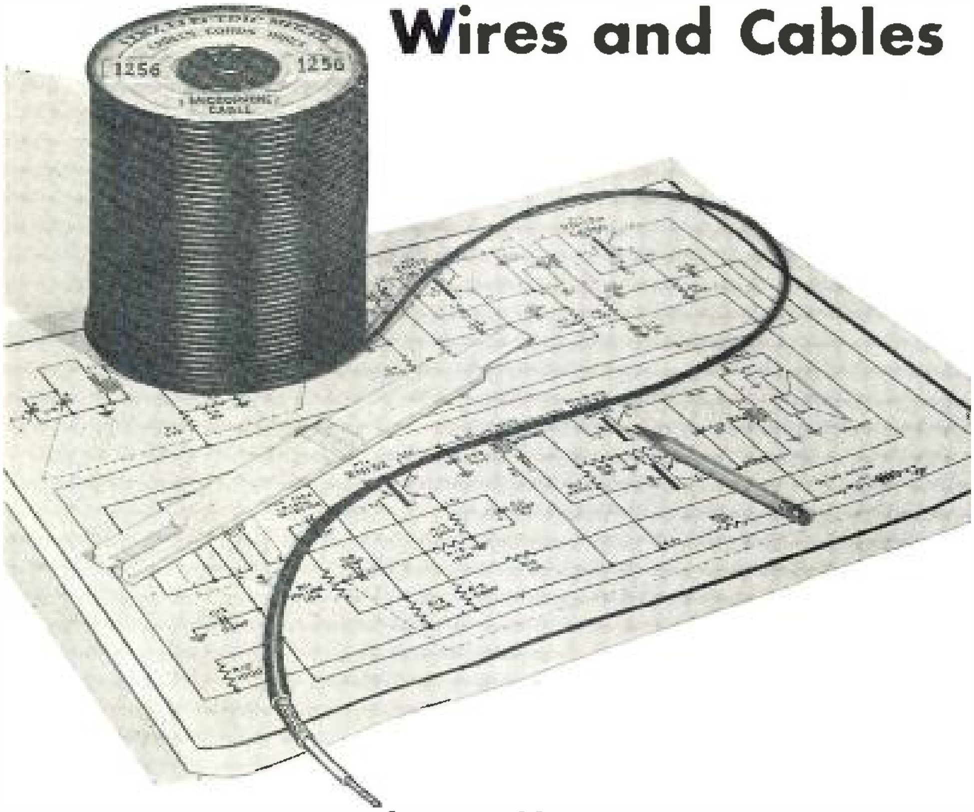
Shunt Capacitance

The Type 1U1 diode has an inherent shunt capacitance of approximately 170 mmf. Therefore, during the non-conducting half cycle, a capacity voltage division takes place through the 0.001 μf capacitor and the diode shunt capacitance in series. Approximately 83% of the initial voltage will appear across the 100 K resistors. To recover this voltage loss, the 0.001 μf capacitor may be increased to 0.002 μf as shown. The recovered voltage is greater than 90% as compared to 83% prior to the change in capacitor value.

Although the Type 1U1 selenium diode can be used as direct replacement in some TV receivers, there are several voltage values which should be considered to obtain the best operation of the horizontal AFC circuit. The sawtooth voltage from the horizontal output system should have a value of approximately 15 v peak-to-peak. The positive and negative pulse voltages from the phase inverter are equal and should have a peak value of about 18 v. Obviously, these voltage values will change with input signal and any B-plus variation. However, these changes are not large in most TV receivers which have reasonable AGC operation.

References

[1]* Selenium Diode Applications, *Radio-TV News,* Sept., 1953.



"Free-Power"

(Continued from page 67)

Light-Powered Oscillators

The overall performance of an active element under operating conditions is tested by means of its self-excitation because the production of oscillations in a feedback circuit is based on a power gain somewhat greater than unity. The simplest oscillator circuit is the Hartley type whose transistor is inserted into a tank circuit with a center-tapped coil.

In the a-f range, such an ocillator starts oscillations at a supply energy of ⅓ μw and, therefore, can easily be fed by a small photocell. This, by no means, has to be exposed to full sunlight. Assuming the brightness of diffused daylight or artificial illumination as 500 lux, this then equals an energy of 75 $\mu w/cm^2$. A selenium photocell with an efficiency

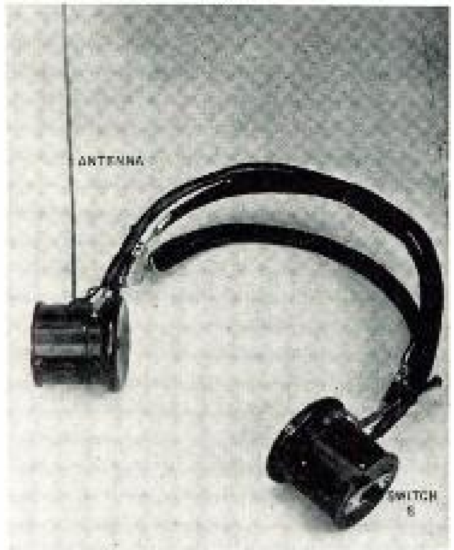


Fig. 6b: Compact CW monitor

of only 1% requires, for example, a surface of only 1.5 cm^2 to cause a transistorized a-f oscillator to burst into oscillations.

However, the available potentials in the vicinity of a few tenth's of a volt limit the self-excitation of today's junction transistors to relatively-low frequencies. As a rule of thumb, we may say that the maximum oscillation frequency increases with the driving voltage so that higher frequencies can only be obtained with higher collector voltage and thus more driving power, until the breakdown or avalanche voltage and thermal dissipation sets a limit. The following examples will disclose what frequencies can be produced under the various operating conditions and with the aid of different forms of free energy.

Light-Powered Receiver

Having found that modern junction transistors operate satisfactorily at a power level of a fraction of a mw, the thought occurs to build a multistage regenerative receiver sensitive enough so as to be fed by a few selenium cells or solar batteries. Fig. 1 is the circuitry of the first laboratory model whose photograph is shown in Fig. 2. The receiver contains a detector transistor with feedback from collector to emitter via a tickler coil, and control is performed by means of a variable condenser which provides a varying by-pass for the r-f choke in the collector circuit. In the broadcast band from 500 to 1600 KC, the receiver begins to operate with only 40 μw driving energy which can easily be produced by the 6 selenium photocells arranged on top of the housing and subjected to diffused daylight or artificial illumination. Under these operating conditions, the audio amplifier produces only earphone volume but greater photocells or solar batteries may drive a little "power amplifier" and loudspeaker. The device illustrated at the left of the dotted lines in Figs. 1 and 2 will be discussed later.

Although a regenerative receiver is the simplest form requiring a minimum of transistor stages and driving power, a heterodyne receiver was built with a single i-f stage and a single a-f amplifier. Such an active receiver, of course, begins to operate satisfactorily with a minimum of 1 or 2 mw, and therefore needs a multiplicity of selenium cells or a powerful solar battery.

Hand-Powered Transmitters

A small flashlight generator or hand-dynamo easily produces between ¼ and ½ w., which is sufficient to generate useful r-f energy. Fig. 3 is the photograph of a miniaturized transmitter for 250 KC. The ac from the hand-dynamo is rectified and converted into dc, but a relatively small filter capacitor provides a hum modulation by the fluctuating driving frequency. A satisfactory antenna efficiency is obtained by a ferrite core loop antenna. If the radiation of the small oscillator is picked up with a sensitive receiver, the a-f signals can be utilized to actuate a relay for the remote control of house and garage doors, radio and TV receivers, and the like. Moreover, the hand dynamo can be miniaturized further and brought into the form of a flip generator which is actuated by merely pushing a button. Such a miniaturized transmitter having the size of a cigarette lighter then is a "Radio Key" in the true meaning of the word.

By the use of a hand-dynamo, one is not limited in frequency as before. Fig. 4 shows the outside and structure of a hand-powered telephone transmitter with built-in generator, crystal stabilization at approximately 4 MC, and AM with the aid of a sound-power mike driving a diode modulator. In open terrain, the small transmitter covers a range of a few miles. Its advantage as compared with other and more powerful transmitters is that it requires no maintenance and has no shelf life problems, but is ready for use at all times, provided the user is physically able to push the generator lever and to address the microphone.

