ELECTRONIC INDUSTRIES

TELE-TECH

A Caldwell-Clements Publication

AUGUST, 1953

FRONT COVER: CALIFORNIA—ELECTRONIC GOLD COAST—Breathtaking panoramic view is Art Director Charles Dreyer's concept of how the West Coast would look to on observer in a guided missile hundreds of miles above the earth's surface. At the bottom is White Sands, New Mexico, center of considerable missile and rocket experimentation, with associated studies of telemetering and remote control by radio. Moving up and to the left across the arid miles, we cross Arizona and enter Nevada. Here, close to the California border, are Yucca and Frenchman Flats, historic scenes of recent atomic bomb explosions. Into the southern part of California are the motion picture and aircraft—and fast growing electronic industries, paced only by rapidly rising population. Heaviest concentration of TV-electronic manufacturing is in the Los Angeles area, with the San Francisco region also boasting considerable activity. Products include computers, communication equipment, components, instruments, controls, TV, audio, radar, sonar, industrial electronic equipment, and many other electronic devices. For more details, see page 76.

DEPARTMENTS

TELE-TECH*, Vol. 12, No. 8. Published monthly by Caldwell-Clements, Inc. M. Clements, President; Orestes H. Caldwell, Treasurer. Acceptance under Section 34.64 Postal Laws and Regulations authorized at Bristol, Conn., February 8, 1952 with additional entry at New York, N. Y. 75c a copy. Annual Subscription Rates: United States and Possessions: $7.00; Canada: $8.00; All Other Countries: $10.00. Please give title, position and company connection when subscribing.

CALDWELL-CLEMENTS, Inc.

Publication Office, Bristol, Conn.

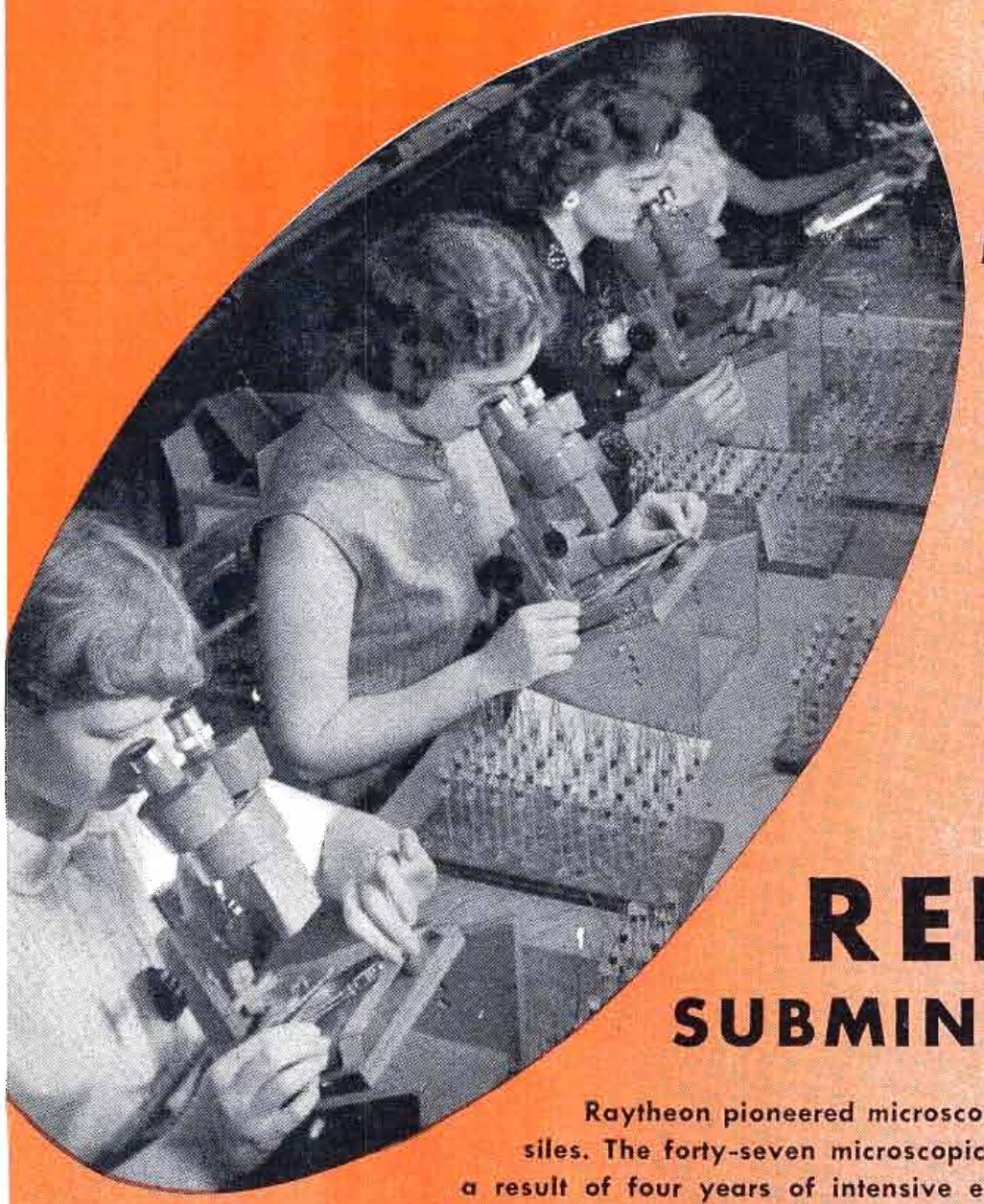
Editorial/Business Offices 480 Lexington Ave., New York 17, N. Y., Tel. Plaza 9-7880

Publishers also of TELEVISION RETAILING

* Reg. U. S. Pat. Off.

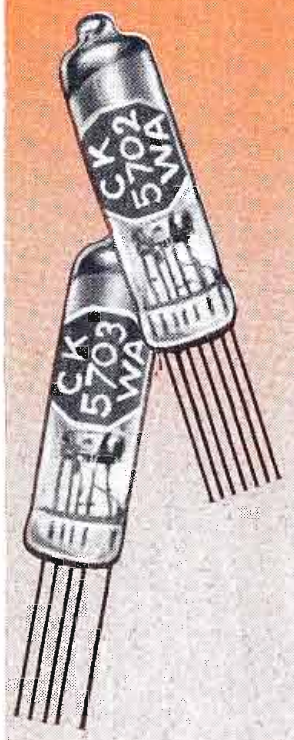
TELE-TECH'S CIRCULATION, 21,000

Because of increases in circulation which obviously cannot be shown in current audited statements, advertisers should disregard any comparison based on a previous period or any that fails to show TELE-TECH'S guaranteed circulation of 21,000.



47 MICROSCOPIC TESTS on all RAYTHEON RELIABLE SUBMINIATURE TUBES

Raytheon pioneered microscopic inspection of reliable tubes for missiles. The forty-seven microscopic tests were developed by Raytheon as a result of four years of intensive experience with visual inspection. This rigid multiple test procedure has been adopted as standard practice on every Raytheon Reliable Subminiature Tube. It assures utmost dependability of performance.



All these Raytheon Reliable Subminiature Tubes must pass microscopic inspection

Type	Description	Heater Volts	Heater Ma	Plate Volts	Plate Ma	Grid Volts	Screen Volts	Screen Ma	Amp. Factor	Mut. Cond.
CK5702WA	RF Amplifier Pentode	6.3	200	120	7.5	R_k = 200 ohms	120	2.5	—	5000
CK5703WA	High Frequency Triode	6.3	200	120	9.4	R_k = 220 ohms	—	—	25.5	5000
CK5744WA	High Mu Triode	6.3	200	250	4.2	R_k = 500 ohms	—	—	70	4000
CK5783WA	Voltage Reference		Operating voltage approximately 86 volts between 1.5 and 3.5 ma.							
CK5784WA	RF Mixer Pentode	6.3	200	120	5.2	-2	120	3.5	—	3200
CK5787WA	Voltage Regulator		Operating voltage approximately 100 volts between 1 and 25 ma.							
CK5829WA	Dual Diode	6.3	150		Max. Peak Inverse 360 volts. I_o = 5.5 ma. per plate					
CK6021	Medium Mu Dual Triode	6.3	300	100	6.5	R_k = 150 ohms	—	—	35	5400
CK6111	Medium Mu Dual Triode	6.3	300	100	8.5	R_k = 220 ohms	—	—	20	5000
CK6112	High Mu Dual Triode	6.3	300	100	0.8	R_k = 1500 ohms	—	—	70	1800
CK6152	Low Mu Triode	6.3	200	200	12.5	R_k = 680 ohms	—	—	15.8	4000

Note: All dual section tube ratings (except heater) are for each section.

Write for New Edition of Raytheon Reliable Subminiature Tube Booklet

RAYTHEON®

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division — for application information call

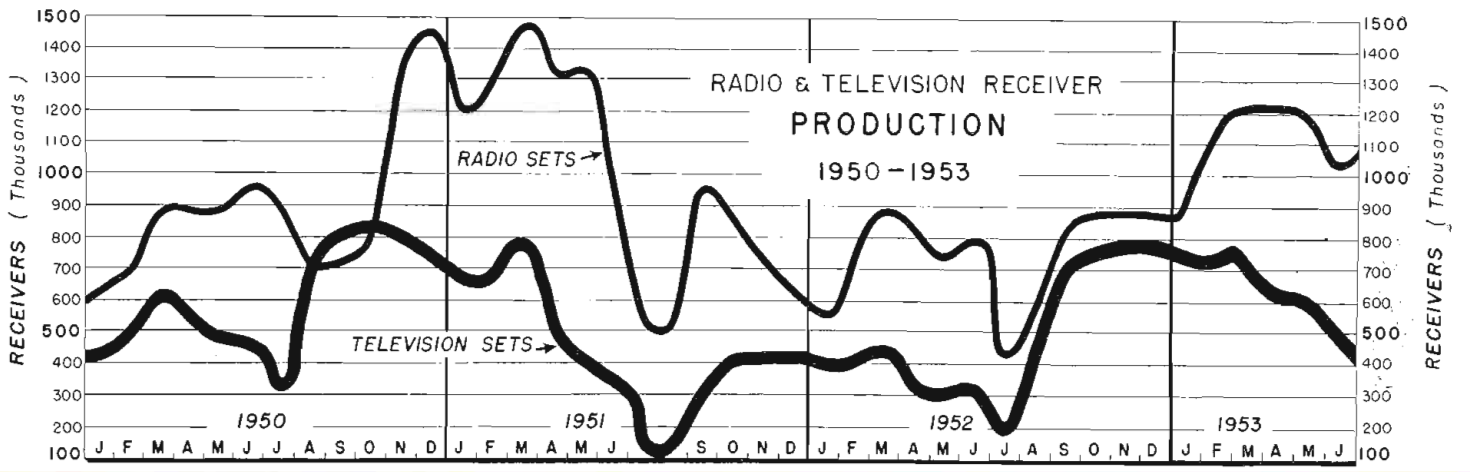
Newton, Mass. Bigelow 4-7500 • Chicago, Ill. NAtional 2-2770 • New York, N. Y. WHitehall 3-4980 • Los Angeles, Calif. Richmond 7-5524

RAYTHEON MAKES ALL THESE:

RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES

Facts and Figures Round-Up
August, 1953

ELECTRONIC INDUSTRIES TOTALS



Broadcast Stations in U.S.

	AM	FM	TV
Stations on Air	2391	570	154 VHF 45 UHF
Under Construction (CPs)	147	65	135 VHF 232 UHF
Applications Pending	225	10	402 VHF 200 UHF

Radio and TV Receiver Production

	TV	Radio	
June, 1953		Home	250,000
		Battery	225,000
		Auto	480,000
		Clock	122 000
Total	427,000		1,077,000
Six months, 1953 Jan.-June Incl.		Home	2,021,000
		Battery	999,000
		Auto	3,159,000
		Clock	1,117,000
Total	3,748,000		7,296,000

Military Electronics, $5.5 Billions

More than $5.5 billion worth of electronic products for the armed services have been delivered since the start of the Korean War, reports RTMA President A. D. Plamondon, Jr., who points out that such military deliveries represent more than two-thirds of the production of electronic equipment throughout World War II when the industry was engaged solely in military production.

"The future of the industry," Mr. Plamondon said, "was never more promising despite a temporary and seasonal lull in set sales and an approaching decline in military procurement. Despite a high ownership of TV sets in many areas, the industry confidently expects to produce approximately seven million television receivers in 1953."

The Association President's report noted that "while reductions in military procurement are both inevitable and desirable from the national economic point of view, it seems unlikely that our country will turn to the disastrous disarmament policy which followed World War II. Moreover, the growing importance of electronics in all aspects of military operations indicates that our industry, like the aircraft industry, will be heavily engaged in military production so long as there is any threat to national security.

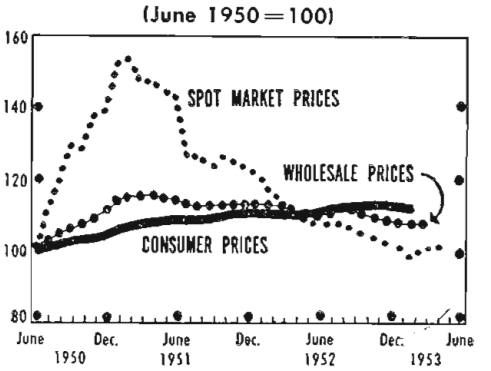
"The industry's record for fulfilling commitments to the armed services is one of which it may well be proud. Deliveries of electronic equipment and components to the military in 1953 are expected to total $3 billion."

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies in June-July 1953.

Acellerometers	$933.794
Actuators, aircraft	137,833
Altimeters, pressure	1,051,710
Amplifiers	7,783,184
Analyzers. servo type	138,965
Batteries	9,958,593
Cable	566,158
Check Sets, radiosonde	104,506
Circuit Breakers	371,361
Code Practice Equipment	140,320
Computers	331,358
Connectors	230,827
Control Equipment	1,504,011
Consoles	300,381
Countermeasures Receivers	98,640
Coupler, transmission line	109,411
Crystal Units	571,560
Cutting Equipment, ultrasonic	100,000
Delay Lines, solid	58,205
Diodes	85,000
Generators	3,686,992
Headsets-Handsets	49,609
Ignition Analyzer Assys	2,316,380
Indicators	7,237,467
Insulators	30,105
Intercommunication Stations	36,910
Inverters	668,495
Line Kits, transmission	45,597
Loudspeakers	26,529
Meters	2,344,950
Microphone Simulator Sets	75,178
Motor Assys	47,543
Oscillators, test	599,441
Oscillographs	121,883
Racks	71,773
Radar Sets	2,167,860
Radio Compasses	3,996,820
Radio Sets	6,615,828
Radome	164,850
Receivers, radio	5,704,441
Recorder Reproducers	315,422
Reflection Plotters	110,286
Regulators	1,143,588
Relays	303,136
Resistance Bridges	70,372
Rheostats	135,023
Solder	117,520
Solenoids	133,205
Spare Parts (meters, crystals, etc.)	5,339,136
Standards, frequency	67,466
Switch boxes	41,400
Switches, control stick	85,253
Teletypewriters	400,709
Terminal Boxes	102,263
Test Sets	2,029,011
Thermocouples	31,252
Transformers	437,029
Tubes, electron	4,345,428
Tuning Assys	189,977
Vibrators, power supply	151,328
Wire	220,576

BLS Price Indices
(June 1950 = 100)



—U. S. Bureau of Labor Statistics

WAFM-TV

TELEVISION ALABAMA
CBS NETWORK
BIRMINGHAM 3, ALABAMA

MAY 20, 1953

MR WILLIAM H. ZILLGER
VICE PRESIDENT
STANDARD ELECTRONICS CORP.
285 EMMET STREET
NEWARK 5, N. J.

DEAR BILL:

MAY I TAKE THIS MEANS OF EXPRESSING MY APPRECIATION AND SINCERE THANKS FOR THE SPLENDID COOPERATION I RECEIVED FROM YOU AND YOUR ENTIRE STAFF DURING THE RECENT INSTALLATION OF OUR FIRST 20KW STANDARD ELECTRONICS AMPLIFIER.

IN MY 21 YEARS' EXPERIENCE, I HAVE NEVER INSTALLED A TRANSMITTER SO EASILY. I HAVE ONLY ONE SUGGESTION: INSTEAD OF YOUR SLOGAN, "ADD-A-UNIT", IT SHOULD READ, "ADD-A-UNIT & PLUG-IN"; HONESTLY, THAT WAS ABOUT ALL WE HAD TO DO HERE AT WAFM-TV TO ADD YOUR AMPLIFIER TO OUR OLD-TYPE TRANSMITTER.

PLEASE CONVEY MY THANKS TO ALL OF THE PEOPLE, THERE AT THE PLANT, WHO MADE IT POSSIBLE TO BEAT THE DEADLINE FOR US.

SINCERELY,

James L. Evans

JAMES L. EVANS
CHIEF ENGINEER

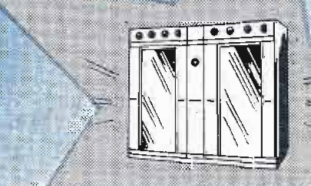
JLE:MB

STANDARD SE ELECTRONICS

FIRST with HIGH POWER

There is a single factor—almost indefinable—which makes one company outstanding in its field. While it may manifest itself differently for every form of human endeavor, the end result is invariably the same: QUALITY OF ACHIEVEMENT.

In our business, that factor is most nearly defined by the word "Service", or as referred to in this letter, "Co-operation" . . . in planning . . . in delivery . . . in performance . . . in maintenance. At Standard Electronics, "Cooperation" is the guiding hand, continually shaping the results of our thinking into products for you which deserve the confidence they inspire.



cabinetry by DREYFUSS

standard electronics corporation

A SUBSIDIARY OF CLAUDE NEON, INCORPORATED

newark 5, new jersey

devoted exclusively to the engineering, manufacturing, and servicing of equipment for the broadcast and television industry

TELE-TECH

DR. O. H. CALDWELL, *Editorial Director*
M. CLEMENTS, *Publisher*

BERNARD F. OSBAHR, *Executive Editor*
DR. A. F. MURRAY, *Consulting Editor*
HARRY D. WULFORST, *Assistant Editor*
ALBERT FORMAN, *Assistant Editor*
JOHN H. BATTISON, *Contributing Editor*
B. V. SPINETTA, *Directory Editor*
R. C. DAVIES, *Washington News Editor*
CHARLES F. DREYER, *Art Director*
GAIL CARLSON, *Editoriol Secretary*
Lt. Col. STANLEY GERSTIN *Consulting Editor*
(Vice Pres. & Gen. Mgr., Coldwell-Clements Monuols Corp.)

BUSINESS DEPARTMENT

M. H. NEWTON, *Business Manager*
HOWARD A. REED, *General Sales Manager*
HAROLD PRINCE, *Sales Promotion Manager*
JOSEPH DRUCKER *District Monager*
C. HERBERT CLARKE, *District Manager*
JAMES S. COLEMAN, *Asst. Sales Manager*
N. McALLISTER, *Asst. Business Manager*
A. O'ROURKE, *Production Manager*
A. SHILLIN, *Asst. Production Manager*
BARBARA PARK, *Reader Service Dept.*
480 Lexington Ave., New York 17, N. Y.
Telephone PLaza 9-7880

S. M. GASKINS, *Western Manager*
JOHN D. LUPTON, *District Manager*
201 N. Wells St., Chicago 6, Ill.
Telephone RAndolph 6-9225

CHRIS DUNKLE & ASSOCIATES
California Representatives
3257 W. 6th Street, Los Angeles 5, Calif.
Telephone DUnkirk 7-6149
1355 Market St., San Francisco 8, Calif.
Telephone KLondike 2-2311, Ext. 579

WARREN S. BROWN, *Circulation Manager*
M. GROENING, *Asst. Circulation Manager*
JOHN J. BORGHI, *Controller*

CIRCULATION 21,000

Because of increases in circulation which obviously cannot be shown in current audited statements, odvertisers should disregard any comparison based on a previous period or any that fails to show TELE-TECH's guaranteed circulotion of 21,000.
TELE-TECH* & ELECTRONIC INDUSTRIES is edited for top-level engineers and executives throughout the electronic industries. It gives the busy engineering executive outhoritative informotion ond interpretotion of the lotest developments and new products, with emphasis on subjects of engineering import and timeliness. Special attention is given to:

MANUFACTURING

—Electronic equipment, communications, broadcasting, microwove relay, instruentation, telemetering, computing.
—Militory equipment including rador, sonor, guided missiles, fire controls.
—TV-FM-AM receivers, phonographs, recorders, reproducers, omplifiers.

OPERATION

—Fixed, mobile and airborne communications in commerciol, municipol, oviation and government services.
—Broodcosting, video ond oudio recording, records, oudio ond sound systems, motion picture production.
—Military, civilian ond scientific electronic computing and control systems.

* U. S. Pat. Off.

MEPCO'S NEW SEALED Precision Resistors STOP Humidity Failures

Over 2 years of laboratory development and testing were required to achieve a sealed resistor design up to Mepco's standard of quality. No sacrifice of our standard time-proven features have been made in order to perfect this sealed resistor.

SPECIFICATIONS: Meets all requirements of MIL-R-93A and JAN-R-93.

SEALING: Completely encapsulated and bonded.

OPERATING TEMPERATURE: −65°C. to +125°C.

WINDINGS: Reversed and balanced PI-windings for low inductance with use of only the finest "certified" resistance alloys.

EXCLUSIVE INTERNAL FEATURES: Internal section's cross-over wire insulated from winding by 2000 v. insulation (patented). Special metal molded connecting feature, which bonds end of winding and terminal in a non-corrosive and mechanically secure manner — no solder or flux used.

TERMINALS: Rigid hot solder coated brass terminals for easier and more secure soldering.

TYPE	NOMINAL WATTAGE RATING	RESISTANCE MIN.	RESISTANCE MAX.	NO. SECTIONS	SUPERSEDES JAN-R-93 TYPE
RB15 (M15)	.25 .50	0.1 ohm 0.1 ohm	.185 meg. .6 meg.	2	RB10
RB16 (M16)	.35 1.00	0.1 ohm 0.1 ohm	.3 meg. 1.5 meg.	2	RB11
RB17 (M17)	.50 1.00	0.1 ohm 0.1 ohm	.3 meg. 2.0 meg.	4	RB12
RB18 (M18)	.50 1.00	0.1 ohm 0.1 ohm	.75 meg. 4.0 meg.	4	RB13
RB19 (M19)	1.00 2.00	0.1 ohm 0.1 ohm	4.0 meg. 15.0 meg.	8	RB14
RB52 (M52)	.25 .50	0.1 ohm 0.1 ohm	.1 meg. .5 meg.	2	RB51

MIL - R - 93A
WATTAGE & RESISTANCE TOLERANCE

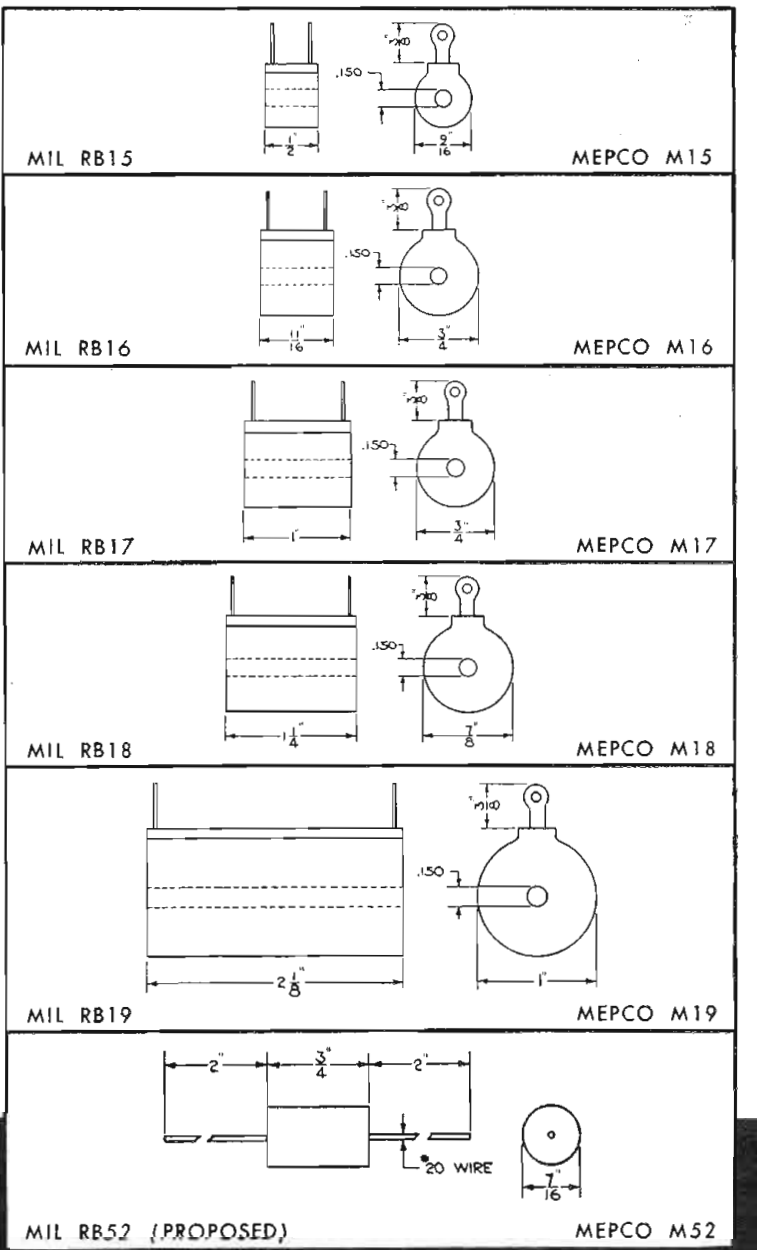
TOLERANCE SYMBOL	RESISTANCE TOLERANCE	PERCENT OF NOMINAL WATTAGE
B	0.10 %	50 %
C	0.25 %	50 %
D	0.50 %	75 %
F	1.00 %	100 %

MIL - R - 93A
TEMPERATURE COEFFICIENT
(REFERRED TO 25°C)

SYMBOL	EXPRESSED IN PERCENT PER DEGREE C.	
	NEGATIVE, MAX.	POSITIVE, MAX.
E	0.0022	0.0022
J	0.0040	0.0155
K	0.0050	0.0255

SPECIAL REQUIREMENTS

Variations of the above ratings, tolerances, temperature coefficient, etc. can be supplied to special order.



MEPCO, INC.
MORRISTOWN, NEW JERSEY

LETTERS...

What's Ahead in British Broadcasting

Editors TELE TECH:

The British are in somewhat of a furor over the advantages and disadvantages of sponsored television and the particular brand that they now have which is strictly unsponsored. Advocates of each are about equally divided but it is certain now that British TV will go commercial, at least in part, and within the next eighteen months.

As most people know, the British Broadcasting Corporation is owned and operated by the Government and ever since its establishment no breath of advertising has been permitted to polute the austere British atmosphere. Now, however, they are to have a limited number of strictly commercial stations which will be permitted to broadcast paid-for advertising though it is hoped and believed that 'Commercials' will be neither as blatant nor as frequent as American viewers have had to endure.

New "Commercial" Stations

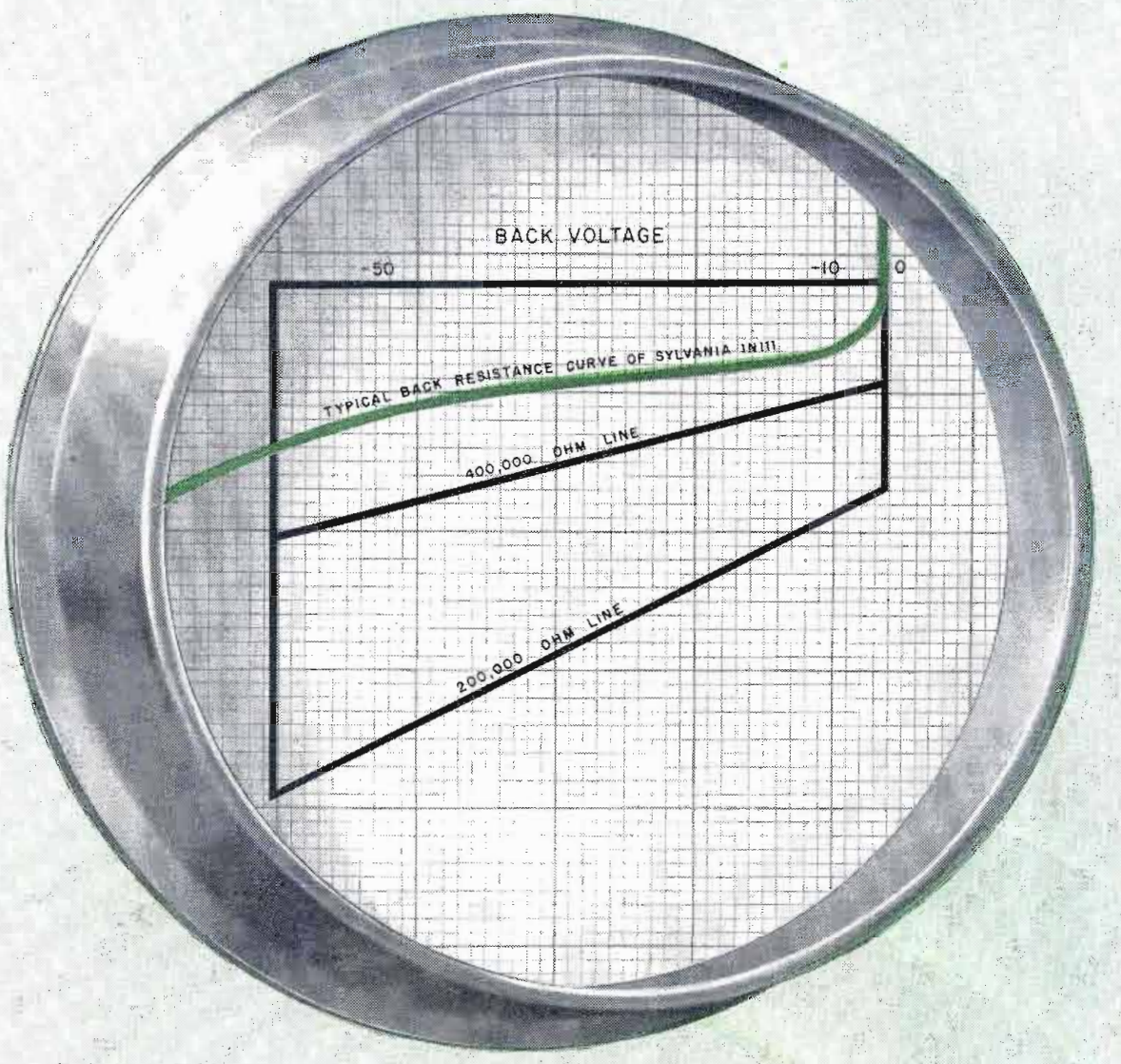
No one knows as yet just how many of the new commercial stations will be permitted. So far, the Government has indicated only that a limited number will be welcomed. The new plan will in no way effect the present broadcasting activities of the eight TV stations now operated by the B.B.C., though there will be a realignment of facilities and within an estimated period of two years the plan is to increase the number of transmitters to a total of eighteen. At present the B.B.C. has transmitters located in London, Wemboe (Wales), Sutton Coldfield (Birmingham), Holme Moss (Huddersfield), and Kirk O'Shotts (Edinburgh—Glasgow). The eventual set-up will include these five to which there will be added five high power stations of 50 KW and an effective power output of 120 KW and 13 low power stations of ½–1 KW. When these are put in operation three of the original transmitters which were of low power and were established to broadcast the Coronation spectacle will be eliminated. The new stations that are to be installed will be spotted near to Newcastle, Belfast, The Isle of Wight, Plymouth, and Aberdeen.

When the new set-up is complete it will make possible 97% coverage as compared with the present 84% coverage. There are approximately 2½ million vision receivers in the service area at present involved.

This of course has nothing to do with the new commercial stations which will be established as soon as the Government gets around to laying down definite rules and regulations which will cover not only the number, location and power of these commercial outlets but will also designate exactly how the stations are to be operated, the number of hours they may be on the air and the kind and character of the programmes

(*Continued on page* 166)

Sylvania Computer Crystal Diodes



1N111
1N112
1N113
1N114
1N115

All Dynamically Tested at 55° C. For High Back Resistance and Stability

Sylvania Types 1N111, 1N112, 1N113, 1N114 and 1N115 were designed specifically for computer use. All Sylvania's Computer Diodes are tested at raised temperatures simulating actual operating conditions. To insure maximum stability and life, all units are tested for evidence of drift and hysteresis. Each diode is hermetically sealed in glass and is designed so that it may conveniently be soldered or clipped into a circuit.

Mail this coupon Today

SYLVANIA

LIGHTING · RADIO · ELECTRONICS · TELEVISION

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building
St. Catherine Street, Montreal, P. Q.

Sylvania Electric Products Inc.
Dept. 3E3008, 1740 Broadway, New York 19, N. Y.

Please send me data sheets on Sylvania Computer Crystal Diodes.

Name_____

Address_____

City_____ Zone____ State____

TELE-TIPS

HILARIOUS SATIRE on tube specs has been concocted by Eitel-McCullough, Inc. Brainchild number one is the Umac 606: "The Umac 606 is an infernal anode, helical beamed phantasatron . . . of the double sucked type permitting a clear view of the non-emitting triple processed prophylac plate . . .. urinated tungsten filament—adjust until half as bright as flashlight . . . requires minimum air flow of 5000 cubic feet per second . . . ratings will be available as soon as our competitors issue their catalogue . . . exhaustive tests in our advertising department have shown that the 606 will give 50 per cent more output than you will obtain . . . in case of tube failure, our tests show that you have exceeded the safe limit, regardless of output." A synopsis of brainchild number two reads: "The Wemac 1Z2Z is a travelling ripple tube . . . cooling is readily done at the north pole by means of a fan . . . at the equator, a bigger fan is needed . . . maximum over-all dimensions 36-22-34 in. . . . height 5 ft. 6 in. . . . shipping weight 123 lbs. . . . mounting . . . " And as a final touch, the valid-looking "encabulator sub-assembly" diagram is really the floor plan of the Illinois State Prison!

LIGHTNING PROTECTION for aircraft antennas is provided by a device described at the AIEE Summer General Meeting by J. Bryant, M. Newman and J. Robb. It consists of a capacitor with 10 times the antenna capacity, placed in series with the lead-in wire as close to the feed-through insulator as possible. A spark gap cartridge provides the ground from the antenna side of the capacitor to the aircraft fuselage. Fifty units installed on American Airlines craft indicate total charge transfer.

ELECTRONIC BOOKIE is in the offing, predicts a subscription TV firm. In five or ten years you'll be able to place $2 on the nag's nose from the home subscription TV set. The information will be fed to the track's pari-mutual machines. Then the circuit will be switched to a camera at the racetrack so the bettor can see the race.

(*Continued on page* 52)

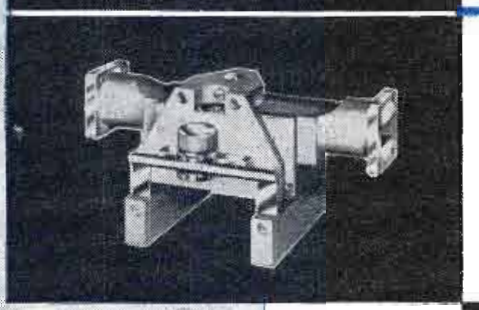
Microwave TEST COMPONENTS

PRD offers a complete line of test equipment for precise measurements in the Microwave region. This equipment, the finest obtainable anywhere, includes Frequency Measuring Devices, Signal Sources and Receivers, Attenuators and Terminations, Impedance Measurement and Transformation Devices, Detection and Power Measurement Equipment, Bolometers and Accessories.

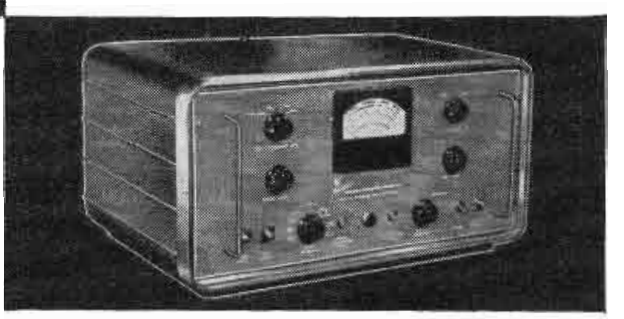
When you test, use the best—

PRD **QUALITY**
DEPENDABILITY
ACCURACY

TYPE 250-A BROADBAND PROBE – Frequency range of 1 to 12.4 Kmc/s; two tuning knobs permit precise adjustment for maximum power transfer from the probe tip to the crystal or bolometer detector; third knob controls depth of probe tip insertion.



SLOTTED SECTIONS—The mechanical and electrical design of PRD slotted sections emphasizes these important features: Instrument accuracy assured indefinitely by virtue of three bearing carriage suspension to minimize wear; waveguide section machined from solid aluminum alloy stock, to ovoid warpage no castings are used.



TYPE 275 VSWR AMPLIFIER – Featuring high gain; A.G.C. to maintain output constant for slow variation in r-f power source; low input noise level of 0.03 microvolts; wide VSWR ranges of 1:1.3, 1:3, 3:10, 10:30, and 30:100; greater accuracy because VSWR scale on meter is linear.

WRITE FOR NEW CATALOG

Address requests for your copy of the new catalog to Department T-7 — no obligation.

Polytechnic RESEARCH & DEVELOPMENT COMPANY• Inc

55 JOHNSON STREET, BROOKLYN 1, NEW YORK
WESTERN SALES OFFICE:
741½ NO. SEWARD ST., HOLLYWOOD 38, CALIF.

TELE-TIPS

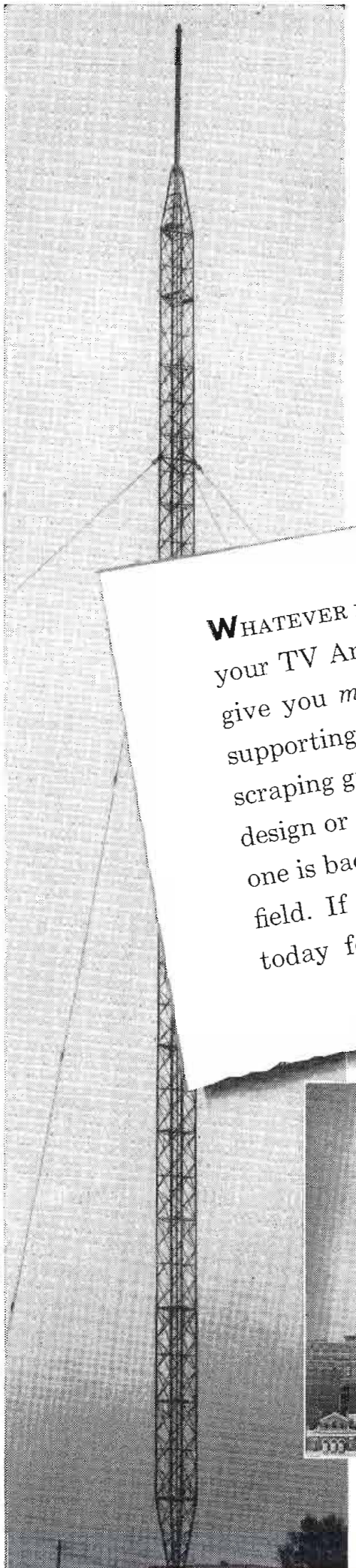
(*Continued from page* 50)

COLOR-MOVIES—Whatever color's future importance may be in the television world, color-films are still in the minority in the movies! After more than 20 years' color experimentation and use, the films being currently produced, according to the Motion Picture Association, are 60% black-and-white, 39% in color, and 1% sepia.

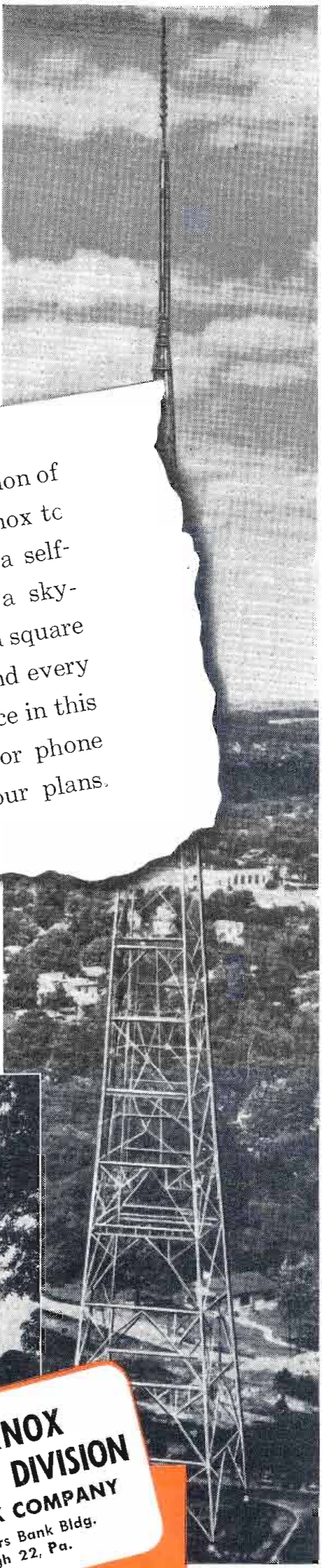
RAYDIST—The Raydist Navigation Corp., affiliate of the Hastings Instrument Co., of Hampton, Va., recently conducted tests with Raydist to measure the speed and to obtain crash stop data of the North Dakota, a Texas Company tanker. These tests were made by anchoring a trawler, the Malolo, out of Hampton, off Winter Quarter Light which is approximately 50 miles from shore. The "North Dakota" then ranged from 20-30 miles seaward from the small boat, as Raydist recorded the necessary data. Raydist makes it possible to conduct ship tests at any convenient location off the coast rather than to go great distances to obtain courses within sight of land. As in the recent tests of the "United States," the Raydist tests were successfully conducted in spite of very rough weather.

TVI ROMANCE—While engineers and the FCC study "ham" interference on television channels, a case of such interloping signals with happy consequences comes to our attention from a neighboring Connecticut town. A lovely young widow was in a group there watching TV one evening when suddenly they heard a man's voice cut in with the usual ham chatter, followed by a reference to his nieces, "Julie and Susan." These names the widow quickly identified as belonging to a neighboring family—also giving her a clue to "Uncle Bob's" identity as a yacht-clubbing bachelor she had never met. A year later, at a New Year's party, she and "Uncle Bob" were introduced for the first time by a mutual friend. Politely making conversation, widow Brown recounted how the strange man's voice, with mention of the nieces' names, had come in on her TV set long before. Quickly admitting his identity, Mr. W4ZDX evinced a sudden interest in his unwitting correspondent, asked permission to call, and orange blossoms in June completed the story!

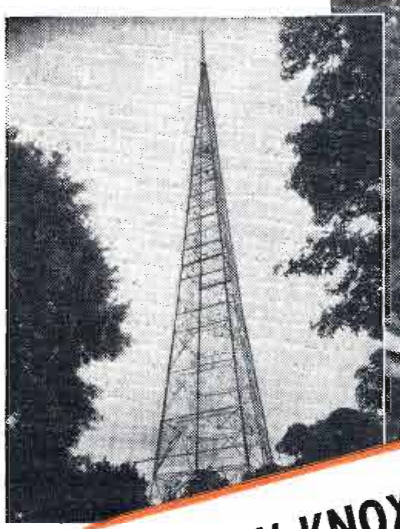
(*Continued on page* 54)



Designs Unlimited



WHATEVER factors determine the type, height and location of your TV Antenna Tower, you can depend on Blaw-Knox tc give you *more for your money*. Does the job call for a self-supporting structure atop a mid-town building or a sky-scraping guyed tower out in the open? Do you prefer a square design or triangular? Blaw-Knox builds them all—and every one is backed by more than four decades of experience in this field. If you are anticipating a TV license, write or phone today for capable engineering assistance with your plans.



Distributed by GraybaR
OFFICES IN 100 PRINCIPAL CITIES

BLAW-KNOX

BLAW-KNOX EQUIPMENT DIVISION
BLAW-KNOX COMPANY
2038 Farmers Bank Bldg.
Pittsburgh 22, Pa.

TELE-TIPS

(*Continued from page* 52)

TAXES continue to rest heavily on all of us. On page 3 of this issue, 1952 federal taxes related to the electronic industries are presented. Just for the record, the following are a selected few of the specialized taxes incurred in the process of adding a measure of pleasure to daily living.

Beer drinkers	$ 722,150,000
Card players	7,353,000
Cigarette smokers	1,474,072,000
Fishermen (weekend)	2,857,000
Liquor imbibers	1,621,543,000
Would-be athletes	13,644,000
Women (cosmetics, etc.)	112,892,000

TV FOILS FORGERS!—A London, England, bank now uses television to verify signatures appearing on checks. Due to war conditions the bank in question had to transfer all its original files to safe storage in the country. A microwave beam between the London bank and the archives enables cashiers to verify signatures on a 3 x 5 inch screen. Presumably, the kit of an up-to-date con-man must now include a microwave scrambler!

PERSPIRATION MANUFACTURE may never find a mass market, but it has a definite place in supplying researchers with the material needed to study the effects of perspiration on paint, metals and other finished surfaces. Scientists at Minneapolis-Honeywell brew the stuff synthetically, combining valeric acid, acetic acid, butyric acid—and, oh yes—a pinch of salt.

TV CLOSED DOWN while the employees of the Netherlands Television station took their annual vacation between the second and eighteenth of August of this year. In addition to staff holidays, the equipment at the Bussum Studio was overhauled. Wonder what would happen if the major U. S. networks followed the same system!

AUTO TAGS in Florida carry the call letters of amateur radio stations instead of the usual markings. These made-to-order license plates ($1 extra) combine with the 8-ft. whip and a zealous facial expression to make the mobile ham a truly distinctive individual. 73 OM, 88 YL, QRT.

"SOUNDEST ADVICE to anyone who has ever won an award in any business is simply this:— Forget it!"—Sam Goldwyn

TELE-TECH
& ELECTRONIC INDUSTRIES—RADIO-TELEVISION

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

The "Bending" of the MICROWAVES

Marconi's Third Great Discovery. His Prophecy of 1932

There is an aspect of the history of great discoveries that has a way of repeating itself—they are often practically applied and utilized before the world of science comes to an agreement on the nature of what has been "discovered."

A little over half-a-century ago, Marconi confounded the science of the time by demonstrating that electric waves, instead of following the laws that govern light and travelling in straight lines, could be made to follow the surface of the earth. He disproved that theoretical barrier to the usefulness of wireless so positively predicted by those who then claimed to understand the "laws of nature."

While Marconi did not pretend to understand the phenomenon that he had uncovered, he knew what to do to apply it practically; and he created the art of long distance signalling without wires. Years passed before the world of science reached agreement as to what it was that he had discovered.

THE GREAT INVENTOR POINTED THE WAY

We presently find ourselves in the same position with respect to some of the characteristics of microwaves. We are utilizing discoveries about the propagation of those waves, yet without any agreement as to the mechanism by which they are being transmitted. A set of circumstances such as this is not in itself too unusual. But when we look into the origin of the uncovering of the new phenomenon, we encounter an arresting fact—that it was once again Marconi who, making his third basic discovery in the field of propagation, pointed the way for us. It is seldom that a man makes two basic discoveries. When a man makes three, his attitude toward problems and his method of work merit the closest analysis and study.

All too little attention has been paid to Marconi's approach and his way of thinking, in part perhaps because of his own natural reticence, but mainly because there has been, in this country at least, a widespread lack of understanding of the facts about Marconi's discoveries.

My old teacher at Columbia University, Professor Michael I. Pupin, paid tribute to Marconi's first great achievement on the gala occasion when the A.I.E.E. welcomed him after the historic reception of the letter "S" at St. John's, Newfoundland, from the Poldhu transmitter in the British Isles. It was my pleasure and privilege in 1951 to tell the story of Marconi's second fundamental discovery—that of the "daylight wave"—when he found that if "short" waves were made short enough, the 22-year-old radio axiom that transmission at night was superior to that by day had to be applied in reverse.

THE "HERTZ RAYS" OF OLD DO CURVE!

Now it is my purpose to pay tribute to Marconi's third great discovery, one made some twenty years ago, but whose significance we are just beginning to appreciate—that even the microwaves, or the Hertz rays of old, curve around the surface of the earth and may be detected far beyond the optical horizon.

* * * * *

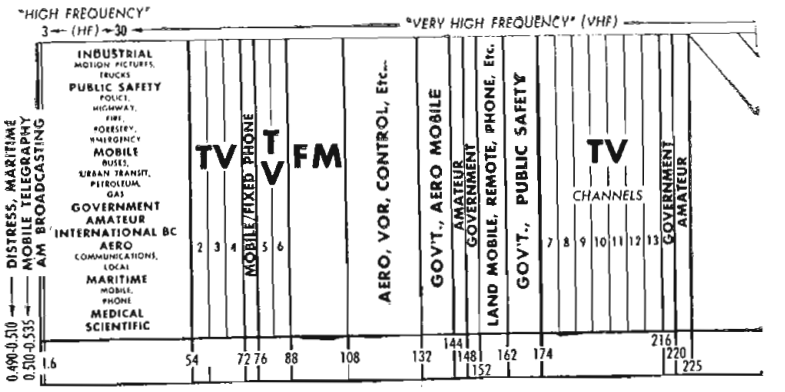
In 1932, we find Marconi, with the able assistance of Mr. G. Mathieu, working with a sixty-centimeter beam located on high ground in the vicinity of Rome, testing out for himself once again whether the "laws of nature" were as they were supposed to be. Once again we find in his account of his work the same painstaking experimentation, the same awareness that he did not know the answers, although others were already satisfied that they did. While others extrapolated observations into theories, Marconi worked with his apparatus and let the results speak for themselves.

(*Continued on page 222*)

A guest editorial by Dr. Edwin H. ("Major") Armstrong, himself generally accredited as "the most important of all radio inventors, except Marconi," and longtime Professor of Electrical Engineering at Columbia University. Dr. Armstrong has made four basic discoveries that have revolutionized radio, both AM and FM. These are: The regenerative circuit, which took radio out of the crystal-detector stage; the superheterodyne circuit, the basic circuit of today's standard radio; the superregenerative circuit, used in military, forestry and other ultra high frequency communications, and frequency modulation, or static-free high-fidelity radio. The attached comments are excerpts from Dr. Armstrong's paper of June 15, before AIEE, entitled "The Spirit of Discovery."

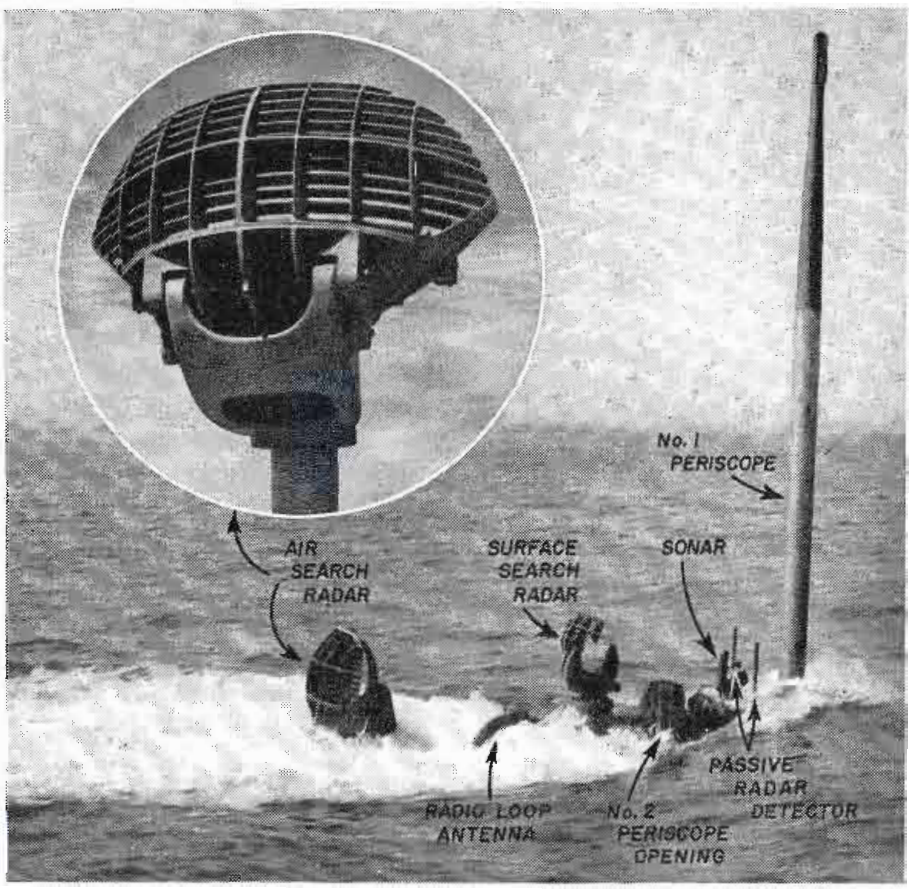
RADARSCOPE

Revealing Important Advances Throughout the Spectrum of Radio, TV and Tele Communications



DEFENSE PRODUCTION

CHANNELLING STRATEGIC MATERIALS—With last-minute passage by Congress and President Eisenhower's signing just before the June 30 midnight deadline of a bill extending portions of the Defense Production Act, the government's mobilization agencies have put into effect the new defense materials system to channel strategic materials to military and atomic energy projects. Replacing the controlled materials plan which had been in operation for the past two years—and which was felt to be too comprehensive for the limited controls program the present administration desires—the new DMS sets up a program that insures the Department of Defense and the Atomic Energy Commission sufficient quantities of steel, copper, and aluminum to meet their production and construction programs for defense, and places the remainder on the "free market." Each producing unit in the three controlled materials industries will be informed of its share of this defense requirement, and the mills will then reserve a portion of their total production for defense orders.



Radio, radar, sonar and other observational equipment atop the submerged conning tower of a modern U. S. submarine, running under water. The complete outfit of electronic detecting apparatus and transmitters are shown at the left of the extended periscope. In the circle above is seen the Western Electric SV type radar, which can transmit radar impulses vertically through 60 degrees and horizontally through 360 degrees. (Official photo, U. S. Navy)

NEW HORIZON

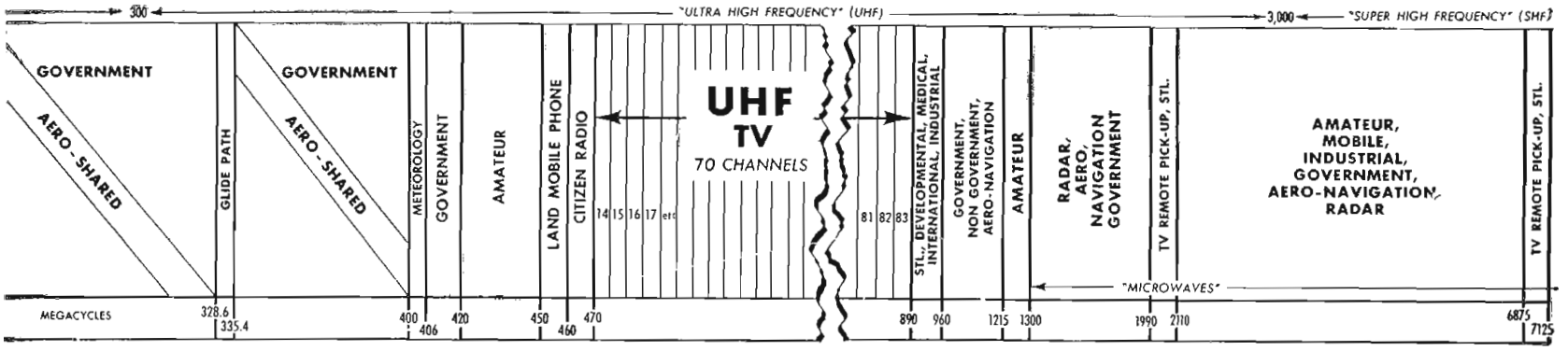
AUTOMATIC FACTORIES—Remington-Rand Inc., has announced development of an electronic computer described as the forerunner of the "automatic factory." The computer, "ERA 1103," makes it possible to apply automatic processing to a large oil-refinery or chemical plant. It provides storage capacity up to 17,408 super speed registers—plus unlimited supplementary magnetic tape bulk storage, high operating speed (60 microseconds per unit of addition) and wide programming versatility. First commercial models will be available for delivery in 1954, the company said. Other applications of the computer are for air-traffic control and air defense, aircraft simulation (testing without making actual models), automatic data reduction, and economic planning. As applied to refineries and chemical plants the computer would receive data on processing through "sensing" devices at various stages in the operation. The data would be processed in the computer in accordance with instructions, and used to control manufacture.

ASPECT RATIO

"GOLDEN RECTANGLES" of the movies have had any standards of "aspect ratios" they ever possessed now pretty well shattered by the latest demands of 3-D modifications. (See May Tele-Tech, pages 66-67). Happily, TV's own aspect ratio still remains faithfully 4 to 3, or 1.33 to 1. But some of the new 3-D movie screens go to such extremes as even 2.5 to 1. Old Man Euclid, back in 300 B.C., defined his classical "Golden Rectangle" as that oblong having its width to its length in the same ratio as its length bears to the sum of width plus length. Thus Euclid's "Golden Rectangle" figures out as an aspect ratio of 1.62 to 1,—the only proportion fitting the old Greek's definition. Euclid may have been right, back in 300 B.C. But we prefer to take our '53 TV, strictly 4 by 3!

PUBLIC OPINION

AUDIENCE VOTING—Dr. V. K. Zworykin, of RCA Laboratories, is working on an "electronic audience-voting system." Dr. Zworykin hopes to be able to equip the standard home television receiver with a button which, when pressed, will register a vote of 'yes' or 'no' at the television station. The purpose, of course, is to get from listeners and lookers their reactions to programs and issues of the day. Thus, eventually we may have a national push-button poll, the results of which can be tabulated automatically by electronic computers at a central point. In this way, public opinion throughout the nation could be sampled instantaneously.



PERSONAL

SECURITY? — "Will you take a chance, or will you play it safe? In other words, what is your concept of security?" asked Don G. Mitchell, Sylvania board chairman, of a 1953 class of engineering graduates.

"Let me say this much to you: security is not a 'safe' job, nor a good salary. Security comes from achievement, security comes from *doing*. Or to put it another way, the man who takes a chance, probably isn't taking a chance at all. In his confident mind, the so-called chance is really an opportunity, and he will make the most of it. To the man who has almost a phobia about security, any departure from established routine is 'taking a chance.' The net result is that he never is really secure; he actually is sheltered or isolated, but he is not secure in the sense that he has the strength which comes from accomplishment.

"To the engineer looking constantly for new opportunities, will some the reward of professional attainment. When the going gets rough—and it surely will—just relax, search your soul, and say to yourself: 'The answer is somewhere, I'll work until I find it'."

SUPER POWER TV

LOOKING TO THE FUTURE, the American Broadcasting Company plans to squeeze every kilowatt allowed by the FCC, from the antennas of its five television stations. The ultimate installation of 50 KW transmitters at WJZ-TV, WBKB, WXYZ-TV, KECA-TV and KGO-TV, will make Channel 7 a favored channel in their respective cities. Specifically planned to make ABC television operations the most up-to-date in the country, all their associated equipment will be capable of handling NTSC color-television as well as the full band width of high fidelity monochrome transmission. ABC pioneered "fill-in" radiation from its high-gain antenna on Mt. Wilson and now has designed new downward radiation antennas to insure that the new multi-hundred KW radiators provide optimum field-stregth to all parts of their service areas.

EDUCATION

ENERGETIC WRITERS of correspondence courses in almost every field, including radio and TV, met recently in Washington at the National Home Study Council's annual convention. Anyone who thinks that home educators are poor speakers who rely solely on typewriters for effect should have heard the extremely lively discussion that followed the submission of every topic on the agenda. In particular the plan to set up an accrediting board met with a very enthusiastic reception.

CANADA

OUR NEIGHBOR north of the border, larger in land mass than the United States, and smaller in population, also gets by with many fewer stations in its networks than does the United States. The Canadian English-language network comprising sixteen medium frequency stations has a total power of about 385KW and the French-language network consisting of three medium frequency stations has about 61KW. Five FM stations and eleven short wave stations radiate the domestic programs together with twenty-seven local 25-watt relay stations. Sackville, New Brunswick, utilizing seventeen frequencies provides high frequency transmissions to foreign countries.

Bell Telephone Laboratories' Dr. William Shockley (left), who directed the research leading to the invention of the transistor, discusses the crystal structure of semi-conductive materials with Dr. Walter H. Brattain (center) and Dr. John Bardeen, inventors of the point-contact transistor. Below are shown some experimental models of the transistor. Because of their extremely small size and infinitesimal power requirements, these rugged amplifiers and oscillators have opened up many new electronic possibilities. June 30 was the fifth anniversary of Bell Lab's announcement of the transistor.

Impact of Electronic Research

Will the West Coast become a future national research and develop and ideal year-round climate are among factors given to support

By Dr. A. M. ZAREM

Manager, Los Angeles Div., Stanford Research Institute, 621 S. Hope St., Los Angeles, Calif.

MANY of us have the feeling that this thing called the electronic industry can only be very vaguely defined. This is undoubtedly a great convenience to those of us who deal in "facts and figures" and find it necessary to describe the growth of the industry. Almost anything written on the subject is certainly open to question. Particularly in the West, where expansion is occurring so rapidly, there is a real scarcity of up-to-date data. It appears that only generalities are safe!

It would be an easy matter to put together a series of charts and diagrams on the growth of the Western electronic industry, which would impress even a careful reader, but it seems to me that such figures, however glamorous, will not reveal the true significance of the changes that are taking place in the West and nationally, and how they influence the electronics industry here. The underlying reasons for the enormous expansion of electronic activities are simple, basic and interesting and they point dramatically to what can be expected in the future—granted an overall national healthy economic development.

Industry Beginnings

The electronic industry, as we know it today, developed from the invention of the three-electrode vacuum tube by Lee DeForest in 1906. In the West, the beginnings can probably be best taken to be approximately 1927, when the advent of sound motion pictures opened a new era of entertainment. Previous to that time the industry was extremely small, amounting only to a few radio manufacturers who were viewed with "tolerance" by their larger brothers in the East. The growth of electronic activity in the West from 1927 to 1940 was related to the general increase of activities in the aircraft and entertainment industries, which in turn stimulated the population increase that occurred during that time. The enormous impetus given the industry by the armament program for World War II and the Korean situation since then has perhaps best been described by a visiting scientist from France. During a tour of laboratories in Southern California he was heard to mutter at frequent intervals: "Fantastic! Fabulous!"

A realistic evaluation of the growth and possibilities of this "local" industry does not become apparent merely by recording the increase in the number of workers employed or square feet of manufacturing space or any of the other ordinary factors by which such developments are characteristically described. A real feeling for this growth can only come when one recognizes the many logical reasons that could have been given for *such growth NOT to have taken place.*

West Competing With East

When one frankly evaluates the disadvantages, the hardships and the economic difficulties which have been either ignored or surmounted, only then does the true force behind the development of the electronic industry in the West become visible. That electronic equipment manufacturers in the West might some day be competitive with the vast productive centers of the East, was unthinkable just a few short years ago.

To begin with, the West is a relatively sparsely populated area. It has only recently developed a population base sufficiently broad to provide a market that will support its own industry. In addition to being located at great distances from the primary markets in the United States, this area is relatively isolated from the rest of the country by a physical and practical barrier in the form of mountains and shipping costs, and by a mental barrier in the form of attitudes of management in the East. The possibilities of an integrated development of industry in the West are only now beginning to be recognized in the East. These barriers are very real, but there is every reason to believe they will be submerged in the rising tide of Western population.

Since population is one of the most dynamic factors in the development of any area, an examination

---

DR. ZAREM was Valedictorian of his class when graduated from the Illinois Institute of Technology with a B.S. in Electrical Engineering. California Institute of Technology awarded him a doctorate Magna Cum Laude in 1944. After receiving his Ph. D., Dr. Zarem became a research and development engineer for Allis-Chalmers, where he invented an automatic oscillograph with memory.

In 1945, he returned to Cal Tech as a research group leader for the Manhattan District Project. After heading the basic research for the Electronics Section of the Naval Ordnance Test Station at Pasadena, he became head of the Electricity Section of the newly-formed Physical Research Division of the Navy. In 1947, he designed a shutter and means for obtaining photos with sub-microsecond exposure times. In the same year, he invented what the Navy has named the "Zarem Camera."

In 1948, the national electrical engineering honor society Eta Kappa Nu selected Dr. Zarem as "The Outstanding Young Electrical Engineer of the U. S." Two years later, the U. S. Junior Chamber of Commerce chose him as one of "America's Ten Outstanding Young Men." Professionally very active (well over a dozen professional societies), and highly community-minded (numerous civic organizations), he finds time to write an impressive number of

technical and semi-technical articles. As chief administrative and scientific representative of Stanford Research Institute in Southern California, Dr. Zarem has concerned himself directly with the major problems facing the future development of that region.

on the Development of the West

ment center? Availability of engineering personnel, modern plants, this view. West Coast production making inroads on national markets.

of growth in population in the West and the trends are worthwhile. The population of Washington, Oregon and California together in 1900 was approximately 2,400,000, in 1940 it was 9,700,000, in 1950 it was 14,000,000 and it is estimated today to be close to 16,000,000! Most of this growth occurred in the State of California, for which the figures are:

1900	1,400,000
1940	6,900,000
1950	10,600,000
Today	11,750,000

40% or 4,700,000 of the people in California reside in Los Angeles County alone! Less than 50 years ago, there were more animals in Los Angeles County than there were people. Now, more TV sets have been sold in Los Angeles than there are telephone subscribers in the area.

While the population of the United States, in the interval from 1940 to 1950, increased by 14.5%, the population of the three Pacific states increased by 48.8% and the population of California increased by 53.3%. The end is not yet in sight. In fact, according to Dr. J. Philip Warnette, editor of the Michigan Business Review, California will be the most populous state in the Union in 1970. At that time (Heaven help us!) it is estimated the population will be 21 million people. Past experience has shown that this figure may even be pessimistic. It has been said, and perhaps not in jest, that the West is going to become a pretty great place if the population of New York and Illinois hold out!

The West is not only a very large place, it is a very rich place in natural resources. In standing lumber reserves, in potential hydroelectric power, in agriculture and in minerals, mining and petroleum products, it occupies a dominant position in the national economy. The stable support of a rapidly growing population can only continue to be economically healthy in this area by a consistent increase in its ability to create wealth.

New Wealth

The creation of new wealth is accelerated by the development of new products, new processes and new techniques for effecting the conversion from raw resources to finished products. The source of these processes, products and techniques is research. *Every dollar spent on research and development in the West today can be viewed as insurance that we will attract the new industries of the future.*

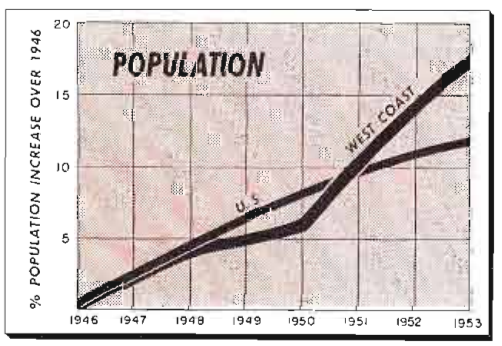
Many of these industries are mobile—that is they can be located anywhere and are not physically restricted to occupying any peculiar geographic location, either because of source of supply or other factors. Some examples are: plastics, scientific instruments, radio equipment, electrical devices, etc. The fact is that many industries could have started in places other than they did. A close examination reveals that in many instances the areas in which industries have grown were fortuitously chosen or came about by accident. Once an industry locates, however, it becomes a part of a vast interwoven fabric which creates an attractive climate for the location of other related industries.

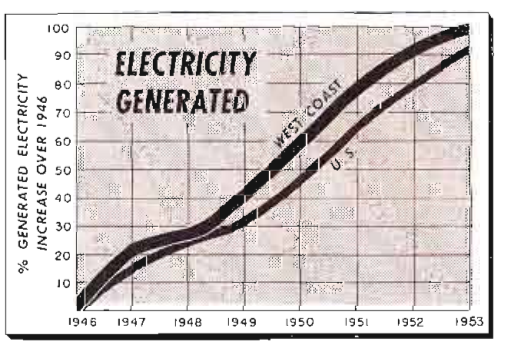
At the basis of the establishment of such industries somewhere is a man, who sees a need and is willing to take a chance. The phenomenal lure of the West for trained people is therefore bound to have its impact on the future of the Western electronic industry. Indeed there was a time when graduates in electrical engineering from Western universities had no choice but to go East to earn a living. This situation has long since changed. The West now utilizes the skills of all it trains and many many more, as we well know. It is this consistent attraction of skilled people which assures the basic success of industry in the West. More specifically, the electronic industry which has sprung from activities in the research laboratory is not only sensitive to the surge of technology; it is leading it. The products of today were the laboratory curiosities of yesterday. Since our future frontiers are scientific rather than geographic, it is important to recognize the scientific vitality developed in this area by the great Western universities. The production centers for the electronic industry all cluster about universities—and this is no accident!

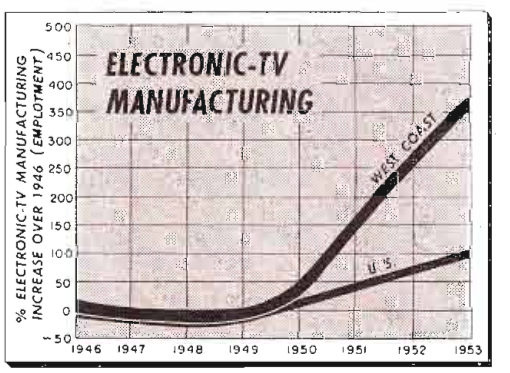
But science is one thing and production capacity and markets are

(*Continued on page* 172)

GROWTH COMPARISON — U.S. and WEST COAST







Statistics compiled by TELE-TECH & ELECTRONIC INDUSTRIES show how population for the three Pacific states has risen from 13,657,000 in 1946 to 16,000,000 in 1953, while U.S. rise has been from 139,893,000 to 158,300,000. Power generated (kw-hrs) rose from 30,501,000 to 60,525,000 for West; 223,178,000 to 428,565,000 for U.S. Estimates for personnel employed in electronic industries in West climbed from 12,000 to 56,000; for U.S. increase for seven years was 220,000 to 530,000. During 1952, four new electronic plants and 16 expansions in Los Angeles area cost $4,627,547. In San Francisco region, 42 new plants costing $3,336,000, and 52 expansions costing $12,491,742 have been made since 1945

Electronic-Acoustical Devices

By JOHN K. HILLIARD,
Chief Engineer
Altec Lansing Corp.
9356 Santa Monica Blvd.
Beverly Hills, Calif.

THE science of acoustics and its application is now occupying a major role in the field of medical electronics. Research and development are already undertaken or seriously being considered in the following fields:

1. Study of the heart and the circulatory diseases.
2. The use of a microphone probe tube to locate deepseated arteries as an aid to neuro-surgery.
3. Shock or blast effects on experimental animals.
4. Improved communication systems and X-rays as an aid to surgery.
5. A study of the impairment of hearing as a result of high industrial noise.
6. Study of impairment of hearing and rise of stress from high noise levels in military operation.

Heart Studies

Electrical stethoscopes using the small condenser microphones make it possible to pick up and amplify heart sounds so that a large group can listen simultaneously, as well as record these sounds on magnetic tape for later evaluation. (Fig. 1.)

The stethoscope attachment consists of a small plastic bell-shaped cup, approximately 1.5 in. in diameter. The small end of the cup is clamped around the microphone and an airtight seal is effected with a rubber gasket. A very small hole is provided in the side of the cup to relieve the suction effect when it is applied to the skin. Fig. 2 is a photograph of the microphone attached to its 157A base, which contains the cathode follower tube. The stethoscope attachment is mounted on the microphone by means of the threads directly below the perforated cap.

The acoustical stethoscope generally used is efficient only at the lower frequencies. The higher frequencies are attenuated by the small rubber coupling tubes and are not audible. The electrical stethoscope is capable of reproducing all of the frequencies within the range of human hearing and thus reproduce sounds not heard in the acoustical stethoscope.

Dr. A. Graybiel, Director of Research, Acoustic Laboratory, U. S. School of Aviation Medicine, Naval Air Station, Pensacola, Florida, suggests an intermediate technique to accustom the physician to the additional sounds transmitted by the electrical stethoscope. The method is to pick up the vibrations electrically and reproduce them over a loudspeaker. This allows the listener to hear the sound directly or through the acoustical stethoscope, which is held within two feet of the loudspeaker.

It is believed that the use of the electrical stethoscope in the operating room will help both the operating surgeon and the anesthetist to monitor the heart continuously during the operation. It appears to be especially valuable to the anesthetist since it his duty to maintain the proper amount of anesthetic, depending upon the patient's response. It notifies him of any change in the condition of the heart.

At the present time there is an acute shortage of nurses and it often becomes necessary for one nurse to attend as many as five patients simultaneously in the recovery room. It is being planned to provide an electrical stethoscope for each patient during recovery period so that a single nurse can continuously monitor their condition and should they move or regain consciousness, it is instantly recognized. Oftentimes the rate of heart beat approaches 300 beats per minute which is difficult or impossible to count, and it appears practical to provide a counter which will continuously indicate the rate on some form of indicating meter.

Fluids in Arteries

Dr. Stacey at Ohio State University is conducting experiments to measure the propagation constant of fluids in arteries. The technique consists of driving the artery by a small loudspeaker system and placing a small condenser microphone at the opposite end to measure the transmission characteristics. Depending upon the size of the artery used, either the entire microphone, which is approximately 0.6 in. in diameter

Fig. 1: Microphone stethoscope attachment

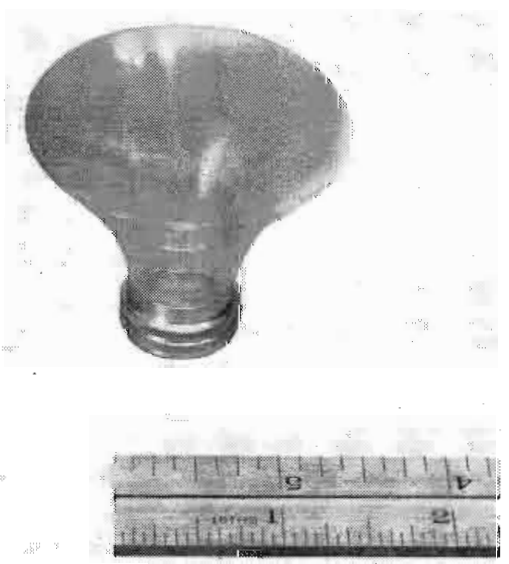
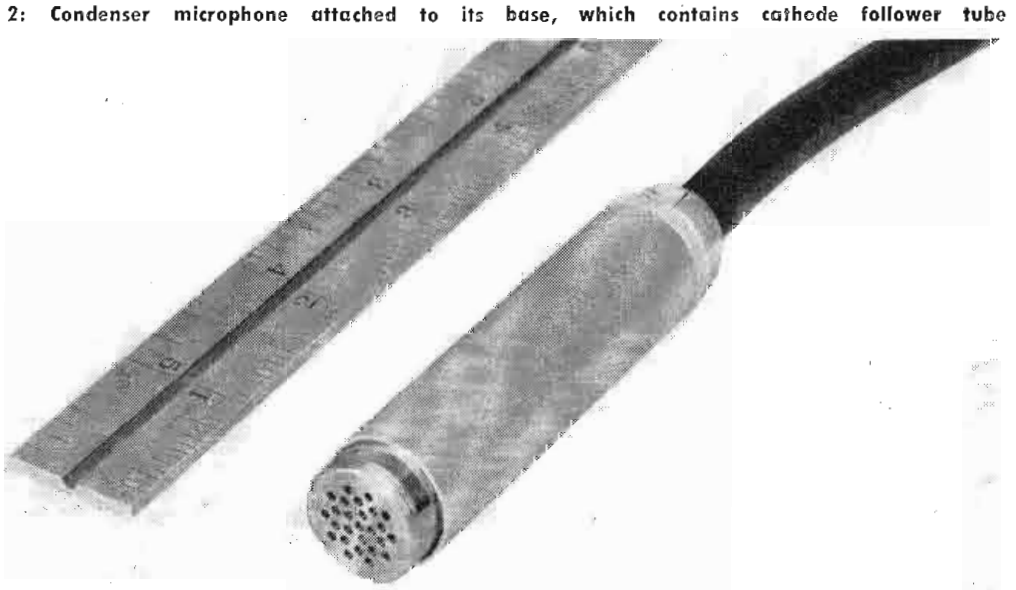


Fig. 2: Condenser microphone attached to its base, which contains cathode follower tube



in Medical Research

New microphone aids facilitate heart studies. Ultrasonic radiations locate tumor cells. Auditory loss in industry and military investigated

or small probe tubes 0.1 in. in diameter are used.

In some phases of neuro-surgery, it is necessary to anesthetize a deepseated artery in the neck. The surgeon often finds it difficult to locate this artery and it has been proposed to use the small probe tube to localize the artery by observing its sound. The probe tube will be equipped with a hypodermic needle in its center and after determining the exact location of the artery, the hypodermic needle can be used to administer the anesthetic.

Research is now in progress at the Acoustic Laboratory at the Massachusetts Institute of Technology on the detection of brain tumors by supersonic methods. The general procedure is to immerse the head in a pan of water and excite the water with ultrasonic radiation. Beams of ultrasonic energy approximately the size of a lead pencil are directed through the head and the area is scanned. It appears that there is less absorption in tumor cells than normal cells. Ultrasonigrams are made so as to have a permanent record of this absorption.

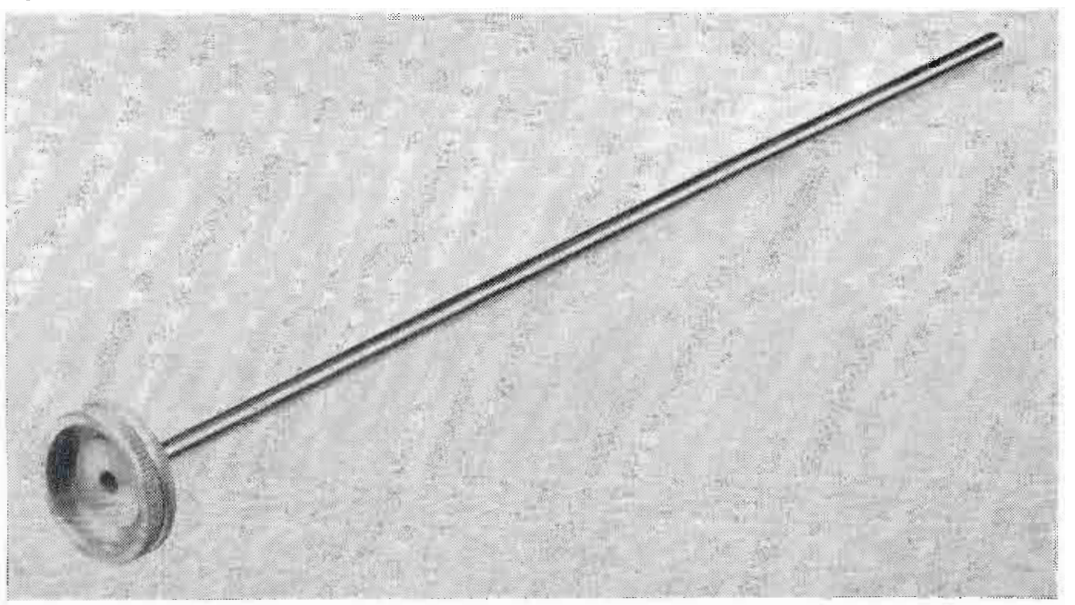
Dr. Benedict Cassen, Atomic Engineering Project, University of California at Los Angeles, has conducted experiments on animals to determine the biological effects of blast or shock waves, ranging from 5 to 30 psi, which is equivalent to 50 pounds of TNT at 10 feet. Live rodents were suspended on a flat metal sheet with their feet outstretched and taped to the sheet. The animals were spaced at the proper distances so as to be subjected to the range of shock indicated above. Two types of shielding were employed. One type protected the thoracic area and the other protected the head. When using shielding only on the thoracic area, the tests indicated that very little protection was afforded. A shield over the head alone was found to give considerable protection from the shock.

Shock Effects on Lungs

Immediately after the exposure, the animals were guillotined and the lungs removed for inspection. In the case where only the thoracic area was shielded, the lungs were found to be highly edematous, hemorrhagic, and enlarged to two or three times their normal size. When the shield was placed around the head, however, this enlargement of the lungs was reduced approximately 30%. This suggests that the central nervous system directly controls the effect of this lung damage.

Other experimentation includes the use of a 1 mm bore probe tube to measure the internal shock pressure in animals. (Fig. 3.)

Fig. 3: Bore probe tube, 1 mm in diameter, for measuring internal shock pressures in animals



In bone surgery metal pins are often deflected when being inserted and it is anticipated that an X-ray-TV link will facilitate the appraisement of these pins. It is proposed to monitor the procedure with X-ray and relay this to the TV chain so that the operating surgeon can view the TV tube in order to determine the exact position of the pin.

Another phase for the use of the X-ray-TV link is in an emergency operation for the removal of foreign elements which have been swallowed. In a typical case of a child who may have swallowed a safety pin, the usual procedure is to place

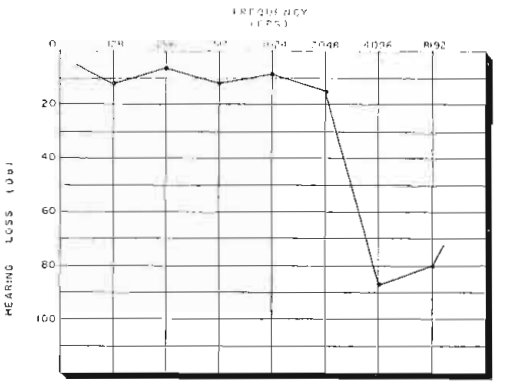


Fig. 4: High noise levels cause hearing loss above 1 KC, with greatest trauma around 4 KC

the child under an anesthetic and take several X-rays. After they are developed and dried, the radiologist goes through the sterilization procedure and advises the operating surgeon in the operating room regarding the position of the foreign object, entailing a delay of approximately fifteen minutes, while the patient is under anesthesia.

It is proposed to have the radiologist remove the wet film from the plate, place it in the TV camera and then have it reproduced beside the operating table in the operating room.

By means of an inter-communicating system, the radiologist can then point out the significant factors regarding the location and removal, while he is still in the X-ray development room.

Hearing Loss in Industry

The loss of hearing to personnel operating and testing equipment in factories today is considered to be a liability which management must evaluate to provide protection for the worker. It is estimated that large sums are now involved in legal action, resulting from claims on loss of hearing. Drop forges, trip hammers, riveting and the testing of jet engines develop sound pressure lev-

(*Continued on page* 142)

Cybernetics for Industry and

By GEOFFREY POST
*Senior Development Engineer**
Servomechanisms, Inc.
El Segundo, Calif.

THE basic concepts of Cybernetics are interlinked with the action of feedback. This notion forms the main analog control element of any control or communication device and can be defined as the control of a unit on the basis of its actual performance rather than its expected performance.

The next concept of importance is that of entropy, a fundamental of current thought in thermodynamics, whose statistical definition is a measure of information in the information theory of Weiner and Shannon. This entity is linked with the main digital control elements of a communication and control system.

A third fundamental idea is that of teleology, the philosophy of which differentiates between devices which are controlled with feedback and without feedback. This essentially is the difference between closed loop and open loop servomechanisms, though much more fundamental in its generalization. The teleological mechanism is described as a controller which is purposeful and employs feedback in the negative sense, the soul of firm control. A further differentiation is sometimes employed when describing teleological devices, and that is classification as to goal, a unifying element between analog and digital systems. The goal is defined by its dynamics.

A normal servo system which uses an error signal to maintain a desired state whether it be temperature, speed or voltage, depending on its command signal, has a stationary goal decided by its input. That is, for any given period a certain state is to be maintained which is relatively constant and static. This fixed goal servo can be called a teleostatic servo system. On the other hand, a logical digital computer will make a multitude of decisions in respect to varied inputs. This moving goal gives it the name of teleodynamic servo system and intuitively implies more generality since in the special case, a static goal can be achieved.

TABLE I: TELEOSTATIC ANALOGIES

NON-HUMAN SYSTEMS	HUMAN SYSTEMS
1. a sensing device to indicate deviation from static goal	1. a sense organ; proprio-, intero-, and extero-ceptive
2. an amplifier	2. summation of subliminal impulses to reach threshold level in the central nervous system.
3. central controller to set goals	3. affective tone in the cells of the central nervous system
4. power actuator elements	4. muscles and glands
5. damping elements	5. physiological inhibition
6. frequency selective networks	6. inhibition and facilitation due to filter properties
7. relaxation oscillator	7. heart hydro-mechanical action
8. oscillator	8. physiological nervous disorder

TABLE II: TELEODYNAMIC ANALOGIES

NON-HUMAN SYSTEMS	HUMAN SYSTEMS
1. storage elements and predictive filters	1. memory and reflex
2. synchronization	2. temporal organization of responses
3. relays and gates of logical circuitry	3. neuron structural organization
4. computer programming	4. purposes, goals and ideas
5. scanning circuitry	5. visual cortex, memory scan
6. circuit disorders	6. functional psychoses

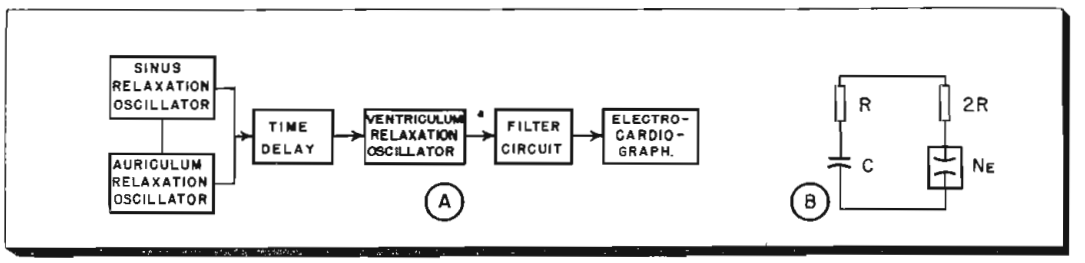


Fig. 1: Diagram of heart simulator. Output read on electrocardiograph is similar to human heart

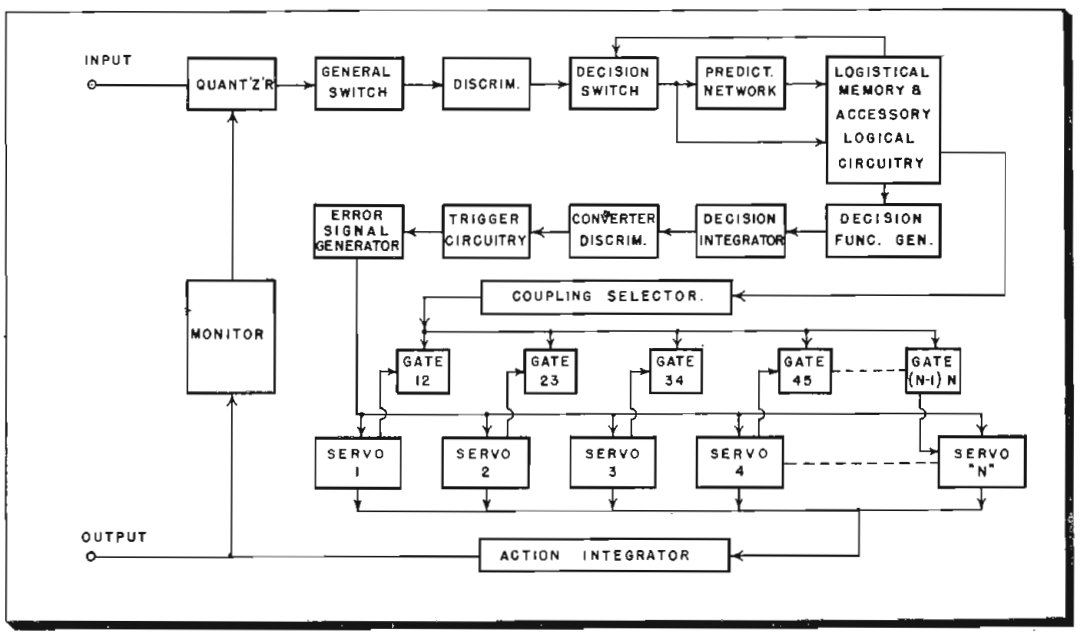


Fig. 2: Block diagram of a production synthesizer or automatic factory without power supply

Combination of Systems

The combination of teleodynamic and teleostatic systems form a union of logical decision and physical regulation which can perform any number of desired functions approaching the human communication and control system in its gamut of behavior, exceeding the human in speed of operation but not in com-

*Mr. Post is also Research Director of General Cybernetics Assoc., P. O. Box 987, Beverly Hills, Calif.

Military Applications

Applied methods show promise for early fulfillment in automatic factories, fire control, nuclear power generation and medical research. Analogies between human and non-human systems aid understanding

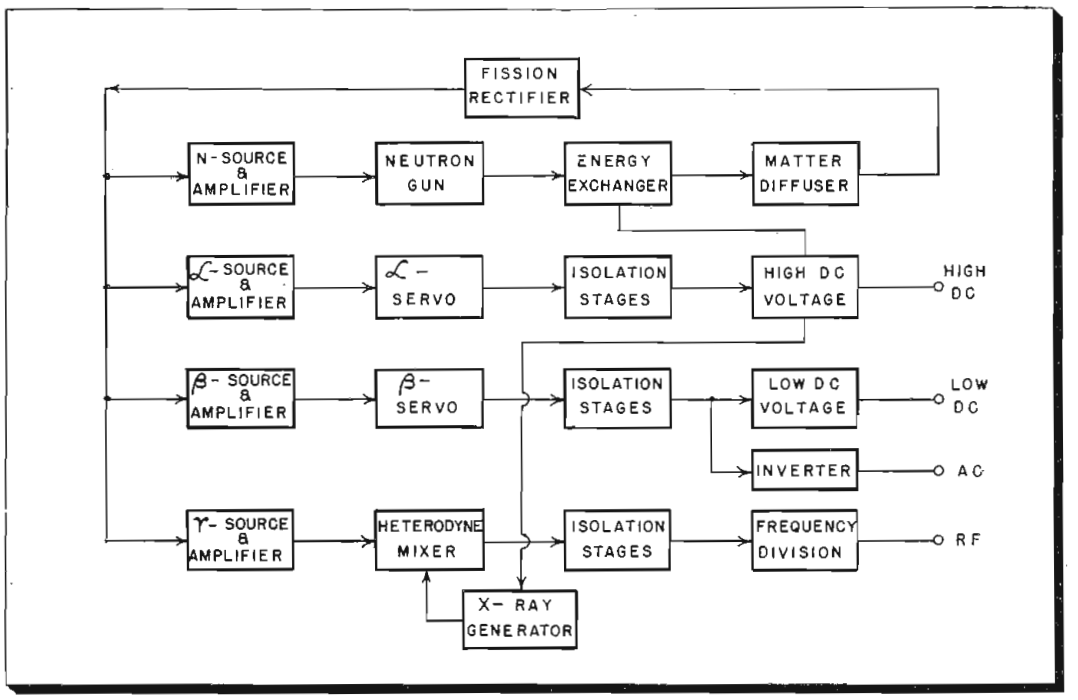


Fig. 3: Nuclear type power supply system for use with automatic factory shown in Fig. 2

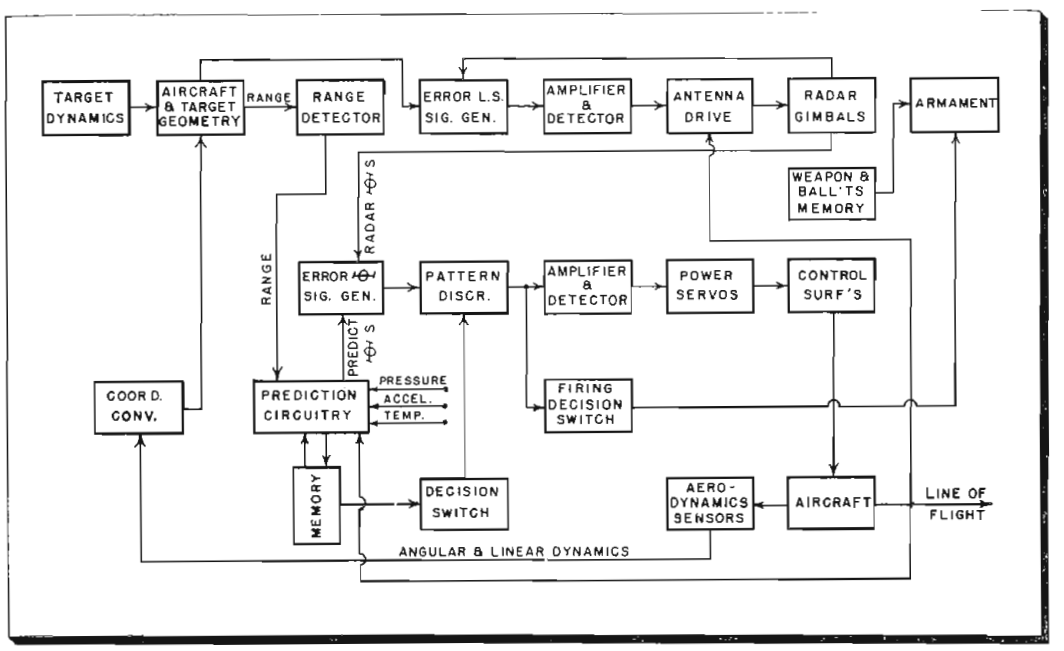


Fig. 4: Inner loop of automatic fire control system without automatic range tracking

plexity of coupling or circuitry.

The manner of application of cybernetics is simply the resolution of the problem in terms of the quantities of control and communication, ferreting out wherever possible all the desired goals, possible inputs, noise, disturbances and information storage needed. One can develop from the knowledge accumulated a generalized transfer function whose equivalent physical design will represent the maximum desired performance and behavior of your system. This implies that the design of an automatic control system for aircraft which will perform in its most efficient sense must include in the control loops every dynamic element aboard and related intercoupling in such a manner to produce continuous coordination.

As the complexity of these feedback systems increases, there unfolds the new problem of disorders which exhibit both "physiological" and "psychological" natures. This portends of great difficulty of analysis without extensive study. A "physiological" disorder in a non-human system is the failure or rupture of an element and in general is not troublesome of diagnosis. However, the radiation and induction from closely coupled dynamic loops whose frequencies of operation can produce instability manifestations which can show physical harm yet defy proper analysis or substance until the notion of feed-problem of psychological disorder is already extant in the digital computer field though still evoking more amusement than understanding. It is an omen of the future that even machines can be neurotic.

Medicine and Psychology

Of all the fields of human endeavor, the field that we know or understand the least, most paradoxically, is that of human medicine and psychology. Here is involved an abundance of teleodynamic and teleostatic automata and it is here that Norbert Weiner chose to begin some of his work in the field he was to name Cybernetics.

Mechanistic theories of medicine have existed from earliest recorded history and had no real integration or substance until the notion of feed back arrived. Disorders are related quantitatively as well as qualitatively to the diseases of the teleostatic and teleodynamic systems involved. This has led to the idea of a "diagnostic cumputer" which is currently under design. Some of the analogies being used are presented in Table I and Table II.

Some of the assumptions made in the use of the analogies to human systems are the following:

(1) The operation of the life processes proceeds under control of masses of feedback mechanisms whose central control elements are guided by decisions of a computer assembly in the brain whose program in turn is a group of purposes, goals and ideas.

(2) These purposes are multi-element arrays which are derived by the computer on the basis of past experience, heredity, environment and phys-

(*Continued on page* 132)

A 50-Watt FM

High powered cw tube, operating in conjunction with mechanical tuning system, tunes continuously through 1990-2110 MC range and is the heart of new TV microwave relay system. Transmitter is FM'd with "halo" cathode emission

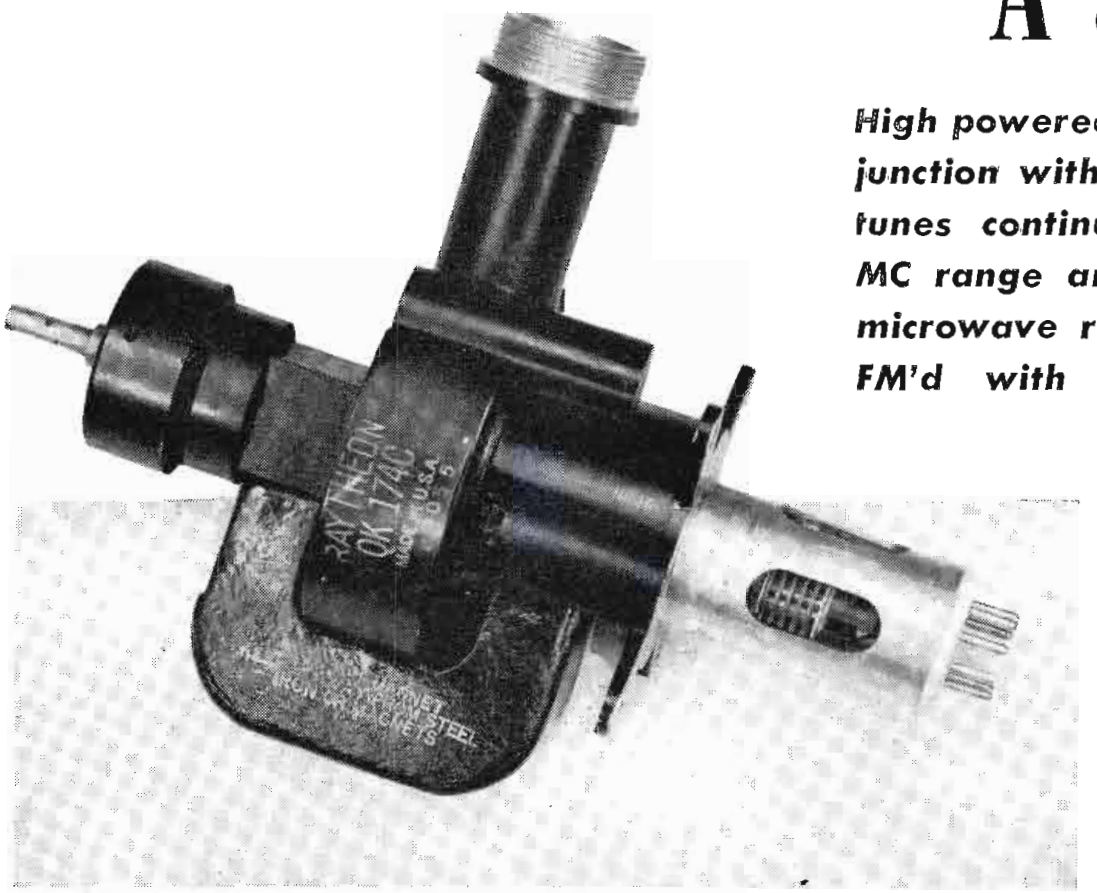


Fig. 1: QK-174C magnetron oscillator delivers at least 50 watts to 52-ohm coax output

By DAVID P. KENNEDY
Raytheon Mfg. Co., Waltham 54, Mass.