Voice-Powered Telephone Transmitter

The ultimate in the field of free power is the telephone transmitter depicted in Fig. 5, which has neither a battery nor photo-element nor an extra generator nor any other power source. Its supply energy is directly generated by the sound-power microphone or an equivalent PM speaker whose original duty is nothing but amplitude modulation. In the present case, the sound-power mike not only provides the AM but, at the same time, feeds a minute "power pack" in the form of a step-up transformer which, via a crystal diode, charges a large filter condenser. A modulating signal is taken from a fraction of the transformer's secondary windings and is superimposed upon the dc across the condenser. In this way, satisfactory collector modulation is performed equivalent to the plate-modulation of a tube-type oscillator. The illustrated model generates a frequency of 250 KC and is provided with a ferrite rod antenna. The output energy, even under the full impact of loud speech, never exceeds a few μw, so that the range is limited to a few

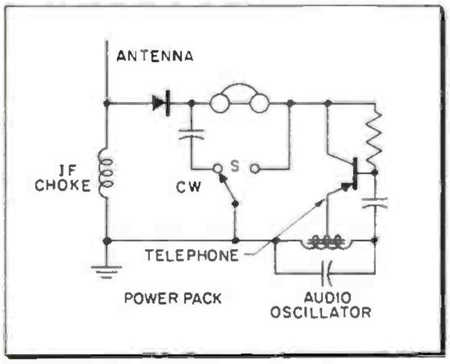


Fig. 6a: CW monitor circuit

hundred yds. High-sensitive transistors, having an avalanche voltage in the vicinity of 1 v., permit the generation of several MC, which extends the range up to a mile.

Earphone Monitor

Of all types of free energy, the driving of transistor apparatus with r-f energy has yet to be discussed. An illustrative example is the CW Monitor described by means of its circuit diagram in Fig. 6A, and its photograph in Fig. 6B. In the vicinity of a telegraph transmitter, there is such a strong radiation field as to permit a short antenna wire to recover sufficient energy to drive an a-f oscillator. As long as the station is on the air, the oscillator is energized and its a-f can be heard in the earphones. Morse telegraph signals or automatic keying signals produce associated tone signals without the necessity of any tuning, as in the case of beat frequencies. Furthermore, practical application is facilitated in that the minute r-f power pack as well as the a-f oscillator are built into the enlarged capsules of the double-earphone. The operator or amateur has his station under continuous control without being handicapped by a cord.

In addition, there is a little switch "S" which allows the conversion of the CW monitor into a conventional crystal set for the detection of telephone signals.

Semi-Passive Receivers

The novel principle of converting incoming r-f energy into dc power and then reconverting this energy into "new" r-f energy opens an entirely new field. In most cases, the primary carrier will be deprived of its modulation signals so that the new carrier may be said to be generated by "secondary" energy.

The principle of secondary energy is demonstrated most convincingly by means of the aforementioned transistor receiver. For this purpose, the receiver illustrated in Figs. 1 and 2 contains, at the left of the broken line, an r-f power pack which replaces the previous photoelements. It can easily be seen that the power pack is an efficient crystal set having such a large filter condenser that a pure dc voltage develops across the terminals. As pointed out before, the dc voltage may be stabilized by means of little wet cells.

A receiver driven by secondary power represents a new category which combines the advantages of gpassive receivers such as crystal sets, and those of active types characterized by the relay action of their active network elements, vacuum tubes or transistors. Since the new receiver has its place between passive and active types, it may be called a "Semi-Passive" device. Semi-passive receivers offer no maintenance or shelf-like problems but their sensitivity, selectivity, and power handling capacity are great enough to permit the detection and amplification of weak radio signals of distant stations far below the level of the powering transmitter. In other words, a semi-passive receiver utilizes the energy of a powerful radio station, for example, the local broadcast station, for the detection and amplification of weak signals from remote transmitters. In the vicinity of the local station, with the aid of an efficient antenna, sufficient energy can be recovered to feed a small loudspeaker.

At first glance, the detection and amplification of the primary signals with the aid of secondary power seems to offer no advantage as compared with the passive reception with a crystal set, because the output energy, in both cases, is given by the recovering ability of the antenna. A closer inspection, however, discloses that a semi-passive receiver is capable of greater output volume than a passive type. This becomes obvious if we keep in mind that the output level of a crystal set is equivalent to the carrier level multiplied by the degree of AM whereas the level of a semi-passive receiver is given exclusively by the carrier energy whether there are modulation signals superimposed or not. Hence, the available output energy of a semi-passive receiver can be adjusted equivalent to the powering carrier with a modulation of 100% or greater, provided the associated distortions are tolerable.

Conclusions

The principle of secondary power is by no means confined to semi-passive receivers. Another application is a secondary-powered transistor oscillator driven by the rectified r-f amplitudes of a supply transmitter. In this way, the incoming r-f is converted into another frequency band. At the same time, the new carrier can be subjected either to AM or FM by the incoming signals so that these are reradiated at another carrier frequency and with the same or another type of modulation as the primary signals. In addition, secondary-powered transmitters and semi-passive receivers may be combined so as to form transceivers or walkie-talkies the range of which is confined, of course, to the vicinity of a powerful supply transmitter. In this way, many problems offer themselves to the transistor expert whose consequences can hardly be predicted.

Signal Corps Studies "Duct" Propagation

At the Army Electronic Proving Ground, Fort Huachaca, Ariz., the Signal Corps is using airborne electronic equipment to analyze ducting effects on microwave transmissions.

A duct is a layer of atmosphere, either based at the earth's surface or aloft, containing abnormal temperature and humidity conditions. The usual vertical dimension of a duct ranges from 10 to 100 ft., although some ducts have been measured from 100 to 500 ft.

W.C. Distribs

(*Continued from page* 95)

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(*Continued from page* 77)

Conoco Corporation.

"Engineering Studies of Sensory Organs," Joseph Hirsch, Aerophysics Corporation.

"Cybernetics Past, Present and Future," Leonard Gardner, Rocketdyne.

MICROWAVE TUBES I

Chairman: L. M. Field. Hughes Aircraft Co.

"Design of Laminar Flow Electrostatically Focused Electron Beams," W. M. Mueller*, Univ. of California, Berkeley.

"Growing Waves in Magnetically Focused Electron Beams," R. W. Gould, California Inst. of Tech.

"Gain of a Low Level Signal in the Presence of a Large Signal," H. L. McDowell, BTL.

"Noise and Spurious Oscillations in Backward Wave Oscillators," W. Rorden and C. Conner, Varian Associates.

"Gridded Pulse TWT Serrodynes for Application to Continuously Coherent MTI Radars," R. M. Whitehorn and H. Mandoli, Varian Associates.

"A Backward-Wave Oscillator for the 4 mm Wavelength Region," C. F. Hempstead, Bell Telephone Labs.

RELIABILITY; ORGANIZATION, SYSTEMS, AND EQUIPMENT

Chairman: Bernhard Hecht, Los Angeles.

"Organizing for Reliability," A. M. Okun and J. Cohen, Bell Aircraft Corp.

"Price of Reliability in Airborne Electronic Equipment," Arthur H. Wulfsberg, Collins Radio Co.

"Missile Unreliability Cost Evaluation," A. L. Stanly and J. Tampico, Associated Missile Products.

"Calculations of the Risk of Component Applications in Electronic Systems," J. A. Connor, RCA.

For product information, use inquiry card on last page.

"Reliability as a Management-Engineering Responsibility," H. S. Hansen, Servo Mechanisms, Inc.

CONTROL MECHANISMS AND AUTOMATION

Chairman: E. M. Grabbe, Ramo-Woolridge Corp.

"Mechanization and Application of Vertical Reference Systems," G. H. Singer, Kearfott Co.

"The Eye as a Control Mechanism," Robert B. Lockard, U. S. Naval Ordnance Test Station, China Lake.

"Automatic Determination of Missile Air Foil Characteristics in Mass Production," Ed. L. Watkins, Convair.

"A New Digital Path Control System for Machine Tools," Jack Rosenberg, Electronic Control Systems.

CIRCUIT THEORY — SWITCHING THEORY TOPOLOGY AND TIME DOMAIN SYNTHESIS

Chairman: L. A. Pipes, Univ. of California, Los Angeles.

"Switching Theory," D. A. Huffman, MIT.

"Some Aspects of the Network Analysis of Sequence Transducers," J. M. Simon, Sperry-Rand Corp.

"Some Topological Considerations in Network Theory," F. Reza, Syracuse Univ.

"Network Synthesis for Prescribed Impulse Response Using A Real Part Approximation," R. A. Pucel, Raytheon Manufacturing Co.

"Time Domain Synthesis by Delay Line Analogy," M. Strieby, Ramo-Woolridge Corp.

CYBERNETICS SYMPOSIUM

Chairman: Leonard Gardner, Rocketdyne.

"The Philosopher's Approach to Cybernetics," Abraham Kaplan, UCLA.

"Studies of Neural Physiology in the Learning Processes," Joseph A. Gingerelli, UCLA.

The third and fourth periods of this session will be devoted to an open panel discussion with audience participation.

Panel members: Robert Tschirgi, Stanley Frankel, Joseph Hirsch, Leonard Gardner, Abraham Kaplan, and Joseph A. Gingerelli.

MICROWAVE TUBES II

Chairman: H. R. Johnson, Hughes Aircraft Co.

"Characteristics of Modern External Tuning Cavity Reflex Klystrons," T. Moreno, Varian Associates.

"A Rugged 8 mm Reflex Klystron," W. G. Abraham and F. L. Salisbury, Varian Associates.

"An X-Band Folded Line Type Backward-Wave Oscillator," R. H. Winkler, Cascade Research Corp., Los Gatos.

"A Demountable Tube for Gas Discharge Microwave Detection Studies," H. Farber, Polytechnic Inst. of Brooklyn.

"Means for Electronically Controlling the Current from a Magnetron Cathode," J. S. Needle, Northwestern Univ.

"Design and Calculation procedures for Low-Noise TWT's," G. Wade, R. W. DeGrasse and L. D. Buchmiller, Stanford Univ.

"A Rugged 915 MCCW Magnetron for Electronic Cooking," P. C. Gardiner, G. E. Co., Schenectady.

COMPONENT RELIABILITY AND TEST METHODS

Chairman: G. H. DeWitz, Hoffman Laboratories.

"The Unreliable Universal Component," Marcus A. Acheson, Sylvania Electric Products, Inc."

"Improved Guided Missile Tube Reliability," Alfred Blattel, Raytheon Mfg. Co.

"Tube Failure Rate Variations," M. B. Feyerhern, RCA.

"Cine-Radiography, A New Testing Concept of Component Reliability," W. H. Grumet, Rototest Labs.

PANEL ON EDUCATION

Moderator: George Tenny, Vice President, McGraw-Hill.

Frederick Terman, Dean of Engineering of Stanford Univ.

Thomas L. Martin, Jr., Chairman, Electrical Engineering Dept., Univ. of Arizona.

Dan Noble, President, Motorola.

Burgess Dempster, President, Electronic Engineering Co.

COMPUTERS: ANALOG TECHNIQUES

Chairman: Milton E. Mohr, Ramo-Wooldridge Corp.

"Magnetic Amplifier Analog Computation Techniques," Henry W. Patton, Airpax Products Co., Baltimore.

"Wide-Dynamic Range Analog Integrator," George Myers, Rome Air Development Center, Air Research and Development Command, Rome.

"A New Computer for Complex Functions," Merle L. Morgan, Electro-Measurements, Inc., Portland.

"Automatic Computation of Fourier Expansion Coefficients by Analog Means," R. W. Hubbard and W. E. Johnson, National Bureau of Standards, Boulder.

TRANSISTOR CIRCUITS—SWITCHING AND COMPUTER APPLICATIONS

Chairman: M. S. Kesselman, Hughes Aircraft Co.

"Critical Survey of Fundamental of Junction Transistor Pulse and Switching Circuits," D. O. Pederson, Univ. of California, Berkeley.

"Maximum Efficiency Switching Circuits," R. H. Baker, Lincoln Lab., MIT.

"Transistor Circuitry for Analog to Digital Conversion," F. H. Blecher, Bell Telephone Labs.

INSTRUMENTATION TECHNIQUES

Chairman: F. Stanley Atchison, U. S. Naval Ordnance Lab., Corona.

"Distributed-Parameter Variable Delay Lines Using Skewed Turns for Delay Equalization," Frank D. Lewis and Robert M. Frazier, General Radio Co.

"Application of Scale Factors in Data Recording Systems," Thomas L. Greenwood, Redstone Arsenal.

"Adjustable Pulse Width High Voltage Power Supplies" by Victor Wouk, Beta Electric Corp.

"Transistorized Logarithmic Time-and-Amplitude Quantizer," Euyen Gott, Johns Hopkins Univ.

ANTENNAS II

Chairman: J. T. Bolljahn, Stanford Research Institute.

"Relation of Scattering Problems to Radiation from Simple Shapes," K. M. Siegel, Willow Run Laboratories, Univ. of Michigan.

"Launching Efficiency of Wires and Slots for a Dielectric Rod Waveguide," R. H. DuHamel and J. W. Duncan, Electrical Engineering Research Lab., Univ. of Illinois.

"Analysis of a Shunt Excited Airframe Antenna," T. G. Dalby, Boeing Airplane Co., Seattle.

"A New Method for Optimum Yagi Design," H. W. Ehrenspech and Poehler, Air Force Cambridge Research Center, Bedford, Mass.

HIGH TEMPERATURE COMPONENT PARTS

Chairman: Floyd Paul, Castell Corp.

"Miniature High Altitude and High Temperature Connectors," C. H. Stuart and R. F. Dorrell, Amphenol Corp.

"Impregnation of Toroids for High Temperature Service," E. O. Deimel, General Electric.

"Typical Expected Performance Characteristics of Extreme Temperature Range Tantalum Capacitors," J. W. Maxwell, P. R. Mallory.

"Some Basic Physical Properties of Silicon and How They Relate to Rectifier Design and Application," G. P. Finn, Sarkes-Tarzian.

RELIABILITY OF ELECTRONIC TUBES

Chairman: To be announced.

"White Noise Vibration Test for Electronic Tubes," John D. Robbins, Sylvania Electric.

"Environmental Effects of Vacuum Tube Life," H. D. Pleak, Sylvania Electric.

"Increased Reliability of Guided Missile Tubes Through Comprehensive Quality Control," H. H. Hoyle and N. J. Davis, Raytheon Mfg. Co.

"New Filamentary Tubes of High Reliability," Ross Wood, Raytheon Mfg. Co.

COMPUTERS: SOLID STATE SWITCHING DEVICES

Chairman: Lester L. Kilpatrick, Autonetics, North American.

"Magnetic Cores as Generalized Non-Linear Components," William H. Bridge, Airtronic Research, Inc., Washington.

"Pulse Response Properties of Magnetic Materials for Switching Applications," James D. Childress, General Ceramics Corp.

"High-Current Switching Applications of Low Power Transistors," Chaang Huang and William F. Palmer, Sylvania Electric Products, Inc., Woburn.

"High-Gain Transistor for Very High Switching Speeds," James B. Angell, Philco Corp., Philadelphia.

CIRCUIT THEORY—TRANSISTOR AND ACTIVE CIRCUITS

Chairman: R. D. Middlebrook, California Inst. of Technology.

"Power Transistor Specifications for Circuit Applications," H. T. Moore, Minneapolis-Honeywell.

"Transister Bootstrap and Miller Sweep Circuit," J. S. Sherwin, Univ. of California, Berkeley.

"An All Transisterized Pulse Generator," E. J. Fuller, Sperry Gyroscope Co., Great Neck.

"Negative Impedance Converter Design and Its Use in Active Circuits," A. I. Larky, Stanford Univ.

"A D-C Negative Immittance Converter," M. A. Karp, Applied Physics Laboratory, Johns Hopkins Univ.

BROADCAST TRANSMISSION SYSTEMS

Chairman: John Knight, Engineer in Charge, KRCA (NBC).

"The Application of Modern Techniques to The Determination of Service Areas of Television Stations in Smooth and in Mountainous Terrain," A. Earl Cullum, Jr., Earl Cullum Jr. and Associates.

"Achievement of Practical Tape Speed for Recording Video Signals," C. P. Ginsburg, Ampex Corp., Redwood City.

"A Transistorized Television Camera Chain," W. Ussler, R. J. Decredico, G.. W. Trebing, and J. W. Smiley, RCA, Camden.

"Design Considerations for a High Quality Transistorized Program Amplifier for Remote Broadcast Use," John K. Birch, Gates Radio Co.

MICROWAVE THEORY AND TECHNIQUES —FERRITES AND TEST EQUIPMENT

Chairman: Eric Strumwasser, Hughes Aircraft Co.

"Coupling Through an Aperture Containing Ferrites," Donald C. Stinson, Univ. of California.

"Microwave Frequency Doubling in Ferrites from 9 to 8 KMC," P. H. Vartanian, J. L. Melchor, W. P. Ayres, Electronic Defense Laboratory, Sylvania Electric.

"A Ferrite Image Rejection Filter for Use in S-Band Microwave Receivers," James H. Burgess, Electronic Defense Laboratory, Sylvania Electric

"Calorimeters for Centimeter and Millimeter Waves," Sam Hopfer, Polytechnic Research and Development Co.

ENVIRONMENTAL EFFECTS ON COMPONENT PARTS

Chairman: A. W. Rogers, Signal Corps Engineering Labs.

"Environmental Testing of Precision Potentiometers," Shultz-Green, Helipot Corp.

"Capabilities of Hot-Molded Composition Resistors," A. C. Pfister, Allen-Bradley Co.

"Hermetic Sealing of Precision Potentiometers," I. W. Braun, Circuit Instrument Inc.