THE QK-174C magnetron oscillator is a high powered C-W tube capable of delivering a minimum of 50 watts of r-f power to a 52-ohm coaxial output cable. (See Fig. 1.) Unlike the radar magnetron, it is frequency modulated by the use of a modulating element called a halo cathode. The magnetic field required for the operation of this oscillator is obtained from a permanent magnet which is an integral part of the tube. Air cooling was used in the design of this tube in preference to water cooling, which is used in many of the high powered microwave oscillators. By the addition of cooling fins to the external surface of the anode, adequate cooling is obtained from blower systems of modest capacity. Operation in any of the TV relay channels between 1990-2110 MC has been made possible by incorporating a mechanical tuning system capable of providing continuous tuning throughout this band.

The magnetron anode, Fig. 2(a), consists of 12 vanes mounted on the inner surface of a copper ring to form 12 resonant cavities. Two circular straps at the center of the anode connect alternate vanes in a manner which is electrically equivalent to connecting 12 resonant circuits in parallel. An indirectly heated cylindrical cathode is mounted concentrically through the anode in a plane which is parallel to the magnetic flux lines. The anode being at a high positive potential with respect to the cathode will exert a force on the cathode emission which is perpendicular to the magnetic flux, causing the electrons to follow a path resulting from the two forces.

The electron trajectory pattern, Fig. 2(b), indicates that there is a bunching of the electrons in their flight between the cathode and the anode due to the high r-f potentials that exist between the vanes of the resonant cavities. The geometrical pattern formed by the electrons resemble the spokes of a wheel rotating at a speed proportional to the frequency of oscillation.

The operating frequency of the magnetron oscillator is primarily established by the physical dimensions of the anode resonant cavities. A metallic object placed near these cavities will, in effect, alter the dimensions causing a change in the frequency of oscillation. In practice, a tuning ring placed at one end of the anode is attached to a driving mechanism to change its position with respect to the vanes, thus providing continuous tuning of the oscillation frequency.

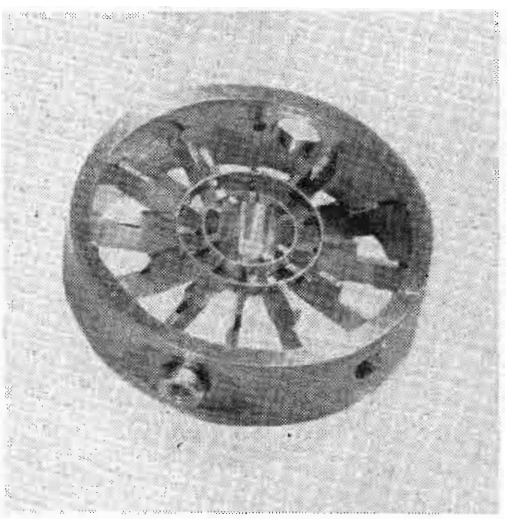


Fig. 2: (a) Magnetron anode has 12 resonant cavities formed by vanes mounted on copper ring

Electron Cloud

Frequency modulation of this oscillator is accomplished by propogating an electron cloud through the resonant cavities. Electrons within the inner cavity space will change the dielectric constant between the vanes, resulting in a change of the resonant frequency in proportion to the cloud density. A disc shaped cathode, called the "halo cathode," is used as a source of frequency modulating electrons. The halo emission, being parallel to the magnetic field, will be forced to travel between the vanes terminating in the tuning

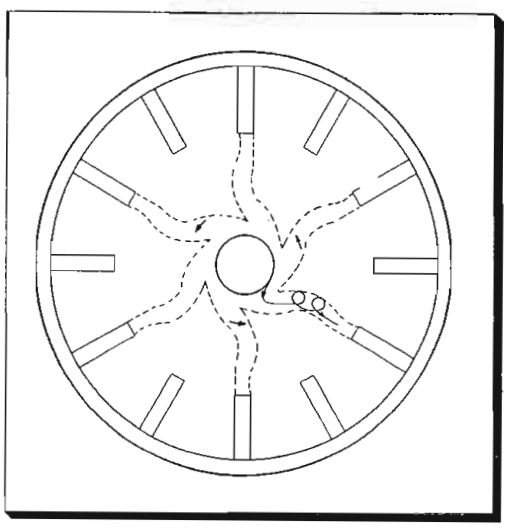


Fig. 2: (b) Electron trajectory pattern shows bunching caused by vanes' high r-f potentials

Magnetron for Relay Service

mechanism area. Modulation of the oscillation frequency is obtained by modulating the halo to anode potential which will introduce a change in the cathode emission density.

The r-f power generated within the anode is coupled to a 52-ohm coaxial line by the use of a coupling loop inserted into one of the cavities.

From this brief description of the operation of a magnetron oscillator it can be seen that the two predominant factors influencing the oscillation frequency are the physical dimensions of, and the electron densities within the anode. Thermal expansion of the copper components used in the construction of this anode block is the principal source of unwanted changes in the anode dimensions. A thermostat attached to the external body of the magnetron can be used to switch the blower motor, giving adequate control over the anode temperature to reduce frequency instability due to thermal expansion to a satisfactory value. A holder has been provided on the anode body for the insertion of a thermostat for this purpose.

The second factor which can introduce frequency instability is variations in the electron densities within the anode. This could be a result of changes in the line voltages supplying the heaters or anode voltages for the oscillator. To eliminate this possibility the high voltages for the magnetron are supplied through a series pentode which offers a high dynamic resistance to the load. In this manner, with adequate feedback, the power supply will be high impedance or constant current source for the magnetron oscillator and, at the same time, operate as a current regulator for variations in line voltages. Using the above precautions, unwanted variations in the oscillation frequency can be reduced to less than ±1 MC.

Volt-Ampere Characteristic

A factor that must be considered in the application of this magnetron to a microwave communication system can be seen in its volt-ampere characteristic, Fig. 3. This curve represents a plot of the voltage that will be found across the magnetron when a given current is applied. The slope of this curve represents the dynamic resistance that the magnetron will present to the power supply during operation. Since this curve has a negative slope in the low current region, precautions must be taken to insure that oscillations do not take place between the high voltage power supply and its magnetron load.

If a horizontal line is drawn across Fig. 3, through the negative resistance region, the points of intersection represent the currents that can be drawn by the magnetron. In this case there are three points of intersection which are the positions where the magnetron can be operated. This implies that the magnetron loading a constant voltage or low impedance power supply may be unstable. If a vertical line is drawn on Fig. 3 representing the current supplied by a constant current or high impedance power supply, there will be only one intersection with the volt-ampere curve, showing that the system is completely stable. In practice, a high voltage power supply having an impedance of 2500 ohms or greater, has been found satisfactory for operation of this magnetron oscillator.

TV Relay System

The television relay system, designed in conjunction with the QK-174C magnetron, has been designated the RTR-1C, Fig. 5, 6. The transmitter, making use of the magnetron oscillator, is capable of transmitting television signals over greater distances than has been possible in the past with commercially available microwave communication equipment.

The block diagram of Fig. 7a, indicates the basic components of the RTR-1C transmitter. The QK-174C magnetron oscillator obtains its power from a high voltage constant current power supply of the type

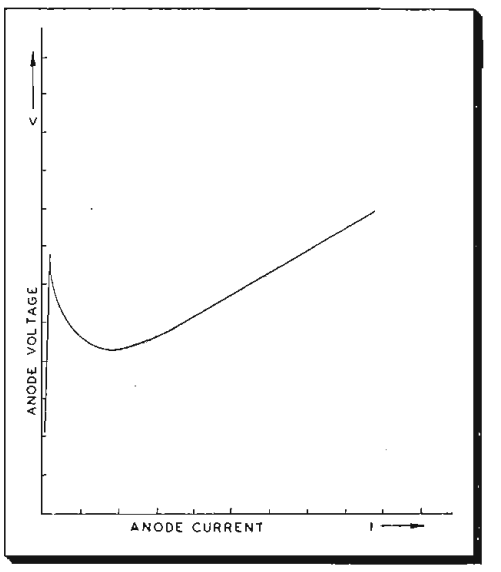


Fig. 3: Magnetron volt-ampere characteristic

shown in Fig. 4. This circuit is capable of delivering to the magnetron a current of 150 ma. at a potential of approximately 1800 v. Modulation of the halo cathode is accomplished by placing a type 4D32 pentode in series with this frequency modulating element. This pentode, having a high dynamic plate resistance, will maintain a constant halo current for variations in the magnetron, while changes in the line voltage are corrected by operating this circuit from a voltage regulated power supply. The video signal is supplied to the halo cathode through the grid of this 4D32 modulator stage. The video circuit used to drive the modulator is capable of amplifying a 0.5 v. input signal to a level of 30 v. which is required for full modulation of the magnetron. The video bandwidth of this amplifier is in excess of 6 MC resulting in a high resolution picture having a low amount of overshoot.

In the RTR-1C transmitter, Fig. 5, the magnetron, located on the second panel from the top, is mounted in an air duct which directs the blower output across the cooling fins.

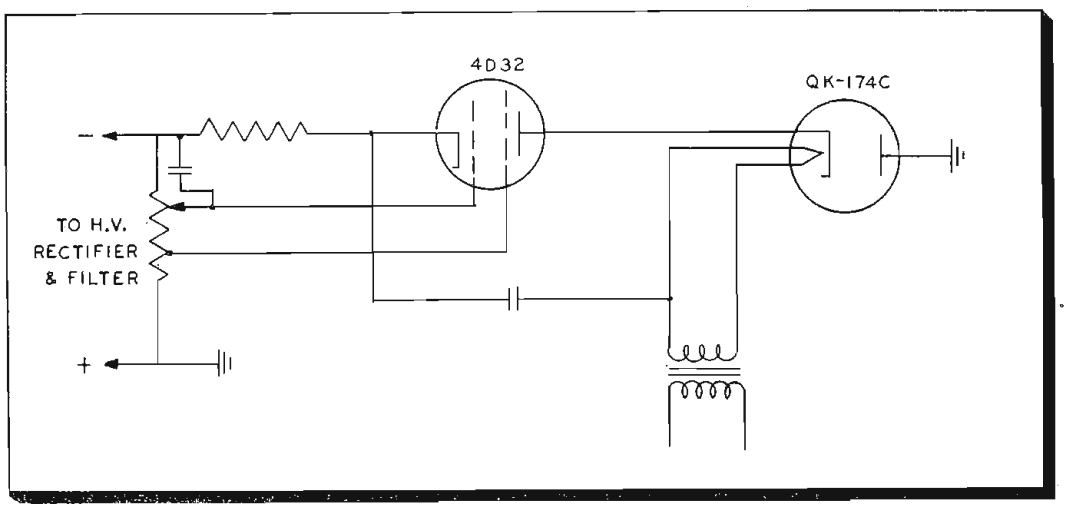


Fig. 4: High impedance power supply for QK-174C employs feedback resistance in cathode circuit

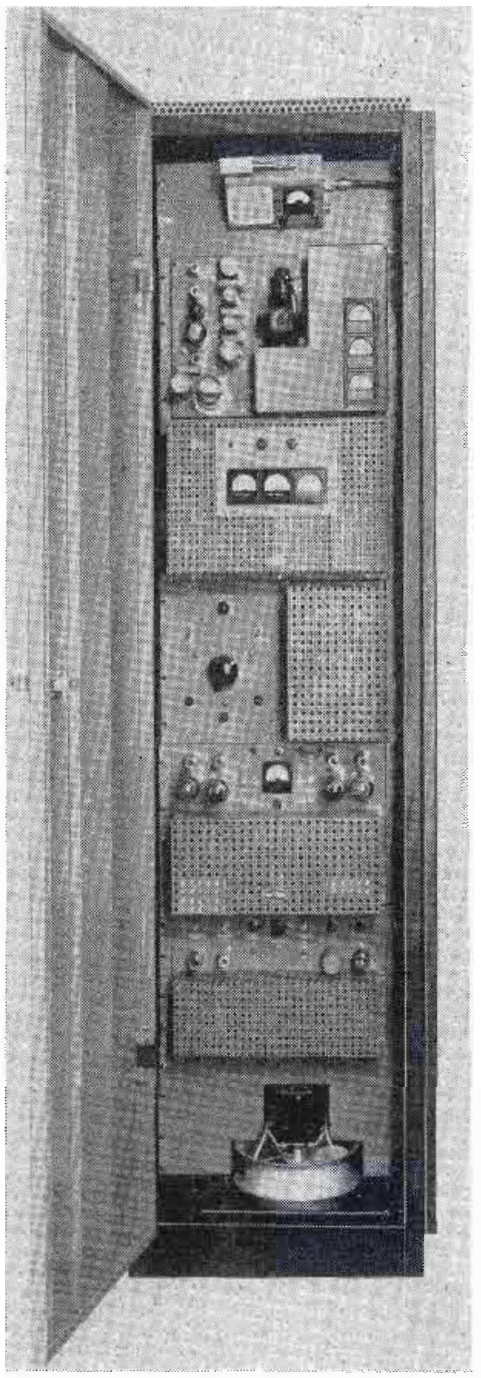


Fig. 5: In RTR-1C transmitter, magnetron is on second panel from top, video amp adjacent

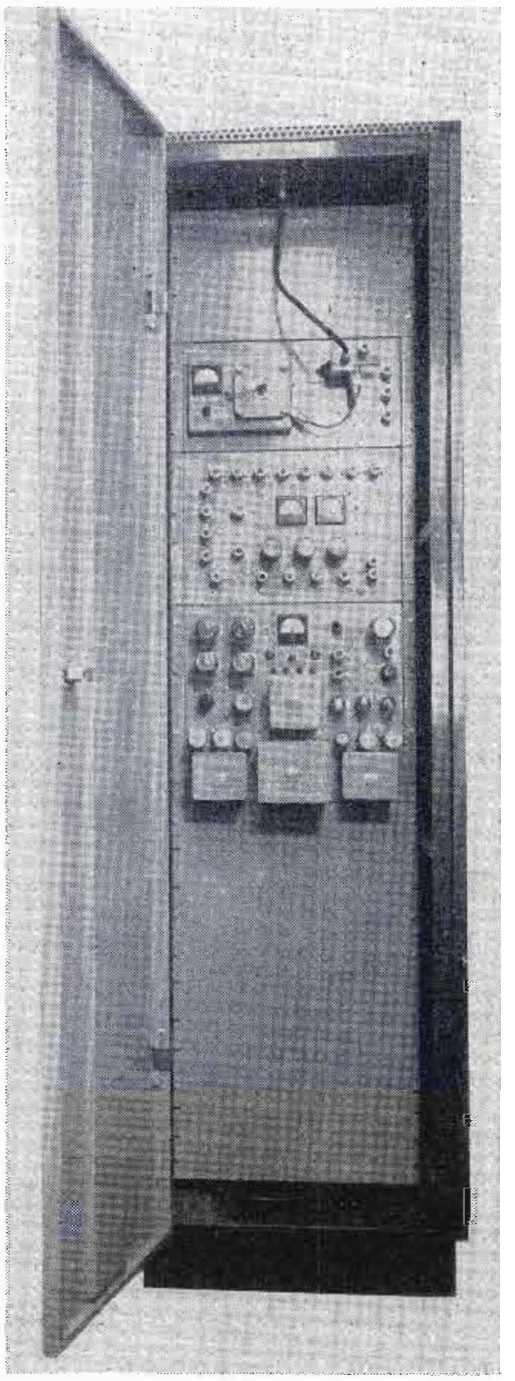


Fig. 6: In RTR-1C receiver, oscillator, 1st i-f and mixer are at top, video amp at center

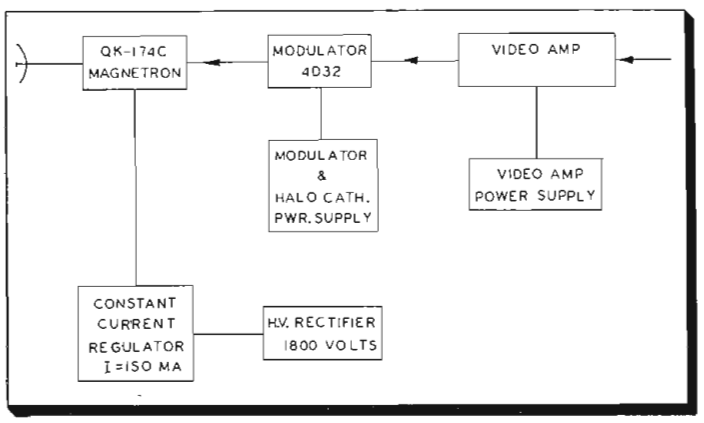
The video amplifier and modulator, mounted on a subassembly, are found adjacent to the magnetron eliminating the necessity of long video cables within the transmitter. The high voltage power supply current regulator and filter circuits are located in the assembly immediately below the magnetron panel.

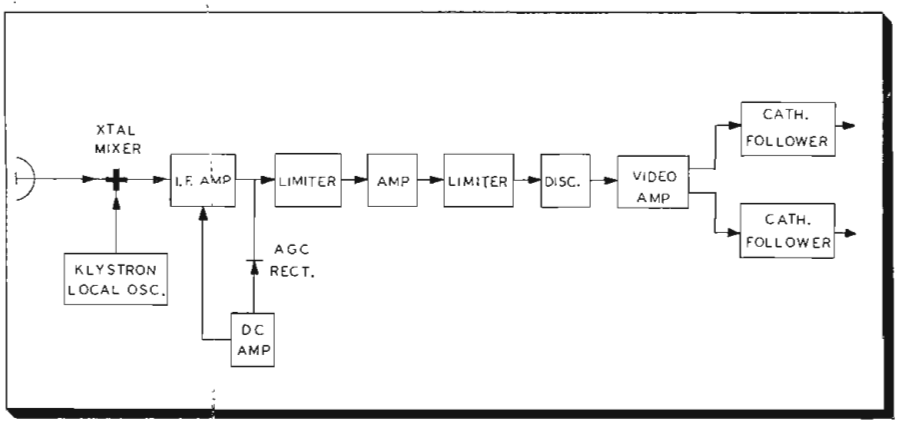
A low capacity feed is used between this power supply and the magnetron to insure stability when a negative resistance is present. The high voltage rectifier, located in the fourth assembly from the top, is capable of delivering 2200 v. to the regulator and filter panel. The primary control circuits such as overload relays, primary switching and high voltage variac are located in this assembly. Beneath the high voltage rectifier is a voltage regulated power supply for the video amplifiers and modulator. The upper transmitter panel, Fig. 5, contains a calibrated cavity wavemeter for adjustment of the magnetron center frequency.

FM Receiver

The wide band frequency modulation receiver used in this television relay system, Fig. 6 and Fig. 7b, makes use of the 2K28 reflex klystron for a local oscillator. The crystal mixer output is used to drive a wide band i-f amplifier having a low noise cascode input stage. This i-f amplifier has a passband of the overcoupled type with a bandwidth of 17 MC between peaks, and a peak to valley ratio of approximately 1.5 db. The limiters used in this receiver are of the plate limiting variety and have been found to be capable of a high degree of AM rejection when the modulating frequency exceeds 8 MC. At the input to the first limiter crystal diode is used to develop a dc proportional to the carrier level. This dc level is amplified and used as an automatic gain control biasing voltage for the receiver. In this way, the carrier input level may be kept at an optimum value at the first limiter grid. A change in the carrier level between 70 and 50,000 μv. to the input of the i-f amplifier will result in a level change from 1 to 2 volts at the first limiter grid. The automatic gain control circuit will insure that an adequate degree of limiting is available during fades, or over a wide variety of propogation paths without the need of a manual adjustment. The limiters are followed by a wide band FM discriminator and video amplifier. The video output of this receiver is available at two coaxial terminations providing a program feed and a local monitoring line at the same time.

Fig. 7: (a) Block diagram of relay transmitter using QK-174C magnetron. (b) Receiver in RTR-1C system employs 2K28 reflex klystron oscillator





Reactance Chart Calculations

New modifications bring reactance chart up-to-date for radio-TV-electronic industries; permit rapid solution to at least 15 interdependent equations.

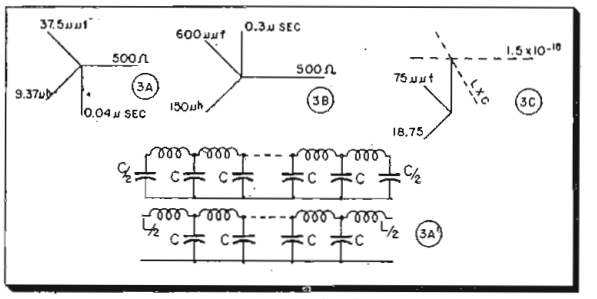


Diagram for Example 3

By CHESTER W. YOUNG
Sr. Research Engineer
Consolidated Vultee Aircraft Corp.
San Diego 12, Calif.

ALTHOUGH the reactance chart has been used for so many years that is is almost as common as graph paper, there are some new modifications which bring it up to date for the radar-TV-electronic industry. There are at least 15 interdependent equations which can be solved with the accompanying chart to save many many hours of tedious calculations. The dependent variables to be determined are as follows:

1. Inductive Reactance
2. Capacitive Reactance
3. Resonant Frequency
4. Bandwidth of a Tuned Circuit
5. Load Resistor for a Parallel Circuit of Given Q
6. Circuit Q
7. Shielding Skin Depth Penetration
8. Circuit Time Constant
9. Video Low Frequency Cut-off
10. Video High Frequency Cut-off
11. Pulse Rise Time Through a Video Circuit
12. Delay Line Characteristic Impedance
13. Total Delay in Delay Line
14. Number of Delay Line Sections
15. Velocity of Propagation Through Delay Line

Example No. 1

Determine the characteristics of a parallel tuned circuit as shown:

L=100 μh
C=2.54 μμf (pf)
R=62,800 ohms (Fig. 1)

A. Find the intersection of L=100 μh and C=2.54 pf.

This occurs at f=10 MC vertically and X=6280 ohms horizontally.

The following equations have thus been solved:

$X_L=2\pi fL$
$X_C=1/(2\pi fC)$
$f=1/(2\pi\sqrt{LC})$ (Fig. 1A)

B. Find the intersection of C=2.54 pf and R=62,800 ohms.

This occurs at f=1 MC vertically.

The following equations have been solved: (Fig. 1B & 1B¹)

$\Delta f=1/(2\pi RC)$
$Q=f/\Delta f=R/X_L=R/X_C$
$R=QX_L=QX_C$

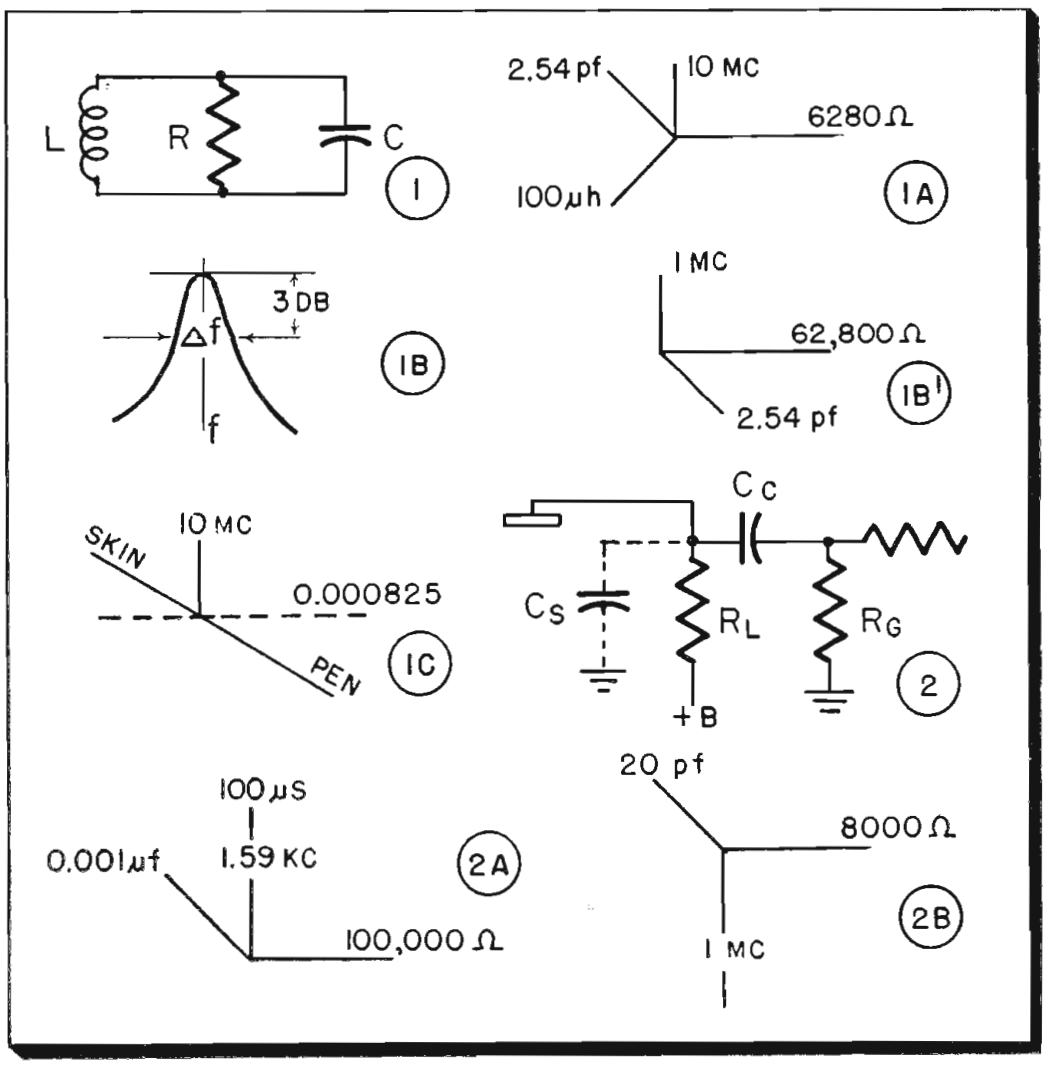
C. Find the intersection of f=10 MC and the Skin Penetration lines. This occurs at 0.000825 in.

This solves the equation:

$d=2.61/\sqrt{f}$

At the depth of 0.000825 in. the density has dropped to 37% of the surface density. (Fig. 1C)

Diagrams for Examples 1 and 2



Example No. 2

Determine the frequency characteristics of a video amplifier as shown:

R_g=100,000 ohms
C_c=0.001 μf
R_L=8,000 ohms
C_S=20 μμf (pf) (Fig. 2)

A. Find the intersection of R_g= 100 k and C_c=0.001 μfd.

This occurs at 1.59 KC and 100 μsec vertically (upward).

The following equations have been solved:

$f_L=1/(2\pi R_g C_c)$
T.C.=RC (Fig. 2A)

B. Find the intersection of R_L= 8,000 ohms and C_s=20 pf.

This occurs at 1 MC and 0.35 μs vertically (downward.)

The following equations have been solved: (see footnotes)

$f_H=1/(2\pi R_L C_s)$
$R.T.=0.35/f_H$

Example No. 3

Determine the parameter values of a delay line having the following characteristics:

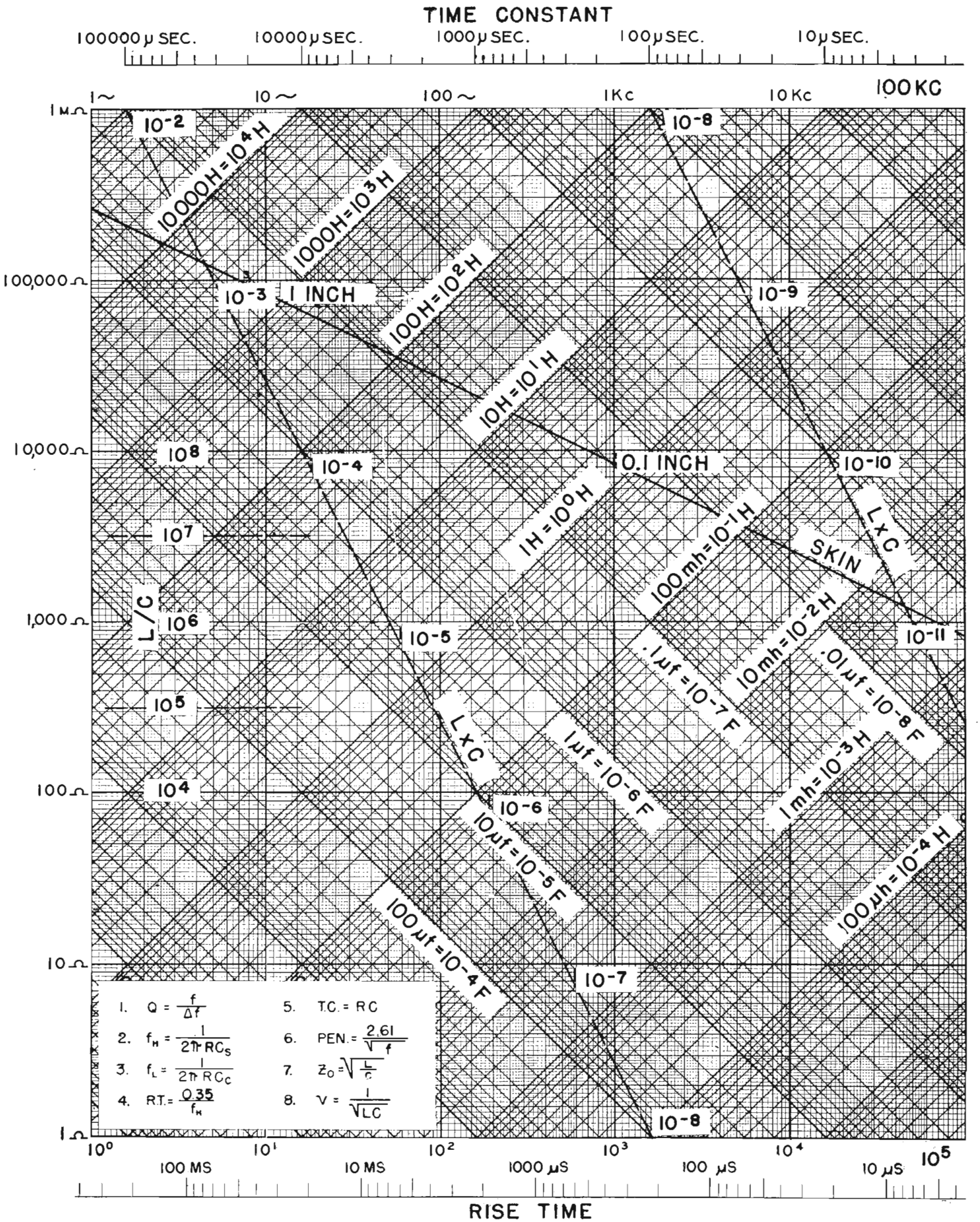
Z_0=500 ohms

(*Continued on page* 176)

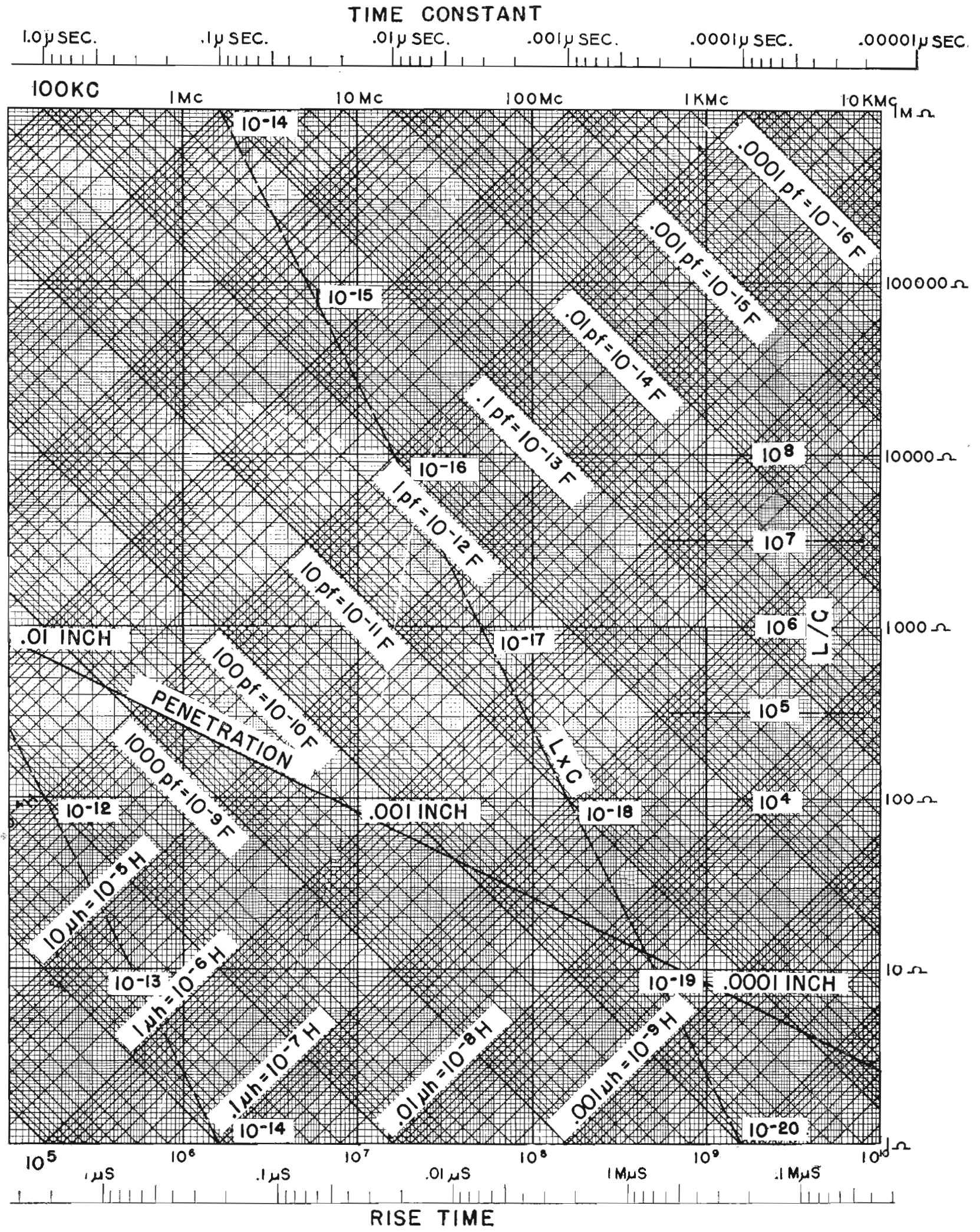
SEE CHART on FOLLOWING PAGE

SEE TEXT
on PRECEDING PAGE

Modern Reactance Chart enables rapid de-
circuit bandwidth; circuit Q; tuned circuit
pulse rise time; delay line characterestic im-



termination of: inductive & capacitive reactance; resonant frequencies; tuned load; skin effect; circuit time constant; low and high frequency video cut-off; pedance; delay in delay line; number delay sections; propagation velocity.



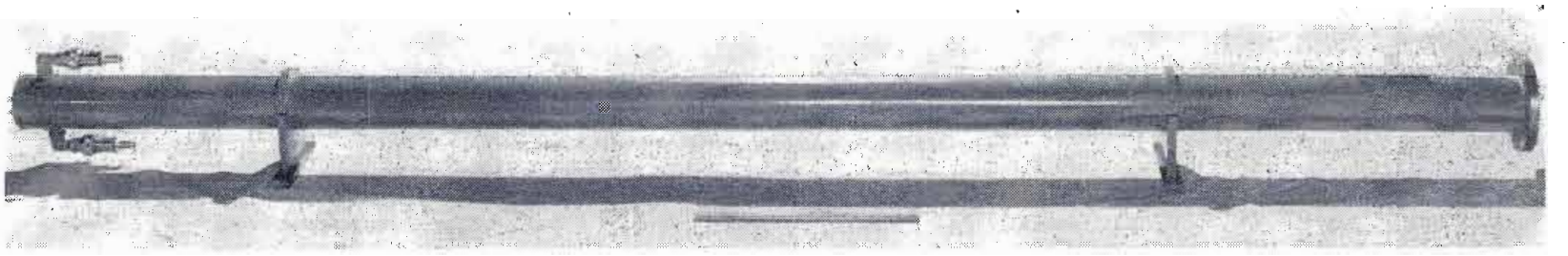


Fig. 1: Overall view of new UHF water load. Body diameter is 3-1/8 in. and length is 7 ft. Unit weighs 35 lbs.

High-Power UHF Water Load

Accurate power measurements to 15KW in the 470-1200 MC range made feasible by new low-VSWR dummy load having rapid response

By BRUCE E. NELSON
Development Engineer, Varian Associates, Palo Alto, Calif.

DURING the course of development of the 15-kw Varian klystron amplifier for UHF TV which was announced last year,[1] testing problems arose requiring a dummy load capable of absorbing and measuring this amount of r-f power. Since no suitable device was commercially available, a special unit was developed. A water dissipative load was considered the only practical approach to the problem and the resulting device was produced along these lines. It is illustrated in Fig. 1, and a disassembled view with the various coaxial elements is displayed in Fig. 2. Overall body diameter of the load is 3-1/8 in. Length is 7 feet, and weight, 35 lbs. The voltage standing wave ratio over the frequency band 470 to 1200 MC is less than 1.15, while calibration accuracy is better than 2% for power levels from 1 to 15 kw.

Computing R-F Power

In loads of this kind, r-f power is converted to heat and the heat raises the temperature of a liquid, usually water, which is circulated through the load. Measurement of the rate of liquid flow and temperature rise gives data from which the r-f power is easily computed. The generally accepted formula is:

$P = 0.264\ F\ (t_2 - t_1)$, where

P = power in kilowatts
F = water flow in gallons per minute
t_2 = temperature of exit water in degrees C
t_1 = temperature of inlet water in degrees C

and the constant (0.264) includes the specific heat of water. Typical values for 15 kw might be 3 gal./min. flow with a temperature rise of 19° C.

In addition to high power-absorbing ability, several other features were desired. First, the load was required to be well-matched to the line over the entire frequency band (470-890 MC) so that all the power delivered to the load would be absorbed, and a negligible amount reflected back towards the klystron. Although it is theoretically possible to use an impedance transformer to match the load to the line, such devices are frequency sensitive and so would have to be adjusted for each frequency region. Furthermore, even when carefully built in coaxial line, they are somewhat lossy and become very hot at these power levels.

Second, good water-load design requires that the water system be thermally well insulated from its environment. A perfect water load would be so designed that all r-f energy is turned into heat in the water, and none of this heat is lost to the atmosphere before the exit water temperature is measured. Furthermore the thermal insulation should be such that the incoming water absorbs no heat from the atmosphere after its temperature is measured.

And third, the response of the exit water temperature to changes in r-f power level should be rapid. This is insured in this load by using a high rate of water flow in contact junction with a small volume of water contained in the load itself.

Fig. 3 gives a schematic view of the water load as it finally was developed. All parts shown have circular symmetry. The unit mates directly with the standard 3-1/8 in. diameter 50-ohm coaxial line used in UHF TV installations. In Fig. 3, this line is shown with (1) being the outer conductor and (2) the center conductor. The center conductor is tapered from its initial diameter of 1.314 in. to a small-diameter rod (3). Two plastic cylinders surround the tapered center conductor. The outer plastic cylinder (4) is fixed onto the center conductor at (5) to make a water-tight seal and is supported coaxially with the outer conductor. A plastic head (6), screwed onto the right end of the load, contains the water fittings and the thermometers for measuring temperature of inlet and exit water, not detailed here.

The direction of water flow is shown by the arrows. The inlet water comes from the right; it flows between the inner (7) and outer (4) plastic cylinders. Outgoing water flows towards the right, between plastic cylinder (7) and the rod (3), and out of the load.

Lossy Material

Almost all water loads previously developed for use in this frequency range had employed some lossy material, such as a graphite coating on the center conductor, to absorb the r-f power and convert it into heat. The heat was then transferred to the water where it could be measured. All such loads suffered breakdown under high power for one of two reasons: either the lossy material itself underwent a chemical or mechanical change under very high powers, or the local heating became so great that the water literally exploded into steam.

Therefore it was decided to use only low-loss materials in the Varian load, and rely completely on

the dielectric losses of water itself to absorb the power. It was realized that this would make the load rather long physically because water, unfortunately, is not as lossy at these frequencies as it is at the higher microwave frequencies. Also the total loss obtainable in a given length of water column is a direct function of the number of wavelengths contained in that length. Since the wavelengths involved in the UHF region are relatively quite long (for microwaves), it was obvious that the physical length would be large, though in actual practice the load is about 7 ft. long overall, which is not excessive.

In selecting the low-loss plastic to use, such factors as dielectric constant, machinability, coefficient of expansion, etc. had to be considered as well as low electrical loss. In the final design the outer plastic cylinder (4) is made from Teflon, although Textolite and polystyrene are also usable. Polyethylene is used for the inner cylinder (7) while polystyrene is used for the head (6).

Two Transmission Lines

The load can be considered electrically to be two transmission lines in parallel. One line includes the water-filled region inside the Teflon cylinder (4) while the other line includes the air-filled region outside this cylinder. Attenuation, for all practical purposes, occurs only in the water-filled region. In order to maintain the boundary conditions there must be a continual flow of power from the air-filled to the water-filled region to replace the power dissipated in the water as the wave travels down the load. By reducing the center conductor diameter to a small rod it is possible to get a large percentage of power into the water-filled region. This is helpful in increasing the losses in a given length of load. However, the small center conductor increases the characteristic impedance of the coaxial line from 50 ohms to several hundred ohms. The tapered length of center conductor (2) serves as a matching section between these impedances so that the load will be matched to the 50-ohm coaxial feed line.

The small center conductor stops short of the right end of the load, presenting a large impedance discontinuity. The power which reaches this discontinuity does not propagate to the end of the load (because the outer conductor acts as a waveguide-below-cutoff attenuator), but is reflected back to-

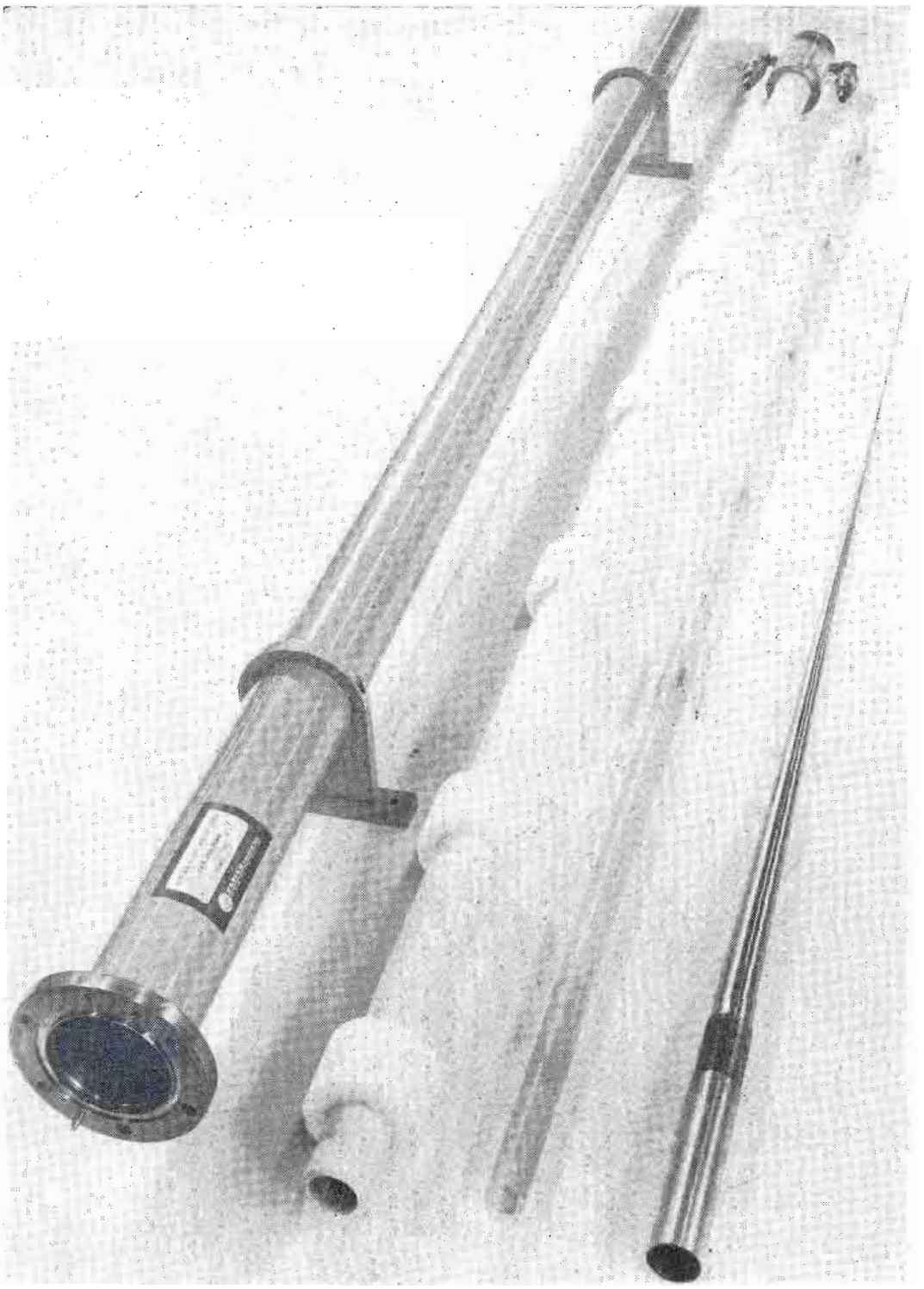
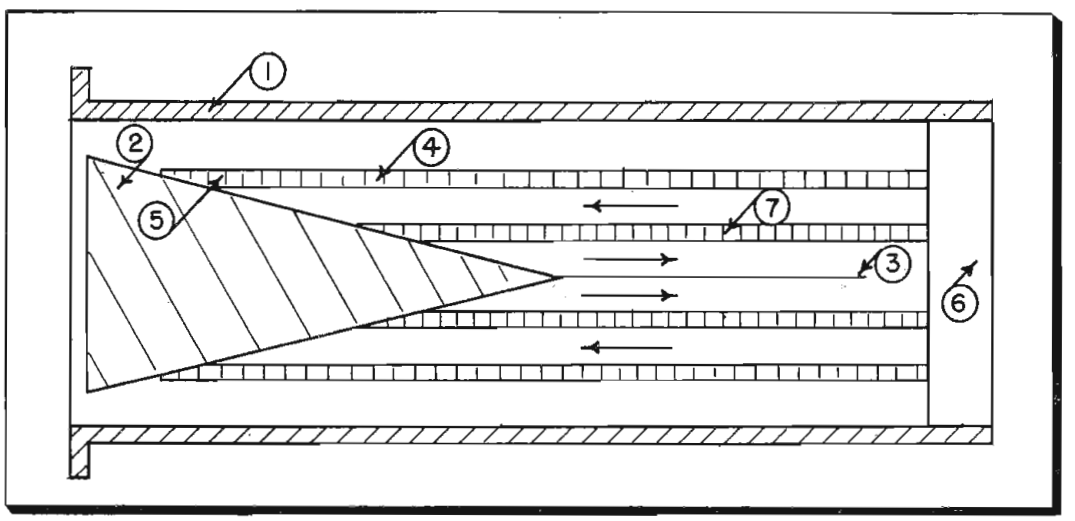


Fig. 2: Disassembled view of water load with the various coaxial elements displayed

wards the input end. However, it is further attenuated on this return path and a negligible amount reaches the input end. It is desirable that the power does not reach the right end of the load for two reasons. First, the power might act directly on the thermometers and destroy the accuracy of the instrument, and, second, some of the power might propagate through the

(*Continued on page* 204)

Fig. 3: Schematic view of water load. All parts have circular symmetry



Microminiature Variable Inductors

By J. W. ENG
Physics Laboratories
Sylvania Electric Products Inc.
Bayside, N. Y.

THE development of the transistor, whose active volume may be only a thousandth of a cubic inch, has presented the miniaturization engineer with the challenging problem of developing components consistent in size with the transistor. Fortunately, the reduction of transistor size is accompanied by a reduction in the magnitude of voltage and amount of power utilized. This reduction of power consumption may remove some of the present restrictions on the selection of materials and methods of construction, which in turn will open up new possibilities for miniaturization.

In general, the desirable characteristics of inductors are high Q and good stability. In addition to these characteristics, miniature variable inductors must be small and also have provision for simple adjustments. Since this component is intended for miniaturized packages where the components are placed in close proximity, there is a need for good shielding in order to prevent undesirable coupling.

The design of a high Q miniature inductor has always involved inherent difficulties, for the Q of an inductor is not only a function of the coil diameter but also of the wire size. This is shown by an examination of the fundamental expression for inductance which is,

$$L=4\pi^2N^2r^2\mu'/1=\pi^2D^2N^2\mu' \quad (1)$$

This fundamental equation may be written in terms of a design formula[1]. Thus,

$$L=N^2\ f_L\ (xy)\ \mu'$$

and,

$$Q=D^2(Nf_Q/\rho)\ (xy) \quad (3)$$

which is the design formula for Q, where,

D = diameter of the coil
$f_L(xy)$ = Q form factor
$f_Q(xy)$ = Q form factor
N = number of turns
μ' = effective permeability
ρ = loss factor of powdered iron

In accordance with common experience, as the coil diameter and the wire size decrease, the value of Q will decrease. With these considerations in mind, it does not seem possible to design a high Q miniature inductor by either reduction of coil diameter or wire size. However, by winding the coil around a powdered iron core the number of turns required for the same value of inductance may be greatly reduced, because of the increase in effective permeability. This reduction in the number of turns has the threefold effect of reducing the resistance, decreasing the inductor size and increasing the Q. Thus, the size of the inductor may be greatly reduced without affecting the Q by utilizing a powdered iron core. There is, however, a maximum limit to which the Q may be increased since powdered iron has hysteresis, eddy current and residual losses. This maximum occurs when the copper loss of the coil is equal to the powdered iron losses. In order to obtain the maximum Q for a given application the following factors should be considered: [2,3,4]

a) Inductance value
b) Frequency of operation
c) Form factor
d) Flux density

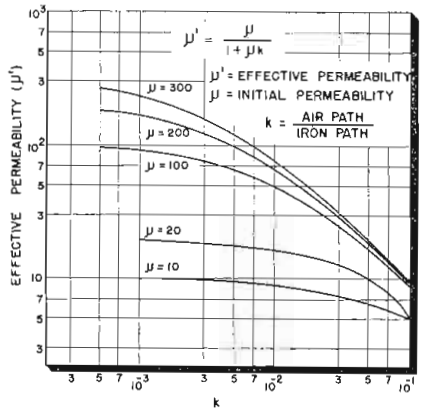


Fig. 1: Effective permeability vs ratio of air gap to magnetic path

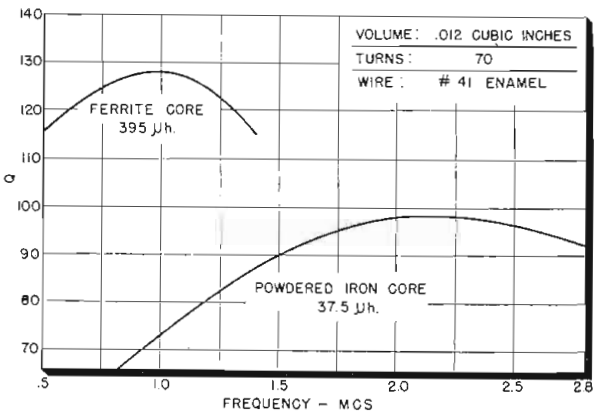
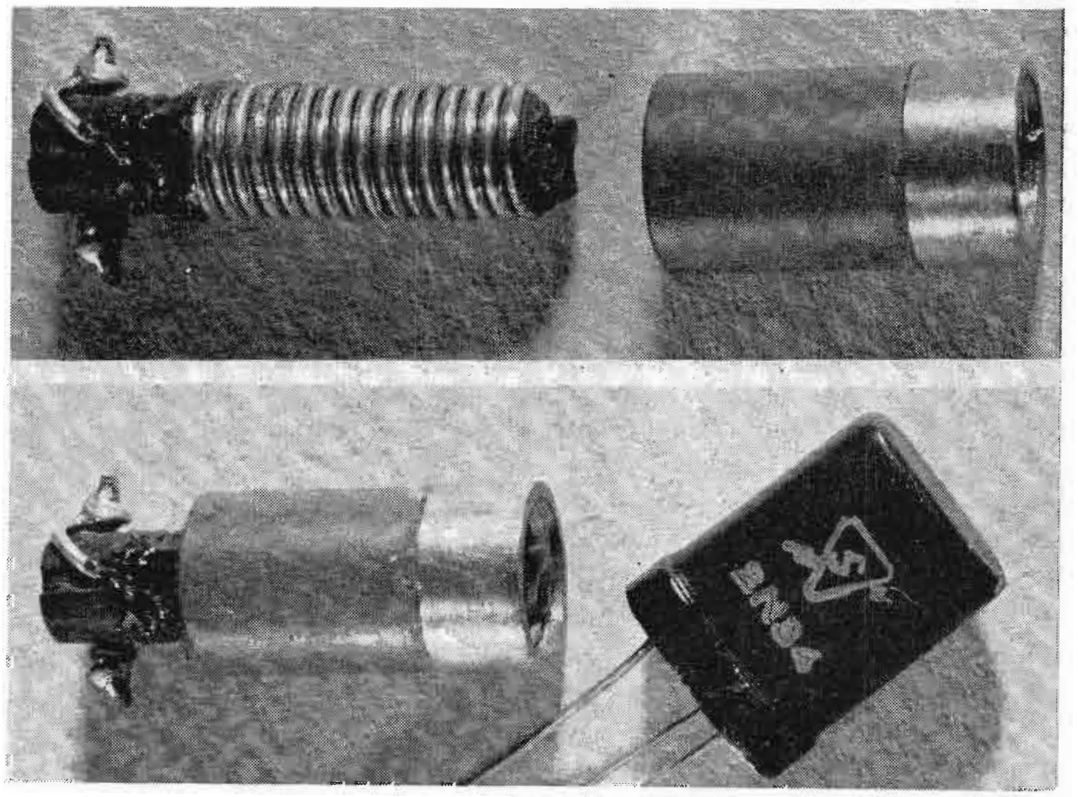


Fig. 2: Curves showing Q vs frequency for ferrite and powdered iron cores

Fig. 3: (Above) Coil design which uses a brass shorting cylinder to obtain inductance variations. (Below) Size comparison with transistor



Type of Material

Since the loss coefficients of powdered iron material are a function of frequency, inductance and permeability[4] it is essential to know what type of material is best suited for any given frequency and inductance. This selection is further influenced by the range in which the inductance is to be varied.

Because this type of inductor relies on the powdered iron for its high Q value, the stability depends, to a great extent, on the core material. The value of inductance of the iron-

for Transistorization

Use of powdered iron or ferrite cores permits sizeable reductions in coil size while retaining relatively high Q. Inductance values may be changed by shorting turns or varying permeability

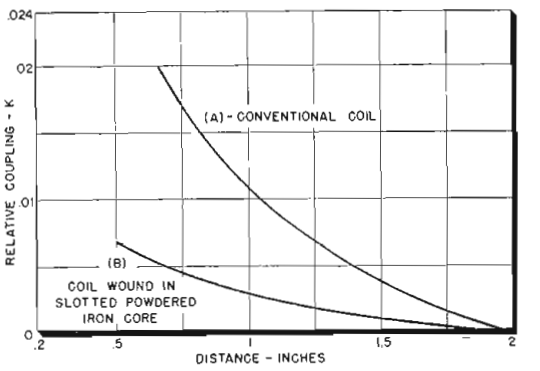


Fig. 4: Q and inductance vs number of turns

type inductor may be changed if there is any variation of the permeability. This change in permeability may be brought about by ageing, magnetization or temperature variations. These factors, however, may be controlled. The effect of ageing can be minimized if the core materials are properly cured, and magnetization does not generally affect powdered iron cores due to the great number of air gaps in their structure. However, other magnetic materials such as ferrite may be affected. The hysteresis and residual losses of the powdered iron core vary proportionally with the temperature, whereas the eddy current loss is inversely proportional to the temperature. Therefore, it is important in the selection of a core material to choose one that is stable with temperature.

Stray Coupling

One of the problems of miniaturization is that inductors are placed in close proximity to one another with the result that there is a certain amount of stray coupling. It has been a common practice to eliminate this stray coupling by placing a metal can around the coil. This has the effect of increasing the volume and decreasing the Q, both of which are undesirable features. In view of the foregoing, it is desirable to design an inductor which will have adequate shielding and at the same time dispense with the bulk of a metal can.

Once the type of material to be used has been determined, there are two basic methods by which the inductance may be varied. This variation may be achieved either by varying the number of turns or the permeability, with numerous ramifications combining these methods. The method which utilizes the variation in number of turns is best illustrated by referring to Eq. 1, which states that the value of inductance varies proportionally with the number of turns squared. This method of variation is limited to small values of inductance, in the range from 0.1 to 2 μh, and thus the geratest advantage is achieved in high frequency application. Although the transistor frequency range is not very high at the present time, it is expected that this range will be greatly increased in the future.

The other method of varying the inductance is achieved by changing the effective permeability. The common method of accomplishing this variation is by changing the air gap which in turn changes the effective permeability. This variation of effective permeability is expressed as follows:[5]

$$\mu' = \mu/(1 + \mu k) \qquad (4)$$

where,

μ' = effective permeability
μ = permeability of magnetic material
k = ratio of the air gap length to the magnetic material length.

The variation of effective permeability (μ') with air gap for various materials of different permeability is shown in Fig. 1. It is of interest to note that by introducing an air gap in the magnetic circuit, the temperature effect on the effective permeability (μ') of the core was greatly

(*Continued on page* 187)

Fig. 5: (Above) Inductance variation is obtained in coil by changing the effective permeability. (Below) Size comparison of design with transistor

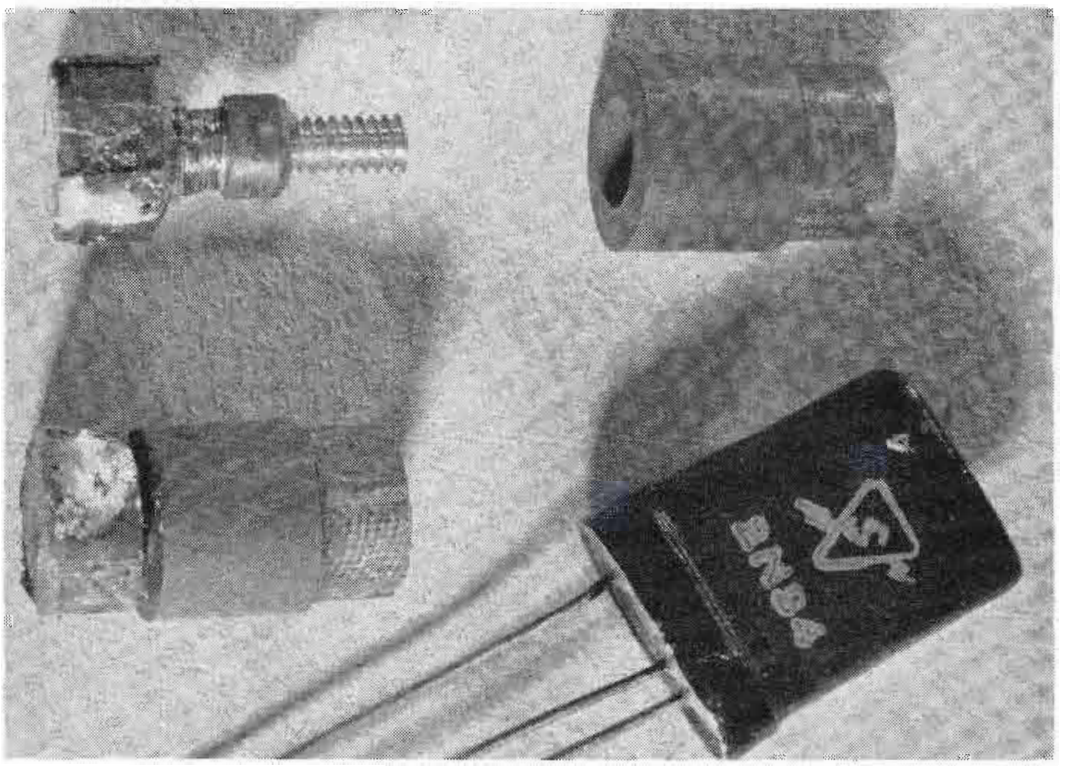


Fig. 6: Inductance vs core position

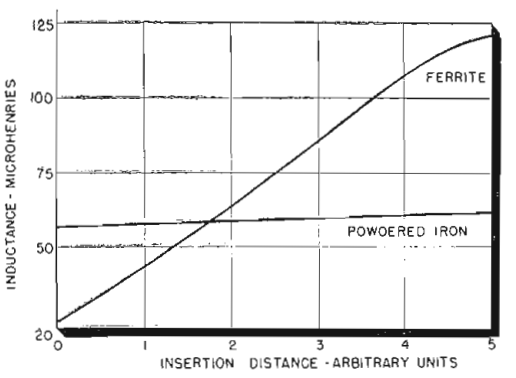
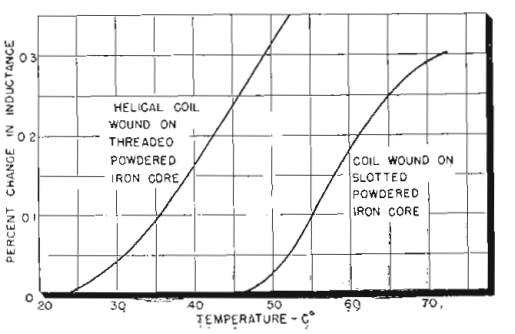


Fig. 7: Coupling vs separation



1953 WESCON Ready to

View of San Francisco Municipal Auditorium, location of 1953 WESCON.

HORACE GREELEY's century-old advice to "go west young man," is the keynote idea of the thousands of engineers and associated personnel in the electronic industries who will gather in San Francisco's Civic Auditorium, on Aug. 19-21, for the 1953 Western Electronic Show & Convention (WESCON). This marks the third year of joint sponsorship of WESCON by the West Coast Electronic Manufacturers Association (WCEMA) and 7th Region IRE. Each year it rotates between the Los Angeles and San Francisco areas.

Since WCEMA started the show in a small way back in 1945, it has grown significantly. As recently as 1950, there were 130 exhibitors, 7,345 attendance, and 46 technical papers. In 1952, the numbers rose to 195 exhibitors, 15,092 attendance, and 125 papers. This year, WESCON will feature 390 exhibitors showing the products of more than 500 manufacturers and 125 technical papers. A detail list of exhibiting companies, and the program of papers contained in 25 technical sessions, is presented in accompanying listings.

WESCON is operated by an eight-man board of directors. For 1953, it consists of Chairman J. W. Landells (Westinghouse), R. A. Huggins (Huggins Labs.), W. E. Noller (Remler Co.) N. E. Porter (Hewlett-Packard), H. G. Grove (West Coast Electronics Co.), R. G. Leitner (Packard-Bell), W. D. Hershberger (U. of Calif.), and L. B. Ungar (Ungar Electric Tools). Business manager is Heckert Parker; asst. mgr. Mal Mobley, Jr.; admin. asst. B. A. Parker; publicity, Frank Haylock; exhibitor registration, Vy Barry.

Membership Growth

WCEMA membership has grown from a handful of companies in 1945 to 150 firms with total plant floor area over 7,000,000 sq. ft. These companies employ over 50,000 people, and manufacture a wide range of electronic components and equipment which falls into 175 product categories. WCEMA activities include surveys of West Coast plant facilities, personnel, wages, and military procurement. The Association has set up a scholarship fund, and this year will make several thousand dollars available to help college students further their study in electronic and allied fields.

Other organizations which are lending their support to WESCON are the Los Angeles and San Francisco Chapters of The Representatives, and the National Electronic Distributors Association (NEDA).

As an advance tip for the coming year, WESCON 1954 will be held in Los Angeles' Pan Pacific Auditorium, Aug. 25-27, 1954. Some 475 exhibit booths are planned. For more information, contact Heckert Parker at the WESCON business office, 1355 Market St., San Francisco, Calif.

Technical Papers Program

WEDNESDAY, AUGUST 19

I—Electron Devices I

"A 1.8-4 KMC High Gain Wideband TWT Amplifier"—S. F. Kaisel, L. A. Roberts, & R. P. Lagerstrom, Stanford Univ.
"A Wideband Power Mixer Tube"—H. R. Johnson, Hughes Labs.
"A Wide Tuning Range Microwave Oscillator/Amplifier"—J. L. Putz & W. R. Luebke—Stanford Univ.
"Helix-Type Backward-Wave Oscillators"—D. A. Watkins—Stanford Univ.
"Cross-Modulation in Traveling-Wave Amplifiers"—A. W. C. Nation & J. W. Christie—Univ. of Washington.

II—Computers I

"A Series-to-Parallel Data Converter"—G. A. Neff, R. L. Sink, & H. E. Burke—Consolidated Engineering Corp.
"A New Analog-to-Digital Voltage Converter"—J. Zweizig—Calif. Inst. of Technology.
"An Analog-to-Digital Conversion System with Printed Decimal Read Out"—J. L. Lindesmith, Clary Multiplier Corp.

1953 WESCON Board of Directors: (l to r) Joseph H. Landells, IRE, Westinghouse Electric Corp.; Richard A. Huggins, WCEMA, Huggins Lab. Inc.; Walter E. Noller, IRE, Remler Co. Ltd.; Noel E. Porter, WCEMA, Hewlett-Packard Co.; Richard G. Leitner, WCEMA, Packard-Bell Co.; W. D. Herschberger, IRE, Univ.

Set New Records

Attendance of more than 15000 expected at this year's event which takes place Aug. 19-21. Products of more than 500 manufacturers will be displayed in 370 exhibit booths. 125 technical papers to be presented.

"An Analog-to-Digital Converter"—A. D. Scarbrough—Hughes Aircraft Co.
"The Analyzing Reader"—David H. Shepard —Intelligent Machines Research Corp.

III—Noise and Signal Spectra

"Instantaneous or Measurable Frequency Spectra"—A. D. Watt & V. J. Zurick—National Bur. of Standards.
"The Response of Linear Systems to Non-Gaussian Noise"—B. Gold & G. O. Young —Hughes Labs.
"Linear Detection of Non-Stationary Noise-Like Signals"—Ralph Deutsch—Hughes Labs.
"A System of Noise Analysis"—S. D. Wanlass & D. M. Jacob—Hughes Labs.

IV—Computers II

"An Improved Reading System for Magnetically Recorded Digital Data"—Samuel Lubkin—Electronic Computer Div., Underwood Corp.
"Magnetic Materials for Digital Computers" —David R. Brown—M. I. T.
Panel Discussion on "The Relative Merits of Different Memory Types"—Moderator: Prof. P. L. Morton—Univ. of Calif.

V—Airborne Electronics

"The Air Navigation Development Board's Program for the Development of the Common System of Air Navigation and Traffic Control"—D. K. Martin—Air Nav. Devel. Bd.
"The Measurement of Performance of Airborne, Voice-Modulated Communication Systems"—E. J. Moore & John Taylor—Stanford Research Inst.
"Corona Interference Reduction by Polarity Discrimination"—M. M. Newman—Lightning and Transients Research Inst.
"Magnetic Amplifiers and Their Applications"—Victor Boros & David Seddman—Polytechnic Research and Devel. Co.
"Airborne Weather Radar for Transport Aircraft"—Richard White—Trans World Airlines.

VI—Instrumentation I

"The Application of Counter Techniques to Precision Frequency Measurements"—A. F. Boff—Berkeley Scientific, Div. of Beckman Instruments.
"Two Timing Circuit Inovations"—H. B. Brooks—Hughes Aircraft Co.
"Strain Gage Oscillator"—E. A. Varallo—Raymond Rosen Eng'g. Products.
"Measurements of Time Jitter in Trains of Video Pulses"—John L. Fitch & Robert R. Buss—Stanford Univ.
"A Peak Reading Vacuum Tube Voltmeter which has a Long Decay Time and is Capable of Measuring the Amplitude of Short Pulses"—Leonard S. Cutler—Gertsch Products, Inc.

VII—Electron Devices

"Convection Current Noise—Theory and Experiment"—S. V. Yadavalli—Univ. of California.
"Microwave Oscillator Stability"—George Hetland & Robert R. Buss—Stanford Univ.
"Air-Coolers for High Power Vacuum Tubes"—A. L. London—Stanford Univ.
"A High-Gain K-Band Amplifier"—W. G. Abraham & F. L. Salisbury—Varian Associates.
"Operating Behavior of High-Power Pulsed Klystrons"—John Jasberg—Stanford Univ.

THURSDAY, AUGUST 20

VIII—Transistors

"Recovery Time Measurements on Point Contact Germanium Diodes"—Morgan McMahon, T. E. Firle, J. F. Roach—Research and Devel. Labs., Hughes Aircraft Co.
"A Point Emitter-Junction Collector Transistor"—R. H. Kingston—Lincoln Lab., M. I. T.
"Measurement of the Small Signal Parameters of Transistors"—Geoffrey Knight, Jr., R. A. Johnson, R. B. Holt—Transistor Products, Inc.
"Rapid Determination of Some Electrical Properties of Semi-Conductors"—Luther Davis, Jr., Lawrence Rubin, W. D. Straub Raytheon Mfg. Co.

IX—Antennas I

"Design and Performance of Rotationally Symmetric Feeds for Paraboloidal Reflectors"—H. W. Haas, R. W. Dressel, R. D. Ewing—State College, New Mexico.
"A New Antenna Feed Having Equal E and H Plane Patterns"—Alvin Chlavin—Hughes Aircraft Co.
"Waveguide Slot Arrays of Large Squint Angle"—R. J. Adams, A. M. Lide—Naval Research Lab.
"The Impedence Properties of Narrow Radiating Slots in the Broad Face of Rectangular Waveguides"—Arthur A. Oliner —Polytechnic Inst. of Brooklyn.
"Principles of Spiral Scanners for Equal Pulse Distribution"—J. Richard Huynen —Dalmo Victor Co.
"Boresight Theory for Homogeneous Dielectric Radomes"—M. C. Horton, W. E. L. Boyce, E. O. Hartig—Goodyear Aircraft Corp.

X—Nuclear Radiation Measurements

TENTATIVE TOPICS:
"Gamma and Electron Spectrometry with Crystals at High Energy"
"A Discussion of Some Unsolved Instrumentation Problems in Nuclear Physics"
"The Current Status of Radiation Detector Development"
"Neutron Source Standardization"
(Titles and speakers to be announced in official program)

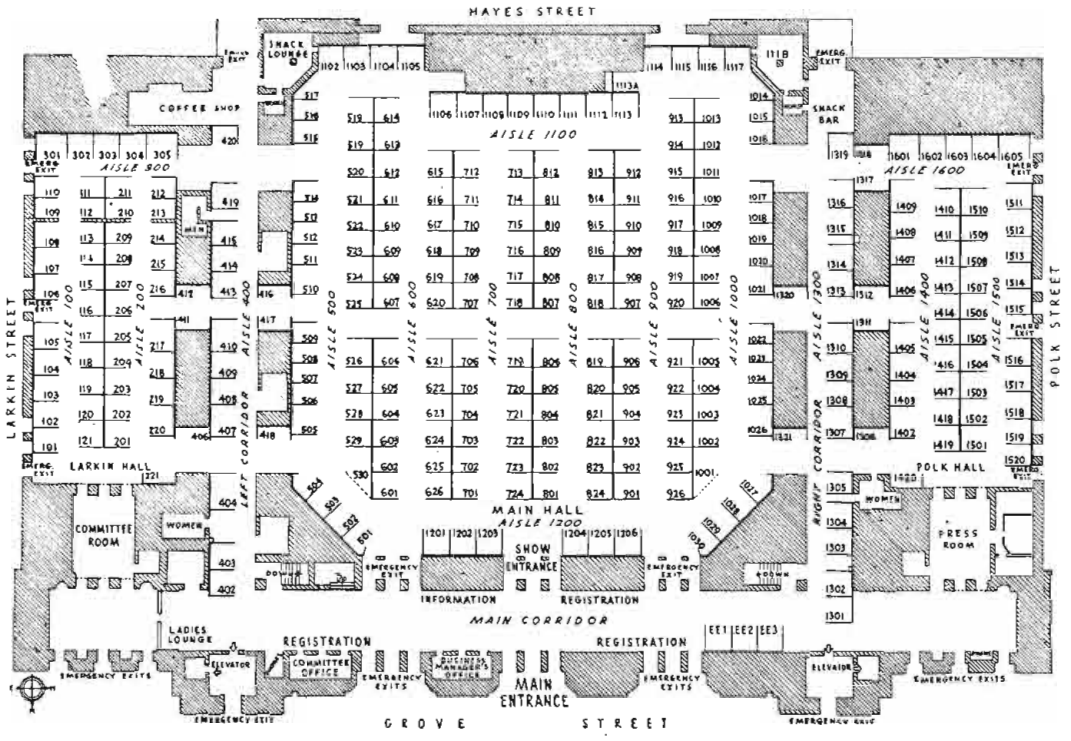
XI—Servomechanisms

"Nonlinear Control Systems with Random Inputs"—R. C. Booton, Jr.—M. I. T.
"Comparison of Linear and Nonlinear Servomechanism Response"—T. M. Stout—Univ. of Washington.
"Time Quantization in a Feedback System" —J. F. Waddel & H. D. Morris—Radiation Lab., Univ. of California.
"Stability of Feedback Systems Using a Dual Locus Diagram"—Paul Jones—California Inst. of Technology.
"Geometrical Interpretation of the Response of Linear Systems to Special Inputs"—J. R. Moore—North American Aviation.

Interior view of auditorium shows some exhibits at earlier WESCON

of Calif.; Howard G. Grove, IRE, West Coast Electronics Co.; and Leon B. Ungar, WCEMA, Ungar Electric Tools Inc. Heckert Parker, business manager of the show, and Mal Mobley, Jr., Assistant Manager, are shown in last two photos. Next year 1954 WESCON will be held August 25-27 in Los Angeles.

WESCON (Continued)



Floor plan of auditorium space showing location of exhibitors booths

XII—Transistor Circuits

"Recent Developments in Transistors"—Irving Wolff—Radio Corp. of America.
"Transistor Shift Registers"—R. H. Baker, I. L. Lebow, R. E. McMahon—M. I. T.
"A Point Contact Transistor VHF FM Transmitter"—D. E. Thomas—Bell Telephone Labs., Inc.
"A Four-Digit Transistor Accumulator"—D. J. Eckl—Lincoln Lab., M. I. T.
"A Transistor Feedback Amplifier for Carrier Frequency Applications"—J. C. Lozier, D. D. Cherry—Bell Telephone Labs., Inc.

XIII—Microwave Theory & Techniques I

"Mode Representations in Open and Closed Uniform Waveguides"—Nathan Marcuvitz—Polytechnic Inst. of Brooklyn.
"Applications of Coupled Helices"—Peter D. Lacy,—Hewlett-Packard Co.
"New Applications of Faraday Rotation in Waveguides"—A. G. Fox, M. T. Weiss, S. E. Miller—Bell Telephone Labs., Inc.
"Non-Reciprocal Circuits Comprising Ferrite-Loaded Rectangular Waveguides"—A. G. Fox, M. T. Weiss, S. E. Miller—Bell Telephone Labs., Inc.
"The Generation of Electromagnetic Oscillations in the Microwave Region Using an Adiabatic Kind of Amplification"—Gedalia Held—Univ. of California.

XIV—Antennas II

"Arrays of Closely Spaced Non-Resonant Slots"—Robert J. Stegen & Richard H. Reed—Hughes Aircraft Co.
"Diffraction Theory and the Patterns of Suppressed Antennas"—George Sinclair—Univ. of Toronto.
"Beam Shaping and Optimum Bandwidth Methods Applied to UHF TV Transmitting Antennas"—John Ruze & John E. Martin—Gabriel Labs.
"Voltage Protection of Isolated Cap Aircraft Antennas"—Robert L. Tanner—Stanford Research Inst.
"A Slotted Cylinder Omni Range Projector"—J. P. Shanklin—Collins Radio Co.

XV—Servomechanism Equipment

(Titles and authors to be listed in official program).

XVI—The NTSC and Color Television

Speakers: W. R. G. Baker, Vice President in charge of Electronics, General Electric Co. & Chairman of National TV Systems Committee.
Donald G. Fink, Director of Research, R, T & A), Philco Corp., Chairman, Panel 12 of the NTSC.

FRIDAY, AUGUST 21

XVII—Audio Symposium

"Microphones"—William B. Snow—Western Electro-Acoustic Lab.
"Recording"—Frank G. Lennert—Ampex Corporation.
"Amplifiers"—Arthur N. Curtiss, RCA Victor Division.
"Loudspeakers"—Bob Hugh Smith—Univ. of California.

XVIII—Circuit Theory I

"The Practical Implication and Applications of Formal Network Theory"—D. F. Tuttle—Stanford Univ.
"Design of a Simple Band-Pass Amplifier with Approximate Ideal Frequency Characteristics"—W. E. Bradley—Philco Corp.
"Quasi-Distortionless Filter Functions"—J. L. Stewart—Univ. of Michigan.
"Fluctuation Noise Theory as Applied to Circuit Design"—T. S. George—Air Force Missile Test Center.

XIX—Microwave Theory & Techniques II

"A Microwave Oscillograph"—Richard C. Honey—Stanford Research Inst.
"Instrumentation of Microwave Electron Resonance in Magnetic Fields"—R. C. Mackey & W. D. Hershberger—Univ. of California.
"An Improved Cross Guide Directional Coupler"—Henry J. Riblet—Microwave Devel. Labs., Inc.
"Two Novel Types of Waveguide Switches"—Amasa Pratt—Century Metalcraft Corp.
"Broad Banding Circular Polarizing Transducers"—D. L. Margerum—Microwave Engineering Co.

XX—Propagation—General

"Waveguiding on Surfaces with and without Loss"—Francis J. Zucker—Air Force Cambridge Research Center.
"A New Solution to the Ionospheric Wave Equation"—A. J. Mallinckrodt—Ralph M. Parsons Co.
"Ionosphere Soundings by Cross-Correlation Techniques"—P. B. Gallagher & A. M. Peterson—Stanford Univ.
"The Long-Distance Horizontal Directivity of a 13.7 MC Antenna"—Richard Silberstein—National Bur. of Standards.
"Whistlers"—J. H. Crary & R. A. Helliwell—Stanford Univ.

XXI—Propagation VHF UHF

"Results of Tropospheric Propagation Measurements on Frequencies from 92 to 1046 MC at the Cheyenne Mountain Field Station"—Alfred F. Barghausen & K. O. Hornberg—National Bur. of Standards.
"Characteristic of a Radio Transmission Path at 8.6 mm—C. W. Tolbert & A. W. Straiton—Univ. of Texas.
"An Investigation of the Variation of VHF Field Strength Beyond Line-of-Sight"—G. H. Keitel & H. M. Swarm—Univ. of Washington.
"Air-to-Air Propagation—Experimental and Theoretical Results"—Ming S. Wong—Development Center, Wright Field.
"The Role of Angular Distance in Tropospheric Radio Wave Propagation"—Kenneth A. Norton—National Bur. of Standards.
"Normal Propagation of Short Radio Waves Well Beyond the Horizon"—Thomas J. Carroll & Rose M. Ring—M. I. T.

XXII—Circuit Theory II

"Solving Physical Systems with very Large Number of Variables in Easy Stages—Gabriel Kron, Consulting Eng'r.—General Electric Co.
"Matric Analysis of Linear Time-Varying Circuits"—Louis A. Pipes—Univ. of California and U. S. Naval Ordnance Test Station.
"Unbalanced RLC Networks Containing Only One Resistance and One Real Transformer"—Louis Weinberg—Hughes Labs.
"An Iterative Method for Network Synthesis"—R. E. Scott—M. I. T., and R. L. Blanchard, Transonics, Inc.

XXIII—Instrumentation II

"Measurement Problems in VHF-UHF Television Antenna Systems"—R. A. Soderman—General Radio Co.
"An Auto Impedance Meter for VHF-UHF"—John Ebert—Polytechnic Research Devel. Co.
"A Ratiometer"—Nicholas L. Pappas—Hewlett-Packard Co.
"An Improved Method of Measuring the Current Amplification of Junction Type Transistors"—F. R. Stansel—Bell Telephone Labs.

XXIV—Audio

"Stereophonic Tape System"—Ross H. Snyder—Ampex Electric Corp.
"Application and Suggestions for Research Concerning Acoustical Problems in Medical Areas"—John K. Hilliard—Altec Lansing Corp.
"An Investigation of the Air Chamber of Horn Type Loudspeakers"—Bob H. Smith—Univ. of California.
"A Simple Calibration Technique for Low Sensitivity Transducers"—William J. Galloway—Univ. of California.

XXV—Medical Electronics

"Area Display by Electronic Mapping, Especially of the Electrical Activity of the Heart—Stanford Goldman, Prof. of Electrical Eng'g.—Syracuse Univ.
"Electronic Mapping of the Brain"—Archie R. Tunturi, Prof. of Anatomy—Univ. of Oregon Medical School.
"Radioactive Tracer Mapping"—H. O. Anger and C. A. Tobias—Univ. of California Radiation Lab.

EXHIBITORS and their BOOTH NUMBERS

Acme Electronics, Inc.	518
Advance Electric and Relay Co.	607
Aerovox Corporation	519
Aircraft-Marine Products, Inc.	530
Airpax Products Co.	406
Airtron, Inc.	712
Alpha Wire Corp.	1023
Altec Lansing Corp.	601-602
American Electric Motors, Inc.	103
American Lava Corp.	1509
American Microphone Co.	807
American Phenolic Corp.	521-522
Amperex Electronic Corp.	1413A
Ampex Electric Corp.	214
Andrew Corporation	410
L. H. Appleman	1305
Harry Appleton Company, Inc.	515
Arnold Engineering Co.	203
Arrow-Hart & Hegeman Electric Co.	1508
Assembly Products, Inc.	1514
Audio Devices, Inc.	526
Automatic Electric Sales Corp.	625
Avery Adhesive Label Corp.	1205
Herb Becker Company	719
Bendix Computer Div. Bendix Aviation Corp.	1516
Scintilla Magneto Div. Bendix Aviation Corp.	1517-1520
Bendix Radio Div. Bendix Aviation Corp.	1518-1519
Berkeley Scientific Div. of Beckman Instruments	528-529
E. L. Berman Co.	220
Beta Electric Corporation	1115
Bird Electronic Corp.	817
Bliley Electric Co.	206
Bogue Electric Mfg. Co.	517
Bomac Laboratories, Inc.	1407A
Boonton Radio Corp.	809-810
Bourns Labs. Instrument Sales Corp.	113

(Continued on page 213)

A Portable Transistor FM-Receiver

Design and circuit details on the first completely transistorized unit

By R. C. BALLARD
RCA Laboratories Division,
Radio Corp. of America
Princeton, N. J.

ENCLOSED in a transparent cabinet and provided with a built-in retractible dipole antenna, the transistorized, tubeless FM receiver permits reception with almost the same convenience as with a portable AM receiver. See Figs. 1 and 2. This receiver was built to study the applicability of transistors and not to yield commercially-acceptable characteristics. Although shortcomings in performance were evident, much basic information was obtained which may be of use in future designs.

Several compromises were made due to the characteristics of available transistors. At the time the receiver was designed, amplification with transistors at 100 MC was not feasible, and gain per stage at 10.7 MC, the normal i-f used in FM receivers, was low. Hence an r-f stage was omitted and a lower-than-standard i-f of 5 MC was chosen.

I-F Amplifier

The i-f amplifier uses six grounded base stages of developmental point contact transistors. The i-f transformers T_1 to T_6 are of the toroidal type. The choice of toroidal core construction with its small external field permits compact assembly of components without instability. The tight primary-to-secondary coupling obtained is desirable for the single-tuned stages which have ceramic trimmers shunting the primaries. The cores are ferrite "doughnuts" ¼ in. O.D., 3/16 in. I. D., and 1/16 in. thick. The primaries are 65 turns and the secondaries 12 turns wound on single layers of No. 36 enameled wire opopsite each other on these cores. This turns ratio provides an approximate impedance match from one collector to the following emitter.

A self-contained antenna is almost an essential feature of a portable radio receiver. Since loop and ferrite antennas were considered too inefficient for FM reception, a collapsible dipole antenna like the indoor TV rabbit ears was considered. The resulting design consists of a pair of steel measuring tapes mounted at the top ends of the cabinet. These tapes are silver plated and joined by a metal strip to make a simple bent dipole. A jack at the center permits substituting a twin-lead feed from a roof-top antenna where better reception is desired.

Local Oscillator

Fig. 3 is the schematic of the receiver. The local oscillator makes use of a selected point-contact type transistor similar to the RCA 2N33 in a special circuit similar to a shunt-feed Hartley. A variable air capacitor tunes the oscillator from 83 to 103 MC and is ganged with the mixer tuning capacitor. A ferrite slug serves as trimmer. Since the oscillator output decreases at higher frequencies, below-carrier operation was chosen to insure adequate excitation. The transistor-oscillator is relatively insensitive to battery voltage, requiring approximately a 5-volt change to shift the frequency 200 KC or one full FM channel. Frequency shift due to temperature change was not noticeable with casual operation of the receiver over a temperature range of approximately 20°F.

(*Continued on page* 206)

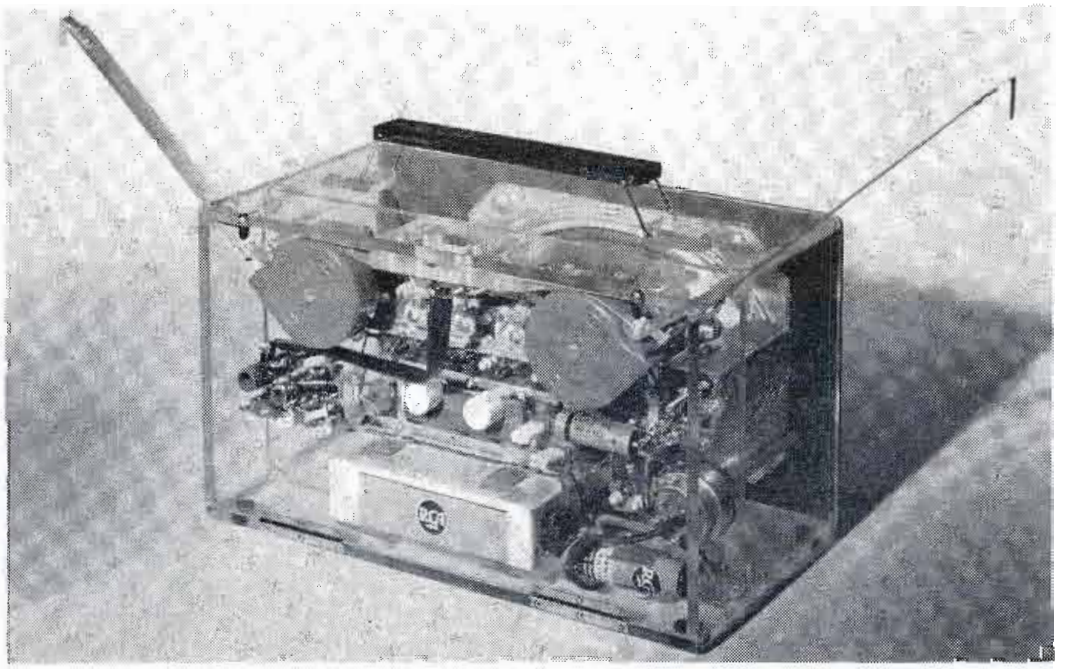


Fig. 1: Rear view of completely transistorized developmental FM receiver

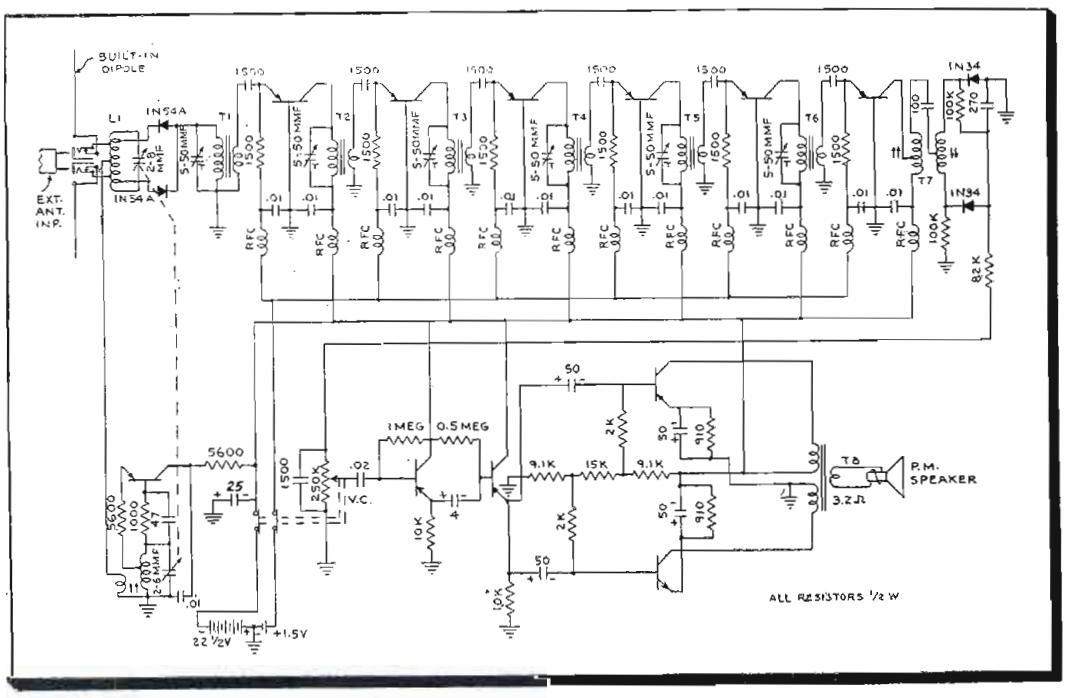


Fig. 2: Schematic shows receiver to have 11 transistors; 4 germanium diodes

Designing Cathode Followers for

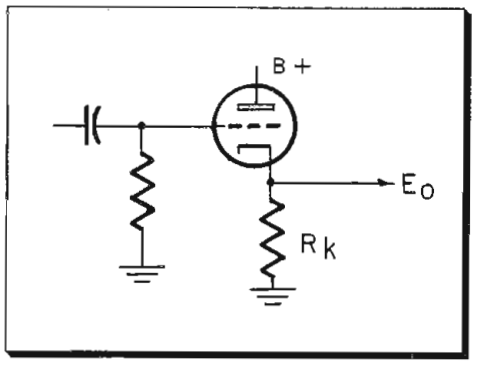


Fig. 1: 12AT7 as a positive pulse amplifier

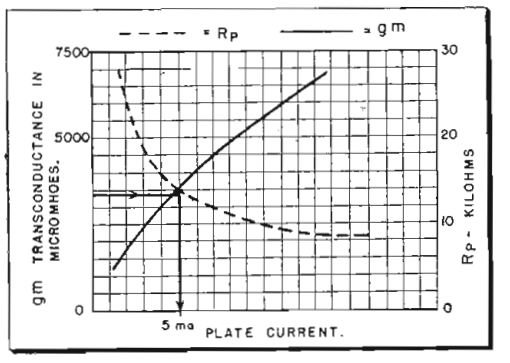


Fig. 2: G_m and R_p vs. plate current for 12AT7

How to determine design parameters quickly by graphical means for positive, negative, and high-output negative pulse amplifiers.

By HOLLICE A. FAVORS
Stoddart Aircraft Radio Co., 6644 Santa Monica Blvd., Hollywood 38, Calif.

THE g_m of a cathode follower just as a conventional amplifier increases with an increase of current through the tube. Since the output impedance decreases as the g_m increases, a tube with high g_m lends itself to a good high frequency response. For small input signals, where a low impedance output is desired, working on the high portion of the tube characteristics is desired.

The following shows how the performance of cathode follower circuits can be calculated in a minimum amount of time. For simplicity, no mention has been made of the dc component of the input wave. An input pulse width, small compared to the repetition time, has been assumed in order that the average or dc component will be very low. With wave forms of high duty cycle, the input may be clamped to a given reference level. Too, the time constant of the input parameter is such that the input wave form is not differentiated.

+Pulse Amplifier

Maximum output impedance not to exceed 300 ohms.
E_{bb}—plate supply voltage
g_m —transconductance
R_k —cathode resistor
E_{rk}—voltage developed across cathode
E_b —voltage developed across tube
Z_0 —output impedance
See Fig. 1.

1. $Z_0 = 1/g_m = 300$

g_m = 3333 micromhoes (approx.) From the tube curves, Fig. 2. 3333 micromhoes corresponds to approximately 5 ma static current.

2. *Determination of cathode resistance.* (Fig. 3.) From 5 ma on the vertical axis, project horizontally to the right. Simultaneously, from the plate supply voltage of 300 volts, project vertically. The bias as read at the intersection of these lines is −3.7 volts. This condition assumes that the full 300 volts will be developed across the tube; however, since we are using cathode bias, and if we assume the value is 3.7 volts, only 296.3 volts will be developed across the tube.

Visually interpolate and select a point on the current projection such that the bias, as read from the tube curves, when projected to the horizontal axis equals a voltage removed from the plate supply voltage of 300 volts.

By inspection, we choose −3.6 volts.

3. Draw load line through this point to E_{bb} = 300.

4. $R_k = \dfrac{\text{Bias}}{\text{Static Current}} = 720$ ohms.

5. Limit the current to a maximum value above which distortion will occur. i = 25 ma max.

6. Projecting horizontally from the maximum current value, the bias is − 0.8 volt; thus for 18 volts output (25 ma, across 720 ohms) the input signal must equal 18 −0.8 equals 17.2 volts.

7. *Determination of gain.* The output changed from 3.6 to 18 volts, a 14.4 volt change. The input changed from 0 to 17.2 volts.

$$\text{Gain} = \frac{\text{output}}{\text{input}} = \frac{14.4}{17.2} = 0.84$$

8. Note that at 25 ma, the g_m is approximately 8000 micromhos, which gives an output impedance of approximately 125 ohms.

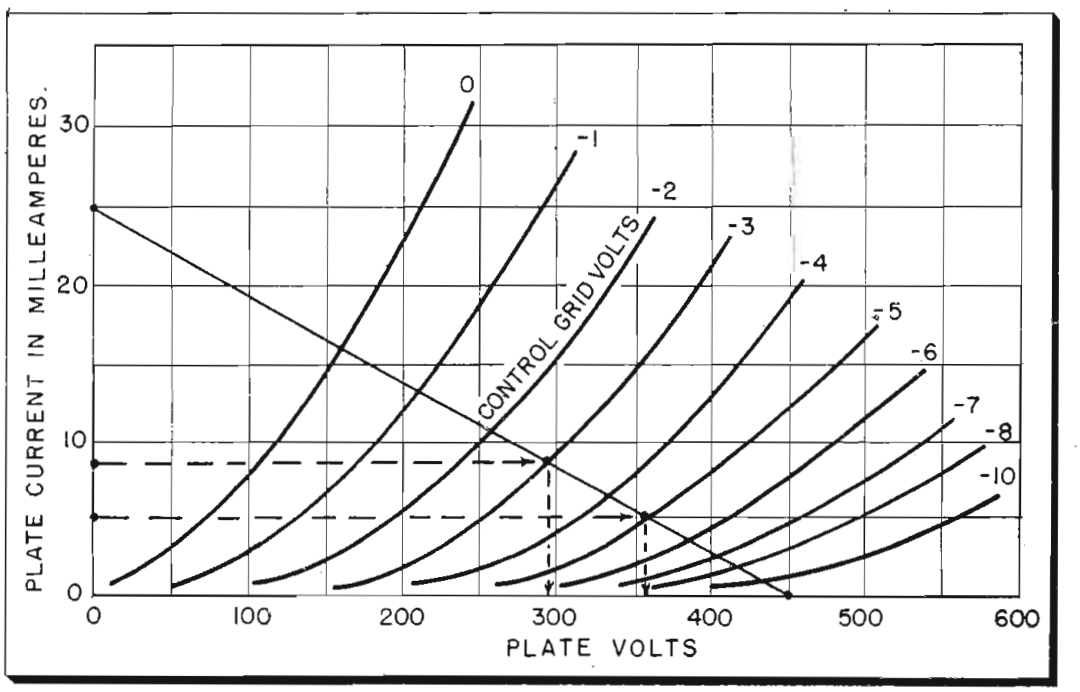
The instantaneous output voltage during the pulse interval is

$$E_o = \frac{ER}{R + r} \epsilon^{-\frac{T}{(R + r)c}}$$

where r is the generator impedance. See Fig. 4.

The instantaneous voltage output

Fig. 3: Determining cathode resistance from 12AT7 static characteristic curves



Pulse Type Circuits

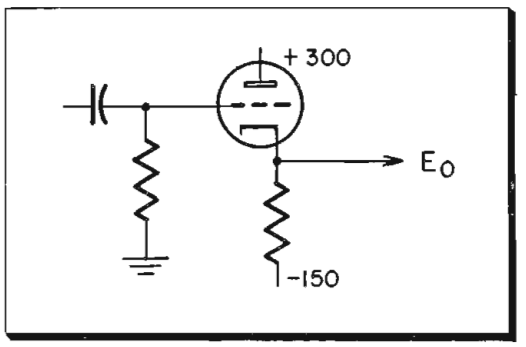


Fig. 4: Loaded positive pulse amplifier

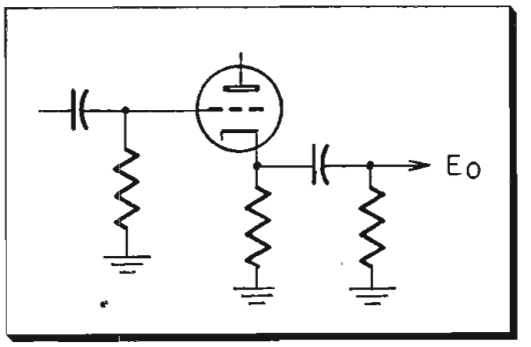


Fig. 5: Hi-output negative pulse amplifier

after the input pulse disappears is

$$E_o = -\frac{ER}{R+r}\left[\epsilon^{\frac{T}{(R+r)c}} - 1\right]\epsilon^{-\frac{t}{(R+r)c}}$$

where T is the pulse input duration.

9. Thus we can see, that coupled with the stray capacitance which limits the reproduction of the input waveform, it is important that the generator impedance be very low, as can be seen from the equation.

—*Pulse Amplifier (Hi-output)*

Many times one has needed a large output voltage with a low output impedance. See Fig. 5.

1. Since the grid is at ground, there will be at least a 150 volt drop across R_k. For the moment, let us assume this to be the case.

2. Thus, on the above assumption, 300 volts will be dropped across the tube.

3. From the tube data, the plate dissipation is approximately 2.5 watts. Having assumed 300 volts across the tube, we can easily determine the maximum current that the tube can stand. This is:

$$i = 2.5/300 = 8.35 \text{ ma}$$

4. *Determination of cathode resistor.*

$R_k = 150/.00835 = 18{,}000$ ohms.