"The Effects of Nuclear Radiation on Electronic Components," C. C. Robinson, W.A.D.C.

SEMICONDUCTORS I

Chairman: John W. Peterson, Pacific Semiconductor.

"Semiconductor Materials and Properties," Phyllis E. Stello, D. M. Van Winkel, and J. Dale Turner, Hughes Aircraft.

"Developments in Transistor Physics," Leopoldo B. Valdes, Shockley Semiconductor Labs.

"High Current Amplification—Forward and Reverse—At High Collector Current in PNP Transistors," A. P. Kordalewski, General Electric.

"Very High Power Transistors with Evaporated Aluminum Electrodes," Gene Strull and H. W. Henkels, Westinghouse Electric Corp.

"Silicon Alloy Power Transistors," R. E.

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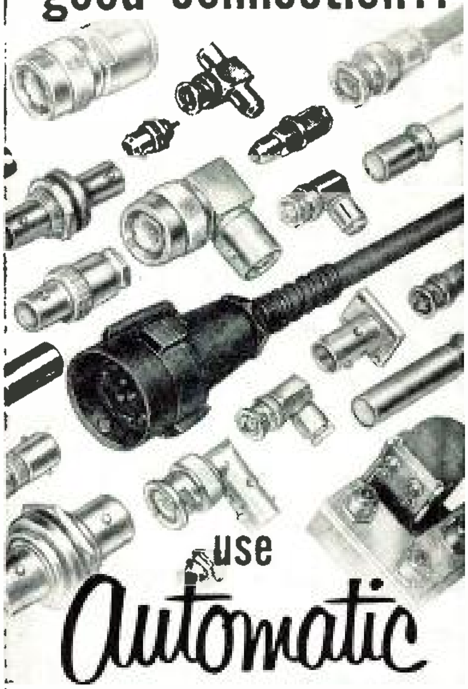

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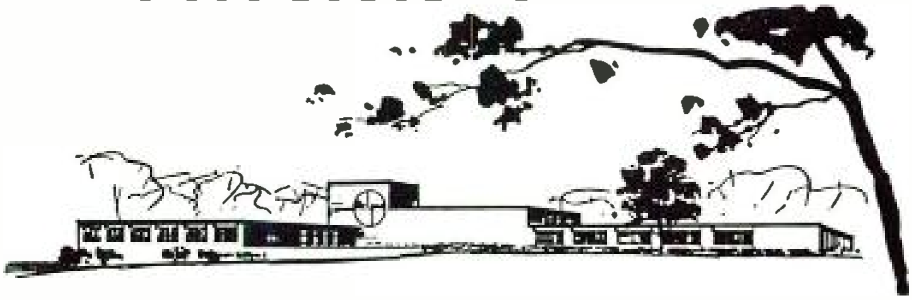

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Chairman: John L. Barnes, Systems Laboratories Corp.

"The Effect of a Transverse Field on Switching Rates of Magnetic Memory Cores," T. D. Rossing and S. M. Rubens, Remington Rand-Univac, St. Paul.

"High Speed Coincident-Flux Magnetic Storage Principles," E. W. Bauer and L. P. Hunter, IBM.

"Investigation of Problems Using Analog-Digital Computer Combinations," Herbert E. Salzer, Convair, San Diego.

"The Synthesis and Analysis of Digital Systems by Boolean Matrices," J. O. Campeau, Hughes Aircraft.

RADAR SYSTEMS

Chairman: Fred J. Nichols, Sprague.

"Taxi Radar—Eyes of the Tower," "The Radar Approach Control (RAPCON) Center," D. R. Kirschner, Rome Air Development Center, Rome.

"Extended Radar Range Timing Techniques," A. I. Mintzer, RCA, Moorestown.

"TACAN Bearing and Distance Measurement Techniques," J. B. Majerus and K. W. Porter, Collins Radio Co., Cedar Rapids.

VEHICULAR COMMUNICATIONS I

Chairman: Newton Monk, Bell Telephone Labs.

"A Communication System for the New York Throughway," D. S. DeWire, New York Telephone Co.

"Transistorized Communications Receivers," Seymour Schwarts, MIT.

"VHF Radio Coordinated Traffic Light Control System," Elmer W. Hammel, General Electric.

"VHF-UHF Communications System Interference Reduction through Use of Selective Filters," M. W. Caquelin, Collins Radio Co.

ANTENNAS III

Chairman: M. D. Adcock, Hughes Aircraft Co.

"Fundamental Problems in the Antenna Field," S. Silver, Univ. of California, Berkeley.

"Scanning Lens Design for Minimum Mean-Square Phase Error," E. K. Procter and M. Rees, General Electric Co., Palo Alto.

"A Duplexer for Sweep-Frequency Pulse Transmitters," R. Silberstein, National Bureau of Standards, Boulder.

"The Triport Conical Scan Antenna," E. Wantuch and L. A. Kaiser, Raytheon Manufacturing Co., Bedford.

NEW TRENDS IN COMPONENTS

Chairman: R. H. Baker, RCA.

"The Impact of New Electronics on Mercury Battery Designs," J. L. Dolfonso, P. R. Mallory.

"Criteria for Selection of Magnetron Beam Switching Tube as a Circuit Component," S. Kuchinsky, Haydu Brothers, Burroughs Corp.

"Application of Large Capacitors for Energy Storage," D. F. Warner, General Electric.

"Film Type Precision Resistors," B. Solow and C. Wellard, International Resistance Co., Philadelphia.

SEMICONDUCTORS II

Chairman: D. M. Van Winkle, Hughes Aircraft.

"Point Contact Diode Theory," Melvin Cutler, Hughes Aircraft.

"Component Improvement, Germanium and Silicon Low Power Rectifiers," G. N. Hall, General Electric.

"A Miniature Silicon Diode for Both Power and Circuit Applications," Arthur L. Rossoff, Radio Receptor Co., Inc.

"A New UHF Transistor Structure," Wolfgang W. Gartner, Evans Signal Lab.

"Transistors with Vacuum Tube Properties," M. N. Ross and Hans E. Hollmann, National Aircraft Corp.

COMPUTERS: DATA GATHERING AND PRESENTATION SYSTEMS

Chairman: George W. Brown, International Telemeter Corp.

"Electrofax Printer, A Continuous Direct

Dry Process Enlarger for Digital Computing Systems," Henry G. Reuter, Jr., Radio Corp. of America, Camden.

"Ultratype Camera, A High Speed Electron Optical Printer for Digital Computing Systems," A. M. Spielberg, S. R. Parker, and K. G. Kaufmann, Radio Corporation of America, Camden.

"A High Speed, Precision, Large Quantity Data Processing System; IDIOT II," Martin L. Klein, Rocketdyne Division, North American Aviation, Canoga Park.

"A Centralized Data Processing System for the Air Force Flight Test Center," O. F. Vogel, Electronic Engineering Company of Calif., Los Angeles.

AIRBORNE ELECTRONICS

Chairman: C. A. Ripinski, Electronic Industries, Burbank.

"Thermal Design and Evaluation of an Airborne Electronic System," Richard E. Burton, Collins Radio Co., Cedar Rapids.

"Flight Control Systems for Jet Transports," H. Miller and R. H. Wagner, Sperry Gyroscope, Great Neck.

"Electronic Problems Encountered in High-Speed Commercial Jet Aircraft," Dick Hedges, Douglas Aircraft, Santa Monica.

"Bearings and Their Properties as a Design Consideration in Electronic Systems," H. F. Stern, Industrial Tectonics, Inc., Los Angeles.

VEHICULAR COMMUNICATIONS II

Chairman: Maurice Kennedy, County of Los Angeles.

"Communications with Moving Trains in Tunnels," Newton Monk, Bell Labs.

"New Developments in Two-Way Communications," Aungus MacDonald, Motorola.

"Railroad Communications," D. L. Kesselhuth, Bendix.

INFORMATION THEORY

Chairman: Richard H. DeLano, Systems Laboratories Corp.

"Synthesis of the Linear Time-Varying Predictor for Stationary Signals," Cheng Ling, Minneapolis-Honeywell.

"The Relationship of Sequential Filter Theory to Information Theory and Its Application to the Detection of Signals in Noise by Bernoulli Trials," Herman Blasbalg, Johns Hopkins Univ.

"Theory of Weighted Smoothing," Louis A. Ule, Gilfillan Bros., Inc.

"The Response of a Phase-Locked Loop to a Sinusoid Plus Noise," Stephen G. Margolis, Jet Propulsion Lab.

"Autocorrelator for Radioactive Sample Noise Generator," G. W. Anderson and James E. Murrin, J. B. Rea Co.

PRODUCTION CONSIDERATION OF ELECTRONIC EQUIPMENT

Chairman: Marvin Whitney, Hoffman Electronics Corp.

"Problems of Semi-Automatic Assembly of Electronic Test Equipment," C. S. Selby, Hewlett-Packard.

"Eyelet Failure in Etched Wiring," W. J. Hodges, Hughes Aircraft.

"Mechanical Design Considerations in the Erma System," R. W. Melville, Stanford Research Inst., Palo Alto.

"The Selection of Coatings for Printed Circuits," R. A. Martel and L. J. Martin, Hughes Aircraft.

Personal

(*Continued from page* 148)

William D. Bell has been retained as Consulting Engineer for Beckman Instruments' new Data and Control Systems Dept., Fullerton, Calif. He is head of Mellonics, sales and engineering consultants for electronic data processing.

PROBLEM #4

Design a miniature audio input transformer for airborne operation. Transformer to operate in an ambient temperature of plus 85°C, and to conform to the applicable parts of MIL E-5400 and MIL T-27. Duty cycle to be continuous with a minimum life of 1000 hours. Transformer to couple a 300 ohm source to a tube grid. Step-up turns ratio to be 1:17 minimum, with the maximum possible desired. Frequency response to be flat within 0.75 db from 20 cps to 7,000 cps, and flat within 1.2 db from 15 cps to 10,000 cps. Maximum signal level to be 500 mv @ 20 cps in 300 ohm primary. Electrostatic shield required between primary and secondary. Electromagnetic shielding to be 40 db minimum. Size to be kept minimum but must not exceed 1⅛" x ⅞" x 1⅜" high.

SOLUTION BY PEERLESS

Audio Transformer, low level input, miniaturized.
Construction: Grade 1, Class A, MIL T-27
Duty Cycle: Continuous
Life: Greater than 1,000 hours.
Ambient Temperature: +85 C max.
Primary: Three terminal, center-tapped winding, 300 ohms nominal impedance.
Secondary: Two terminal winding, 125,000 ohms nominal impedance.
Turns ratio: 1:20½
Electrostatic Shield: Between primary and secondary.
Electromagnetic Shield: 45 db
Frequency response: 20 cps—7,500 cps, flat within 0.5 db and 10 cps—10,000 cps, flat within 1.0 db with 125,000 ohm load.
Maximum Input Voltage: 500 mv at 20 cps
Dimensions: 1" x 11/16" x 1" high +¼" terminal

The Peerless engineering staff has had a long and successful history of designing transformers to unusual and difficult specifications. Knowledge of this outstanding accomplishment is one of the reasons that Peerless transformers are the first choice of engineers throughout the country. Uniform dependability is assured by the most rigid quality control and advanced custom production techniques.

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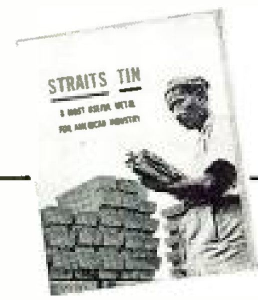

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News of Reps

Carl A. Stone Associates, Inc., 1102 South Western Ave., Los Angeles 6, has been named representative for the states of Calif. and Ariz., plus So. Nevada, by Shielding, Inc., Riverside, N. J., manufacturers of electromagnetic shielding enclosures. Mitchell Spears Co., Fort Worth, has been named sales engineering rep for Okla. and Texas, except for El Paso County, by Shielding, Inc.

W. L. Cunningham & Associates has been established at 435 Addison Ave., Elmhurst, Ill., to represent manufacturers of electronic equipment in the Chicago area. The new firm will represent Hammarlund Mfg. Co., New York, and Electrical Communications, Inc., San Francisco.

Syntronic Instruments, Inc., Addison, Ill., has named two new reps to handle its line of military and special-purpose deflection yokes and focus coils: Charles Segal Co., Boston, will handle the New England states, and Massey Associates, Washington, will cover the District of Columbia, Eastern Pa., Delaware, Md., Va. and Southern N. J.

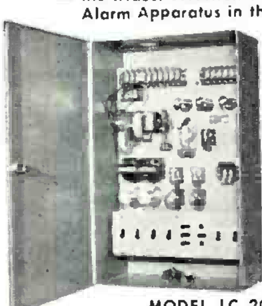
McCarthy Associates, Los Angeles reps for Perkin Engineering Corp., El Segundo, Calif., now also cover No. Calif., Ariz., and Nevada, and have opened a San Francisco area office at 441 W. California Ave., Palo Alto.

Tel Instrument Electronics Corp., Carlstadt, N. J., has appointed two manufacturer sales reps for its TV studio and production test equipment: McCarthy Associates, Los Angeles area, will handle Calif., Ariz., and Nevada; Ken Meyers, Park Ridge, Ill., will represent TIC in Illinois, Wis., Ohio, Indiana, Michigan and Eastern Iowa.

Hugh Marsland & Co., Chicago, has been named sales rep for 12 Mid-Western states by Non-Linear Systems, Inc., Del Mar, Calif. Robert A. Waters, Inc., Wayland, Mass., has been named New England representative for Non-Linear Systems, Inc., of Del Mar, Calif.

Eugene Black has joined Land-C-Air Sales Co., Tuckahoe, N. Y., as a sales engineer.

Jack Berman has become sales representative for British Industries Corp., Port Washington, N. Y., in So. Calif., So. Nev. and Ariz. Harry A. Lasure has closed his sales office, which formerly represented B. I. C.



News of Reps

Computer-Measurements Corp., North Hollywood, Calif., has announced these new technical reps: L & M Associates, Fair Lawn, N. J., for New York, incl. Long Island, N. J., and Eastern Pa.; M. P. Odell Co., Westlake (Cleveland suburb), for Ohio, Eastern Michigan, Northern West Va., and Western Pa.; and Mitchell Spears Co., Fort Worth, to serve Okla. and Texas, except El Paso County.

James B. Lansing Sound, Inc., Los Angeles, has appointed two factory reps: Delzell-Maynard Sales Co., Dallas, for Texas, Okla., Alabama and Louisiana; and Dougherty Enterprises, Lanikai, T. H., will handle Hawaii.

Oak Mfg. Co., Chicago and Crystal Lake, Ill., is now using industrial distributors, instead of selling direct. Frank A. Emmet Co., Los Angeles, will cover Calif., Ariz. and So. Nevada. The Emmet firm has added 7000 sq. ft. to its Pico Blvd. office and warehouse, and plans to add display booths for products of manufacturers they represent.

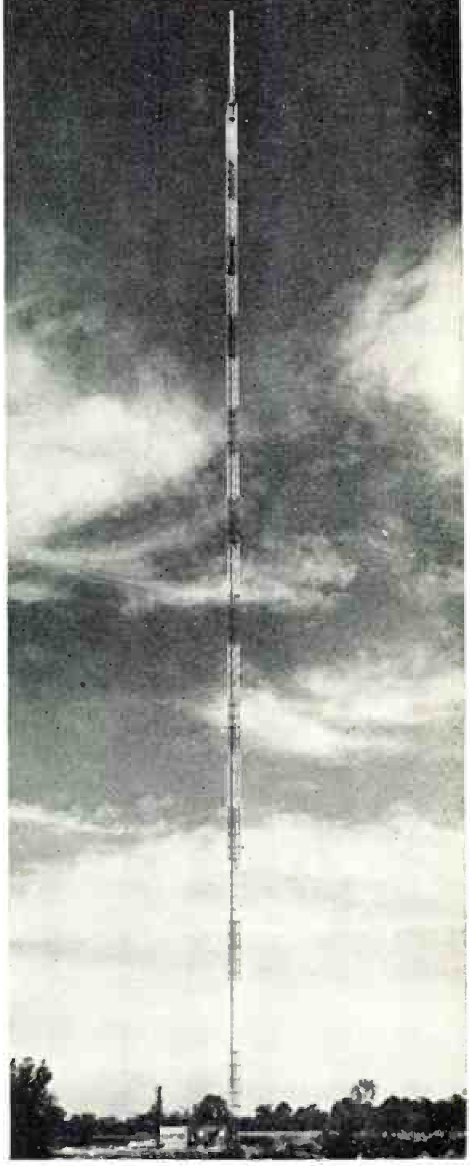
Egbert & Fields Co., New York, has been reorganized. **Samuel S. Egbert Co.**, 97 Reade St., New York 13, will specialize in industrial, radio, TV and Government markets for electronics sales, while **Jack Fields Sales Co.**, 5 Howard St., Verona, N. J., will service high fidelity and radio parts jobbers in the New York Metropolitan and New Jersey areas.

RMC Associates has moved from 170 East 80th St., New York, to 236 East 75th St., New York 21.

Frank O'Keefe and **George H. Weiland** have been named representatives of Central Transformer Co., Chicago. O'Keefe will cover Ohio and Indiana, and Weiland is assigned to Metropolitan New York and New Jersey.