5. Draw load line, noting that E_{bb} now equals 150 + 300 volts.

$$i = 450/18{,}000 = 25 \text{ ma}$$

6. From Fig. 6, project horizontally from the assumed static current of 8.35 ma. The bias at the intersection of the load line is approximately −3.05 volts; but 8.35 ma through R_k of 18,000 ohms is only 150 volts, which would give us a bias of 0.

Therefore, assume a slightly higher static current. For convenience choose 8.5 ma.

Bias from curve is −3 volts.

Voltage developed across cathode is (0.0085) (18,000) = 153 volts, which is a plus 3 volts above the grid. Therefore, static current is 8.5 ma. The bias is 3 volts. The drop across tube is 300 −3 = 297 volts.

Our first assumptions, although not correct, nevertheless gave us a basis upon which to approximate the operational point and plate dissipation.

Now that we have correctly determined the operation point, let us check again and see if we are overly dissipating the power capabilities of the tube.

(0.0085) (297) = 2.505 watts

This value is only slightly higher than that given by the tube manufacturer.

7. Limit the current to a minimum value below which distortion will occur. For convenience, choose 5 ma. Projecting to the load line from this value, *the bias is observed to be −5 volts.*

E_{rk} = (0.005) (18,000) = 90 volts above the −150 volt supply, 60 below ground. To satisfy our tube curves, the input should be 5 volts below the cathode −60-5 = −65 volts.

Determination of gain. The output varied from 3 volts above ground to 60 volts below ground, a change of 63 volts.

The input varied from 0 to −65 volts.

Gain = 60/65 = 0.95.

—*Pulse Amplifier*

Maximum output impedance is not to exceed 300 ohms approximately. See Fig. 7.

1. From Fig. 2, choose 5 ma as the current that will give an impedance output of 300 ohms.

2. Determine cathode resistance at this current value.

3. Note that 5 ma is the minimum current, consequently at the start of the negative pulse we should like to have the tube conducting heavily. Choose 25 ma as the resting current.

4. At 25 ma the bias as read from the tube curves is −0.8 volts. But, 25 ma through 720 ohms, the cathode voltage, is 18 volts; consequently, we should like to have the grid sitting at 18—0.8 volts = 17.2 volts.

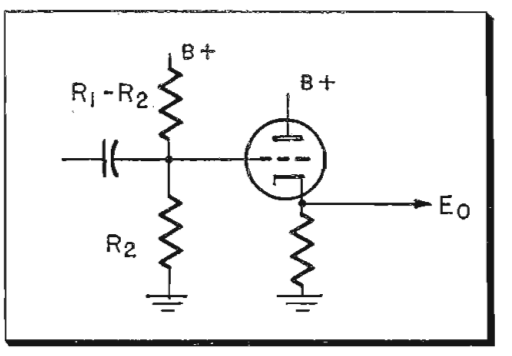


Fig. 7: 12AT7 as a negative pulse amplifier

5. This can be accomplished by a resistor divider network.

R_1 = 2,000,000 ohms

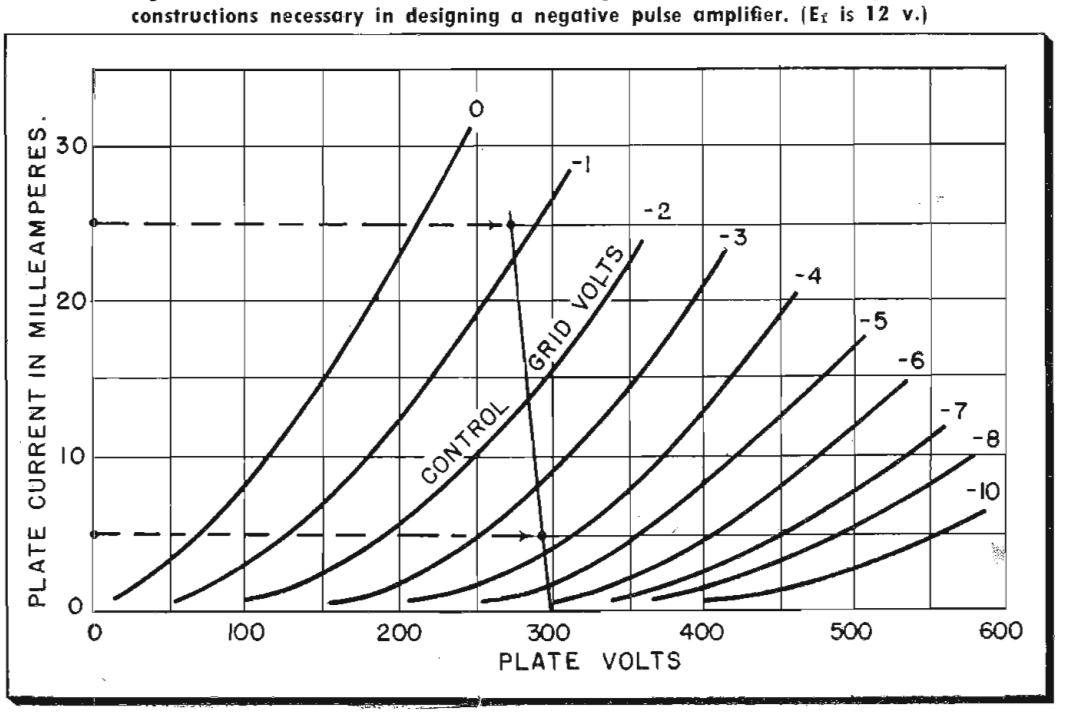
E_g = 17.2 volts = grid voltage

E_1 = 300 volts = supply voltage

$R_2 = E_g\ R_1/(E_1 - E_g) = 122{,}000\ \Omega$.

Ed. Note: Designs assume negligible output capacity loading

Fig. 6: Static characteristic curves for a single section 12AT7 showing the constructions necessary in designing a negative pulse amplifier. (E_f is 12 v.)



A Preset Counter for Time and

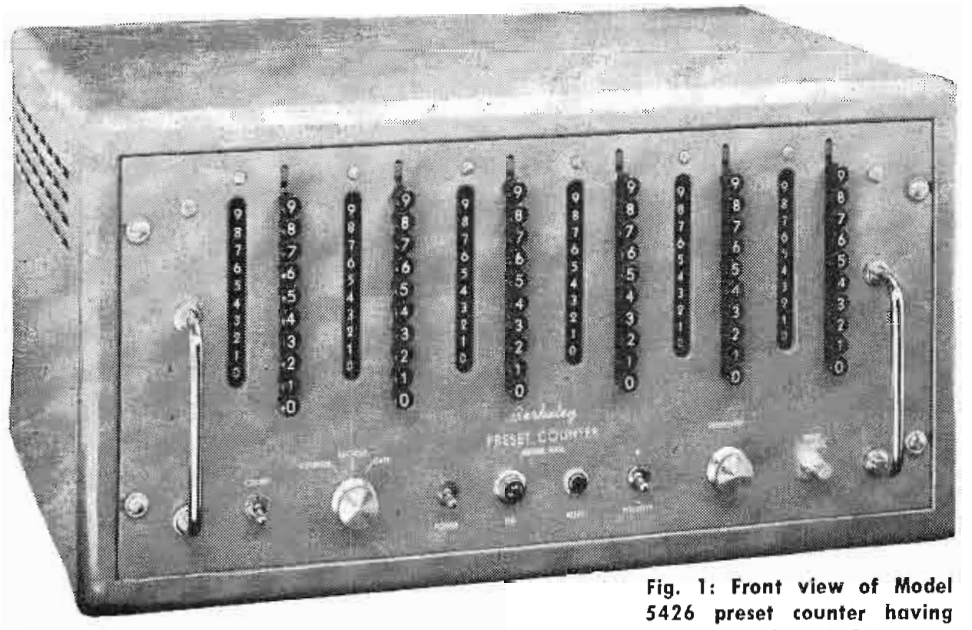


Fig. 1: Front view of Model 5426 preset counter having count capacity of 1,000,000

Instrument sums any discrete physical change that can be converted into a changing voltage. Suitable accessories enable unit to control automatic manufacturing processes

By T. H. THOMASON
Project Engineer, Berkeley Scientific Division, Beckman Instruments Inc.
2200 Wright Ave., Richmond, Calif.

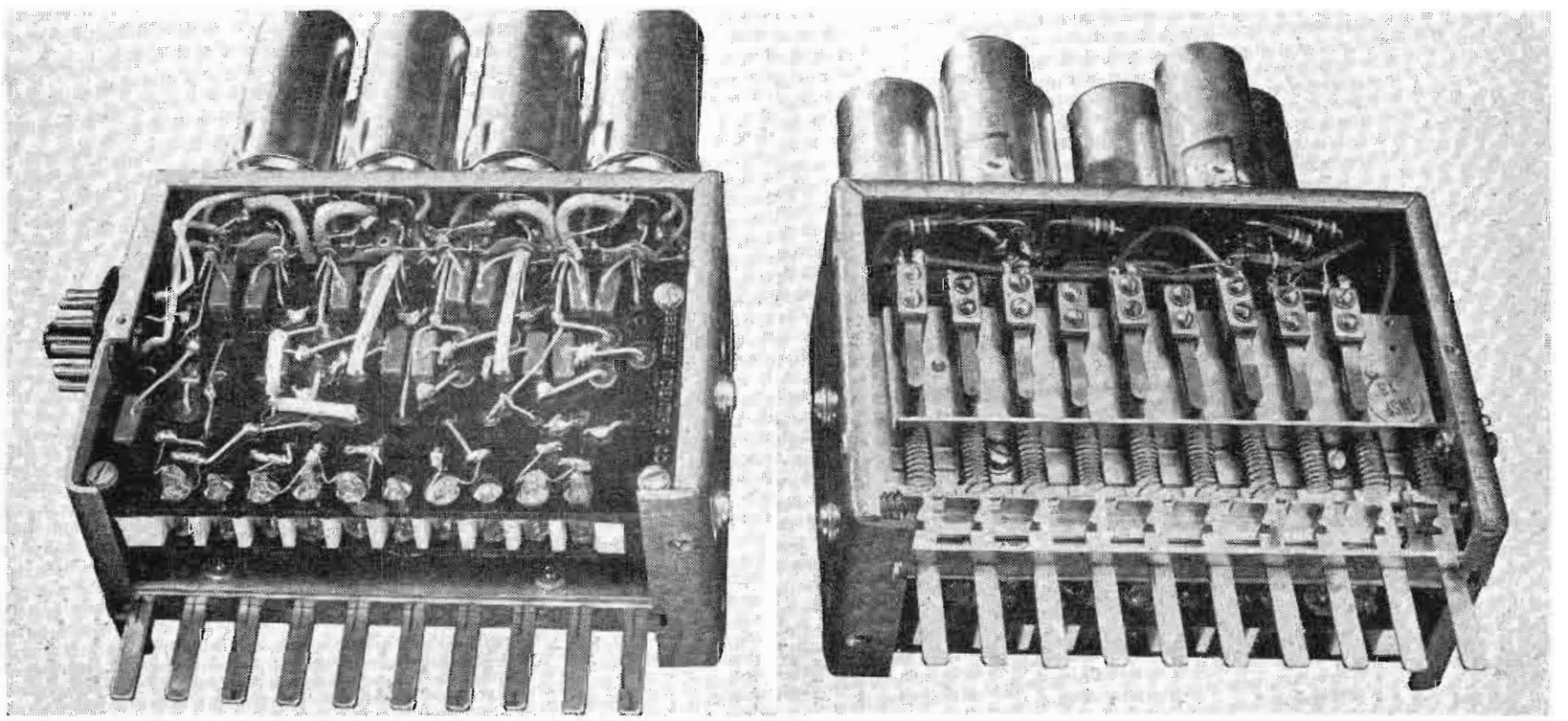
THE preset counter described (Fig. 1) is capable of exerting control in cases where it is desired to count or measure specific quantities such as number of objects, periods of time, etc. Output information may be obtained at any count from 1 to 1,000,000. Any discrete physical change that can be converted into a changing voltage by the use of transducers such as photocells, magnetic pickups, switches, etc. can be counted. These changes may occur at rates from dc to 40,000 cps, the maximum counting rate of the preset decimal counting units (Figs. 2 & 3) used in the instrument.

The counter performs one of three functions according to the position of a front panel switch. In the COUNTER position, the instrument functions as a counter independent of the preset circuit. Output information is obtained each time the full capacity of the unit is reached. In the RECYCLE position, the unit will count to the preset number, provide an output, reset, and indefinitely repeat the cycle without losing a count. This effectively makes the instrument a counter having a variable scaling factor from 1 to 1,000,000. In the GATE position, the instrument counts until the preset number is reached, at which time the input to the counting units is gated off and an output signal is generated. This number is displayed until it is cleared by the RESET button or an external reset pulse.

Preset Counter

The preset counter consists of an input circuit, an electronic gate, a system of cascaded presettable decimal counting units, and an output circuit that provides either a pulse output and relay closure or a pulse output (See Fig. 4). The variations in voltage to be counted are applied to the input circuit, amplified, shaped, and conducted to an

Figs. 2-3: Model 730 preset decimal counting unit without covers showing (left) component mounting in bakelite (right) switch mechanism



Quantity Measurements

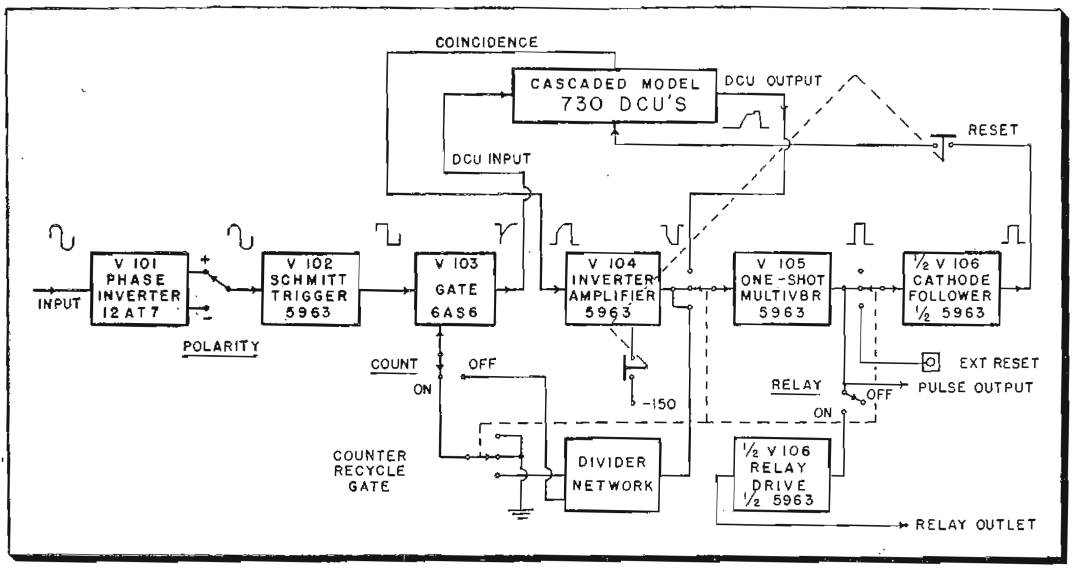


Fig. 4: Functional diagram of the counter

electronic gate. When this gate is opened the incoming count is passed to the first of the cascaded decimal counting units. At the preset number, an output from the coincidence system of the decimal counting units initiates various electronic operations, such as, resetting the counting units, actuating a relay circuit, transmitting an output pulse, and/or closing an electronic gate.

A cathode-coupled phase inverter and Schmitt Trigger make up the direct-coupled input amplifier. Their purpose is to amplify and shape the input waveform so that a standard pulse is always applied to the electronic gate. Provisions are made for balancing and adjusting the plate voltage of the inverter so that it, in conjunction with a polarity switch, always applies positive going signal to the input of the trigger circuit.

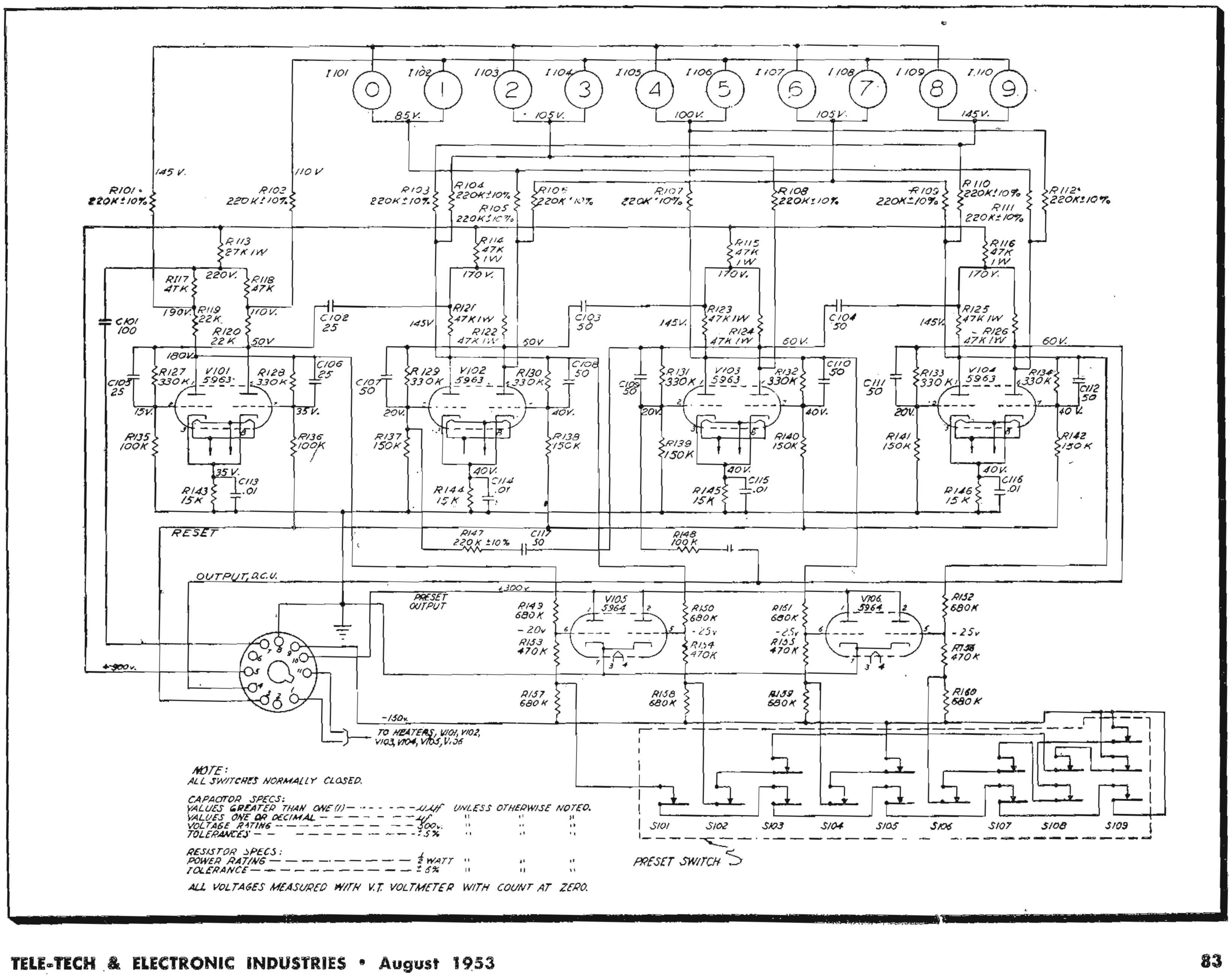
Schmitt Trigger

The output of the Schmitt Trigger is R-C coupled to the control grid of a dual-control pentode that is used as an electronic gate. When the gate is open, as determined by the voltage applied to its third grid, a 100 volt negative pulse is applied to the input of the counting units. In both the COUNTER and RECYCLE positions of the function switch the suppressor grid is grounded and the gate is always open. However, in the GATE position it is open until the preset count is reached at which time it is closed thus stopping the input to the counters.

The output of the electronic gate

(*Continued on page 210*)

Fig. 5: Circuit diagram of the decimal counting unit used in the counter



Recent Electronic Developments at

ELECTRON-BEAM INTERFEROMETER

Research on the wave properties of electrons has resulted in the development of an interferometer that utilizes electron beams to produce interference fringes in much the same way as conventional optical interferometers use light beams. The electron-beam interferometer, developed by L. Marton, J. Arol Simpson, and J. A. Suddeth of NBS, employs diffraction from an extremely thin crystal as a means for splitting and recombining an electron beam and uses an electron optical system for viewing the resulting interference phenomena.

The electron interferometer greatly extends the range of light interferometers used in the direct measurement of length. In addition, the instrument constitutes an extremely sensitive device for measuring gradients of magnetic and electrostatic fields—analgous to refractive indices in optical interferometry—and provides a means for obtaining additional information on the wave nature of the electron. Other suggested applications of the method include studies of the energy levels in solids and an absolute determination of Planck's constant.

One of the major components of the wide-beam electron interferometer developed by NBS is a system of extremely thin crystals that diffract and transmit the beam of electrons. The crystals are mounted in a vacuum chamber placed between the illuminating and viewing systems of a conventional electron microscope. Assume a beam of electrons has passed through the exit aperture of the electron gun and are incident on the first of three crystals. Because of the regular atomic configuration of the crystal, a part of the beam is diffracted and part is transmitted directly through the crystal. A second crystal, less than 5 cm in front of the first, is of such dimensions and so positioned that it accepts only the transmitted beam and one of the first-order diffracted rays. An aperture between the second crystal and the third, which is placed at a distance equal to the separation of the first and second crystals, limits the electron beam to

(*Continued on page* 197)

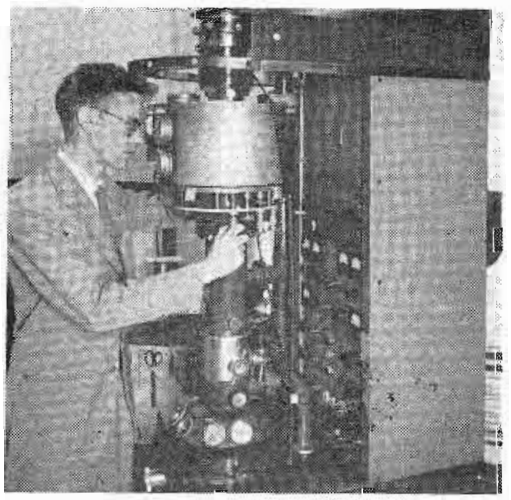


Fig. 1: Adjusting the NBS interferometer

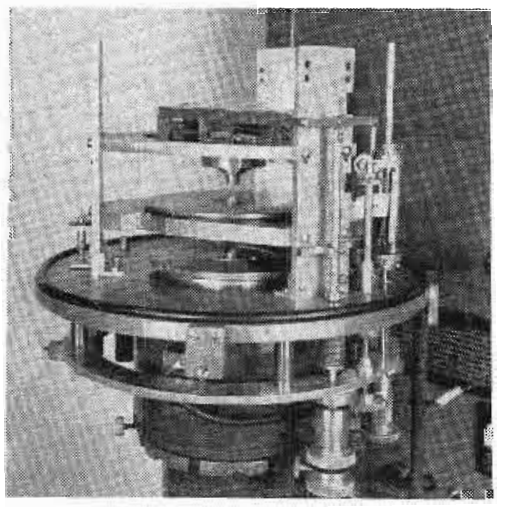


Fig. 2: Internal mechanism of interferometer

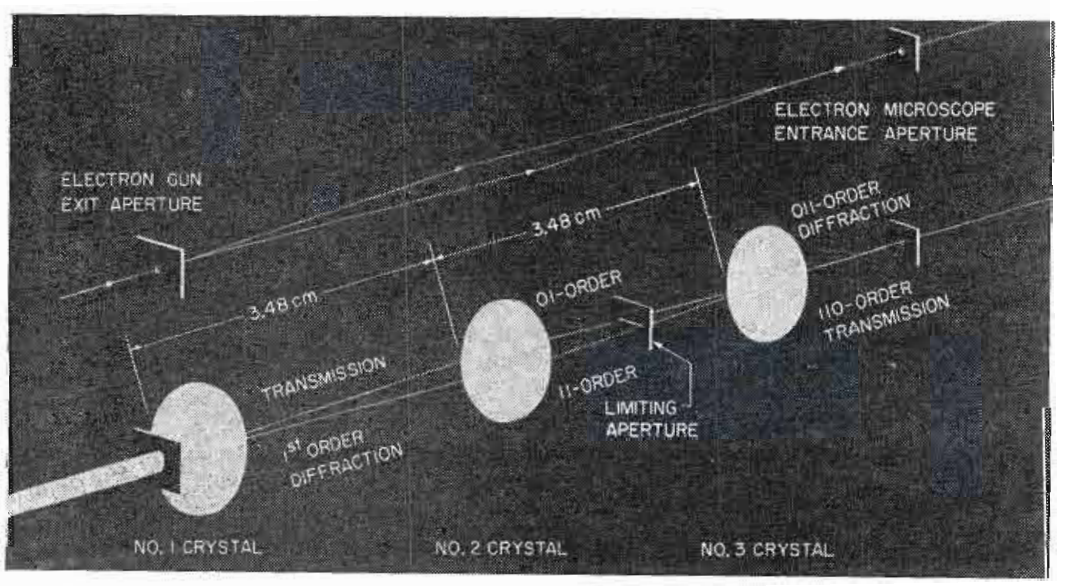


Fig. 3: Sketch demonstrating electron beam diffraction through series of three crystals

VIBRATION GENERATOR

Electronic equipment is being called upon increasingly for applications where it is subjected to severe shock and vibration, and engineers have had to develop special components rugged enough to withstand such strenuous service. Electron tubes are a particular problem from the standpoint of severe

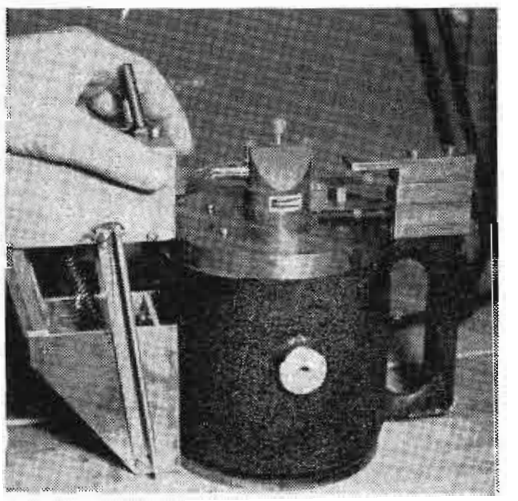


Fig. 4: Inserting experimental subminiature tube into NBS wide-range tube vibrator. Tube under study becomes an integral part of vibrator's armature or moving element when mounted

vibration. In addition to being strong enough not to fail mechanically, the tube must be low in microphonics; spurious electrical signals generated by vibration of the tube must be low in relation to the desired signal that the tube is handling. In ordinary receiving tubes, microphonics may easily be a thousand or even a million times greater than the intrinsic tube noise. Tube microphonics can be a particularly difficult problem in miniaturized equipment.

An improved wide-range vibration generator is facilitating the study of low-microphonic tubes in the NBS electron tubes laboratory. Recently developed by J. D. Rosenberg, W. B. Hillstrom, and L. T. Fleming, the NBS tube vibrator produces accelerations up to 20 times that of gravity and is flat within 20% over the unusually wide range of 100 to 10,000 cps. The tube under study is fitted into a hole in the vibrator's moving element, or armature. The armature is a cylindrical block of nonmagnetic material with a "voice coil"—for the audio-frequency driving voltage—at its lower end. Two flexible metal strips hold the armature centered in an electromagnetic field structure powered by 40 watts of 120-volt dc. Although the only model of the tube vibrator thus far constructed was built to accommodate subminiature-type tubes, the design could readily be modified for microphonics studies of miniature or octal tubes.

Commercially available vibration

the National Bureau of Standards

FOR ELECTRON TUBES

generators of the mechanically driven type have upper frequency limits of only about 300 CPS; they are primarily vibration fatigue testers, having irregular waveform and lacking the flexibility required for development work. Commercial vibrators of the electrodynamic or "loudspeaker" type are seldom useful at frequencies above 3000 CPS. The moving coil in this type of vibrator is usually fastened to a drive rod that typically has objectionably sharp resonances in the neighborhood of 2000 CPS.

In the NBS vibrator the upper frequency limit is raised by making the armature simple and rugged, of a material having a high ratio of rigidity to weight. Linen bakelite, which is only moderately good in this particular respect, was used for the present armature in the vibrator because of its convenience and availability. The fundamental resonance occurs in the neighborhood of 18,000 cycles; response begins to rise at about 10,000 cycles. Use of a material with a higher rigidity-to-weight ratio would substantially raise the frequency of fundamental resonance.

Development of the NBS tube vibrator was dependent upon the previous development of a small barium titanite

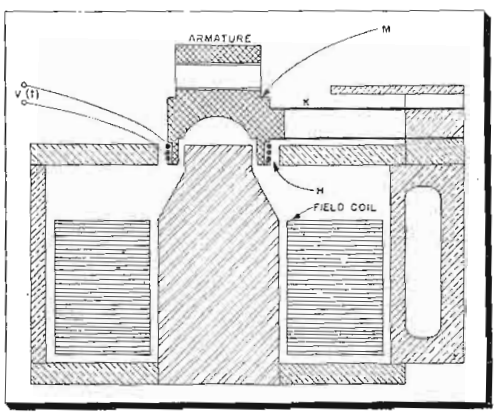


Fig. 5: Cross-sectional drawing shows essentials of the new NBS tube vibrator

accelerometer (NBS Model 3) capable of measuring vibration frequencies to 20 KC at acceleration levels of 0.2 to 10,000 *g*.

Another barium titanate accelerometer, similar in shape and weight to a T-3 subminiature tube, was developed expressly to meet needs arising in the development of the vibrator. The problem was how to design a convenient tube holder for the vibrator, sufficiently free from stray compliances and resonances to assure that the motion of the tube would conform closely to the motion of the vibrator up to at least 10 KC. The subminiature-tube-type accelerometer facilitated the design of a tube holder meeting this requirement.

FREQUENCY DEVIATION METER

To provide more reliable and sensitive receiving and recording instruments for communications signals, NBS has for some time carried on a continuous program of research and development in this field. Most recent product of the program is a comparatively simple frequency deviation meter developed by Norris Hekimian of the NBS Central Radio Propagation Lab. The instrument indicates the deviations of a signal from a reference frequency to better than 0.5%. It performs the same function as the "tuning eye" on some regular radio broadcast receivers but with sufficient precision to be used in the laboratory or as part of the production inspection procedure in a manufacturing operation.

The circuit consists of a limiter-discriminator arrangement and provision for driving an indicating device from the discriminator output. Normally, the arrangement includes two stages of limiting, one of discrimination, and a driving stage. However, by employing the new 6BN6 gated-beam tubes, it has been possible to reduce circuit complexity and to hold the tube complement to two in number. Advantage is taken of the input-output characteristics of the 6BN6 tube—which rises sharply to an equilibrium level, as in a step function—to obtain the second stage of limiting combined with quadrature-grid discrimination. The indicating device—a 150-0-150 microameter—is driven through a dc bridge circuit by the current resulting from an unbalanced condition in the plate circuit of the discriminator. The circuit unbalance arises when the input signal differs from the zero-set or reference signal.

To avoid plate-current cutoff by self bias, which is possible with gated-beam tubes, the NBS circuit employs 60-mh chokes in the signal grid returns of the 6BN6 tubes. Low-value resistors are placed in the plate leads to help dampen the plate surges and to aid in obtaining a flat limiter characteristic. A well regulated plate supply operating at 150 volts has a current drain of only 10 ma. For more stable operation, the heater supply is also regulated. Circuit

(*Continued on page* 199)

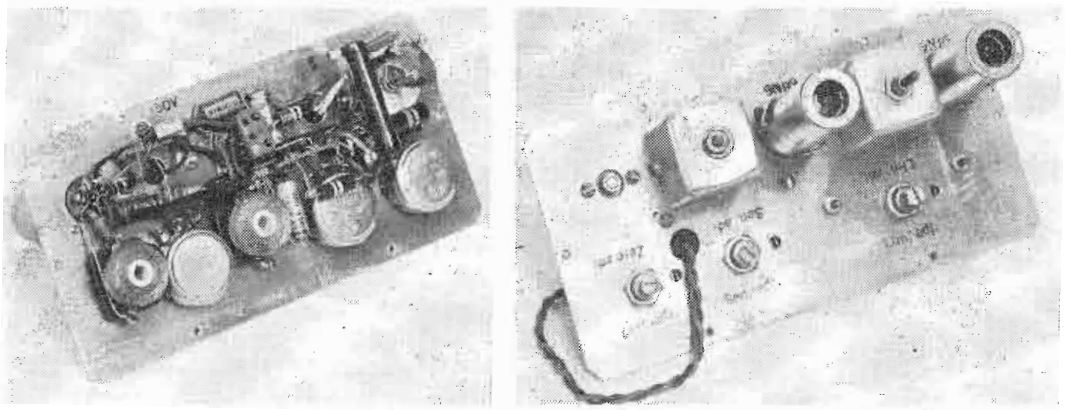


Fig. 6: (Left) Underside of deviation meter shows resonant circuit coils and associated components. (Right) Top side of meter has screw-driver controls for adjusting zero setting, sensitivity, limiting characteristics, reactances etc.

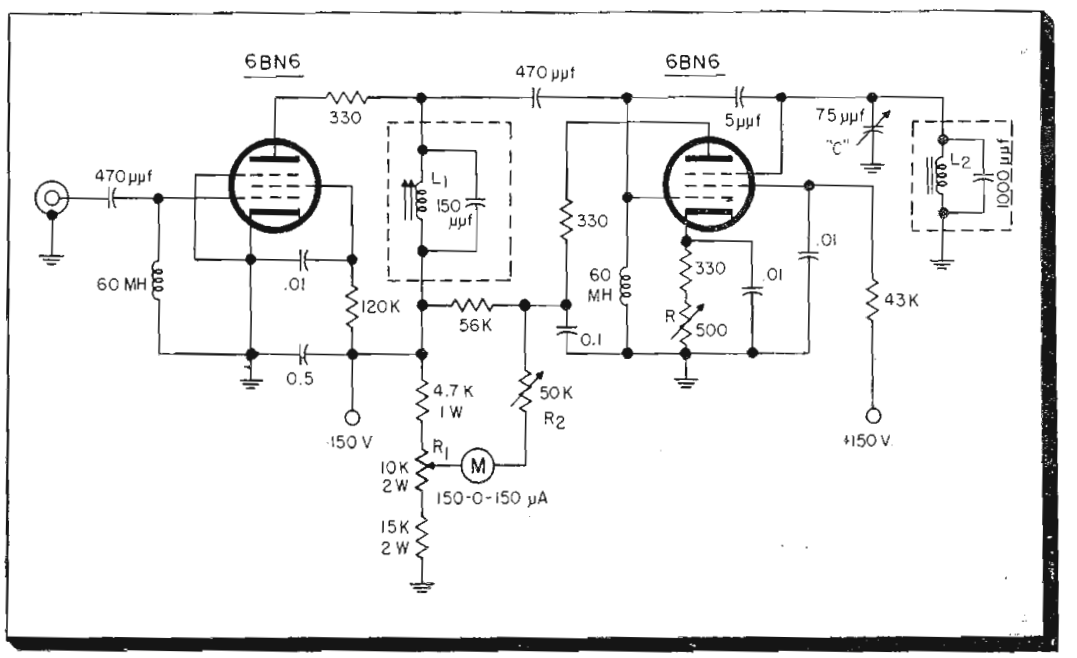


Fig. 7: Circuit diagram of frequency deviation meter. Two 6BN6 gated-beam tubes are used as the limiters and discriminators. Indicator is 150-0-150 microammeter 60 millihenry chokes in signal grid returns prevent self-bias plate current cut-off.

Modulation and Frequency Indicator

By ROBERT GRIMM
Hewlett-Packard Co.
395 Page Mill Rd.
Palo Alto, Calif.

THE accuracy to which TV stations must maintain their carrier frequencies, particularly in the UHF band, imposes stringent requirements on the accuracy of station monitoring equipment. One important reason for high monitor accuracy arises from the use of "offset carriers" to reduce co-channel interference. In areas where more than one signal on a given channel is present, the weaker signal causes a "venetian blind" effect in which moving horizontal black bars disturb the picture. Alternatively, part of the undesired picture may appear.

By offsetting the carrier of one of the transmitters by 10 KC or 20 KC, it has been found that the interference may be reduced by an amount equal to reducing the interfering signal by about 14 db. For this reason certain of the stations on the same channel in adjacent areas are assigned frequencies that are 10 KC above or 10 KC below the nominal channel frequency. However, to be effective in reducing this co-channel interference, the individual stations must maintain their frequency close to their assigned frequency so that the 10 KC or 20 KC spacing between transmitters will be accurate.

The FCC requires that the visual transmitters be maintained within ±1 KC of their assigned frequency. If it is assumed that the monitoring equipment should have an accuracy at least twice the required accuracy of the transmitter, then the monitor must be accurate within 500 cycles for a reasonable length of time without recalibrating. At the upper end of the UHF band, this is an accuracy of about a half part per million for the monitor.

Aural Transmitter Frequency

The frequency of the aural transmitter is not quite so critical as the visual transmitter. However, certain receivers of the intercarrier type use the difference frequency between the aural and visual carriers as the aural intermediate frequency. The nominal 4.5 MC spacing of the visual and aural carriers should therefore be held accurately. The FCC requires that the aural transmitter be within 4 KC of its assigned frequency, Again, if it is assumed that the monitor should have twice the required accuracy of the transmitter, the monitor should then indicate accurately the aural carrier frequency within 2 KC.

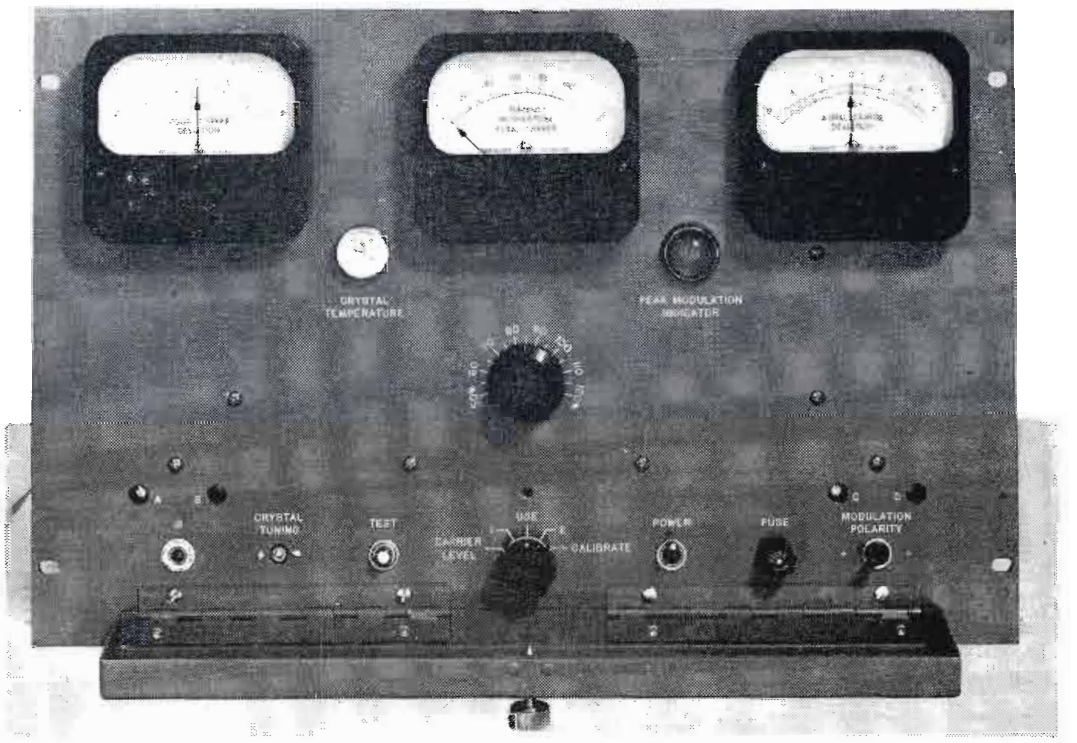
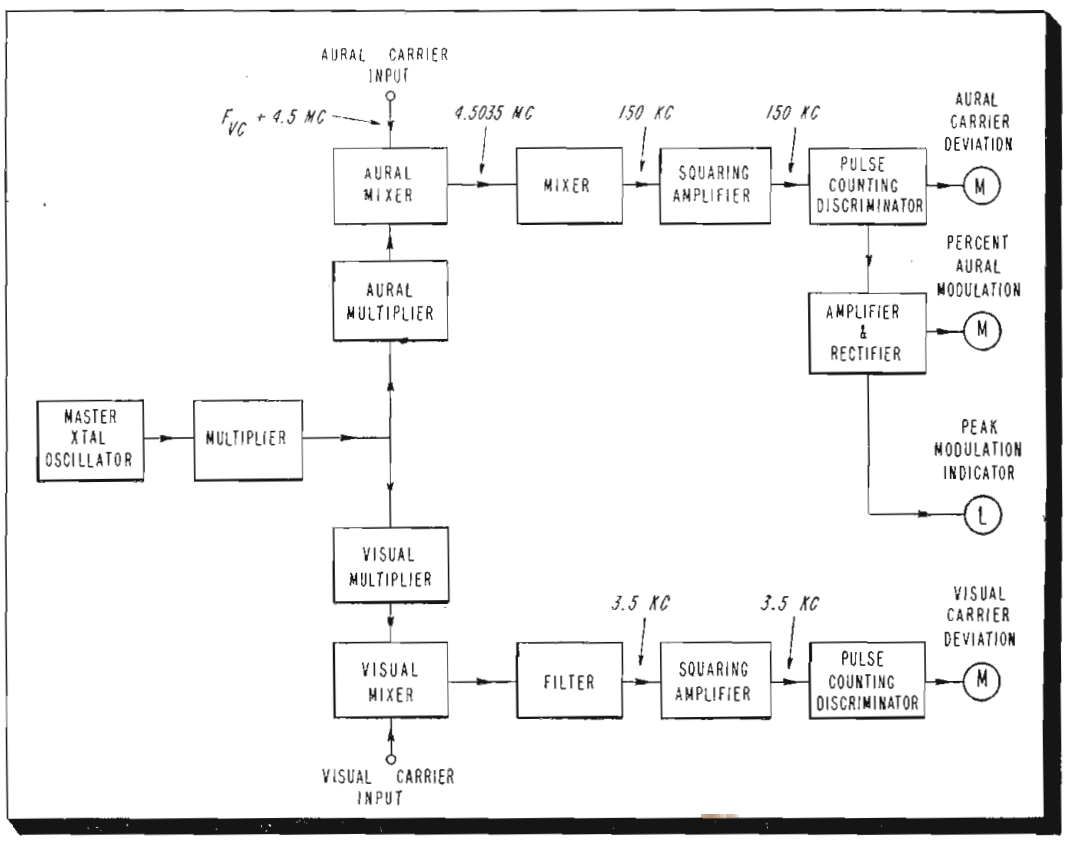


Fig. 1: Front panel view of TV monitor developed by Hewlett-Packard for broadcasting stations

To meet these requirements, the Hewlett-Packard Co. Model 335E TV Monitor (Fig. 1) has been developed specifically for TV stations. The overall functioning of the monitor is shown in the block diagram in Fig. 2.

The monitor as a whole may be considered to consist of four general sections: (1) a very accurate crystal-controlled oscillator and associated multipliers to develop a precise reference frequency for comparison with the transmitter carrier frequencies; (2) mixers to combine the reference frequency with the transmitter carriers; (3) discriminators to measure accurately the difference frequencies from the mixtures and to present the difference readings on meters; (4) an aural modulation cir-

Fig. 2: Monitor comprises oscillator and multipliers, mixers, discriminators, aural circuit



for VHF and UHF

New instrument monitors TV carrier within accuracy of 500 CPS. Peak-reading voltmeter indicates aural modulation level. Unit's importance stressed where offset carriers are used to reduce co-channel interference

cuit to measure the percent aural modulation. These sections will be considered individually in greater detail.

The master oscillator is a twin-tube cathode-coupled Butler oscillator which includes a series-resonant crystal in its feedback loop. The fundamental components of this oscillator are shown in Fig. 3. Tube V1A operates as a grounded-grid amplifier with its input voltage applied to the cathode. The plate circuit is broadly tuned to the resonant frequency of the crystal. V1A is thus an r-f amplifier providing gain at frequencies near the crystal frequency. Tube V1B is a cathode follower driven from the plate of section V1A. From its low-impedance cathode circuit, a voltage may be obtained without loading the plate circuit of V1A. The cathode voltage of V1B is in phase with the cathode voltage of V1A, so that if the two cathodes are tied together directly, the circuit will oscillate at a frequency determined mainly by the plate tank components of V1A. However, by connecting the two cathodes together with a crystal, the circuit will only oscillate at a frequency at which the crystal is a a low impedance, which is at its series-resonant frequency. Since both cathode resistances are only a few hundred ohms, the effects of tube capacities and stray wiring capacities are minimized.

Oscillator Frequency

By making the plate tank of V1A a low Q circuit, its tuning has little effect on the oscillator frequency. By choosing the proper operating points and circuit component values, this circuit has been found to be quite insensitive to heater voltage changes. Measurements have shown the variation in frequency to be less than 0.2 parts per million for a heater voltage change of ±12%. By using a constant-voltage regulating transformer to supply the power for the heaters, frequency variations with line voltage changes have been virtually eliminated.

The crystal itself operates in a temperature-controlled oven which maintains the temperature constant to within 0.1°C, independent of the ambient temperature. Measurements on this oscillator have shown it to be stable to better than a half part per million for a period of ten days. Typical stability curves for two of the oscillators are shown in Fig. 4.

The output of the master oscillator is coupled to the first multiplier. This multiplier in turn drives the separate aural and visual channel multipliers. These multipliers, in individual shielded cans, also serve to isolate the two channel signals from each other.

The frequency of the crystal in the master oscillator is chosen so that one of its harmonics is exactly 3.5 KC below the visual carrier. In the visual mixer, this harmonic from the visual multiplier beats with the r-f input from the visual transmitter to produce a beat note of 3.5 KC when the transmitter is operating at its assigned frequency. After passing through a series of squaring amplifiers, the 3.5 KC signal is applied to a pulse-counting discriminator.

Pulse-counting Discriminator

Fig. 5 shows the fundamental components of the pulse-counting discriminator. From the squaring amplifiers a push-pull pair of square waves is obtained. These square waves are used to turn on and off tubes V_1 and V_2. The cathodes of these tubes are fed from a constant-current source, so that alternately the plate current of V_1 and V_2 is the entire current from the constant-current source. The precision wire-wound resistors R therefore develop a square wave with very closely regulated amplitude. The time constant RC is very short compared to the period of half a cycle of the intermediate frequency. Therefore, C charges and discharges a controlled amount for each cycle of the difference frequency between the visual carrier and the internal reference frequency. By connecting a full-wave bridge rectifier and a meter in the capacitor charge and discharge path, a meter indication can be obtained. The current through the meter is given by the equation

$$I_m = 2I_oRCf$$

where I_m is the average meter current
I_o is the current from the constant-current source
R is the plate load resistance
C is the coupling capacitance
f is the frequency of signal applied to the grids V_1 and V_2

This equation shows that the meter current is exactly proportional to the frequency of the applied signal, if R, C, and I_o are constant. Since R and C are precision components and I_o is obtained from a high-impedance constant-current source, these conditions are met.