William Richter Corp., Rochester, N. Y., has opened two new offices: in Syracuse, operated by **Charles V. Hinxman**; and in Hanson, Mass., for the New England states, with **Robert L. Richter** in charge.

The Jas. J. Backer Co., manufacturers' reps., recently moved into their new building at 221 West Galer St., Seattle 99, where there is an office building and 12,000 sq. ft. of warehouse space.



New Products

VOLTAGE REGULATOR

Type 6627/OB2WA is a miniature 2 electrode, inert gas-filled cold cathode tube for use as a voltage regulator. It maintains practically constant operating

voltage over a current range of 5 to 30 ma. and gives extremely small voltage drift throughout the life of the tube. Type 6627/OB2-WA is specially designed to maintain stable operating voltages under conditions of bulb temperatures up to 150°C. **Chatham Electronics, Livingston, N. J.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-23).

TRIMMER POT

New A10-W subminiature trimmer potentiometer is designed for critical avionic circuitry. Performance exceeds highest requirements of MIL-E-5272A and MIL-R-12934. Wire wound resistor element with 25 turns of wire; usable winding length is 98%. Temperature coeff. is 0.00002/°C. Dimen-

sions .220 x .312 x 1.250 in. Wgt. 2.25 grams. Operating temp.: —55°C. to 200°C. Powered at .8 watts, derated to 0 at 175°C. **Dale Products, Inc., Columbus, Neb.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-38)

New Products

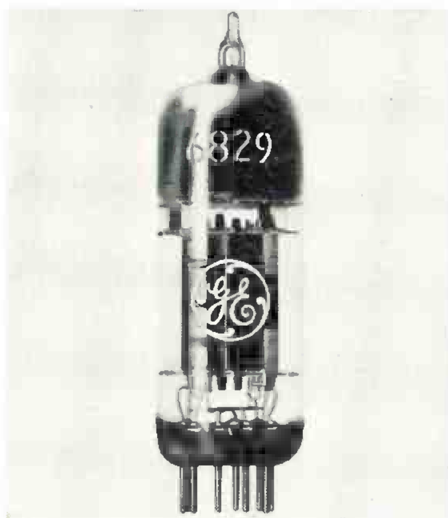
POWER TRANSISTOR

The 2N155 power transistor is designed especially for the audio output stage of automobile radio receivers. Designed to operate from a 12-v. battery, this PNP

germanium-alloy junction transistor features high power gain, uniformity and exceptional reliability. It is plug-in for easy installation. Highly efficient heat dissipation. Heavy copper flange permits flow of heat to chassis. **CBS-Hytron, Danvers, Mass.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-26).

COMPUTER TUBE

The 6829, a 9-pin miniature medium-mu twin triode, is designed for service in ruggedized military computing equipment. Features high-perveance design, low heater power, balanced sharp cut-off characteristics, on-off dependability and long life under

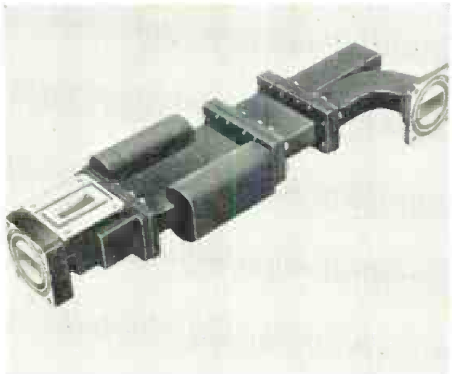


cut-off conditions. Altitude rating of 60,000 ft.; withstands impact acceleration of 450 G and vibrational acceleration of 2.5 G. **General Electric, Schenectady 5, N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-2).

New Products

DUPLEXER

X-band ferrite phase differential duplexer incorporates in a single device both duplexer and load isolation action. Functions as a switching device between



magnetron, receiver and antenna, and it also furnishes effective isolation between the magnetron and r-f energy reflected from line mismatches. Magnetron-to-load isolation is a minimum of 20 db. **Airtron, Inc., Dept. B 1103 West Elizabeth Ave., Linden, N. J.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-34)

MICROWAVE DIODES

New point contact silicon mixer diodes for low noise mixer performance in L, S, C, and X band radar receiver circuitry. 1N23E fixed forward polarity and 1N415E reversible polarity diodes achieve minimum performance of 7.5 db overall systems NF at their X band design center frequency. In

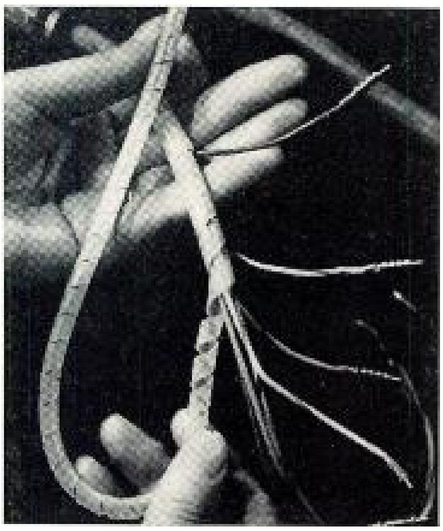
S band equipments the 1N21E or 1N416E reversible mixer diode will result in a maximum overall system NF of 7.0 db. **Microwave Assoc., 22 Cumminton St., Boston 15.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-15).

For product information, use inquiry card on last page.

New Products

CABLE WRAPPING

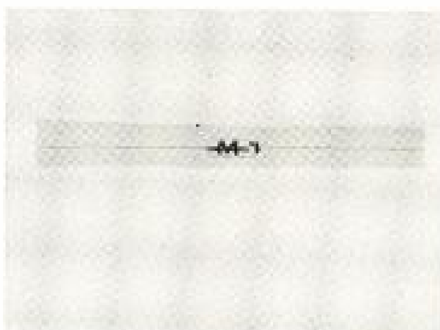
New cable wrapping, SPIRAP, spirally-cut tubing of insulating plastic, is quickly wrapped around wire bundles up to 2 in. in diameter. Individual wires are lead out



or entered through the spiral-cut. SPIRAP forms the leads into a cable which is firm but can be formed to any desired shape. Completely eliminates tedious cable lacing and protects electrical conductors from wear and abrasion over the entire cable length. Computer Control Co., Inc., Wellesley, Mass. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-21).

TANTALUM CAPACITORS

New TNT subminiature tantalum electrolytic capacitors are metal-encased, and 0.145 in. in diameter by ⅜ in. long. They fit readily into miniaturized transistor circuits. Five different ratings



are available: 80 mfd at 3 v.; 50 mfd. at 6 v.; 25 mfd. at 15 v.; 15 mfd. at 30 v.; and 8 mfd. at 50 v. P. R. Mallory & Co., Inc., Indianapolis 6. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-33)

Engineers

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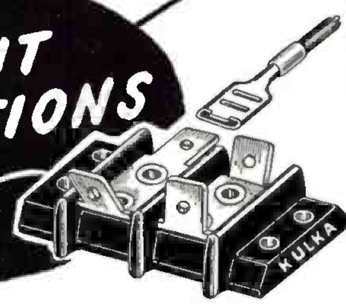
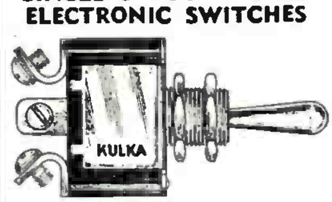


Use "KLIPTITE" TERMINAL BLOCKS (Molded, Barrier-type) with ANGLED TABS Made for AMP, Self-locking Wire Terminals.

Tabs are plated brass and come eyeletted to block, or separately. Tab combinations in various angles, or flat, for single or multiple connections. Several sizes and number terminals.

Other terminal blocks available in approved materials range from subminiature (shown) to jumbo (90 amps).

SINGLE & DOUBLE POLE ELECTRONIC SWITCHES



Toggle handle, aircraft type. Bakelite housing. With screw terminals, or solder lugs. DC, or AC up to 1600 cycles. One-hole mounting.

KULKA ELECTRIC MFG. CO., Inc.
Manufacturers of Electrical Wiring Devices
MOUNT VERNON, N. Y.

Western Rep.: Conrad Strassner Co., 1865 N. Western Ave., Los Angeles, Calif.