Although the circuit as described above gives a very linear indication with freqency, it is more convenient in operation for the carrier deviation meter scale to be expanded and

(*Continued on page* 148)

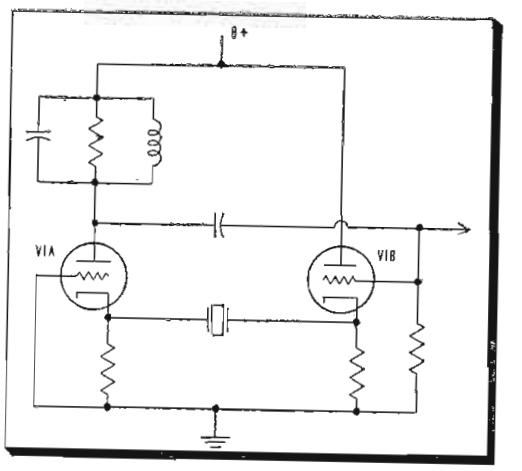


Fig. 3: Cathode-coupled Butler oscillator

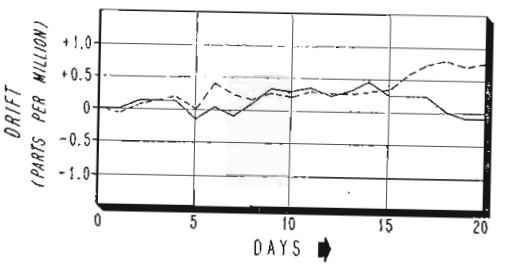


Fig. 4: Stability curves for two oscillators

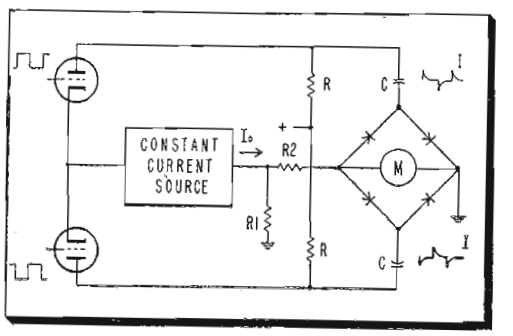
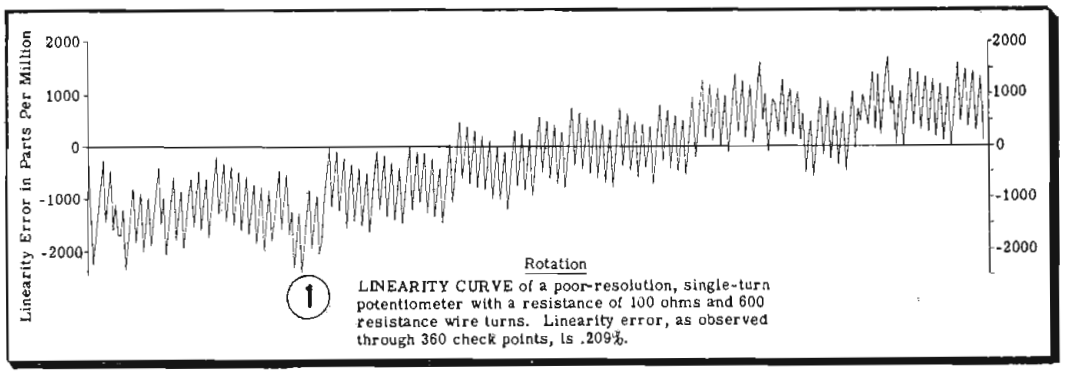
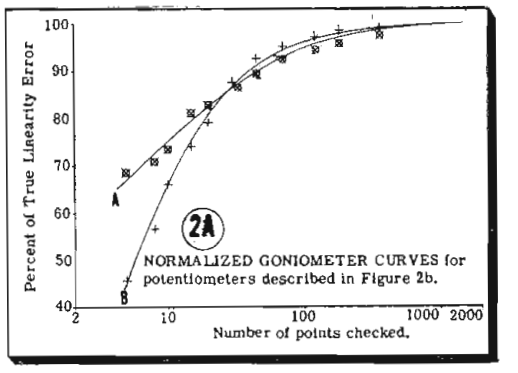


Fig. 5: Visual pulse counting discriminator

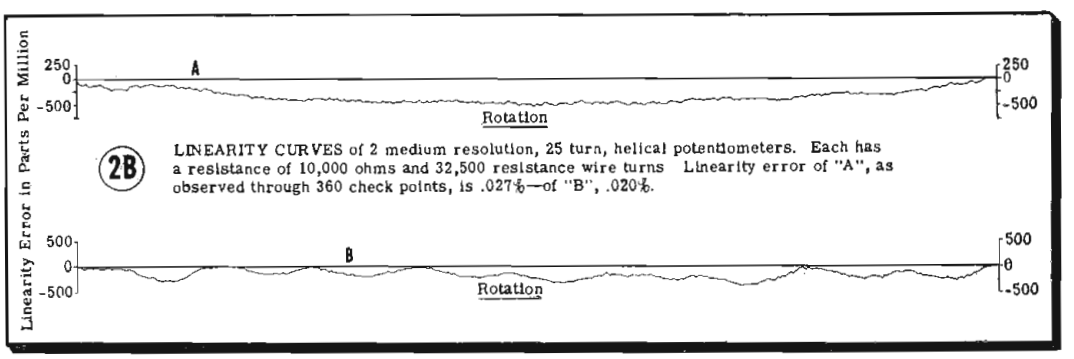
Accuracy of Potentiometer



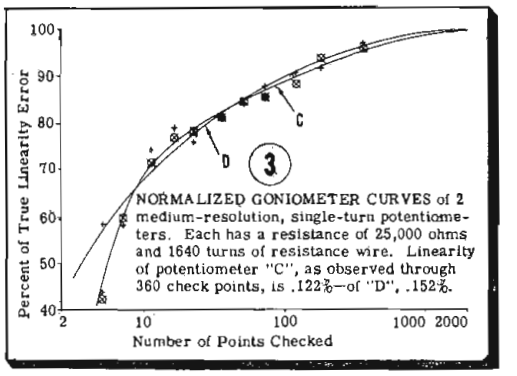
1 LINEARITY CURVE of a poor-resolution, single-turn potentiometer with a resistance of 100 ohms and 600 resistance wire turns. Linearity error, as observed through 360 check points, is .209%.



2A NORMALIZED GONIOMETER CURVES for potentiometers described in Figure 2b.



2B LINEARITY CURVES of 2 medium resolution, 25 turn, helical potentiometers. Each has a resistance of 10,000 ohms and 32,500 resistance wire turns Linearity error of "A", as observed through 360 check points, is .027%—of "B", .020%.



3 NORMALIZED GONIOMETER CURVES of 2 medium-resolution, single-turn potentiometers. Each has a resistance of 25,000 ohms and 1640 turns of resistance wire. Linearity of potentiometer "C", as observed through 360 check points, is .122%—of "D", .152%.

Recent research indicates linearity error values to be far less reliable than generally believed. For calculated linearity error to remain within 10% of true linearity error 250 check points must be used

R. McDONALD & I. HOGAN

Helipot Corp., 916 Meridian Ave., S. Pasadena, Calif.

AS is generally known, a perfectly linear potentiometer would be one in which the resistance obtained would vary absolutely and exactly in direct proportion to the movement of the contact point along the resistance element. So far, the production of a perfectly linear potentiometer has been an impossibility, and today the generally accepted interpretation of "linear potentiometer" is one which has been designed and manufactured to produce as near linear results as possible. The fact that no potentiometer is perfectly linear, necessitates the calculation of linearity error in various models, so that their application and use can better be determined.

For some time Helipot Corp. engineers have felt that the conventional number of check points usually used in estimating linearity error in a wire-wound, linear potentiometer has not been sufficient to produce a reasonably accurate figure. An investigation has recently been completed concerning this question, and the results tend to substantiate the fact that insufficient check points have been used regularly in past calculations of linearity error.

The primary purpose of this investigation was to determine reliability of linearity error, as calculated from a given number of check points in both single-turn and multiturn potentiometers. Consideration was also given to variances that might be caused by length of mandrel and/or number of turns of resistance wire.

Test Procedure

The test procedure used for making linearity measurements on the various potentiometers examined during this investigation was as follows: Using a dividing head, a voltage divider and a galvanometer, each potentiometer was set up in a bridge circuit; then 360 equally spaced readings were taken. From this data, linearity error calculations were made. The number of calculations which could be made from the observed readings was, of course, inversely proportional to the number of check points used. For example, when all 360 points were used only one calculation was possible; if 180 points were used, two calculations could be made; when 120 points were used, three calculations could be made and when 72 check points were included, five calculations were possible.

During this investigation, if less than 72 check points were used, only 5 calculations were made, although more were possible. Calculations concerning linearity error of the potentiometers used in this study were made using 360, 180, 120, 72, 45, 30, 20, 15, 10, 8, and 5 check points on each potentiometer. The linearity values obtained from the check points were plotted on semi-log graph paper, with the observed linearity errors on the linear ordinate, and the different numbers of points checked on the logarithmic abscissa. This resulted in a series of curves which were termed "goniometer curves." Using the 360 check-point data, curves of observed linearity error versus shaft rotation were plotted on standard linear graph paper.

Varying magnitude of observed linearity error made comparison of goniometer curves difficult. To over-

Linearity Measurements

come this difficulty, the curves were normalized by showing the observed linearity error as a percentage of the estimated true linearity, on the linear ordinate, with the true linearity considered as 100%. (Estimated true linearity was found by extrapolating the goniometer curve to the point where it became flat, in other words, to the extent that observed linearity would not change with addition of more check points; it was felt that after 2000 check points, no appreciable change in observed linearity would occur.) Curves normalized in this manner were termed "normalized goniometer curves." Examples of normalized goniometer curves are shown in Figs. 2a, 3, 4, 5a and 6a.

Linearity Error Curve

There is a direct connection between the normalized goniometer curves and the observed linearity error curves, since both are derived from the same data. For this reason, the shape of the 360-point linearity error curve is important. Several types of fluctuation and variations in shape occur in the linearity error curves of typical wire wound potentiometers. As shown in Figs. 1, 2b, 5b, and 6b, there is usually a general shape to the curve; for example, it may be sinusoidal, parabolic, etc. Upon this basic shape are superimposed the point-to-point fluctuations. In multi-turn potentiometers there is usually a cyclic error which repeats itself for each 360 degrees of the potentiometer, or each full turn.

Other important factors in determining the shape of the linearity error curve, as well as the normalized goniometer curve, are variations in resistance wire and core wire, and erratic spacing of resistance wire turns. One of the most dominant factors is resolution error.

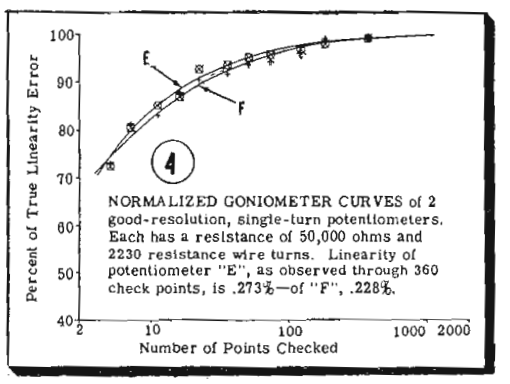
In considering linearity error curves, it is essential to understand the effect of resolution error, an error that is present to a greater or lesser degree in all potentiometers. The potentiometers chosen for investigation included samples of Helipot models having good, medium and poor resolution. A potentiometer with good resolution usually has a large number of resistance wire turns; a potentiometer with poor resolution, usually has a small number of turns. Correspondingly, a small number of turns usually means low resistance; a large number, high resistance.

Resolution error can become a dominant factor in poor resolution potentiometers. It varies in amplitude inversely with the number of resistance wire turns and causes a sawtooth shape on the linearity pattern. With a small number of turns, or a potentiometer of poor resolution, the amplitude of resolution error, as indicated by the height of the sawtooth fluctuations, tends to be large. This is well illustrated in Fig. 1 and Fig. 6b, in which are plotted data on two single-turn potentiometers with a relatively small number of turns (600 and 705 turns respectively) and poor resolution. Note that this type of linearity error curve shows sawtooth shapes; these shapes are arranged in cycles, and may be of considerable amplitude.

Investigation has shown that the pattern of cycles caused by resolution error is determined by the ratio of the number of resistance wire turns to the number of readings. The cycles have been classified in two groups which can be referred to as minor and major cycles. Minor cycles are made up of a group of several readings; major cycles consist of a group of two kinds of minor cycles. The number of readings per minor cycle, the number of minor cycles per major cycle, and the amplitude of both can be calculated by taking into consideration the number of resistance wire turns in the potentiometer and the number of readings to be taken. Cyclic error patterns of this type (showing sawtooth shapes of considerable amplitude) will only be found in potentiometers of the poorest resolution. This is because, as noted above, resolution error varies inversely with the number of resistance wire turns. It is true that some resolution error will appear in potentiometers of better resolution, but not to the extent that the cyclic patterns will be obvious.

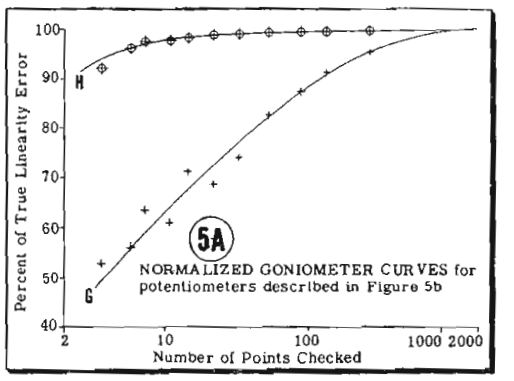
Sawtooth Pattern

If linearity readings could be made at an infinite number of points along a potentiometer coil, the linearity error curve would assume a sawtooth pattern with each tooth of equal spacing and amplitude. This is caused by the fact that as the slider moves from one turn towards another, the resistance reading does not change until the next turn is actually contacted. Thus, too little resistance is read in comparison to the amount of slider movement; hence



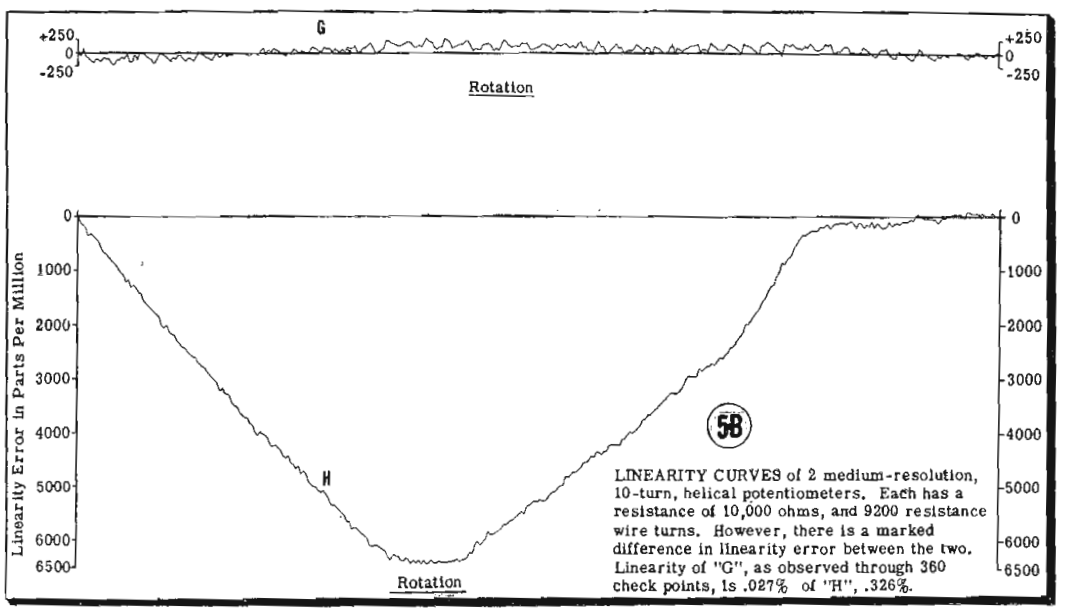
4

NORMALIZED GONIOMETER CURVES of 2 good-resolution, single-turn potentiometers. Each has a resistance of 50,000 ohms and 2230 resistance wire turns. Linearity of potentiometer "E", as observed through 360 check points, is .273%—of "F", .228%.



5A

NORMALIZED GONIOMETER CURVES for potentiometers described in Figure 5b



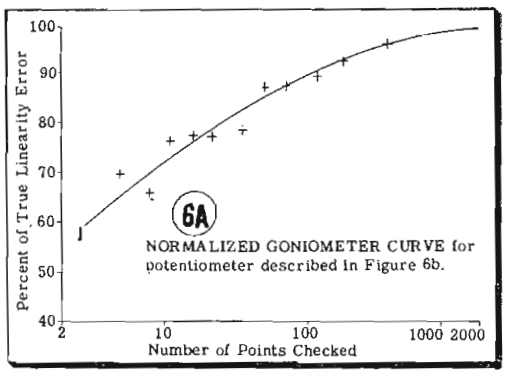
5B

LINEARITY CURVES of 2 medium-resolution, 10-turn, helical potentiometers. Each has a resistance of 10,000 ohms, and 9200 resistance wire turns. However, there is a marked difference in linearity error between the two. Linearity of "G", as observed through 360 check points, is .027% of "H", .326%.

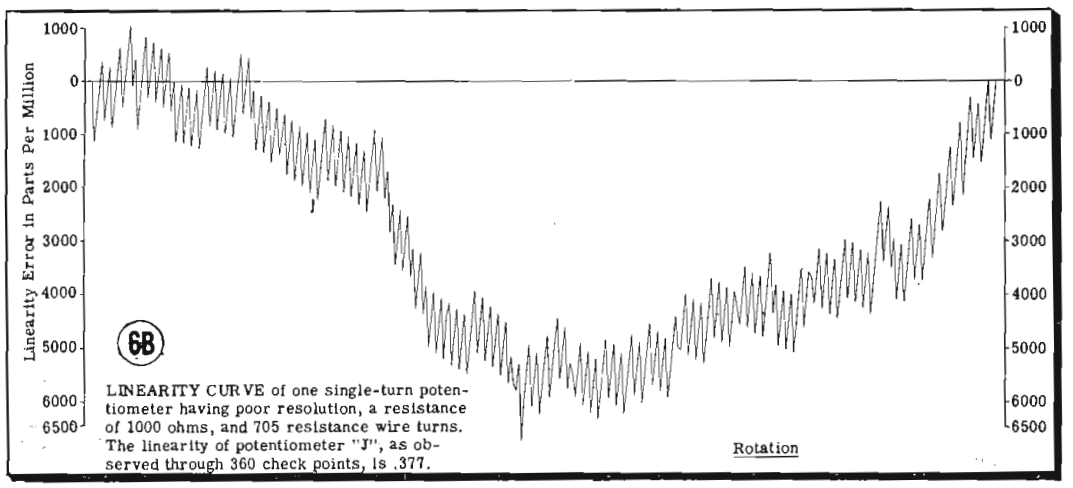
POTENTIOMETER LINEARITY (Continued)

a negative error exists until the halfway point is reached and the slider contacts the next turn. At this point the resistance reading becomes higher in reference to slider position than it should be, and there is a positive error. When the center of the slider crosses the center of this turn, the error passes through zero and becomes negative again.

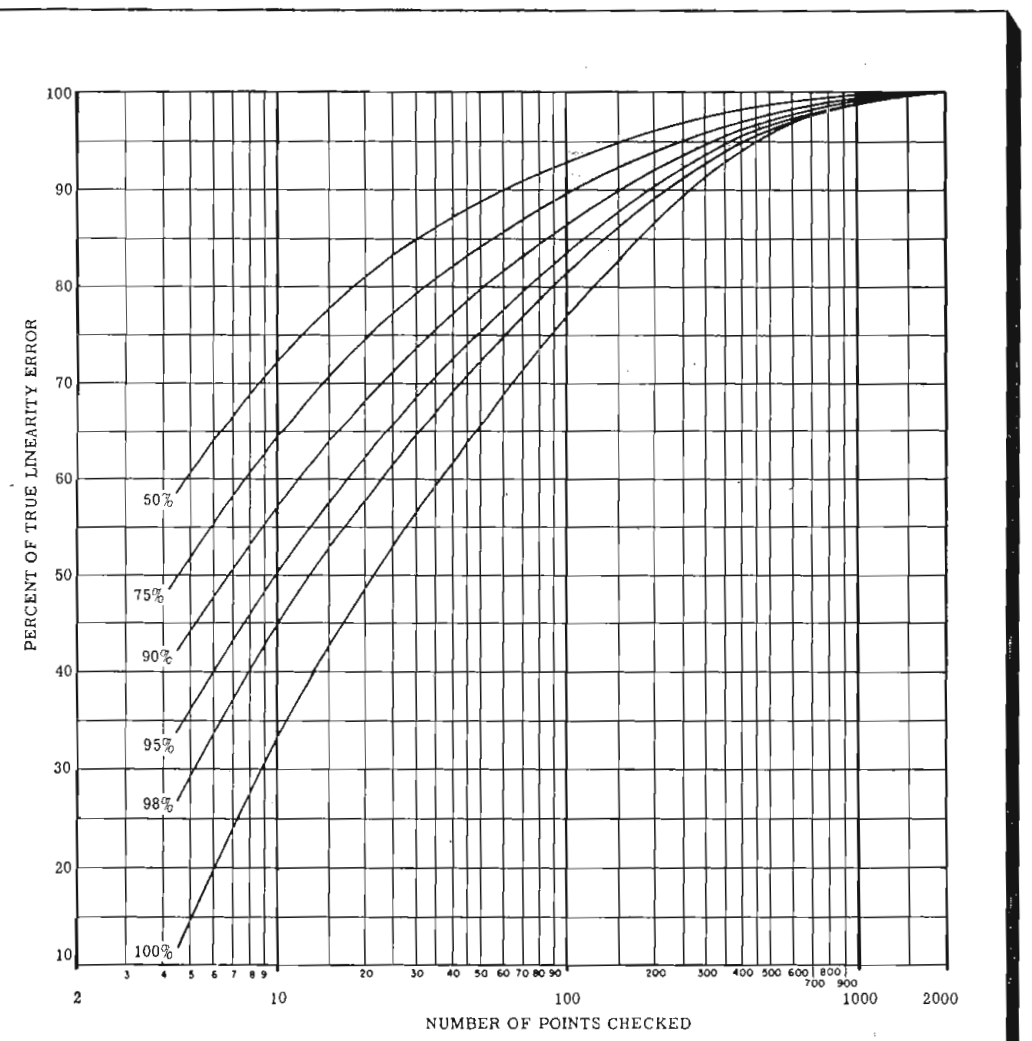
This procedure repeats itself as the slider passes over each turn, thus producing a sawtooth shape on the linearity curve. If linearity readings could be made directly on every turn, or directly on an integral number of turns, there would be no observed resolution error, as each reading would be made at the point of zero resolution error. The linearity error curve thus obtained would be in the form of a comparatively smooth line. Inasmuch as it is not presently possible to take linearity readings at the exact center of each turn, the resolution error is normally indicated by an irregular sawtooth pattern on the linearity error curve.



6A NORMALIZED GONIOMETER CURVE for potentiometer described in Figure 6b.



6B LINEARITY CURVE of one single-turn potentiometer having poor resolution, a resistance of 1000 ohms, and 705 resistance wire turns. The linearity of potentiometer "J", as observed through 360 check points, is .377.



7 **Curves developed from results of approximately 3,000 linearity error calculations made during investigation of calculated linearity errors in wire-wound potentiometers.**

The percentage figure opposite each curve indicates the percentage of linearity error calculations (for any number of check points) that fell above the corresponding curve. For example, the curve labeled "50%" indicates that 50% of all calculations made for any given number of check points, will fall above this curve

Normalized Curves

Results of the Helipot investigation of normalized goniometer curves have shown that apparently no single factor governing the shape of the curves is of such dominant importance as to permit utilizing that factor alone to obtain consistent predictions of results. There is a definite relationship between the shape or height of a goniometer curve and resolution, and between the curve and linearity error. By combining these *two* factors, an acceptable correlation is obtained.

Comparison of the normalized goniometer curves with the ratio of linearity error to resolution error has shown that in general the higher this ratio, the higher the goniometer curve will be. A high curve indicates that fewer points need to be checked to get a reasonably accurate indication of the true linearity error.

By a close examination of the 360-point linearity curve of a potentiometer, a rough estimate can be made of the height of its normalized goniometer curve. A potentiometer with a fairly high linearity error, but with a smooth curve having little "jaggedness" will usually have a high normalized goniometer curve. (See linearity error curve "H" and the normalized goniometer curve "H" in Figures 5a and 5b.) Conversely, a potentiometer having a relatively large resolution error or a large amount of jaggedness will generally have a low normalized goniometer curve. This holds true whether or not the jaggedness is caused by resolution error. Fig. 6b shows a jagged linearity curve because of a high resolution error;

(*Continued on page* 200)

Rapid Parallel-Z Calculations

"Concentric circle" graphical method quickly yields resultant for any two parallel impedances. Only four straight construction lines employed.

By LEO STORCH

Advanced Electronics Laboratory, Hughes Aircraft Co.
Florence Ave. at Teale St., Culver City, Calif.

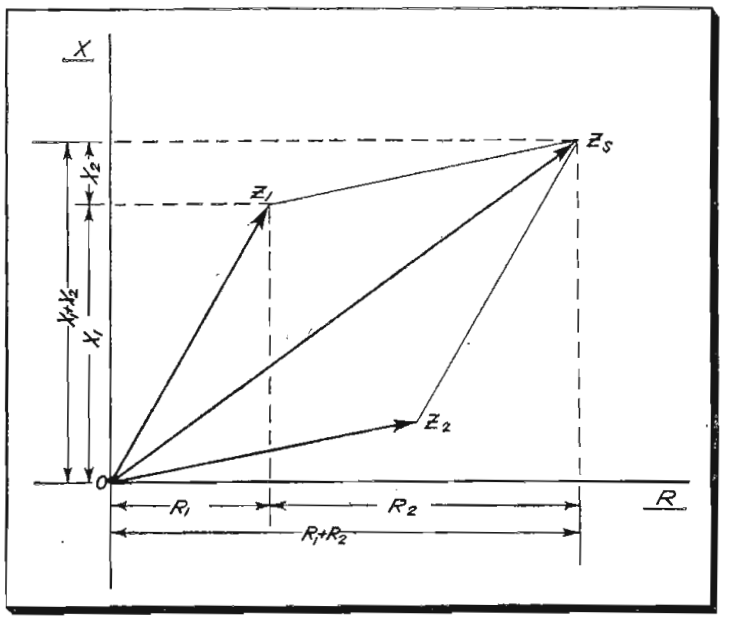


Fig. 1: Graphical representation of impedances in series

COMBINATIONS of two impedances in series or in parallel constitute the two most fundamental and most frequently occurring operations of network analysis and design. The resultant of two impedance connected in series is easy to compute. It is required merely to add the resistive and reactive components of the two impedances separately, in order to obtain the resultant resistance and reactance. In symbols:

$$Z_s = Z_1 + Z_2$$
$$\therefore R_s + jX_s = (R_1 + R_2) + j(X_1 + X_2)$$

Likewise, it is simple to represent the series combination in the impedance plane (Fig. 1). The two impedances Z_1 and Z_2 are plotted in the conventional manner by laying off their R and X components along the two coordinate axes. Thereupon Z_s is obtained by vector addition. This operation consists of translating Z_1 such that its base touches the tip of Z_2 or of translating Z_2 such that its base touches the tip of Z_1. Then Z_s is equal to the vector extending from the origin to the tip of the translated vector.

No such simple method is available for parallel-impedance combinations, assuming that both the initial data and the solution are to be expressed in terms of impedance components. In view of the universal practice of dealing with resistance and reactance rather than conductance and susceptance (admittance components), this assumption is clearly justified. Since two impedances combine in parallel according to:

$$Z_p = \frac{Z_1 \cdot Z_2}{Z_1 + Z_2} = 1 \Big/ \left(\frac{1}{Z_1} + \frac{1}{Z_2} \right)$$

even the most efficient computation of Z_p includes several tedious steps, consisting of conversions from Cartesian to polar coordinates and from polar to Cartesian coordinates. The alternate method of calculating Z_p exclusively by additions, subtractions, multiplications, and divisions is even less satisfactory. When applied to the first term

$$Z_1 \cdot Z_2 / (Z_1 + Z_2),$$

it requires calculating $Z_1 \cdot Z_2$ in the form a + jb by direct multiplications and calculating $Z_1 + Z_2$ in the form c + jd, followed by multiplying both numerator and denominator by c — jd, and simplifying. Applied to $1/(1/Z_1 + 1/Z_2)$, a similar process for the sum of the two inverted terms.

Table I contains a comparative

Fig. 2: Lines OZ_1, OZ_2, and OZ_p not required in contruction

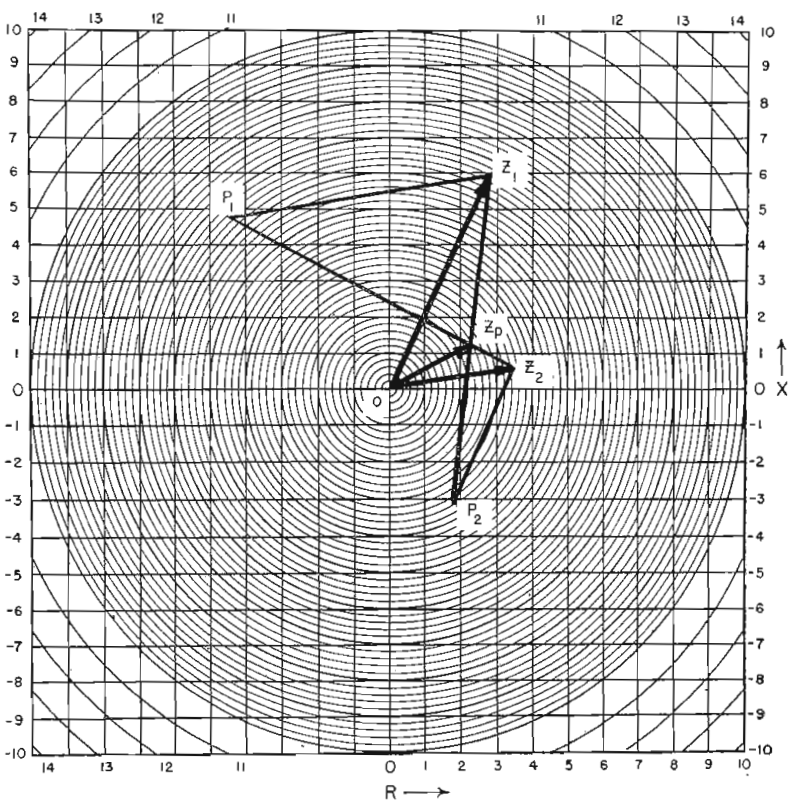
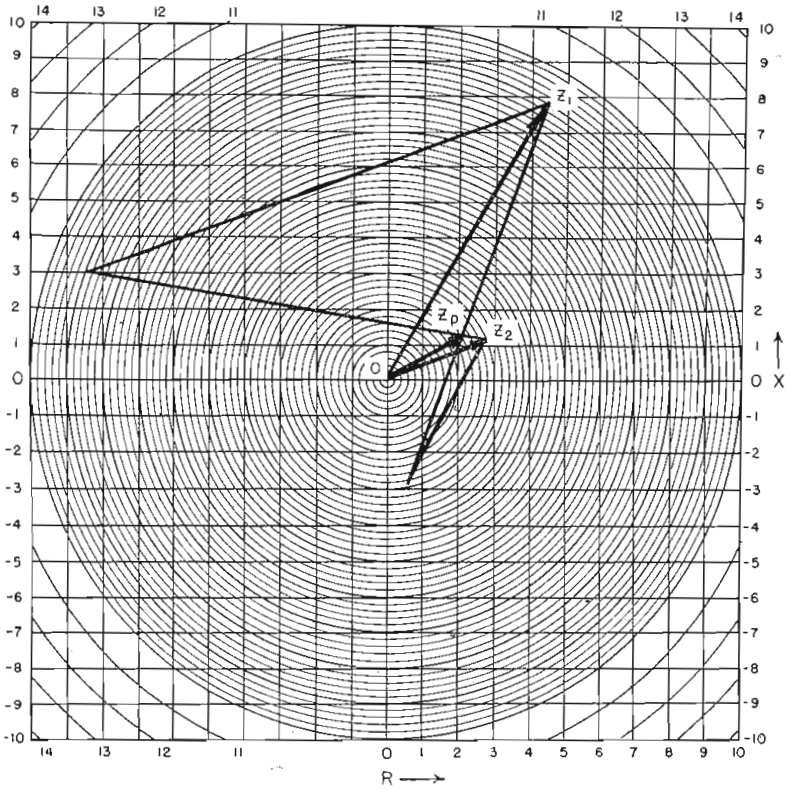


Fig. 3: All values x 10. OZ_1, OZ_2, OZ_p not required in construction



listing of the number of operations for the latter two methods (i.e.: "Impedance - Rationalization" and "Admittance - Rationalization") as well as for the two conversion methods. It should be borne in mind that "Conversion," particularly from Cartesian to polar coordinates, are not simple operations although not broken down further in Table I.

To obviate this slow process and expedite the calculation of Z_p, numerous papers have been devoted to short-cut geometrical solutions of the parallel-impedance problem. Only those methods which supply an all-geometric solution for Z_p without intermediate calculations are of interest here. Different approaches have been employed, enlisting various geometrical principles. The solution by a similar-triangle construction has been prominent among them and has occupied several writers, such as Clarke,[1] Barker[2] and, more recently, Reed.[3] Other line, triangle and circle constructions have also been developed.

"Concentric-Circle" Construction

It is believed that this paper does not merely add another item to an already rich collection, but that it introduces a more compact and satisfactory method than has been available heretofore, at least as far as the writer is aware. This method will be referred to as the "concentric-circle" construction.

Special graph paper of the type shown in Fig. 2 is prepared by superimposing a family of circles, concentric about the origin, on standard rectangular graph paper. With this type of paper available ready-made, the resultant of the combination of any two impedances (except for the special case when Z_1 and Z_2 have the same phase angle or differ by 180°) in parallel can be located by drawing only four straight lines, after Z_1 and Z_2 have been plotted in the conventional manner. Neither compass nor protractor, which have heretofore usually been essential in parallel-impedance constructions, is required. The rules governing the "concentric-circle" construction are extremely simple so that they can be grasped and retained without any special effort. Moreover, the "concentric-circle" constructions can even be performed by persons who are completely unfamiliar with circuit theory or with the manipulation of complex numbers.

TABLE I

	Impedance—Conversion	Admittance—Conversion	Impedance—Rationalization	Admittance—Rationalization
Multiplication	1	0	10	6
Divisions	1	3	2	6
Additions and Subtractions	4	2	7	6
Conversions: Cartesian→Polar	3	3	–	–
Conversions: Polar→Cartesian	1	3	–	–

Including the preparatory item (a), the "concentric-circle" construction (Fig. 2) consists of the following steps:

a) Apply the same but smallest possible multiplier to both R and X scales to make them commensurate with the range of values of the specific problem. This would normally be a power of ten, such as 10, 100, 1000, etc., but an intermediate multiplier may be justified when it improves overall accuracy. Then locate the points Z_1 and Z_2 by means of their resistive (R) and reactive (X) components in the conventional manner.

b) Draw a straight line through Z_1 parallel to $\overrightarrow{OZ_2}$, and mark its point of intersection with the circle passing through Z_1 as P_1. Also, draw a straight line through Z_2 parallel to OZ_1, and mark its point of intersection with the circle passing through Z_2 as P_2.

c) Connect P_1 and Z_2 by a straight line, and do likewise for P_2 and Z_1. The intersection of these two straight lines is Z_p, the resultant of combining impedances Z_1 and Z_2 in parallel.

This simple and straightforward procedure is completely general. It is valid when Z_1 and Z_2 both lie in the inductive quadrant or in the capacitive quadrant, or when they lie in opposite quadrants. Of course, a given impedance vector will not always terminate on one of the available circles. As with every set of discrete coordinates, it is necessary in that case to interpolate between the two adjacent circles.

Let us illustrate the method by

Fig. 4: All values x 10. OZ_1, OZ_2, OZ_p not required in construction

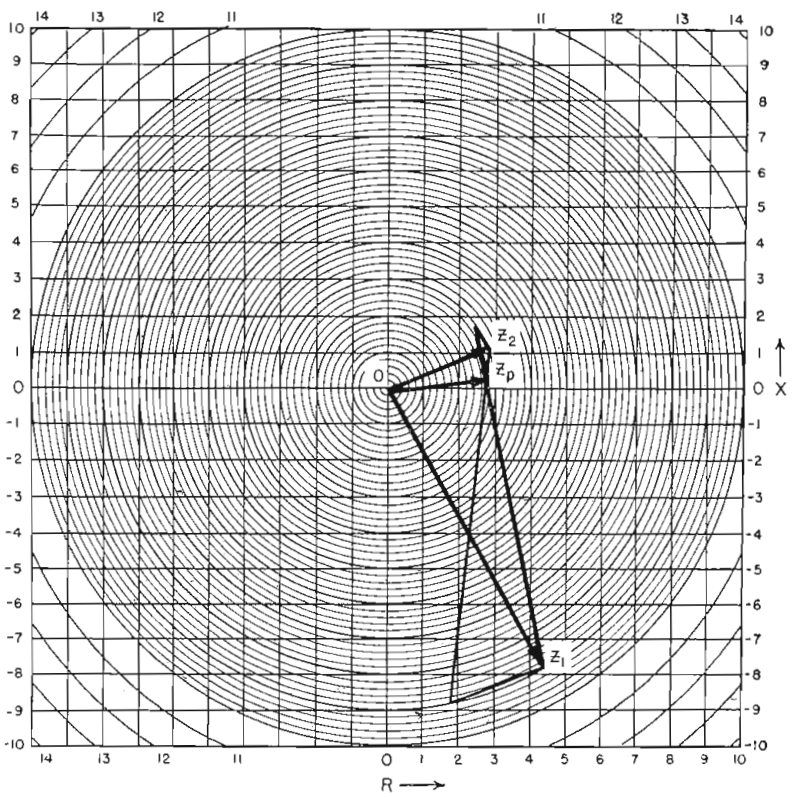
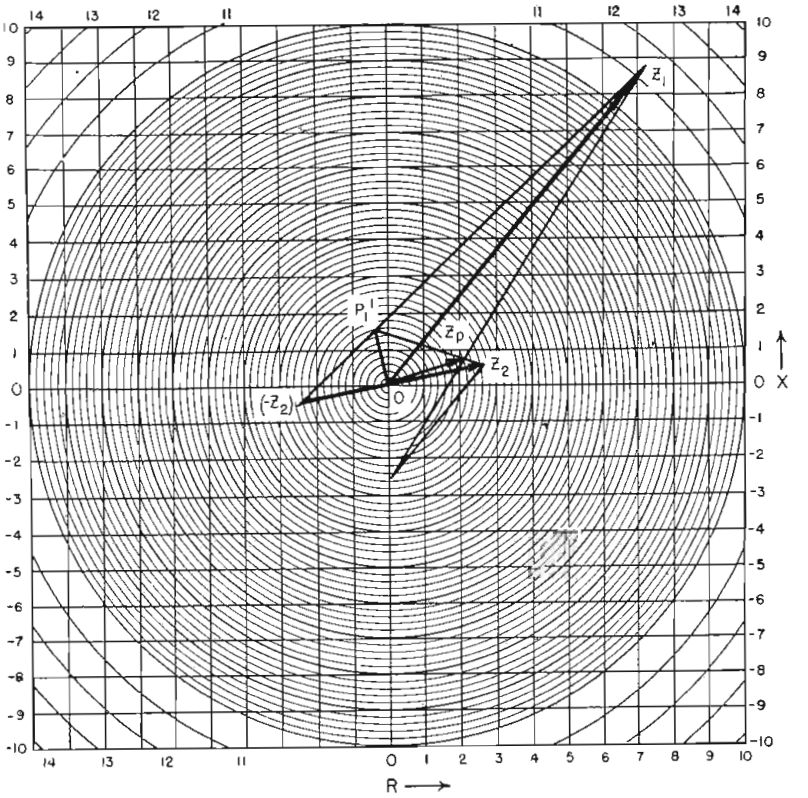


Fig. 5: Auxiliary construction used when intersection is off paper



two specific examples and indicate the equivalent numerical computations.

For the first example, let

$$Z_1 = 44.2 + j78.8$$

and $Z_2 = 28 + j10.6$ ohms.

Using a sheet of the type of Fig. 2 and applying a scale factor of 10, Z_1 and Z_2 are laid off (Fig. 3) and steps b) and c) are executed. The result is: $Z_p = 20.5 + j12$ ohms. Readings are taken to the nearest coordinate lines (for clarity, these are not shown) and without any attempt to interpolate between adjacent lines.

The second example will illustrate the applicability of the "concentric-circle" method when Z_1 and Z_2 lie in opposite quadrants. Let

$$Z_1 = 44.2 - j78.8$$

and $Z_2 = 28 + j10.6$ ohms;

i.e. Z_1 is the complex conjugate with respect to the first example. In Fig. 4, Z_1 and Z_2 are laid off according to these values. Then steps b) and c) are performed exactly as in the first example. No special attention to quadrants or to leading or lagging phase angles is required. As a matter of fact, the whole process is foolproof and it is not likely that any one could go astray in carrying out these two simple steps. The result is:

$$Z_p = 27.5 + j1.5 \text{ ohms}$$

again read to the nearest coordinate lines without interpolation.

Checking Result

To check this result algebraically on a slide rule, it takes the following steps:

$$Z_p = \frac{(44.2 - j78.8) \cdot (28 + j10.6)}{(44.2 - j78.8) + (28 + j10.6)}$$

$$= \frac{(44.2 - j78.8) \cdot (28 + j10.6)}{72.2 - j68.2}$$

$$= \frac{90.4 \angle -60.7^\circ \cdot 30 \angle 20.8^\circ}{99 \angle -43.4^\circ}$$

$$= \frac{90.4 \cdot 30 \angle 20.8^\circ - 60.7^\circ + 43.4^\circ}{99}$$

$$= 27.4 \angle 3.5^\circ = 27.3 + j1.67 \text{ ohms.}$$

Although this numerical outline demonstrates that the effort is considerably greater than in using the geometrical method, it does not even insinuate the numerous slide rule manipulations inherent in making the three conversions from rectangular to polar coordinates and the attendant opportunities for errors.

Accuracy and Range

The comparison of the geometrical with the numerical method would be incomplete without considering accuracy and range. A 20 x 20 in. size sheet with 20 lines per inch secures accuracy corresponding to a 10 in. slide rule. This sheet size is not inconvenient for work on a desk-top, but it is desirable to have available a 24-in. straightedge and a large-size drafting triangle. It is also worth noting that a sheet of similar size will be required with any other geometrical method for comparable accuracy, although the other methods are more laborious and intricate than the "concentric-circle" method. Since the number of significant digits can be increased by resorting to a larger sheet size, the geometrical method can be made arbitrarily accurate at the expense of convenience. It is in this respect similar to the use of longer slide rules or to the carrying of more digits in machine calculations.

Generally speaking, the convenient range for a 20x20-in. sheet may be set at a 50:1 ratio in resistance or reactance of the two impedances, which should be adequate for most practical purposes. The handling of long impedance vectors and of almost resonant, high-Q reactances needs special attention in some cases when the size of the sheet is kept intentionally to a minimum.

Sheet Size

If each of the R, +X, and (−X) scales is 10 in. long on a 20x20-in. sheet (Fig. 2), the circle passing through the points most distant from the origin, i.e. $10 \pm j10$, has a diameter of 28.2". In order to accommodate those parallel-impedance calculations which involve a component lying in the lower or upper right-hand corner of the impedance plane and outside the 20-in. diameter circle, while the other component is of very small magnitude, it would appear to be necessary to increase the size of the sheet to 28.2 x 28.2 in.

This increase in size by 50% for a small percentage of cases seems unwarranted for two reasons. First, every circle of a diameter larger than 20 in. and smaller than 28.2 in. is still represented by four sectors on a 20x20-in. sheet. In some cases belonging to this group, one of the four sectors will intercept the parallel to the short vector drawn through the tip of the long vector. When this

(*Continued on page* 190)

Fig. 6: Division by suitable scale factor will bring Z_p into range

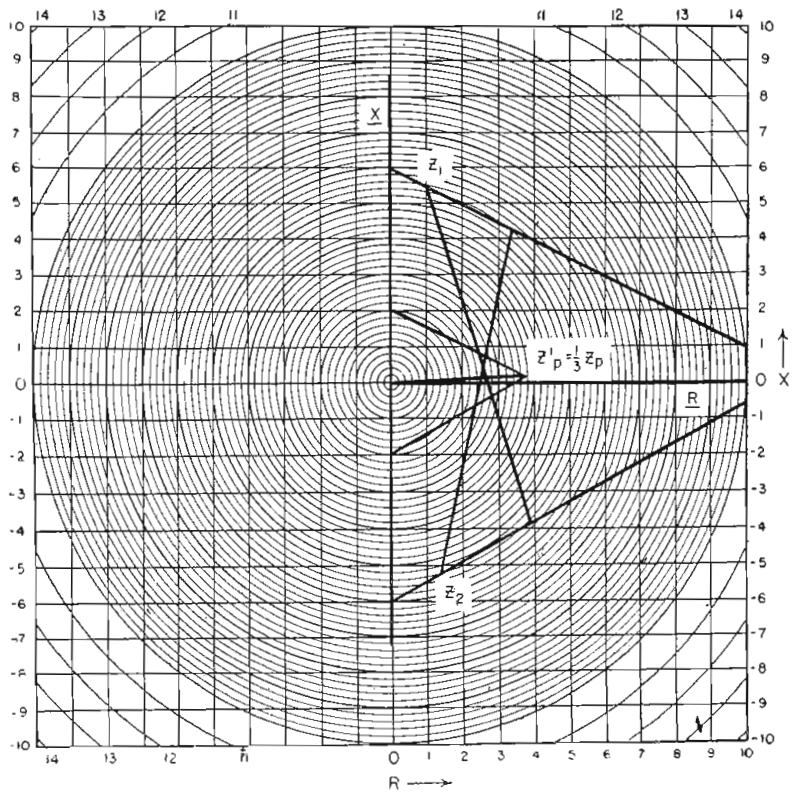
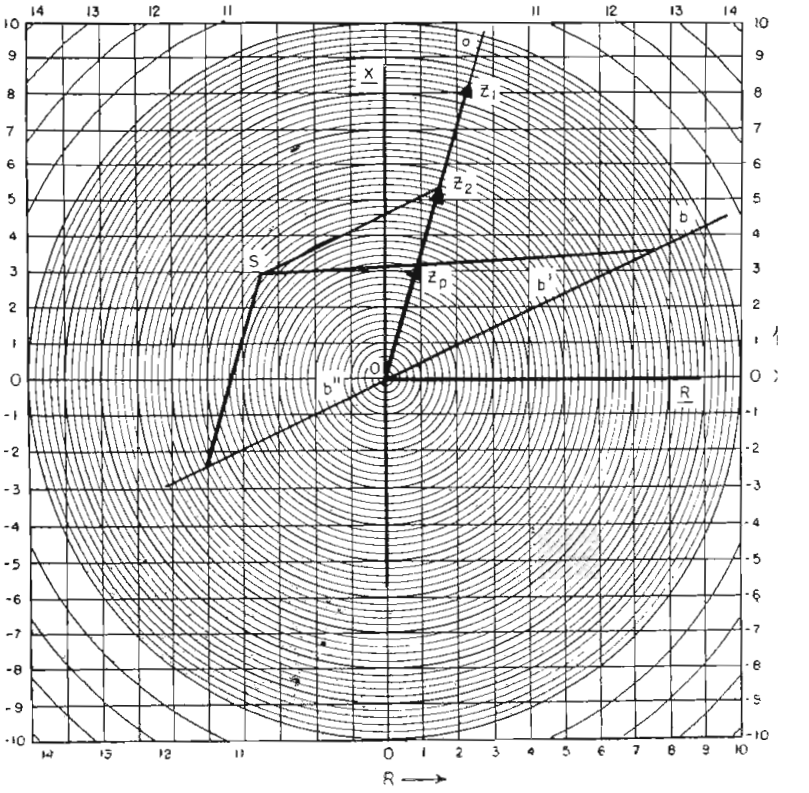


Fig. 7: Construction example for similar impedances in parallel



CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Reducing Hum in Remote Amplifier

H. E. SMITH, Chief Engineer, WAVL, Apollo, Pa.

IN a stubborn case of inherent hum in the Gates Dynamote Remote Amplifier, the cause was found to be the location of the pilot light. This light is between Input Pots #2 and #3, and the hum was picked up in the output leads from these pots. Therefore it was constant, even with all inputs closed. At the particular installation it was necessary to operate with the master gain relatively high, and the hum became more objectionable.

To correct the situation the socket was re-located and new leads made of *tightly* twisted hook-up wire were routed the furthest possible distance from low level circuits. In this manner the hum was reduced 14 db. It was also observed that there was as much as two or three db difference in the hum generated by different bulbs tested. Hum problems in other makes of amplifiers can in some cases also be solved similarly.

Sapphire Protection

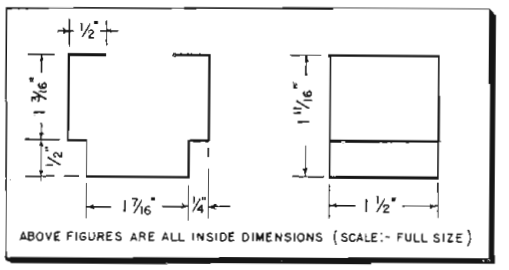
MARTIN KARANT, Program Director, WKPT, Kingsport, Tenn.

WE have an RCA 72DX cutting lathe on each of two RCA turntables, and have had quite a bit of trouble keeping our sapphire cutting needles from being dulled and chipped as a result of careless operators striking the tips with transcriptions as they remove them from the turntables. With a reasonable amount of care, these sapphire cutting needles should last at least ten (10) hours, and we've only been getting around 2 or 3 hours use out of them at best.

In the past 11 months, we have had to re-sharpen or replace 10 needles; an expensive procedure at today's prices, to say nothing of the inconvenience of finding a dulled needle on the head just when you have to use it in a hurry.

In the course of trying to figure out some way to prevent this expensive carelessness, we came up with the following solution: We took an aluminum-base transcription, dipped it in hot water, stripped off the cellulose nitrate on the surface, and marked it with a sharpened nail according to the dimensions on the accompanying drawings. It was placed in a vise and bent as illustrated, and that was all there was to it.

By bending in a littel at the top of the cover, a slight tension is placed on the recording head and the protective cover holds firmly. It simply slips over the front of the head when we are through using it, and it has eliminated the damaged cutting needles.



Transcription disc becomes sapphire cutting needle guard by few bends in a vise

$$$ FOR YOUR IDEAS

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

Remote Dialing System

W. A. SEBASTIAN, Chief Engineer, KWBM, Williston, N. D.

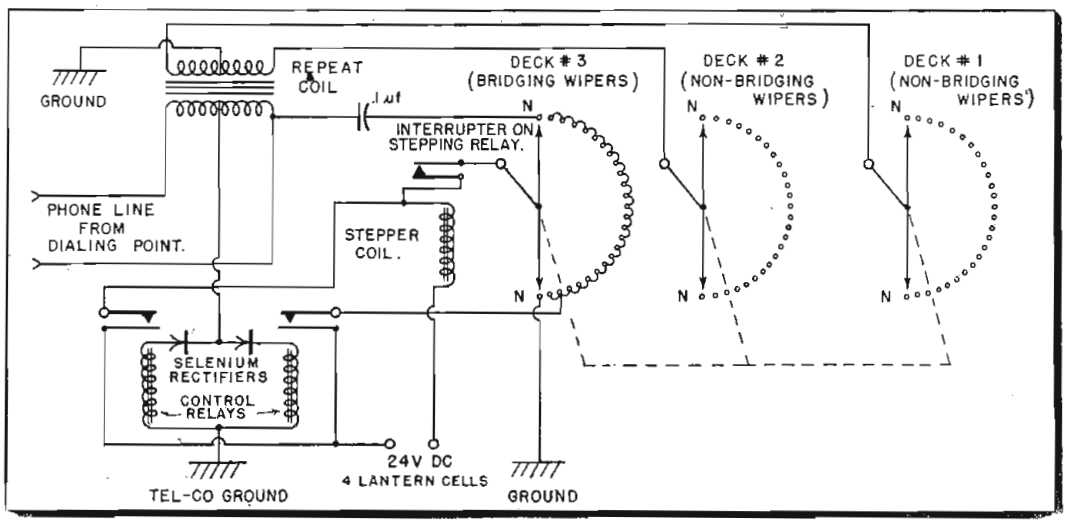
MOST stations can use a system for dialing remote lines, but the cost is prohibitive for smaller stations having limited engineering budgets. The system described can be built for $28.60, excluding the cost of repeat-coils. Perhaps the input of your console can be altered to omit the repeat-coil on the dialing end.