New Products

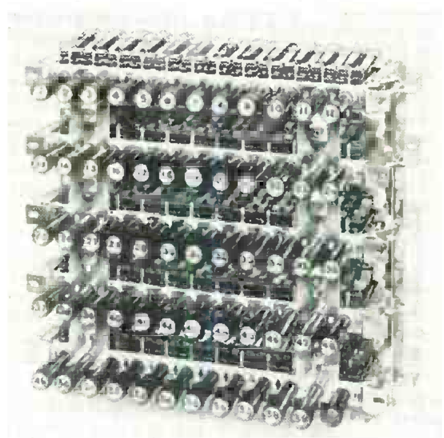
A-D CONVERTER

New analog-to-digital converter is a photo scanner which converts an analog meter indication into digital form. Basic elements are: (1) photocell and light source as-

sembly; (2) a pointer path length mirror; (3) small motor; (4) code disc; (5) relay; and (6) a group of digit storage relays. Digital readings may be taken at 3-sec. intervals and transmitted with an accuracy of 1% over long distances. **Bendix-Pacific Div. 11600 Sherman Way, N. Hollywood, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-37)

PUSH-BUTTON SWITCH

"Multi-Switch" is a multiple push-button switch available in illuminated or non-illuminated push buttons. Can be produced in any multiple from 2 to 12 stations. Choice of mounting centers. By mounting stack switches on a separate plate, up to 4 stacks can be operated by each button. Furnished with Interlock; Non-lock-

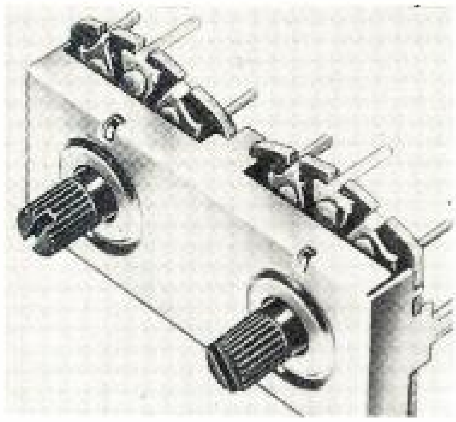


ing; All lock; Interlock and Non-lock combinations; All lock and Non-lock combinations. **Switchcraft, Inc., 1328 N. Halsted St., Chicago 22.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-4).

New Products

TWIN CONTROL

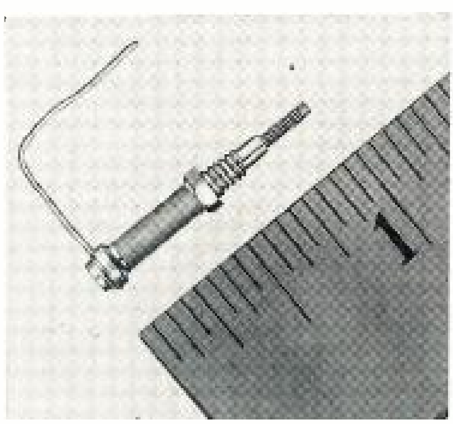
Twist-tab mounting variable resistor containing two control elements and shafts mounted side-by-side on a common base, 7/8 x 2 in. wide offers important savings



in mounting and wiring time for equipment mfrs. Known as Type TU61, the new unit has two 1/4 in. diameter phenolic shafts adjustable from either side. Shafts on the panel side are screwdriver-slotted and cut flush with mounting plate. **Stackpole Carbon Co., Electronic Components Div., St. Mary's, Pa.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-9).

MINIATURE CAPACITOR

Miniaturized variable ceramic trimmer capacitor, type CSM, has a range of 1.7 to 5.0 mmf. Mounts by a single 4-40 threaded stud; dimensions make the capacitor ideal for miniaturized circuitry. All parts are nonferrous and electroplated. Designed to withstand



vibration, shock and humidity, the unit is ideal for varying types of service conditions. **Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-16).

Tele-Tech & ELECTRONIC INDUSTRIES Advertisers—August, 1956

(*Continued from page* 8)

and George Glatz has been placed in charge of the firm's Syracuse, N. Y., office. Ray Over has become Amphenol's district manager in Seattle.

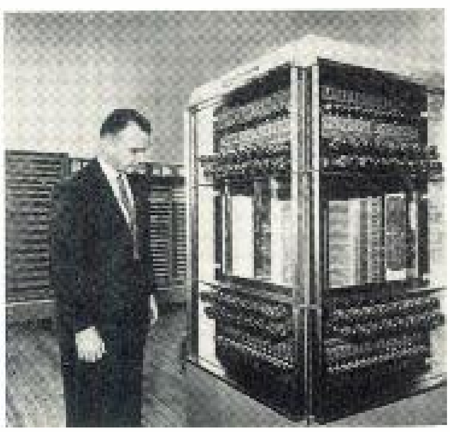
Rear Adm. Joseph I. Taylor, USN, Ret., has been appointed coordinator of plans and programs in the Government and Industrial Products Div., The Magnavox Co., Fort Wayne.

SAGE Computer

(*Continued from page* 20)

abilities of an electronic computer to receive information, to memorize, to calculate, and to record answers with the perspective and display talents of radar to present an instantaneous graphic picture of the location, speed, and direction of all planes within radar range. With a knowledge of flight plans of friendly planes available in the computer, hostile planes can be identified immediately and the most effective defense action taken —again on the basis of computer information and instruction.

The SAGE system starts with a radar ring—on land, on Navy picket ships at sea, on offshore Texas Towers, and on airborne



One of the Memory Array Frames which comprise the heart of the AN/FSQ-7 SAGE computer

early warning planes ranging far out over the ocean. These radars are linked by telephone lines or ultrahigh-frequency radio directly to the high-speed computer. Information about aircraft anywhere within the radar area is relayed continuously and automatically to an IBM computer. This equipment, the AN/FSQ-7, digests all of this information plus Ground Observer reports, flight plans, and weather information as fast as it is received and translates it into an over-all picture of the air situation.

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Here is a coded list of all advertisers in this issue. To get more information simply enter code numbers in boxes below, fill out card and drop in mail.

101 Acme Electric Corp.—Transformers
102 Aircraft-Marine Prods., Inc.—All-purpose dielectric
103 Aircraft Radio Corp.—Airborne electronic equipment
104 Alford Mfg. Co., Inc.—VHF TV transmitting antenna
105 Allen-Bradley Co.—Hermetically sealed composition resistors
105A Altec-Lansing Corp., Peerless Elec. Prod. Div.—Transformer designs.
106 Amelco, Inc.—Connector soldering holder
107 Amelco, Inc.—Low ohm continuity meter
108 American Elite, Inc.—Microphones
109 American Lava Corp.—Ceramic insulators
110 Amperex Elec. Corp.—RF power amplifier tetrodes
111 Anchor Industrial Co., Inc.—Safety glass mounting channels; dust seals; flexible bumper channels
112 Andrew Corp.—450 MC base station antenna
113 Arnold Engineering Co.—Tape-wound and powder cores
114 Audio Devices, Inc.—Magnetic recording tape
115 Automatic Metal Prod. Corp.—Cable connectors
116 Autonetics Div., North American Aviation—Engineering personnel
117 Bendix Aviation, Red Bank Div.—Spark gap tubes
118 Bendix Aviation, Scintilla Div.—Cable clamps
119 Berndt-Bach, Inc.—Magnetic sound-on-film
120 Bird Elec. Corp.—Coaxial line instruments
121 Bomac Labs., Inc.—Gas switching tubes
122 Burnell & Co., Inc.—Adjustable toroid
123 Burroughs Corp.—Engineering personnel
124 Bussmann Mfg. Co.—Fuses and fuseholders
125 Camera Equipment Co.—TV heads, tripods and dollys
126 Cannon Electric Co.—AN type connectors
127 Chicago Telephone Supply Corp.—Variable resistors
128 Cinch Mfg. Corp.—Sub-miniature sockets and edge circuit connectors
129 Cleveland Container Co.—Coil forms
130 Clippard Instrument Lab., Inc.—Automatic capacitance comparator
131 Collins Radio Co.—Speech input console
132 Communication Access. Co.—Toroidal inductors
133 Communication Prod. Co.—Low-loss RF lacquer
134 Concert Hall Society—Binaural tapes
135 Consolidated Electrodynamics Corp.—Analytical and data processing instruments
136 Corning Glass Works—Noninductive resistors
137 Cossor (Canada) Ltd.—Precision deflection yokes
138 Crosby Labs., Inc.—Single sideband signal generator
139 Dale Products, Inc.—Miniature power resistors
140 Davies Laboratories—Magnetic tape data recording systems
141 Daystrom Pacific Miniature wire-wound potentiometers
142 Driver Co., Wilbur B.—Resistance alloys
143 Eitel-McCullough, Inc.—High vacuum rectifiers and clipper diodes
144 Eitel-McCullough, Inc.—Local oscillator klystrons
145 Electra Mfg. Co.—Deposited carbon resistors
146 Electro-Motive Mfg. Co.—Mica capacitors
147 Engineering Company, The—Tungsten hard glass leads
148 Factory Enterprises—Precision-woven meshes
149 Fairchild Camera & Instruments Corp.—High-temperature potentiometers
150 Federal Telephone & Radio Co.—Selenium rectifier
151 Freed Transformer Co., Inc.—Magnetic amplifiers and saturable transformers
152 Fusite Corp.—Solid glass headers
153 Garrett Corp.—Engineering personnel
154 General Electric Co.—Electronic leads, wire and metal parts
155 General Electric Co., Elec. Comp. Dept.—Engineering personnel
156 General Electric Co., Tube Department—TV camera tubes
157 General Electric Co., Ind. Computer Sect.—Engineering personnel

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Tele-Tech & ELECTRONICS INDUSTRIES—AUGUST 1956

CHILTON CO., Chestnut & 56th Sts., Philadelphia 39, Pa.

Not good after Oct. 1, 1956

NQUIRY CARD

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Listings continued from preceding page

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159 General Radio Co.—Poylstyrene capacitor
160 Gertsch Prod., Inc.—Standard ratio transformers
161 Goodrich. B. F., Sponge Prod. Div.—Microwave absorbent
162 Grant Pulley & Hardware Co.—Chasis slides
163 Gudeman Co.—Plastic film dielectric capacitors; miniature dry electrolytics
164 Gudeman Co.—Miniature feed-thru capacitors; radio interference filters
165 Hewlett-Packard Co.—Direct reading electronic counter
166 Hughes Aircraft Co.—Adjustable persistance CRT
167 Hughes Aircraft Co.—Silicon diodes
168 Hughey & Phillips, Inc.—Obstruction lighting controls; alarms
169 Hycon Electronics, Inc.—Rack mounted oscilloscope
170 Indiana Steel Prod. Co.—Permanent magnets
171 International Bus. Mach. Corp.—Engineering personnel
172 International Resist. Co.—Resistors
173 International Rectifier Corp.—Silicon power diodes
174 I-T-E Circuit Breaker Co.—Large waveguides
175 Jennings Radio Mfg. Corp.—Vacuum capacitors
176 Johnson Co., E. F.—Miniature variable capacitors
177 Jones Div., Howard B.—Plugs and sockets
178 J-V-M Engineering Co.—Microwave assemblies
179 Kearfott Co.—Radar test set
180 Kennedy, D. S., & Co.—Antennas
181 Kester Solder Co.—Flux core solder
182 Kittleson Co.—Electronic manufacturers' representatives
183 Klein, Mathias & Sons—Pliers
184 Kulka Elec. Mfg. Co.—Screwless terminal blocks
185 Lavoie Labs., Inc.—Oscilloscope
186 Lenz Elec. Mfg. Co.—Wires and cables
187 Lockheed Aircraft Corp.—Engineering personnel
188 Los Alamos Scientific Labs.—Engineering personnel
189 Magnecord, Inc.—Magnetic tape recorder
190 Magnetic Amplifiers, Inc.—Magnetic amplifiers
191 Magnetic Research Corp.—Low-level D.C. signal amplifier
192 Malayan Tin Bureau—Tin alloys and solders
193 Mallory & Co., P. R.—Subminiature tantalum capacitor
194 Mark Products Co.—Light-weight high gain antenna
195 Measurements Corp.—Signal generator
196 Melpar, Inc.—Engineering personnel
197 Microdot Div., Felts Corp.—Coax connectors
198 Midland Mfg. Co.—Miniature crystal units
199 Motorola Inc.—Engineering personnel
200 Motorola Inc.—Engineering personnel
201 National Vulcanized Fibre Co.—Copper-clad laminates
202 Neely Enterprises—Manufacturers' reps. service
203 N.R.K. Mfg. & Eng. Co.—Microwave and radar components
204 Onan, D. W., & Sons, Inc.—Emergency electric plants
205 Phelps Dodge Copper Prods. Corp.—Coaxial cable
206 Philco Corp., G & I Div.—TV switching system
207 Polarad Elec. Corp.—Microwave receiver
208 Polytechnic Res. & Dev. Co., Inc.—Millimeter waveguide test equipment
209 Precision Paper Tube Co.—Coil forms and bobbins
210 Radio Corp. of America—Precision impedance bridge
211 Radio Corp. of America—Engineering personnel
212 Radio Corp. of America—5-inch display storage tube
213 Radio Materials Corp.—Ceramic capacitors
214 Radio Receptor Co.—Power rectifiers
215 Raymond Rosen Eng. Prods., Inc.—Miniature subcarrier discriminators
216 Raytheon Mfg. Co.—Miniature magnetrons and klystrons
217 Revere Copper & Brass Corp.—Rolled printed copper circuit
218 Rohn Mfg. Co.—Sectional antenna towers
219 Sel-Rex Precious Metals, Inc.—Precious metals processes
220 Sprague Elec. Co.—Miniature aluminum electrolytic capacitors
221 Sprague Elec. Co.—Encapsulated wirewound resistors
222 Stackpole Carbon Co.—Variable resistors
223 Stainless, Inc.—Antenna towers
224 Sterling Mfg. Co.—D.C. milliammeters
225 Sylvania Elec. Prods., Inc.—Transistor-tube "power pack"
226 Synthane Corp.—Laminated plastics
227 Syntronic Insts., Inc.—Deflection yokes and focus coils
228 Tele-Dynamics, Inc.—Miniature subcarrier discriminators
229 Tinnerman Prods., Inc.—Speed nut fastenings
230 Transradio Ltd.—Subminiature connectors
231 Tung-Sol Electric, Inc.—Semiconductors
232 Tung-Sol Electric, Inc.—Engineering personnel
233 Union Switch & Signal Div., Westinghouse Air Brake Co.—Selenium rectifiers and miniature relays
234 United Transformer Co.—Miniaturized transformer components
235 Unitek Corp.—Tweezer type welder
236 U. S. Components—Printed card connectors
237 U. S. Engineering Co.—Brass and stainless steel handles
238 U. S. Radium Corp.—Edge lighted panels; knobs and knob skirts
239 Varian Associates—Miniature backward wave oscillator
240 Vector Electronics—Tube socket test adapters
241 Wacline, Inc.—Microwave; tachometers; adjustable speed A-C drives
242 Waterman Prods. Co., Inc.—Rack mounted oscilloscopes
243 Welwyn International, Inc.—Metal film resistors
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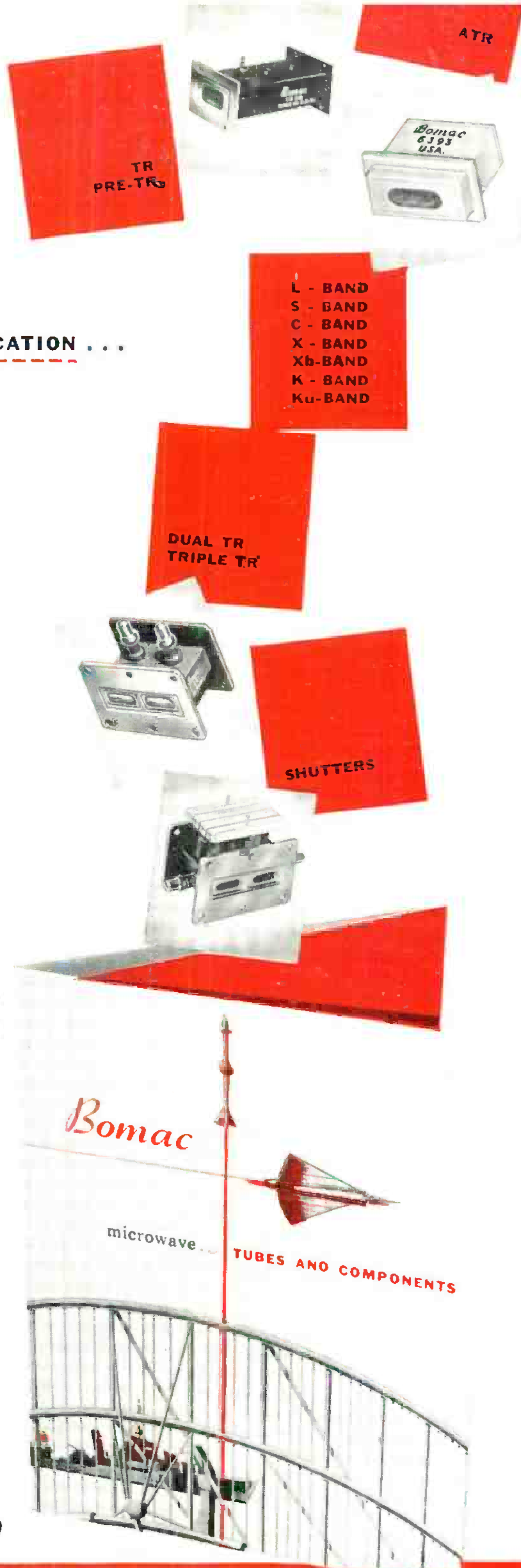

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