When we first priced new stepping relays of the type that clears and steps electrically, we found they were very costly. To my knowledge, no relay that is electrically stepping and clearing is available on the surplus market. We turned to the continuously rotating type of relay without reset coil and devised this circuit to make it step itself back to a neutral position when properly switched.

The relay used has a third deck with bridging wipers used for resetting. All but the first and twenty sixth posts of this bank are wired together. As the telephone company objects to using currents of the magnitude necessary to key this relay, a pair of control relays are used in a polarity-sensitive circuit for keying and resetting the stepping relay. The control relays are actuated by impressing a control voltage of one polarity for keying, reversing it for resetting. This system is almost standard for circuits of this kind.

Don't select the most sensitive control relays you can find. The ones used at KWBM close at about 8ma and have no tendency to trip due to line disturbances. If you have a pair of extremely sensitive relays around the shop that you intend to use, shunt them until they close at about eight ma. The dialing battery used at KWBM is a 90 v. Minimax.

Continuously rotating relay stepping system returns to neutral in $28.60 dialing system



This is about the maximum voltage to ground the telephone company will allow. The battery for operating the stepping relay is 24 v. made up from four lantern cells.

One side of the line is grounded through a capacitor when the stepping relay is in neutral position. This provides an audible indication when the relay is in neutral position. The relay will clear itself in less than a second from any position anyway.

With the circuit shown, the relay will step to the number dialed, plus one. For instance, dial 9, the relay steps to position 10, dial 19, the relay steps to position 20.

Mike Cable Stowage

WALTER PETERS, Engineer,
KNUJ, New Ulm, Minn.

HERE is a handy little kink which is very useful in saving wear and tear on microphone cable and connector to mike, when storing them, or for mikes used for remote purposes. It also eliminates untangling mike cable when mike set-up is needed in a hurry.

I use one 7 in. strand of hard-drawn seven strand antenna guy wire. (Note: any heavy gauge wire will suffice.) I made an "S" shaped hook, with the "U" shaped opening big enough to take the coiled up mike cable snugly. The other end of the "S" hook is hung on the cross member of the microphone name plate, as illustrated and pinched shut. Thus the hook is permanently attached and inconspicuous. To dress it up to match the black mike cable I wrapped the hook with Scotch electrical tape.

FM Tuner for Conelrad

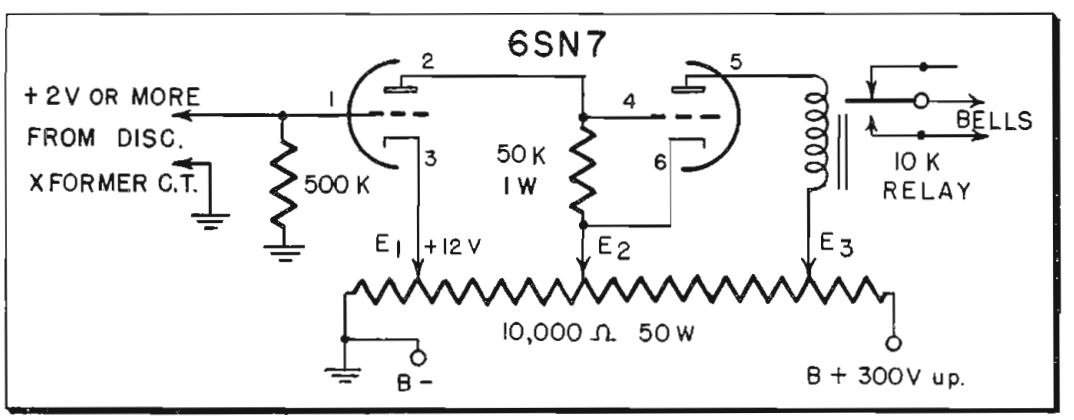
D. W. BEARDEN, Chief Engineer,
WJBY, WJBY-FM, Gadsden, Ala.

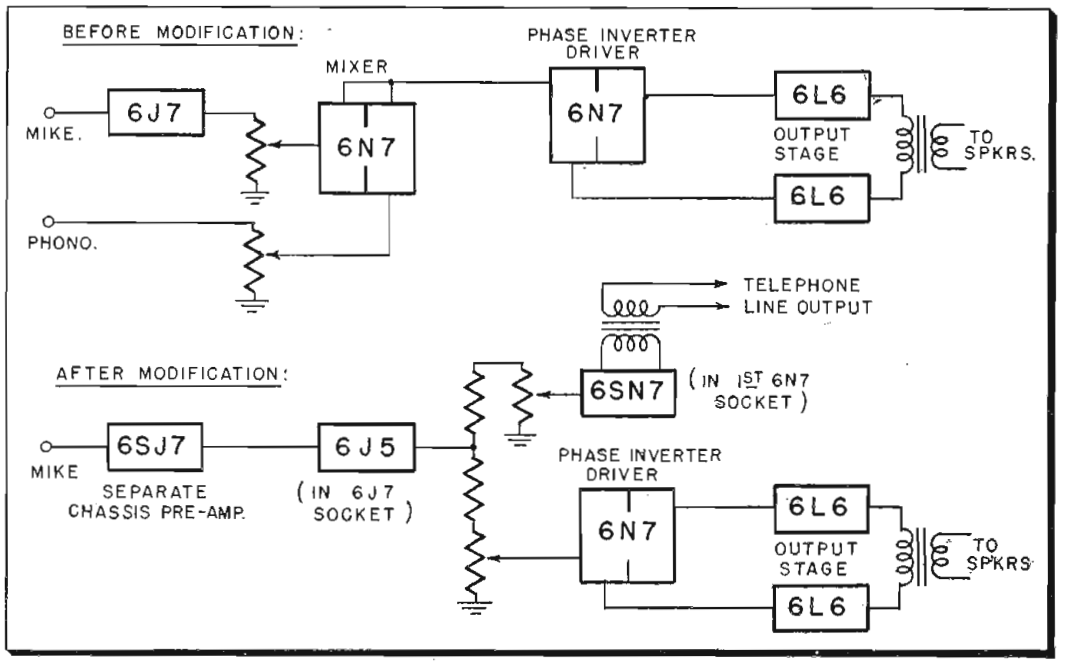
OUR tuner has plus 12 to 13 v. from the center tap of the discriminator transformer to ground when we tune in one of the Birmingham stations (about 55 miles away). In order to utilize the positive voltage I inverted it through a dc amplifier. When the signal drops below 1.7 v. the relay pulls in. The 0.2 v. of noise has no effect. A variable resistor could be used at the E_1 tap for fine settings. A 2.5, or 5 or 10 kilohm relay may be used by adjusting the output plate voltage. The 6SN7 tube will draw enough current for either relay. The normally closed contacts of the relay are not used here. We prefer to have the bells quit when the carrier is returned to the air, since then a short carrier interruption would only give a short burst from the bells and we'd know before we listened to the audio that the bells had sounded a false alarm.

We added a stage of audio for phones since the tuner output is low. Another stage could easily be added for a speaker, but we plan to use the REL 646 receiver and have it on the audition system in 20 seconds.

With a little experimentation on the three bleeder taps weak signal sensitivity could be improved. A variable resistor at E_1 would be helpful there. We can't hear an A.M. key here well enough to build up a.v.c. in the day time, and at night the fade might ring the bells.

FM tuner for Conelrad. E_1, 12v; E_2 165v-150v with signal; E_3 260 v. E_n—160 v no signal





Modification of PA system to provide telco line connection for broadcast operation

Fixed Remotes Pick-Up from PA

FORREST H. FRANTZ,
Frantz Electronics, 512 State Ave., Philadelphia, Miss.

FREQUENTLY, fixed unattended remote pick-ups originate in an auditorium or ballroom where a sound system is used. A system utilizing one microphone or set of microphones for remote and public address pick-up is desirable. The desired result is easily obtained by modification of the public address system to the satisfaction of the client and the release of a remote amplifier for the broadcast station.

A problem of this nature was brought to our attention by the pastor of a large church. He didn't want to be hidden by microphones, and at the same time he wanted his parishoners in the rear seats to hear the service well. We altered the front end of his public address system and used an off-chassis pre-amp to avoid hum problems. It is essential to provide separate gain controls for broadcast and PA functions. The before and after block diagrams indicate changes made in this particular installation.

Mike Call Letter Plates

GENE RIDER, WQAM, Miami, Fla.

BY making our own WE633A and RCA88A field microphone name plates we find that in addition to saving a few dollars we get call letter signs more suited to our particular needs.

We machined the basic plate from quarter inch stock (it's about a one dollar job at most any machine shop if you choose to have them made.) Holes (6/32 in diameter) were drilled and tapped as marked in the

(*Continued on page* 112)

Survey of Various Types of

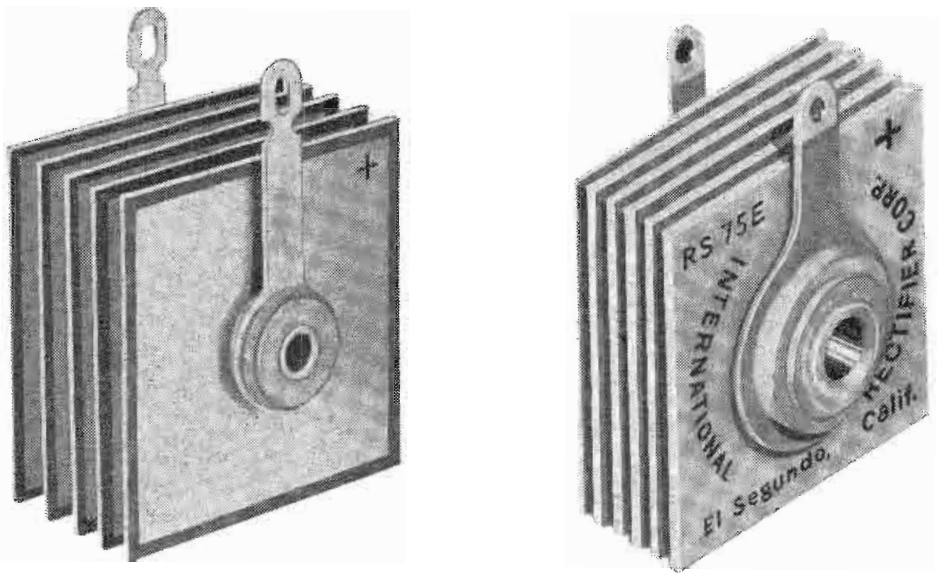


Fig. 1: Selenium rectifiers with open stack construction widely used in radio and TV receivers

Different methods of construction and sealing used in industrial and radio-TV grades clarified. Circuit applications shown include modulators and limiters.

By JOSEPH T. CATALDO

International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

THE average electronic engineer is well acquainted with selenium rectifiers. When a selenium rectifier is mentioned, he usually visualizes the five- or six-plate open stacks such as those shown in Fig. 1, since these units are extensively used in radio and TV receivers. This type of construction is generally referred to as the columnar or open type construction, and is by no means the only method of assembling a selenium rectifier.

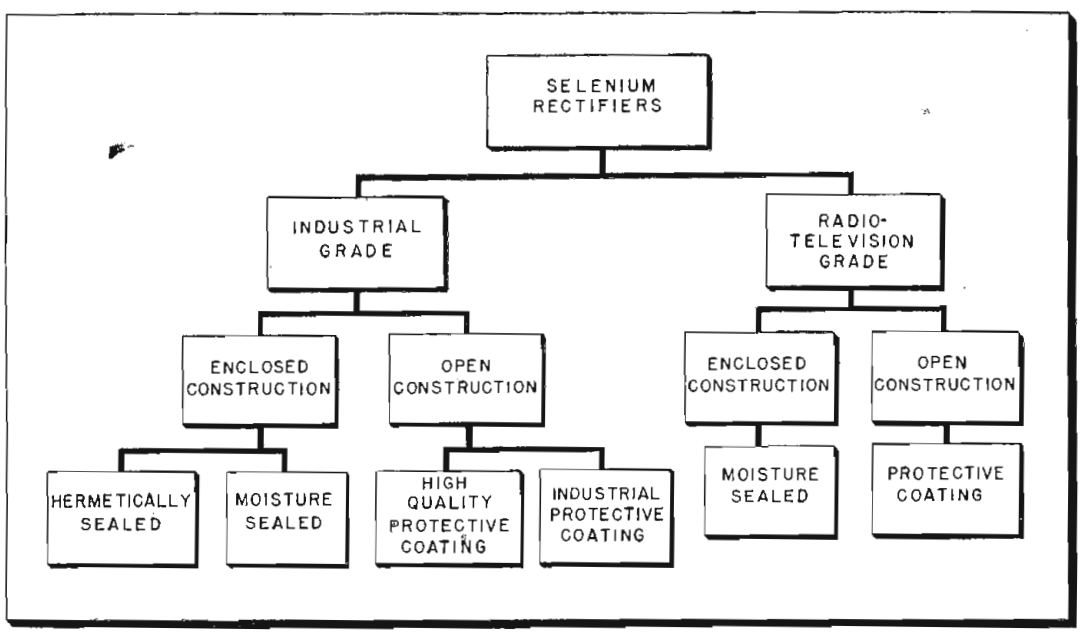
There are two distinct grades of selenium rectifiers produced commercially: industrial grade and radio or TV grade (Figure 2). Although the processes and techniques employed in their manufacture are essentially the same, the radio or TV rectifier stacks are manufactured at a lower production cost per unit. The reduced cost is achieved by producing thousands of certain standard units "day in and day out" on a mechanized production line. The rectifier is then adapted to the receiver application. It is obvious that this sytem eliminates setup and engineering time necessary for the production of industrial stacks which are usually designed to meet customers' specifications. The end result is that the useful life expectancy of the radio or TV stack is from 1000 to 3000 hours, as compared with the industrial stacks having a life expectancy of 20,000 to 60,000 hours or more if properly designed into the circuit.

Long life and efficient operation of selenium rectifiers can only be obtained if properly protected since they are subject to damage and deterioration as a result of abnormal moisture or vapor penetration. To insure long life the open type rectifier stacks are protected with various types of coatings or finishes. The protective coating used in the protection of both grades of rectifiers is usually an organic paint or synthetic varnish. In the production of the radio and TV grade, only one coat of protective finish is applied since the equipment in which they are employed does not experience high humidity conditions. On the other hand, multiple coats of protective finish are applied on the industrial stacks. There are two grades of protective coatings available for the industrial stacks, namely, the industrial and the high quality protective coatings. In general, the industrial coating is adequate for the majority of the diversified industrial requirements.

Protective Coating

Although this superior high quality protective coating is adequate for relatively long life operation of the rectifiers in high humidity atmospheres, it is only a delaying measure since moisture will eventually penetrate its thickness and attack the rectifying element. When exceptional long life operation in extremely high humid and corrosive atmospheres is desired, the selenium rectifier stacks are assembled and sealed within an enclosure. There are two classes in the enclosed type: the moisture sealed and the hermetically sealed construction

Fig. 2: Flow chart shows different construction and coating for industrial and radio-TV grades



Selenium Rectifiers

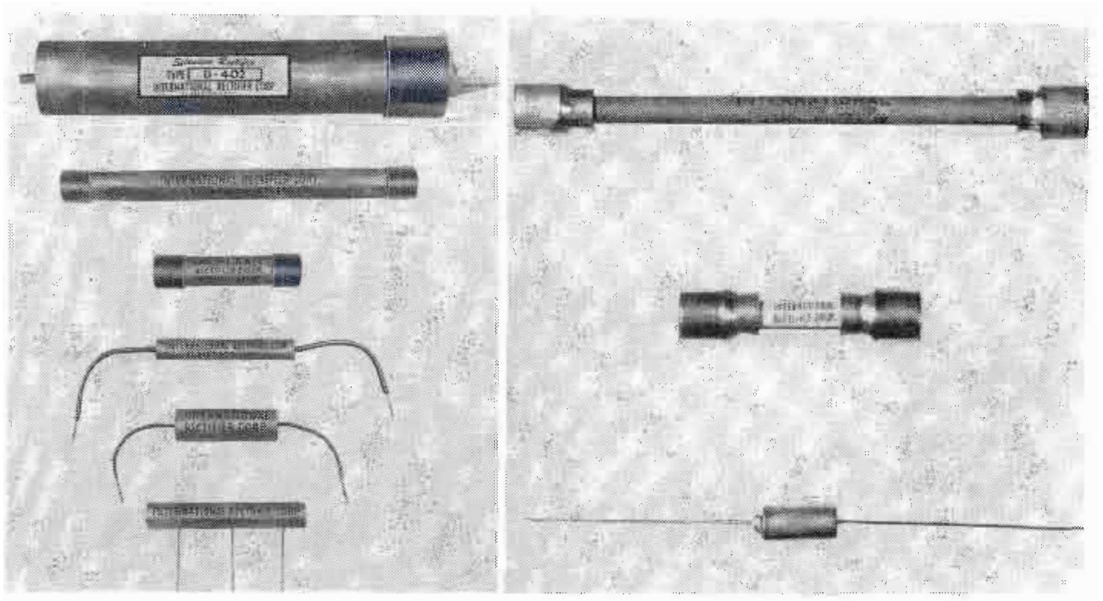


Fig. 3: (l) Industrial moisture sealed cartridges. Fig. 4: (r) Hermetically sealed rectifiers

(Fig. 2). The radio or TV grade rectifiers are also produced in moisture sealed enclosures. For this type, rectangular selenium rectifier plates are secured within a specially processed fibre tube and a plastic compound is used to seal the ends. Electrical connection is made to a pigtail lead located at each end. The industrial grade moisture sealed cartridge units are shown in Fig. 3. In this type, a quantity of circular rectifier cells are assembled in intimate contact with each other within a phenolic tube. As can be seen in Fig. 3, electrical termination of these units is accomplished by means of metal ferrules, pigtails or studs secured to each end. In general, the rectifiers produced in this manner are half-wave units. In most applications, a multiple number of these units are wired to form the circuitry desired, such as, center-tap or bridge. However, when a center-tap or bridge type rectifier is required as a single unit, a slot is cut longitudinally on the tubing and the necessary electrical connections are brought out in the form of pigtail leads or terminal lugs as shown in the bottom of Fig. 3.

Hermetically Sealed Units

The hermetically sealed units are subdivided into two types. One type is assembled in much the same manner as the above moisture sealed units except that a glass tube is used instead of the phenolic tube. The ferrules are secured to the glass tubing by means of glass-to-metal sealing techniques thereby accomplishing a true hermetic seal. The two larger units in Fig. 4 are of this type. Although the small unit in this photograph is a hermetically sealed rectifier, it differs from the others in that a metal container is used for the enclosure instead of a glass tube. Hermetic sealing is effected by securing the metal container to a glass-to-metal or ceramic-to-metal header which is provided with a pigtail lead. A hermetic header, in general, consists of a metal piece through which a glass-to-metal seal is provided. The metal enclosure is electrically "hot" since the second terminal is affixed to it. When insulation from chassis is required, a piece of flexible plastic tubing such as large diameter spaghetti is slipped over the enclosure.

Variations of this type of hermetically sealed rectifiers are shown in Fig. 5. It should be noted that they are provided with multiple terminal headers. These units are by far the most flexible of those previously described in that they are not restricted to half-wave elements. The possible circuitry for these units range from half-wave to three-phase stacks and are produced in numerous shapes and sizes. The assembly of rectifier cells in intimate contact is also practiced in the production of these units. Often, for medium to high current requirements, a completed rectifier stack of the open or columnar construction is enclosed within a metal container which is provided with suitable terminals.

Regardless of the particular method employed to secure the rectifier cells, a heat transfer medium such as oil is used in the final assembly of the hermetically enclosed rectifiers in an effort to dissipate the heat developed by the rectifier to the outer metal case and in turn, to the chassis.

Applications

There are numerous possible applications for the units described, three of which are modulation bridges, lattice modulators and limiters in carrier equipment. Typical circuits for these particular applications are given in Fig. 6. The current rating for operation at an ambient of 35° C is usually limited to

(*Continued on page* 205)

Fig. 5: Construction variations of hermetically sealed rectifiers with multiple terminal headers

Single Sideband Converter

By FRANK A. DUNNIGAN & JOHN D. KANE

Hoffman Laboratories Inc.
6200 S. Avalon Blvd.
Los Angeles, Calif.

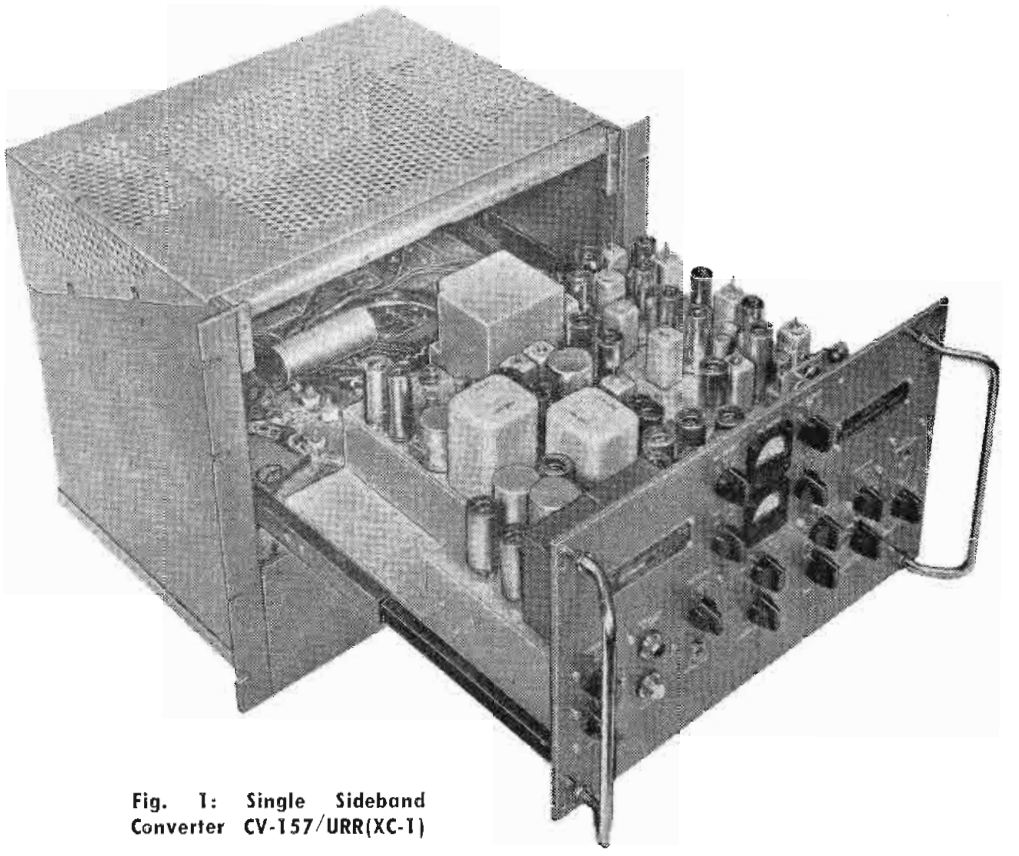


Fig. 1: Single Sideband Converter CV-157/URR(XC-1)

Developed for U.S. Army Signal Corps, new unit makes possible multi-channel teletype or facsimile operation with voice transmission on single LF, MF or HF carrier

INCREASINGLY crowded conditions existing within the radio frequency spectrum have sent both private and governmental researchers scurrying to find a way to pack the greatest amount of intelligence into the smallest possible portion of the spectrum.

One of the most obvious answers to the problem of overcrowding is to transmit simultaneously many messages on a single r-f carrier. In UHF and VHF this becomes a comparatively simple matter because of the large bandwidth. In low, medium and high frequency ranges, which are more desirable for their transmitting distance characteristics, multi-channel operation is a much more difficult matter. Narrow bandwidth requirements restrict the amount of modulation possible, making it necessary to provide a signal stable enough to allow extremely selective filtering in the differentiating equipment.

Single Sideband Method

An amplitude modulated r-f has has two sidebands. One is below and one above the carrier frequency. The frequency of these sidebands is, of course, dependent upon the frequency of the modulating note. Modulating a 1500 KC carrier with a 10 KC note will produce sidebands of 1490 KC and 1510 KC. In single sideband transmission, the carrier (in this case 1500 KC) would be modulted with a 10 KC note and then the lower sideband and carrier suppressed, leaving only the 1510 KC USB. The carrier could then be remodulated with, say, a 5KC note and the carrier and upper sideband suppressed, leaving only a 1495 KC lower sideband. These two sidebands can then be transmitted (with a highly suppressed carrier) producing, simultaneously, 1510 KC, 1495 KC and the carrier.

Through the use of multiplex terminating equipment, both at the transmitting and receiving end of the system, the upper, lower (or even both) sidebands may then be subdivided into additional channels, making it possible to achieve multichannel operation through the proper modulation of the USB and LSB.

In addition to the multi-channel potentialities of the single sideband system another desirable characteristic is that it increases the distance over which intelligence may be transmitted without increasing transmitter power. In ordinary single channel double sideband transmission, better than two thirds of the power output is devoted to the transmission of the carrier, which contains no intelligence. By suppressing the carrier and utilizing the power of the transmitter for the purpose of sending the sidebands containing the intelligence, a 1 kw transmitter may increase the effective range of its modulated output by as much as three times.

Single Sideband Converter CV-157/URR(XC-1) has been developed and built for the U. S. Army Signal Corps (under contract No.

(*Continued on page* 194)

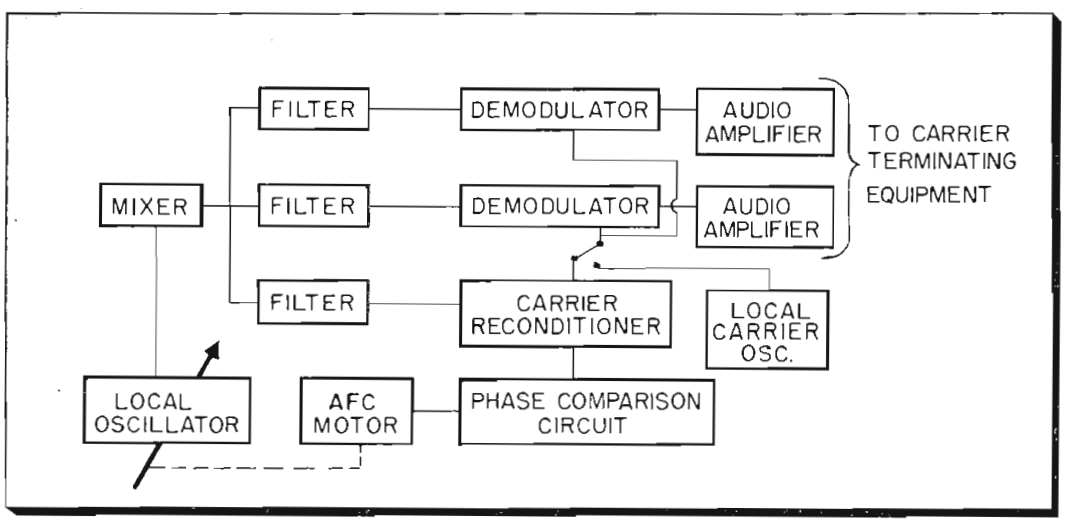


Fig. 2: Block diagram of single sideband converter

1953 DIRECTORY OF THE WEST COAST ELECTRONIC MANUFACTURERS

a service from
ELECTRONIC INDUSTRIES DIRECTORY
of
TELE-TECH

Companies whose listings are preceded with an asterisk (*) are Eastern or Mid-western organizations with manufacturing facilities on the West Coast.

Acme Electronics, Sub. of Aerovox Corp., 300 N. Lake Ave., Pasadena 4, Calif., D. A. Gehlke, RL 1-6325, Coils, Amplifiers, Transformers, Controls

Acra Instruments, 168 Vista Ave, Pasadena 8, Calif., R. E. Frazier, RY 1-7646, Optical Coatings

Adel Div., General Metals Corp., 10777 Van Owen St., Burbank, Calif., O. A. Kehle, SU 2-1131, Aircraft Controls, Hardware

Advance Electric & Relay Co., 2435 N. Naomi St., Burbank, Calif., V. C. Huckabee, RO 9-1446, Relays, Solenoids

Aerosonic Mfg. Co., 2015 Pontius Ave., Los Angeles, 25, Calif., L. E. Bissell, AR 3-0634, Electronic to Ass. Equip, Complete Assemblies

Airborne Electronics Co., Van Nuys, Calif., L. W. Cannon, ST 5-3867, Aircraft Transmitters

Ajax Condenser Corp., 10905 Chandler Blvd., N. Hollywood, Calif., Horace Kreinick, ST 7-1385, Capacitors, Filters

Allied Electronic Equipment Co., 425 Brannan St., San Francisco, Calif., E. Crandall, EX 2-0215, Cables, Cords, Couplings for Aircraft

Allied Reeord Mfg. Co., 1041 N. Las Palmas, Hollywood, Calif., Samuel Salzman, HO 9-5107, Electronic Transcriptions & Records

Allied Research, 6916 Santa Monica Blvd., Hollywood 38, Calif., M. A. Dike, HO 2-1251, Radar Components

Allison Laboratories, 419 Vista Del Llano Dr., Whittier, Calif., R. E. Allison, OX 7-4920, Audio Filters

Aloha Radio & Television Co., 330 W. Bdwy., Long Beach 2, Calif., H. Putnam, 7-4716, Radios & Television

Alpar Mfg. Co., Box 152, Redwood City, Calif., C. R. Parmenter, YL 1-7963, Cable Analyzers

Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif., J. K. Hilliard, CR 5-5101, Amplifiers, Speakers, Mikes

AMELCO, 2040 Colo. Ave., Santa Monica, Calif., Wm. Avila, TE 0-5475, Navigation Equip., Power Supplies

American Diathermy Products, 11858 Miss. Ave., Los Angeles 26, Calif., F. W. Christian, AR 7-5627, Diathermy

American Electric Motors, 4811 Telegraph Rd., Los Angeles 22, Calif., J. F. Serafin, AN 9-7551, Motors

American Helicopter Co., 1800 Rosecranz Ave., Manhattan Beach, Calif., H. E. Roberts, OS 6-1138, Elect. Instr. Equip

American Microphone Co., 370 S. Fair Oaks Ave., Pasadena 1, Calif., W. W. Vogel, RY 1-7444, Microphones

Ames Co., W. R., 150 Hooper St., San Francisco 7, Calif., Uby Ferrari, MA 1-3700, Chassis, Cases

Ampex Electric Corp., 934 Charter St., Redwood City, Calif., W. T. Selsted, EM 8-1471, Magnetic Recorders

Anthony Mfg. Co., 2322 W. Slauson Ave., Los Angeles 43, Calif, Harry Little, AX 1-0032, Coils, Transformers

Applied Electronics Co., 1246 Folsom St., San Francisco 3, Calif., J. M. Glover, MA 1-2634, Mobile & Marine Equip.

Applied Physics Corp., 362 W. Colo. St., Pasadena 1, Calif., R. E. Vaniman, SY 6-0197, Spectrophotometers, Electrometers, Infrared Analyzers

Arthur Electronics Corp, 8667 Melrose Ave., Los Angeles 46, Calif., Arthur Freidson, CR 4-4447, Precision wire wound resistors

Audio Pacific Co., 1143 La Rosa Rd., Arcadia, Calif., Stewy Doubt, DO 7-0300, Wide Range Sound Equip.

Audio Products Corp., 2265 Westwood, Los Angeles 64, Calif., D. K. Kinsey, BR 2-4266, Communicaitons Equip.

Avery Adhesive Label Corp., 1616 S. Calif. Ave., Monrovia, Calif., J. K. Lockridge, RY 1-8197, Labels, Dispensers

Avia Products Co, 7266 Beverly Blvd., Los Angeles 36, Calif., A. C. Pearson, YO 7295, Communications Equip.

Babcock Radio Eng'g., 7942 Woodley Ave., Van Nuys, Calif., B. V. Deltour, ST 5-8648, Mobile Equipment Transmitters

Background Engineers, 7313 Santa Monica Blvd., Hollywood 46, Calif., W. S. Tillisch, GI 1478, Film-TV Projectors

Bardwell & McAlister, 2950 N. Ontario St., Burbank, Calif., Paul Kusler, RO 9-2341, Electronic Controls, Guided Missile Equip.

Beckman Instruments, 820 Mission St., So. Pasadena 1, Calif., Dr. A. O. Beckman, PY 1-2141, Meters, Instruments

Beckman & Whitley, 985 San Carlos Ave., San Carlos, Calif., J. B. Rice Jr., LY 3-7824, Indicators, Spectrographs

Benchmaster Mfg. Co., 1835 W. Rosecrans Ave., Gardena, Calif., Gerald Florence, ME 4-4967, Punch Presses, Milling Machines

Bendix Aviation Corp., Pacific Div., 11600 Sherman Way, No. Hollywood, Calif., R. M. Combes, ST 7-2651, Telemetering Equip., Meters

Bendix Aviation Corp., (Bendix Computer Div.), 5630 Arbor Vitae St., Los Angeles 45, Calif., J. V. Williams, Jr., OR 8-2128, Computers

Bennett Laboratories, 2700 Bay Road, Redwood City, Calif, A. E. Bennett, EM 6-6845, Optical Filters

Benson-Lehner Corp., 2340 Sawtelle Blvd., Los Angeles 64, Calif., B. F. Rutland, AR 9-3723, Computers, Data Reduction

Berkeley Custom Electronics, 2302 Roosevelt Ave., Berkeley 3, Calif., J. H. Minor, TH 3-4180, Custom Installations

Berkeley Scientific Div., Beckman Instruments, 2200 Wright Ave., Richmond, Calif., James Gordon, BE 4-6771, Counters, Controls

Berlant Associates, 4917 W. Jefferson Blvd., Los Angeles 16, Calif., Paul Lotl, RE 4-2196, Tape Recorders, Remote Audio

Berndt-Bach, Auricon Div., 7325 Beverly Blvd., Los Angeles 36, Calif., A. N. Brown, YO 8294, Sound Film Cameras

Best Electronics Corp., 2254 Colby Ave., Los Angeles 64, Calif., E. D. Lucas Jr., BR 2-7087, Broadband TV Antenna

Biggs Co., Carl H., 2255 Barry Ave., Los Angeles 64, Calif, H. A. McDonell, AR 9-6732, Insulation Coatings

Birdsell Mfg. Co., 750 San Antonio Rd., Palo Alto, Calif., H. J. Birdsell, YO 7-9116, Transformers, Reactors

Birtcher Corp., 4371 Valley Blvd., Los Angeles 32, Calif., A. G. Babeaux, CA 2-9101, Tube Clamps

Bodde Screen & Projector Co., 8829 Venice Blvd., Los Angeles 34, Calif., B. M. Bodde, TE 0-2812, Rear Screen Projection

Boeing Airplane Co., P. O. Box 3107, Seattle 14, Wash., K. C. Gordon, MO 3333, Computers

Bone Engineering Corp., 701 W. Bdwy., Glendale 4, Calif., Paul Alpine, AX 1-5442, Custom Electronic Equip.

Booth Co., Arthur E., 265 S. Alexandria Ave., Los Angeles 4, Calif., T. Blakeslee, DU 9-4863, Testers, Power Supplies

Bourns Laboratories, 6135 Magnolia Ave., Riverside, Calif., M. E. Harrison, 7290, Pots, Instruments

Brown Electro-Measurement Corp., 4312 S. E. Stark St., Portland 15, Ore., D. C. Strain, FI 9235, Bridges, Resistors

Browne TV, 12450 W Washington Blvd., Culver City, Calif., J. E. Browne, EX 7-2156, Hi-Fi Amplifiers & Tuners

Brubaker Mfg. Co., 9151 Exposition Dr., Los Angeles 34, Calif., S. F. Arn, TE 0-6441, Filters, Amplifiers

Calbest Eng'g & Electronics, 828 N. Highland Ave., Hollywood 38, Calif., H. Fremont, HO 3-2119, Receivers, Coils

Calif. Magnetic Control Corp., 7245 Atoll Ave., N. Hollywood, Calif., Harry Holubow, PO 5-3365, Chokes, Coils, Delay Lines

Califone Corp., 1041 N. Syeamore Ave., Hollywood 38, Calif., W. R. Smith, HU 2-2353, Sound Systems, Record Players

Calresin Corp, 333 N. Santa Anita, Arcadia, Calif., Douglas Wilkins, DO 7-3504, Laminates, Eneapsulation

Caltron Products Co., 1406 S. Hobart Blvd., Los Angeles 6, Calif., L. Klein, RE 2-4240, Record Equip., Solenoids

Cal-Tronics Corp., 11307 Hindry Ave., Los Angeles, Calif. F. I. Tourtelot, Test Equip.

Calvideo Tube Corp., 5232 W. 104 St., Los Angeles 45, Calif., Ringe Shima, OR 8-3979, Cathode-Ray Tubes

Cameron Craft, 942 Brockhurst St., Oakland 8, Calif., M. F. Cameron, HU 3-3745, Cabinets, Metal Finishing

Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif., R. Bowen, CA 5-1251, Connectors, Solenoids

Canoga Corp., 5955 Sepulveda Blvd., Van Nuys, Calif., G. H. Nibbe, ST 7-6160, Radar Devices

Capitol Records Inc., 5515 Melrose Ave., Hollywood 38, Calif., E. H. Eucke, HO 9-8171, Records

Carad Corp., 93 Leland Ave., San Francisco 28, Calif., H. B. Fleming, Inductors, Carrier Current

Carruthers & Fernandez, Inc., 1501 Colorado Ave., Santa Monica, Calif., F. C. Fernandez, TE 0-3698, Aircraft Equip.

Cascade Research Corp., 53 Victory Lane, Los Gatos, Calif., Dwight Caswell, EL 4-1305, Microwave Components

Central Electronics Corp., 4875 San Fernando Rd W., Los Angeles 39, Calif., N. C. Theobald, CH 5-3611, Record Players, Amplifiers

Century Electronics, Div. of Century Metalcraft Corp., 14806 Oxnard St., Van Nuys, Calif., Dr. E. C. Levinthal, ST 7-1178, Radar, Analyzers

Century Geophysical Corp., 3406 W. Washington Blvd., Los Angeles 18, Calif., R. C. Redden, RE 3-0322, Instruments

Chase Electronics Lab., 2631 Woodlyn Rd., Pasadena 8, Calif., N. C. Chase, SU 7-1441, Power Supplies

Chattin Eng'g Co., 1401 Middle Harbor Rd., Oakland 20, Calif., C. W. Chattin, HI 4-4209, Electro-Acoustic Equip.

Chemo-Vac Electronic Corp., 760 Reed St., Santa Clara, Calif., D. R. Bellis, CH 3-0111, Vacuum Capacitors

Cinema Eng'g Co., Div. Aerovox Corp., 1100 Chestnut St., Burbank, Calif., RO 9-2381, Audio Equip., Connectors

Clary Multiplier Corp., 408 Junipero St., San Gabriel, Calif., R. E. Boyden, CU 3-2724, Computers, Controls, Indicators

Clear Beam TV Antennas, 100 Prospect Ave., Burbank, Calif., Milton Mann, RO 9-2141, TV Antennas

Coast Coil Co., 5352 W. Washington Blvd., Los Angeles, Calif., C. H. Adams, WH 0442, Coils, Chokes

Coastwise Electronics, 322 N. Foothill Rd., Beverly Hills, Calif., H. M. Joseph, BR 2-3407, TV Amplifiers

Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif., G. Edwards, PR 2251, Electrical Instruments

*Collins Radio, 2700 W. Olive Ave., Burbank, Calif., M. Doelz, CH 0-5224, Aircraft Equip.

Color Television Inc., 973 E. San Carlos Ave., San Carlos, Calif., R. H. Stahl, LY 3-9226, TV Cameras, Computers

Colortronics, Inc., 3116 Sunset Blvd., Los Angeles 26, Calif., Neil Chan, NO 3-3228, Television-Electronics

Computer Research Corp. of Calif., 3348 W. El Segundo Blvd., Hawthorne, Calif., H. H. Sarkissian, OS 5-1171, Digital Computer Equip.

Conley's Electronics, 11612 Ventura Blvd., N. Hollywood, Calif., D. Conley, ST 7-1919, Test Meters, Electronic Assemblies

Conrac Inc., 19217 E. Foothill Blvd., Glendora, Calif., J. G. Jones, FL 5-1241, TV & AM-FM Receivers

Consolidated Eng'g Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif., J. R. Bradburn, SY 6-0173, Computers, Instruments

Consolidated Vultee Aircraff, San Diego 12, Calif., C. F. McCabe, W-6611, Aircraft Radio & Electronic Equip.

Cordware Eng'g, 1947 Dennison St., Oakland 6, Calif., J. I. Pruden, KE 3-4618, Audio Equip.

Cratex Mfg. Co., 81 Natoma St., San Francisco 5, Calif., J. C. Craven, GA 1-4845, Rubberized Abrasives

Crittenden Transformer Works, 1220 Nadeau St., Los Angeles 1, Calif., R. M. Power, KI 6173, Transformers

WEST COAST MANUFACTURERS

Cryco, Inc., 1138 Mission St., S. Pasadena, Calif, E. W. Johnson, PY 1-1174, Frequeney Control Crystals
C-S Mfg. Co., 4089 Lincoln Blvd., Venice, Calif., R. J. Collins, EX 6-0078, Loudspeakers
Cubic Corp., 2841 Canon St., San Diego 6, Calif., R. V. Werner, BA 8191, Amplifiers, Instruments, Guides
Culbertson Co., G. K., 8471 Leroy St., San Gabriel, Calif., G. K. Culbertson, AT 7-3005, Turntables
*Cutler-Hammer, 1795 Pasadena Ave., Los Angeles 31, Calif., W. G. Tapping, CA 2-8191, Panel Boards, Switch Boards, Motor Controls
*Cutler-Hammer, 2130 3rd Ave., San Francisco, Calif., C. W. Ludrigsen, HE 1-3835, Panel Boards, Switch Boards, Motor Controls
Cyclotron Specialties Co., Moraga, Calif., D. R. Tibbetts, DR 6-4712, Impurse Registers, Counters

Dallons Labs., 5066 Santa Monica Blvd., Los Angeles 29, Calif., Michael Zielonka, OL-1951, Crystals, Diathermy
Dalmotor Co., 1375 Clay St., Santa Clara, Calif., Ralph Herzog, AX 6-5958, Motors, Generators
Dalmo Victor Co., 1414 El Camino Real, San Carlos, Calif., W. F. Gates, LY 3-3131, Radar Antennas
Davis Electronics Corp., 4002 Burbank Blvd., Burbank, Calif., H. J. Davis, RO 9-2621, TV & FM Antennas
DeCoursey Eng'g Lab., P.O. Box 235, Los Angeles 25, Calif., S. C. Baden, AR 3-2530, Chokes, Coils, Filters
Delta Electrical Instrument, 2700 S. Hill St., Los Angeles 7, Calif., W. S. Richards, PR-0053, Meters
DeMornay-Bonardi, Inc., 3223 Burton Ave., Burbank, Calif., G. Fonda, RO 9-2049, Antennas, Test Instruments, Microwave Equip.
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif., J. K. Rondon, ST 7-5347, Counters, Detectors
Diatron Co., 3327 Dixie Dr., Houston 21, Texas, F. L. Lemm, JA-4458, Oil Well Survey Instruments
Dillon & Co., W. C., 14620 Keswick St., Van Nuys, Calif., R. R. Dillon, ST 5-3168, Testers, Switches
Dirigo Compass & Instrument Co., Boeing Field Airport Box 37, Seattle 8, Wash., H. V. Wenger, Jr., LA 5940, Cabinets
Dollar Co., Robert, 50 Drumm St., San Francisco 11, Calif., R. W. Bunce, YU 2-4479, Transmitters, Receivers
Dondar Devices, P.O. Box 187, La Canada, Calif., D. R. Minkler, SY 0-3702, Intrus'on Alarms
Douglas Aircraft Co., 3000 Ocean Park Blvd., Santa Monica, Calif., E. F. Burton, EX 4-3241, Electronic Data Recorders
Dressen-Barnes Corp., 250 N. Vinedo Ave., Pasadena 8, Calif., D. D. Dressen, SY 3-0691, Regulated Power Supplies, Custom Electronic Equip.
D & R Ltd., 402 E. Gutierrez St., Santa Barbara, Calif., W. E. Reefman, 5-4511, Chokes, Transmitters, Power Supplies
Dunkle Coil Co., 3257 W. 6 St., Los Angeles, Calif., Coils, Chokes, Transformers
Dynamic Air Eng'g., 7412 Maie Ave., Los Angeles 1, Calif., Harry Glascock, KI 3292, Blowers

Eitel-McCullough Inc., 798 San Mateo Ave., San Bruno, Calif., G. T. Howes, JU 8-1212, Tubes, Capacitors
Electrical Communications, 765 Clementina St., San Francisco 3, Calif., E. H. Cogill, KL 2-1947, Remote Controls
Eectrical Eng'g & Mfg., 4612 W. Jefferson Blvd., Los Angeles 16, Calif., G. Maurich, RE 3-0151, Motors, Generators
Electrical Facilities, Inc., 4224 Holden St., Oakland 8, Calif., P. J. Reimann, OL 3-1661 Transformers, Coils
Electrieal Products Corp., 950 30 St., Oakland 8, Calif., E. V. Bacigalupo, HU 3-9300, Crystals, Relays
Electrical Service Co., 1271 Mission St., San Francisco 3, Calif., F. Boyce, UN 1-2245, Photo Electric Controls
Electro-Cap, Div. Acme Electries, 1269 Riverside Dr., Los Angeles 31, Calif., E. L. Shearman, CA 9387, Capacitors, Filters
Electro Circuits, Inc., 401 E. Green St., Pasadena, Calif., Donald C. Erdman, RY 1-6311, Ultrasonic Equip.
Electro Development Co., 6006 W. Washington Blvd., Culver City, Calif., R. L. Finch, VE 8-0508, Switches, Slip Rings
Electro Eng'g Works, 6021 College Ave., Oakland 18, Calif., J. J. Halloran, OL 3-1588, Transformers
Electromagnetic Research, 3210 Winona Ave., Burbank, Calif., B. Obernolte, RO 9-3351, Antenna Test Equip.
Electro-Mechanical Specialties, 6819 Melrose Ave., Los Angeles 38, Calif., N. F. Leo, WE 3-5866, Relays, Switches
Electronic Eng'g. Co. of Calif., 180 S. Alvarado St., Los Angeles 4, Calif., R. B. Bonney, DU 2-7353, Plug-In Circuits
Electronic Medical Foundation, 1478 Sacramento St., San Francisco 9, Calif., Harry Saine, GR 4-0056 Electronic Medical Equip.
Electronic Produets Co., 4755 Telegraph Rd., Los Angeles 22, Calif., J. J. Voorhees, AN 9-7249, Tubes, Strain Gages
Electronic Specialty Co., 3456 Glendale Blvd., Los Angeles 39, Calif., W. D. Gibbs, NO 2-2168, Aireraft Radio, Timers
Electronic Windings Co., 3001 Verdugo Rd., Los Angeles, Calif., L. H. Caron, CA 2-0138, Electronic Coils
Elnetic Corp., 530 Venezia Ave., Venice, Calif., Ernest Carlson Jr., EX 9-1819, Sub-miniature Pulse Transformers
EL Ray Motor Co., 11747 Vose St., N. Hollywood, Calif., C. H. Adams, PO 5-5771, Motors
*Emsco Mfg. Co., 6811 S. Alemeda, Los Angeles 54, Calif., A. A. Ashton, JE 5261, Towers
Engineered Instruments, 815 Soto St., Hayward, Calif., D. R. Callow, JE 7-1545, Chokes, Coils, Relays
Extruders Inc., 3232 W. El Segundo Blvd., Hawthorne 1, Calif., W. S. Towne, OR 8-4071, Plastic Molding

Faber Mfg. Co., Merle F., 35 Stillman, San Francisco 7, Calif., M. F. Faber, EX 2-7302, Metal Tube Parts
Fischer & Co., R. A. 517 Commercial St., Glendale 3, Calif., Robert Fowler, CH 5-2746, Medical Electronic Equip.
Fisher Research Lab., 1961 University Ave., Palo Alto, Calif., Earl Peterman, DA 2-4646, Transmitters, Detectors
Fletcher Aviation Corp., 190 W. Colorado St., Pasadena 1, Calif., W. S. Fletcher, RY 1-6761, Aireraft & Aircraft Accessories
F & M Sales Inc., 1054 Cahuenga Blvd., Hollywood 38, Calif., G. J. Hider, HO 3-1959, Crystal Orientation Heads

Ford Eng'g. Co., 129 E. "A" St., Upland, Calif., A. S. Voak, Potentiometer, Rheostats
Friden Calculating Machine Co., 2350 Washington Ave., San Leandro, Calif., J. L. Moody, SW 8-0700, Aircraft Equip.

Gaertner Radio Co., 3612 Maple Ave., Los Angeles 11, Calif., E. C. Rau, AD 3-8452, Communications, Amplifiers, Coils
Galetronics, Inc., 2607 E. Foothill Blvd., Pasadena 8, Calif., B. F. Grimm, SY 3-1516, Precision Potentiometers, Subminiaturized Instrumentation

Gardner Elect. Mfg. Co., 4227 Hollis St., Emeryville 8, Calif., S. M. Gardner, OL 2-7600, Transformers
General Controls Co., 801 Allen Ave., Glendale, Calif., W. A. Ray, RO 9-2181, Control Equip.
Geniseo Inc., 2233 Federal Ave., Los Angeles 64, Calif., R. E. Braun, AR 9-8913, Instruments, Controls
Gertsch Products, Inc., 11846 Miss. Ave., Los Angeles 25, Calif., L. S. Cutler, BR 2-1795, Frequency Meters, Filters
Giannini & Co., G. M., 590 S. Fair Oaks, Pasadena 2, Calif., G. M. Giannini, SY 3-2103, Gage Indicators, Pots
Gilfillan Bros., 1815 Venice Blvd., Los Angeles 6, Calif., H. G. Tasker, DU 7-5131, Aircraft Equip.
Girard-Hopkins, 1000 40th Ave., Oakland 1, Calif., J. C. Hopkins, KE 2-8477, Capacitors
Glass-Solder Eng'g, 845 El Centro St., S. Pasadena, Calif., G. Northrop, PY 1-2312, Hermetic Sealed Terminals & Headers
Globe Electrical & Mfg. Co., 11019 Buford Ave., Inglewood, Calif., R. E. Peterson, OR 8-4273, Terminal Boards, Relays
G & M Equipment Co., 7315 Varna Ave., N. Hollywood, Calif., A. Montgomery, ST 7-1086, Communications & Test Equip.
Gonset Co., 801 S. Main St., Burbank, Calif., W. W. Smith, CH 0-2139, Transmitters, Mobile Equip.
Good Inc., Don, 1014 Fair Oaks Ave., S. Pasadena, Calif., D. Good, RY 1-1884, TV Accessories
Goslin Electric & Mfg. Co., 2921 W. Olive St., Burbank, Calif., A. J. Goslin, RO 9-3025, Transformers, TV Lead-In
G-W Associates, P.O. Box 2263, El Segundo, Calif., G. Underberger, EL 370, Waveguide, Measurement Equip.

Hadley, R. M., 5112 S. Hoover St., Los Angeles, Calif., A. H. Hadley, AD 4-0131, Coils, Transformers, Chokes
Hallen Corp., 3503 W. Olive Ave., Burbank, Calif., Noel Bartlett, CH 8-6976, Recorders, Amplifiers
Hallett Mfg. Co., 1601 W. Florence Ave., Inglewood, Calif., V. W. Balzer, OR 8-4751, Hardware, Shielding, Generators
Harder Co., D. C., 3338 India St., San Diego 1, Calif., D. C. Harder, W 8-2180, Coil Winding Machines, Filters
Harworth Service Co., 409 El Camino Real, Menlo Park, Calif., Keith Harworth, DA 3-9965, Precision Instrument Parts
Helipot Corp., 916 S. Meridian Ave., S. Pasadena, Calif., F. C. Braugh, PY 1-2164, Potentiometers, Dials
Hercules Elec. Mach'y. & Equip. Co., 1442 E. Washington Blvd., Los Angeles 21, Calif., K. F. Wharton, RI 5269, Relays, Chargers
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif., Brunton Bauer, DA 5-54451, Test Equip., Meters, Amplifiers
Hoffman Radio Corp., 3761 S. Hill St., Los Angeles 7, Calif., C. Wasmandorf, RT 7-9661, Television Electronics
Holl Audio Inc., 5020 N. Encinita Ave., Temple City, Calif., W. F. Holl, AT 7-2902, Audio Amplifiers, Speaker Systems
Hopkins Eng'g. Co., 2082 Lincoln Ave., Altadena, Calif., C. W. Wieland, SY 8-1185, Radio Interference Filters & Capacitors
Houston Fearless Corp., 11801 W. Olympic Blvd., Los Angeles 64, Calif., H. W. Houston, BR 2-4331, TV Pedestals, Film Equip.
Hufco Industries, 2815 W. Olive St., Burbank, Calif., M. L. Pfenind, RO 9-2118, Relays
Huggins Labs., 700 Hamilton Ave., Menlo Park, Calif., R. A. Huggins, DA 2-6989, Amplifiers, Light Equip.
Hughes Research & Devel. Lahs., Culver City, Calif., Dr. S. Ramo, TE 0-7111, Airborne Radar Systems, Guided Missiles
Hughey & Phillips, P. O. Box 686, Encino, Calif., H. E. Whittemore, Jr., ST 4-8218, Tower Lighting Equip.
Hycon Mfg. Co., 2961 E. Colo. Blvd., Pasadena 8, Calif., W. C. McFadden, RY 1-8301, Delay Lines, Test Equip., Meters
Hycor Co., 11423 Vanowen St., N. Hollywood, Calif., R. E. Schlegel, ST 7-6129, Coils, Resistors, Filters
Hydro-Aire Inc., Sub. of Crane Co., 3000 Winona Ave., Burbank, Calif., L. E. Tomlinson, RO 9-1331, Transistors

Industrial Electronic Engineers, 3972 Lankersheim Blvd., N. Hollywood, Calif., D. G. Gumperts, ST 7-1484, Test & Computer Equip., Controls
Industrial Eng'd Products Co., 7416 Melrose Ave., Los Angeles 46, Calif., R. Benton, YO 7167, Soldering Irons
INET, Inc., 8655 S. Main St., Los Angeles 3, Calif., R. Rall, Jr., PL 3-2583, Power Supplies, Chargers
*Int'l Business Machine Corp., 99 Notre Dame Ave., San Jose 10, Calif., R. B. Johnson, CY 4-3560, Computing Machines
Int'l Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif., E. Lidow, OR 8-3778, Diodes, Rectifiers
Int'l Research Associates, 2221 Warwick Ave., Santa Monica, Calif., W. G. Hornbostel, TE 0-4415, Amplifiers, Test Equip.
Int'l Telemeter Corp., 2000 Stoner Ave., Los Angeles 25, Calif., Dr. L. Ridenour, AR 8-7751, Community TV Equip., Computers
iq Industries, 6110 Wilshire Blvd., Los Angeles 36, Calif., C. Kempton, WE 3-8203, Controls, Computers
Int'l Teletronics Inc., 215 Ellsworth Ave., San Mateo, Calif., E. M. Smith, DI 3-9103, Aireraft Equip.

Janco Corp., 3111 Winona Ave., Burbank, Calif., T. A. Andrews, RO 9-2107, Connectors, Antenna Accessories
Javex, P. O. Box 646, Redlands, Calif., C. J. Reimuller, Connectors, Insulating Coatings
Jeffries Transformer Co., 1710 E. 57 St., Los Angeles 58, Calif., O. D. Quintana, LO 8-3436, Transformers, Coils
Jennings Radio Mfg. Co., P. O. Box 1278, San Jose, Calif. J. E. Jennings, CY 2-4025, Capacitors, Relays
Jebbins Electronic Enterprises, 1358 Hollyburne Ave., Menlo Park, Calif., D. E. Lincoln, DA 2-7661, Transformers Magnetie Coils, Power Supplies
Johnson-Williams Ltd., 2625 3 St., Palo Alto, Calif., K. W. Johnson, Detectors, Alarms, Indicators
Kaar Eng'g Corp., P. O. Box 1320, Palo Alto, Calif., J. M. Kaar, DA 3-9001, Receivers, Transmitters
Kahl Scientific Instrument Corp., El Cajon, Calif., G. Wolten, H 4-5944, Temperature & Electrical Glass Instrumentation
Kalbfell Labs., Inc., 1090 Morena Blvd., San Diego 10, Calif., D. C. Kalbfell, WO 6359, Amplifiers, Controls
Karl-Douglas Associates, 3160 W. El Segundo Blvd., Hawthorne, Calif., Jack Chrisman, OR 8-0461, Magnetic Amplifiers
Kartron, 7882 Kartron St., Huntington Beach, Calif., T. B. Linton, Shorted Turn Indieators
Kaye-Halbert Corp., 3623 Eastham Dr., Culver City, Calif., Fred Miller, DO 2-2996, Soldering Irons
Kelnor Mfg. Corp., 222 Kearney St., San Francisco 8, Calif., Fred Miller, Do 2-2996, Soldering Irons
K-F Development Co., 2606 Spring St., Redwood City, Calif., Paul Keeler, EM 8-5670, Precision Potentiometers, Carrier Current Systems
Kinevox Inc., 116 S. Hollywood Way, Burbank, Calif., L. R. Roos, RO 9-3291, Magnetic Film Equip., Power Supplies
Klein, Leo, 2404 S. LaBrea Ave., Los Angeles 16, Calif., L. Klein, WA 3119, Magnetizers, Flux Meters
Calif., E. E. Wachter, CH 5-2376, Soldering Irons
Kwikheat Mfg. Co., 3732 San Fernando Rd., Glendale 4,

Lake Mfg. Co., 2323 Chestnut St., Oakland 7, Calif., Joseph Aletto, TE 2-2498, Amplifiers, Public Address Systems
Lane Electronics, 7254 Atoll St., N. Hollywood, Calif., A. J. Lane, ST 7-3267
Lansing Sound Inc., J. B., 2439 Fletcher Dr., Los Angeles 39, Calif., W. H. Thomas, NO 3-2545, Sound Systems, Speakers
Leach Relay Co,. 5915 Avalon Blvd., Los Angeles 3, Calif., E. K. Neale, AD 8221, Relays
Lear, Inc., Learcal Div., 11916 W. Pico Blvd., Los nas, Transmitters, Receivers
Lee Electric & Mfg. Co., 2806 Clearwater St., Los Angeles 39, Calif., L. V. Lawhead, Jr., NO 3-1295, Power Supplies, Batteries
Lenkurt Electric Co., 1105 County Rd., San Carlos, Calif., G. M. Lebedeff, LY 3-2611, Communications Systems
Lewis & Kaufman Ltd., 17320 El Rancho Ave., Los Gatos, Calif., N. V. Bramley, EL 4-3540, Rectifier & Transmitting Tubes
Librascope Inc., 1607 Flower St., Glendale 1, Calif., D. C. Webster, CH 5-2677, Computers, Amplifiers
*Lindberg Eng'g. Co., 2460 Enterprise, Los Angeles, Calif., TR 2057,
Lipps Co., E. A., 5485 W. Washington Blvd., Los Angeles 16, Calif., C. V Olson, WA 4141, Tape & Disc Recording Heads
Litton Eng'g Labs., 1049 Brittan Ave., San Carlos, Calif., Glenn Lewis, LY 3-3757, Magnetrons, Vacuum Pumps, Gages
Lockheed Aircraft Corp., Burbank, Calif., Aircraft Radio & Electronic Equip.
Loge Sound Engineers, J. M., 2171 W. Washington Blvd., Los Angeles 18, Calif., J. M. Loge, RE 4-9178, Intercoms, Amplifiers
Logistics Research Inc., 141 S. Pacific Ave., Redondo Beach, Calif., C. R. Williams, RF 2-2116, Computers, Photoelectric Units
Louis Bros., 3543 E. 16th St., Los Angeles 23, Calif., Carl Flory, AN 1-7131, TV Antennas
Low-Bar Products, 938 Pico Blvd., Santa Monica, Calif., J. T. Webber, EX 6-5828, Synchros
Luther Electronic Mfg. Co., 5767 W. Adams Blvd., Los Angeles 16, Calif., C. L. Johnson, WY 5826, High Voltage Condensers
Lynch Carrier Systems, 96 Jessie St, San Francisco 5, Calif., R. E. Combs, SU 1-1156, Communication Systems, Transmission Line
Lynn Electronic Research Co., 9 W. Magnolia, Burbank, Calif., C. E. Lynn, RO 9-2864, Connectors, Hardware

Mag-Eleetric Products Corp., 14405 S. Crenshaw Blvd., Gardena, Calif., D. H. Ransom, OR 8-4061, Amplifiers, Servos
Magna Electronics Inc., 9810 Anza Blvd., Inglewood, Calif., T. Gibney, OR 8-5675, Sound Systems, Receivers
Magnasync Mfg. Co., 5517 Satsuma Ave., N. Hollywood, Calif., W. H. Stutz, SU 3-6413, Recorders, Tape Splicers
Manufacturer's Laboratory, 10610 Keswick St., Sun Valley, Calif., H. P. Stark, Pick-Up Arms
Marchant Research Inc., 1475 Powell St., Emeryville, Calif., D. White, HU 3-6603, Computers, Pulse Transformers
Marco Industries Co., 207 S. Helena Ave., Anaheim, Calif., F. A. Harrington, AN 7245, Lights, Preset Panels
Mars Eng'g & Mfg., 3000 N. San Fernando Blvd., Burbank, Calif., T. Ulmer, RO 9-2261, TV & Electronic Research
Masco Products Co., 2119 S. Sepulveda Blvd., Los Angeles 25, Calif., R. Matthews, BR 2-2481, Timers, Switches, Radar
Master Mobile Mounts, Inc., 1306 Bond St., Los Angeles 15, Calif., A. C. Freeman, RI 7-0638, Antennas, Coils
Mattson-Cowley Corp., 1487 Lincoln Ave., Pasadena 3, Calif., E. Mattson, RY 1-7521, Coils, Radio Receivers, Amplifiers, Power Supplies
May Eng'g Co., 6055 Lankersheim Blvd., N. Hollywood, Calif., D. M. May, ST 7-4244, Coils, Counters
McColpin-Christie Corp., 3410 W. 67 St., Los Angeles 43, Calif., S. L. Christie, PL 3-2607, Battery Chargers, Rectifiers
McCormick-Selph Associates, Palo Alto, Calif., F. LaHaye, DA 5-5681, Ceramic-to-Metal Seals
McLaughlin, J. L. A., 367 Bird Rock Ave., La Jolla, Calif., J. L. A. McLaughlin, GL 5-4596, Signal Splitter
Menlo Research Lab., P. O. Box 522, Menlo Park, Calif., C. Weeks, Detectors, Analyzers, Counters
Meridian Metalcraft, Inc., 213 W. Whittier Blvd., Whittier, Calif., E. H. Lockhart, OX 4-2026, Microwave Equip., Waveguides, Test Equip.
Microdot Div., Felts Corp., 1826 Fremont Ave., S. Pasadena, Calif., G. P. Felts, Hardware, Cable Connectors
Microwave Eng'g Co., 4000 Mt. Lee Dr., Los Angeles 28, Calif., R. Krausz, HO 4-7591, Oscillators, Design
Miller Co., J. W., 5917 S. Main St., Los Angeles 3, Calif., W. R. Courtney, AD 3-4297, Terminals, Coils, Chokes

WEST COAST MANUFACTURERS

Miller Instruments, Inc., Wm., 325 N. Halstead Ave., Pasadena 8, Calif., G. W. Downs, RY 1-6317, Analog Computers, Vibration Test Equip.
Miller Television Co., 2840 Naomi, Burbank, Calif., J. Miller, RO 9-1659, TV Antennas, Kits
Mission-Western Engineers Inc., 132 W. Colorado St., Pasadena 1, Calif., J. David, RY 1-6604, Power Supplies, Motors
Mitchell Camera Corp., 666 W. Harvard St., Glendale, Calif., G. P. Mitchell, CH 5-1086, Cameras, Lenses
Mole-Richardson Co., 937 N. Sycamore Ave., Hollywood 38, Calif., M. A. Hankins, HI 8305, Microphone Booms
Monitor Products Co., 815 Fremont Ave., S. Pasadena, Calif., H. E. Blasier, PY 1-1174, Crystals, Ovens
Moore Tool Works, 1311 Riverside Dr., Los Angeles 31, Calif., R. H. Fogwell, CA 1-1166, Special Electronic Machine
Morgan Instruments Co., 21420 Valerio St., Canoga Park, Calif., H. C. Morgan, DI 8-5771, Geiger Counters
Morrow Radio Mfg. Co., 2794 Market St., Salem, Ore., R. E. Morrow, Mobile Equip., Receivers, Coils
Moseley, F. L., 1325 N. Fairoaks Ave., Pasadena 3, Calif., Instrument Recorder
Motordyne, Inc., 2661 S. Myrtle Ave., Monrovia, Calif., J. J. Wittkopf, DO 7-4760, Motors, Generators, Relays, Transformers
Moviola Mfg. Co., 1451 Gordon St., Hollywood 28, Calif., M. Serrurier, HO 7-3178, Film Editing Equipment
Mullenbach Electrical Mfg. Co., 2300 E. 27th St., Los Angeles 58, Calif., E. L. Coe, Jr., LO 5-5331, Coils, Resistors, Transformers

Naer Corp., 11777 Santa Monica Blvd., W. Los Angeles 25, Calif., Martin Baker, AR 9-6212, Switches, Tubes, CR Tester
National Electronics Mfg. Co., 314 W. 58 St., Los Angeles, Calif., Carlyle Blacker, PL 1-5166, AM & TV Receivers
Natural Lighting Corp., 1124 E. Colo. Blvd., Glendale 5, Calif., L. V. Grover, CH 5-4655, Lighting Equip., Cameras
Neal Feay Co., 427 Olive St., Santa Barbara, Calif., N. F. Rasmussen, 2-0722, Nameplates, Meterfaces, Panels
Neomatic Inc., 9010 Bellanca Ave., Los Angeles 45, Calif., T. R. Welch, OR 8-3814, Coils, Relays, Plugs
Neufeld Mfg. Co., 1218 Venice Blvd., Los Angeles 6, Calif., I. C. Neufeld, PR 5918, Control Boxes, Cables
Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif., D. E. Warner, HO 9-5381, Amplifiers, Sound Systems
Nikirk, T. E., 2020 E. Villa St., Pasadena 8, Calif., T. E. Nikirk, SY 6-4264, Custom Built Audio, Electronic & Communication Equip.
Non-Linear Systems, Box S, Del Mar, Calif., Jonathan Edwards, DE 246, Voltmeters, Wave Traps
North American Instruments, Inc., 3445 Cahuenga Blvd., Los Angeles 28, Calif., Bernard Helfand, HO 3-7007, Pick Up Systems, Computers, Frequence Meters
Northern Radio, 314 Bell St., Seattle, Wash., L. G. Reynolds, SE 2519, Communication Equip.
Northrop Aircraft, Inc., 1001 E. Broadway, Hawthorne, Calif., Dr. Wm. Ballhaus, OR 8-9111, All-weather Interceptors, Guided Missiles

Oberline Ltd., 6411 Hollywood Blvd., Hollywood 28, Calif., John Trevor, HO 7-6431, Amplifiers, Audio Consoles, Switches
O'Brien Electric Corp., 6514 Santa Monica Blvd., Hollywood 38, Calif., George Mahassy, HI 1117, Sound Systems, Racks
Olesen Co., O. K., 1534 Cahuengo Blvd., Hollywood 28, Calif., S. W. Stevens, GL 5194, Mike Booms, Light Equip.
Olympic Instrument Labs., Cove, Wash., C. A. Creeelius, VA 2121, Production Equip., Take-Up Reels
Opto Eng'g. Co., 3406 W. Washington Blvd., Los Angeles 18, Calif., R. L. Redden, PA 2222, Gages, Optical Equip. Design
Oregon Corvck Co., 1005 N. W. 16 Ave., Portland, Ore., Charles Shanks, BR 7559, Antennas, Medical Equip.
Oregon Electronic Mfg. Co., 2232 E. Burnside St., Portland 15, Ore., G. W. McPherson, EM 9292, Power Supplies, Probes
Osborne Electric Co., 712 S.E. Hawthorne Blvd., Portland 14, Ore., G. L. Osborne, FI 6448, Aircraft Equip.
Owen Labs., 412 Woodward Blvd., Pasadena 10, Calif., R. P. Owen, SY 6-5167, Differential Amplifiers, Power Supplies
*Ozalid, Div. General Aniline & Film Corp., 1725 Poplar St., Oakland 7, Calif., George Schoner, TW 3-8445, Sensitized Materials for Whiteprint Machines

Pacific Electricord Co., 3217 Exposition Pl., Los Angeles, Calif., J. Schwalbe, AX 3-7205, Cord & Cable Assemblies
Pacific Mercury TV Mfg., Corp., 5955 Van Nuys Blvd., Van Nuys, Calif., S. Cutler, ST 7-2676, Mobile Equip., Receivers
Pacific Optical Corp., 5965 W. 98 St., Los Angeles, Calif., Earl Exley, CA 2-7171, Optical Instruments Precision Optics
Pacific Transducer Corp., 11921 W. Pico Blvd., Los Angeles 64, Calif., G. A. Argabrite, AR 9-6129, Lenses, Sound Pick-Ups
Pacific Universal Products Corp., 168 Vista Ave., Pasadena 8, Calif., R. E. Frazer, SY 5-2571, Mirrors, Optical Equip.
Packard-Bell Co., 12333 W. Olympic Blvd., Los Angeles 64, Calif., C. A. Nichols, AR 7-6721, Navigation Equip., Receivers
Page-Fogwell Corp., 1311 Riverside Dr., Los Angeles 31, Calif., R. H. Fogwell, CA 1-1166, Electrical Plugs
Palmer Inc., M. V., 4002 Fruit Valley Rd., Vancouver, Wash., H. C. Lambert, VA 5-2894, Amplifiers, Filters
Palo Alto Eng'g. Co., 448 Olive St., Palo Alto, Calif., Brunton Bauer, DA 5-3251, Chokes, Coils, Transformers
Pancro Mirrors, Inc., 2958 Los Feliz Blvd., Los Angeles 39, Calif., G. B. Keim, NO 1-2141, Mirrors, Lenses
Pantek Co., 208 42 St., Manhattan Beach, Calif., Eric Swarthe, Counters, Frequency Indicators
PAR Products Corp., 926 N. Citrus Ave., Hollywood 38, Calif., P. A. Roos, HO 5-6298, Lenses, Batteries
Parsons Co., R. M., 135 W. Dayton St., Pasadena, Calif., Paul Reedy, SY 3-6158, Telemetering
PCA Electronics Inc., 2180 Colo. Ave., Santa Monica, Calif., Harvey Smith, TE 0-6716, Printed Circuits, Transformers

Pedersen Electronics, 3667-A Mt. Diablo Blvd., Lafayette, Calif., S. R. Pedersen, 3434, Audio Amplifiers
Peeco Corp., 2760 Whittier Blvd., Los Angeles 23, Calif., M. D. Preston, AN 9-4164, Dielectric Heating Equip.
Peerless Electrical Products, Div. Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif., A. A. Emlen, CR 5-5101, Transformers
Pembrex Theatre Supply Corp., 1969 S. Vermont Ave., Los Angeles 7, Calif., L. M. Wutke, RE 1-3111, Magnetic Preamps, Projectors
Penta Labs., Inc., 216 N. Milpas St., Santa Barbara, Calif., R. L. Norton, 5-4581, Tubes, Vacuum Switches
Perkin Eng'g. Corp., 345 Kansas St., El Segundo, Calif., T. W. Lenay, EL 1366, Power Supplies
Permoflux Corp., 236 S. Verdugo Rd., Glendale 5, Calif., Gerald Widawsky, CH 5-5135, Adapters, Baffles, Chokes, Coils
Pfleger Products, 3901 W. 54 St., Los Angeles 43, Calif., R. A. Pfleger, AX 2-8313, Panels, Terminal Boards
Phaostron Co., 151 Pasadena Ave., S. Pasadena, Calif., Phil Chamberlin, CL 6-2171, Meters, Relays, Resistors
Photocon Research Products, 421 N. Foothill Blvd., Pasadena 8, Calif., C. E. Grinstead, Gages, Indicators
Photographic Products Inc., 6916 Romaine St., Hollywood 38, Calif., William Carroll, HO 4-8151, Instrument Cameras
Pioneer Electronics Corp., 2235 S. Carmelina, W. Los Angeles, Calif., V. E. De Lucia, CR & TV Camera Tubes, Switches
Pioneer Tool Co., 5008 W. Jefferson Blvd., Los Angeles 16, Calif., Ronald Eunson, RE 3-8289, Tools, Cutters, Punches
Pomona Electronics Co., 524 W. 5th Ave., Pomona, Calif., Test Equip.
Precision Crystal Lab., 2223 Warwick Ave., Santa Monica, Calif., W. Rogers, TE 0-5049, Quartz Crystals
Precision Electronics, 7518 Melrose Ave., Los Angeles 46, Calif., Stanley Cherubin, WE 3-3270, Receivers, Sound Systems
Precision Radiation Instruments, 2235 S. La Brea, Los Angeles 16, Calif., L. Norman, YO 5143, Radiation Detectors, Geiger Counters
Prescott Television Co., 7350 Beverly Blvd., Los Angeles 36, Calif., B. W. Reagan, WE 3-7193, TV Receivers
Producers Sales Corp., 2704 W. Olive Ave., Burbank, Calif., John Kiehl, CH 6-2158, Projectors, Cameras, Kine Recording
Product Associates Inc., 318 W. Olympic Blvd., Los Angeles 15, Calif., Robert Waltz, RI 7-4519, Tape Recorders
Professional Electronics Co., 180 E. Calif. St., Pasadena 1, Calif., E. P. Shultz, SY 9-3435, Test Equip.
PSP Eng'g. Co., 8420 Otis St., South Gate, Calif., Walter Sellers, LO 5-8195, Solenoids

Radiaphone Co., 600 E. Evergreen Ave., Monrovia, Calif., R. C Lord, EL 8-2586, Marine Transceivers
*Radio Corp of America (RCA Victor Div.) 11819 Olympic Blvd., W. Los Angeles, Calif., T. Gottier, BR 2-4335, Audio Equip., Microwave Equip., Radar, Recording Equip.
Radio Recorders, 7000 Santa Monica Blvd., Hollywood 38, Calif., H. L. Bryant, HE 3282, Recorders, Sound Equip.
Radio Specialty Mfg. Co., 2023 S.E. 6th Ave., Portland 14, Ore., H. Sterne, EA 8123, Quartz Crystals, Communication Equip.
Rainbo Record Mfg. Corp., 4336 W. 147 St., Lawndale, Calif., Fritz Jensen, OR 8-3489, Recording Discs
Ramsell Mfg. Co., 420 Market St., San Francisco, Calif., W. H. Ramsell, EX 5-2919, Plastics, Proctective Coatings
R-C Scientific Instrument Co., 307 Culver Blvd., Playa del Rey, Calif., L. R. Curtis, EX 8-5411, Radiation Equip.
Rea Co., J. B., 11941 Wilshire Blvd., Los Angeles 25, Calif., K. R. Jackson, AR 7-1204, Computers, Controls
Rectifier Eng'g Co., 1803 E. 7th St., Los Angeles 21, Calif., Claude Osborn, TU 5169, Battery Chargers, Rectifiers
Regulator Eng'g & Devel. Co., 11545 W. Jefferson Blvd., Culver City, Calif., R. S. Kelly, EX 8-5733, Power Supplies
Remler Co., 2101 Bryant St., San Francisco 10, Calif., H. A. Greene, VA 4-3435, Aircraft Equip., Hdwe.
Repath Co., Paul R., 641 E. 61 St., Los Angeles 1, Calif., P. R. Repath, AD 3-7262, Shield Cans, Cases, Transformer Laminations
Resdel Eng'g. 2351 Riverside Dr., Los Angeles 39, Calif., H. Abajian, OL 2955, Amplifiers, Test Equip.
Resonant Co., 360 Quarry Rd., Belmont, Calif., Dana Bowers, LY 3-7661, Radar Waveguides
*Revere Copper & Brass, Inc., 6500 E. Slauson Ave., Los Angeles 54, Calif., D. C. Bergen, UN 0-3331, Copper & Copper Alloys, Aluminum Tubing, Aluminum Extruded Shapes, Brass Rods
RISCO, 265 Minna St., San Francisco 3, Calif., W. J. Johnson, EX 2-7820, Carrier Current Equip.
Robinette Co., W. C., 802 Fair Oaks Ave., S. Pasadena, Calif., W. C. Robinette, PY 1-1594, Control Equip., Indicators
Roesch Co., D. J., 2200 S. Figuero St., Los Angeles 7, Calif., Philip Berstien, RI 7-9655, Amplifiers,, Testers, Sound Systems
Rohr Aircraft Corp., Chula Vista, Calif., F. E. McCreery, HA 2-1121, Power Pkgs., Wing Tanks, Exhaust Systems,, Airplane Parts
Rollin Co., 2010 N. Lincoln Ave., Pasadena 3, Calif., J. E. Stankey, RY 1-7134, Test Generators, Slotted Lines
Rutherford Electronics Co., 3707 S. Robertson Blvd., Culver City, Calif., J. S. Johnson, TE 0-4362, Pulse Equip.
Rutishauser Corp., 490 S. Fair Oaks Ave., Pasadena 1, Calif., R. G. Madsen, SY 3-4340, Amplifiers, Indicators
Ryan Aeronautical Co., 2701 Harbor Dr., San Diego 12, Calif., Bruce Smith, WO 6681, Guided Missile Systems
Rytel Electronics Mfg. Co., 9820 Irwin Ave., 8920 Irwin Inglewood 2, Calif., Arthur Munsiz, OR 8-4787, TV Antenna Connector, Tube Puller, Speaker Grille

Salesmaster Corp., 3717 W. 54 St., Los Angeles 43, Calif., James Sherman, AX 1-6200, Endless Magnetic Tape Reproducers

San Fernando Electric Mfg. Co., 12900 Foothill Blvd., San Fernando, Calif., D. E. Rubendall, EM 1-8681, Capacitors
Sargent-Rayment Co., 1401 Middle Harbor Rd., Oakland 20, Calif., L. W. Rayment, GL 1-7045, Audio Amplifiers
Scala Radio Co., 2814 19 St., San Francisco 10, Calif., Bruno Zucconi, VA 6-2898, Scope Marker Injectors
Schwien Eng'g Co., 16217 Lindbergh St., Van Nuys, Calif., J. T. Harahan, Motors, Navigation Equip.
SEMCO Eng'g & Mfg. Co., 8407 S. Hoover St., Los Angeles 44, Calif., George Korkos, PL 2-7657, TV Receivers, TV Remote Controls
Sequoia Process Corp., 881 Douglas Ave., Redwood City, Calif., P. M. Cook, EM 8-4651, Cable, Wire
*Servomechanisms, Inc., 316 Washington St., El Segundo, Calif., D. W. Moore, EL 1517, Electronic Controls, Instrumentations, Analog Computers, Transducers
Shannon Luminous Materials Co., 7356 Santa Monica Blvd., Hollywood 46, Calif., J. R. Alburger, GR 5509, Flaw Detectors, Black Lights
Shelby Instrument Co., 1701 Magnolia Ave., Long Beach, Calif., Michele Nazak, LO 7-6300, Sub-Sub Min. Electric Equip.
Sierra Electronic Corp., 1050 Brittan Ave., San Carlos, Calif., P. F. Byrne, LY 3-2104, Test Equip., Transformers
Sightmaster of Calif., Santee, Calif., Samuel Freedman, HI 4-7661, Microwave Colorimeters, Waveguides, Solders, Bearing Metals
Signal Equip. Co., 2317 Fourth Ave., Seattle 1, Wash., G. K. Barger, SE 4712, Electronic Filter
Slate & Associates, C. C., 11370 W. Olympic Blvd., Los Angeles 64, Calif., N. Loenard, BR 2-4504, Amplifiers, Filters
Slip Ring Co. of America, 2038 Bdwy., Santa Monica, Calif., Lee LeBeau, EX 3-8256, Slip Rings
Smith Mfg. Co., Nathan R., 105 Pasadena Ave., S. Pasadena, Calif., N. R. Smiht, AL 1141, Coils, Impregnating Compounds
Soderberg Mfg. Co., 628 S. Palm Ave., Alhambra, Calif., W. W. Hulke, CU 3-3382, Aircraft Lights
Solar Mfg. Corp., 2660 E. 46 St., Los Angeles 58, Calif., W. G. Delp, LO 8-2124, Capacitors, Printed Circuits
Specific Products, 5864 Hollywood Blvd., Hollywood 28, Calif., John Coster, HU 2-7200, Fixed Frequency Receivers
*Sprague Electric Co., 11325 Washington Blvd., Culver City, Calif., Fred Potter, TE 0-7491, Radio Noise Filters
Stancil-Hoffman Corp., 921 N. Highland Ave., Hollywood 38, Calif., Mark Siera, HO 4-7461, Recorders, Reels, Selsyns
*Standard Coil Products Co., 1919 Vineburn Ave., Los Angeles 32, Calif., E. P. Thias, CA 2-8161, Television Tuners
Standard Electronics Mfg. Co., 11861 Teale St., Culver City, Calif., M. E. Lippman, EX 7-4248, Precision Wire-Wound Potentiometers
Starbird, George A., 950 N. Highland Ave., Los Angeles 38, Calif., G. A. Starbird, HE 4841, Mike Booms & Stands
Statham Laboratories, 12401 W. Olympic Blvd., Los Angeles 64, Calif., M. Di Giovanni, BR 2-6286, Transducers
Stephens Mfg. Corp., 8538 Warner Dr., Culver City, Calif., R. L. Stephens, VE 9-7578, Speakers, Mikes
Sterling Electric Motors, 5401 Telegraph Rd., Los Angeles 22, Calif., A. A. Allcock, AN 4211, Electric Power Drives
Stoddard Aircraft Radio Co., 6644 Santa Monica Blvd., Hollywood 38, Calif., A. T. Parker, HO 4-9294, Meters, Attenuators
Stone & Smith, Inc., 5965 Alcoa Ave., Los Angeles 58, Calif., S. H. Brown, JE 7144, Sonar Equip.
Summers Gyroscope Co., 2328 Bdwy., Santa Monica, Calif., J. W. Brubaker, EX 3-6711, Gyro-Compments & Automatic Control Systems for Guided Missiles
*Sylvania Electric Products, Mountain View, Calif., P. G. Bohlke, YO 7-6981, Microwave Tubes, TV Picture Tubes
Symphony Radio Corp., 925 S. Western Ave., Los Angeles 6, Calif., S. G. Solat, RE 3-9310, Carbon Resistors

Tally Register Corp., 5300 14 Ave. N.W., Seattle 7, Wash., M. R. Dilling, DE 5500, Digital Data Reduction Systems
Tartak Electronics, 2979 N. Ontario St., Burbank, Calif., H. C. Hornickel, CH 0-4450, Transformers, Chokes
T-bar-B, 5919 Hollywood Blvd., Hollywood 28, Calif., Donna Fargo, HO 9-6211, Rear Screen & Film Projectors
Technical Associates, 140 W. Providencia Ave., Burbank, Calif., H. A. Glassford, RO 9-1994, Radiation Instruments
Technical Development Corp., 4060 Ince Blvd., Culver City, Calif., H. T. Winchel, TE 0-5461, Sonar, Electronic & Mechanical Equip.
Techno Instrument Co., 6666 Lexington Ave., Los Angeles 38, Calif., E. Smith, GL 3304, Amplifiers, Recorders
Tektronix, 9450 S. W. Barnes Rd., Portland 7, Ore., Howard Vollum, CY 2-2611, CR Seopes, Test Instruments
Telecomputing Corp., 133 E. Santa Anita Ave., Burbank, Calif., W. D. Caldwell, CH 0-8161, Computer Equip., Counters
Teletronic Laboratories, 1835 W. Rosecranz Ave., Gardena, Calif., L. A. Burkhardt, ME 9-1131, Test Equip., Cable Cord, Harness, R. F. Connectors
Television Co. of Amer., 1761 Lincoln Blvd., Santa Monica, Calif., A. Vigilante, EX 4-7761, Antennas, Amplifiers
Tempo TV Products Co., 2450 Ramona, Los Angeles 33, Calif., H. K. Leib, AN 3-4240, Hardware, Antenna Towers
Thermador Electrical Mfg. Co., 5119 District Blvd., Los Angeles 22, Calif., J. W. Wardell, KI 6131, Transformers
Thermo Instruments Co., 1166 El Camino Real, Belmont, Calif., D. M. Comb, LY 3-5139, Relays, Indicators
Thomas Associates, 4607 Alger St., Los Angeles 39, Calif., H. P. Thomas, CH 5-3748, Brackets, Bus bars, Clamps, Shims
Thompson Co., H. I., 1733 Cordova St., Los Angeles 7, Calif., J. Warner, RE 3-9161, Insulator Sleeves
Thor Transformer &Electronics, 750 San Antonio Rd., Palo Alto, Calif. H. J. Birdsell, YO 7-9116 Transformers, Coils, Reactors

Tower Sales & Erecting Co., 6100 N. E. Columbia Blvd., Portland 13, Ore., C. H. Fisher, TR 7303, Broadcasting Antenna Towers

*Tracerlab, 2295 San Pablo Ave., Berkeley, Calif., TH 3-2527

Transco Products, 12210 Nebraska Ave., Los Angeles 25, Calif., R. G. Kenway, BR 2-5687, Co-Arial Cable Switches, Antennas

Transformer Engineers, 161 E. Calif. St., Pasadena 1, Calif., J. P. Whistler, RY 1-6906, Transformers, Coils

Trebor Radio Co., Pasadena 18, Calif., J. King, AM Receivers, Record Players, Intercoms

Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif., E. M. Keillor, TE 0-5381, Transformers, Coils

Tri-Dex Co., 126 E. Apia St., Lindsay, Calif., K. B. Howard, LI 2-4051, Coils, Transformers, Terminals, Delay Lines

Triplett & Barton, P. O. Box 3128, Burbank, Calif., R. E. Hiller, RO 9-1291, Portable X-Ray Equip.

Trutone Electronic Eng'g Co., 812 N. Highland Ave., Los Angeles 38, Calif., H. M. Cohen, HI 1202, Sound Equip., Receivers

Tubing Seal Cap, 808 W. Santa Anita, San Gabriel, Calif., F. W. Livermont, AT 9-5111

Turner & Co., W. R. 4831 W. Jefferson Blvd., Los Angeles 16, Calif., W. R. Turner, RE 2-7137, Small Electric Motors

U M & F Mfg. Corp., 10929 Vanowen St., N. Hollywood, Calif., J. M. Dill, ST 7-5526, Aircraft Equip.

Ungar Electric Tools, 4101 Redwood, Venice, Calif., A. R. Knowles, EX 8-5718, Soldering Irons, Tips

U. S. Electrical Motors, 200 E. Slauson Ave., Los Angeles 54, Calif., W. M. Evans, AD 3-3131, Motors, Speed Reducers

U. S. Eng'g Co., 521 Commercial St., Glendale 3, Calif., A. F. Bell, CH 5-1911, Terminals, Hardware

Universal Electronics Co., 2012 S. Sepulveda Blvd., Los Angeles 25, Calif., Edw. Lacey, AR 9-7803, Power Supplies, Rectifiers

Universal Microphone Co., 424 Warren Lane, Inglewood, Calif., J. L. Kane, OR 8-4978, Microphones, Plugs

Vacuum Tube Products, 506 S. Cleveland St., Oceanside, Calif., G. L. Giles, OC 6567, Tubes, Gages, Welders

Vanguard Electronics Co., 3384 Motor Ave., Los Angeles 34, Calif., S. A. Golbert, TE 0-7344, Coils, Potted Circuits

Vapor Recovery Systems Co., 2820 N. Alameda St., Comptun, Calif., G. E. Denny, NE 6-1211, Gages, Indicators

Varian Associates, 611 Hansen Way, Palo Alto, Calif., S. F. Varian, DA 5-5631, Klystrons, Power Supplies

Vector Electronic Co., 3352 San Fernando Rd., Los Angeles 65, Calif., R. R. Scoville, CL 7-8237, Plug-Ins, Adapters, Socket Turrets

Victorlite Industries, 4117 W. Jefferson Blvd., Los Angeles 16 Calif., H. A. Fitzgerald, RE 2-4033, Studio Projectors

Vinson Co., E. R. 1401 Middle Harbor Rd., Oakland 20, Calif., E. R. Vinson, GL 1-2357, Photoelectric Control, Custom Electronic Fabrication

Walkirt Co., 145 W. Hazel St., Inglewood 3, Calif., H. W. Beekwith, OR 8-2873, Computers, Counters, Plug-In Units

Walsco Electronics Corp., 3225 Exposition Pl., Los Angeles 18, Calif., Frank Hurd, AX 3-7201, Antennas, Radio Hardware

Weingarten Electronic Labs., 7556 Melrose Ave., Los Angeles 46, Calif., Rudolf Weingarten, WA 5405, Custom Radio

West Coast Electrical Mfg. Corp., 10008 S. Main St., Los Angeles, Calif., R. W. Worthington, PL 5-1138, AC & DC Solenoids

West Coast Electronics Co., 5873 W. Jefferson Blvd., Los Angeles 16, Calif., H. A. Grove, TE 0-7211, Communication Equip.

Western Gear Works, P. O. Box 182, Lynwood, Calif., John Morris, NE 6-2161, Gears, Gear Drives

Western Gold & Platinum Works, 589 Bryant St., San Francisco 7, Calif., W. L. Hack, SU 1-2065, Metals, Insulators

Western Instrument Co., 826 N. Victory Blvd., Burbank, Calif., A. K. Edgerton, RO 9-3013, Instrument Calibration

Western Insulated Wire Co., 2425 E. 30 St., Los Angeles 58, Calif., Herman Libkind, JE 7103, Cords, Cables

Western Radiation Lab., 1107 W. 24 St., Los Angeles 7, Calif., G. L. Locher, RI 7-8355, Nuclear Equip., Radiation Shields

Westline Products, Div. of Western Lithograph Co., 600 E. 2 St., Los Angeles 54, Calif., Milton Klesey, TR 2641, Adhesive Markers

Wilcox Research Corp., 340 N. LaBrea Ave., Los Angeles 36, Calif., M. G. Abernathy, WE 1-2923, Coils, Stroboscopes

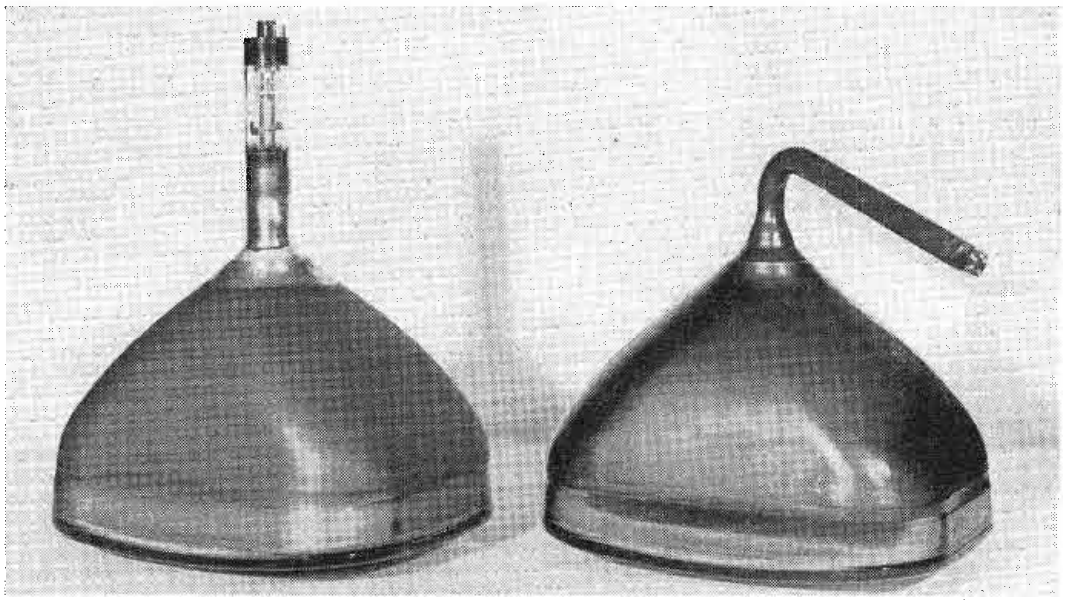
Wildberg Bros., 742 Market St., San Francisco 2, Calif., W. T. Haley, DO 2-3505, Precious Metals

*Willard Storage Battery Co., 5700 E. Olympic Blvd., Los Angeles 22, Calif., J. C. Hartwell, UN 0-1121, Storage Batteries

Wolfe Co., F. C., 3644 Eastham Dr., Culver City, Calif., Joe Nenzell, TE 0-4618, Hermetic Sealing

Woodwelding, 3000 W Olive Ave., Burbank, Calif., F. Wilburn, RO 9-1841, Dielectric & Induction Heating

Bent-Neck TV Picture Tube



Philips' MW36-22 TV picture tube (l) and modified version (r) with neck folded over to reduce front-to-rear distance. Electron gun, 65° cone and 10 x 13 in. screen is same in both tubes

TV receivers may be designed with reduced front-to-back cabinet length with the new experimental tube developed by Philips Research Laboratories in Holland. The decrease in size is accomplished by bending the tube neck at an angle of more than 90°, thereby having the folded neck make an acute angle with the tube axis.

The length of the bent part of the neck is increased. Since this distance no longer influences the depth of the set, and since it allows better focusing than is possible with short necks, the increase is a real advantage.

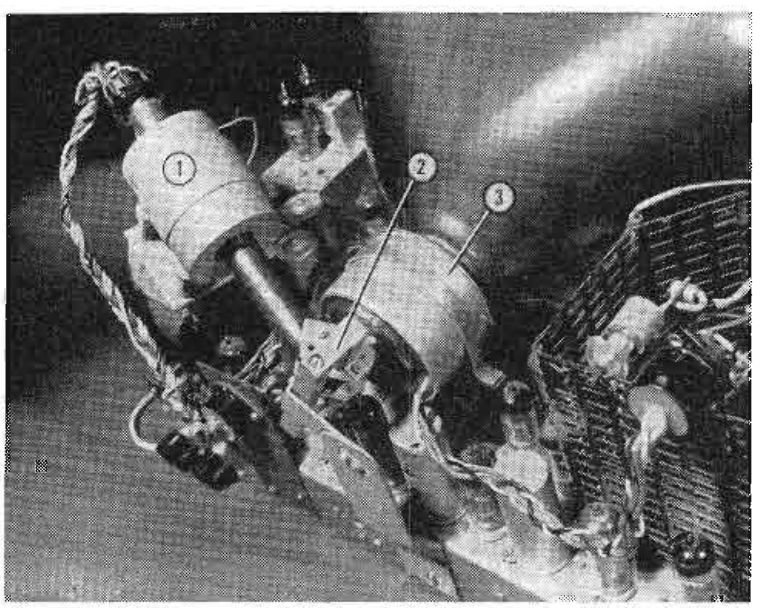
Recognizing that the ions are not deflected as the electrons are, the ion trap has been eliminated. They simply strike the wall of the bent neck and are dissipated. All that is required is a relatively small 70-gauss magnet to bend the electron beam.

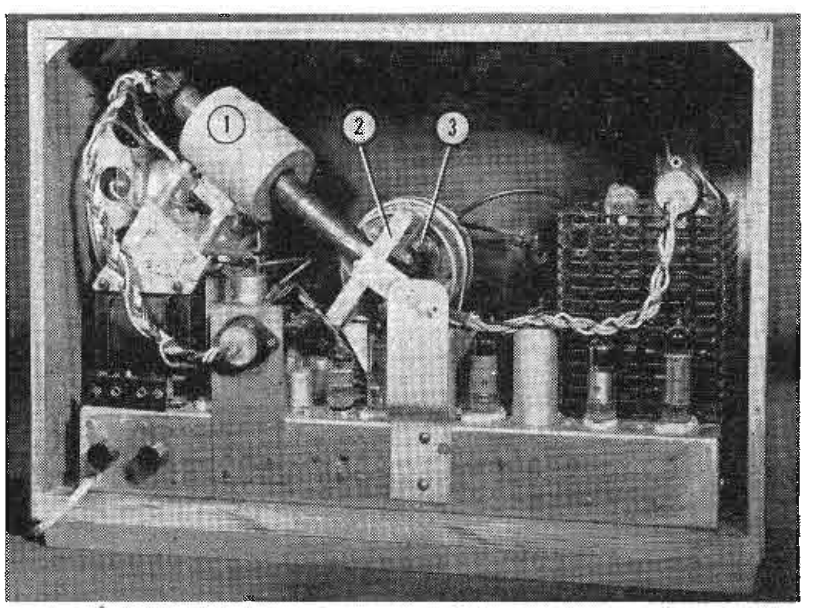
The standard 65° deflection coils conveniently fit on that short distance of neck which lies between the bend and the cone. The height of the specially made focus coil on the bent-over portion of the neck does not affect the tube depth.

A complete TV receiver has been developed, employing the bent-neck version of the MW36-22 tube. Its dimensions are 13.6 in. deep, 19.7 in. wide, and 14.2 in. high—about the size of a standard radio receiver. The screen size is about 10 x 13 in.

Detailed description of the bent TV tube appears in the article written by Dr. J. L. H. Jonker in the Philips *Technish Tijdschrift* (Dutch), Jan. 1953, and Philips *Technical Review* (English), no. 14, June 1953.

Close-up of bent-neck assembly (l) shows (1) focusing coil on lengthened neck, (2) magnet for bending electron beam, (3) deflection coils. Ion trap is eliminated. Complete unit (r) installed in cabinet measures 13.6 in. deep, 19.7 in. wide, and 14.2 in. high

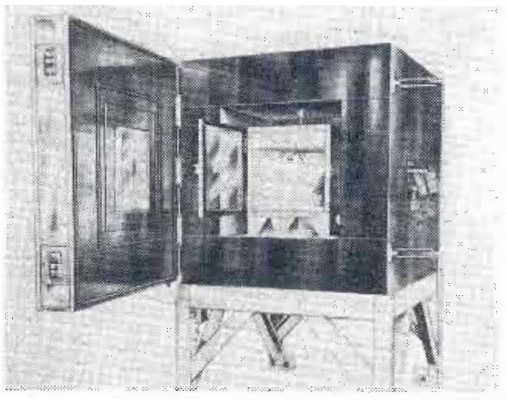




New Laboratory & Plant Equipment

Non-Magnetic Test Chamber

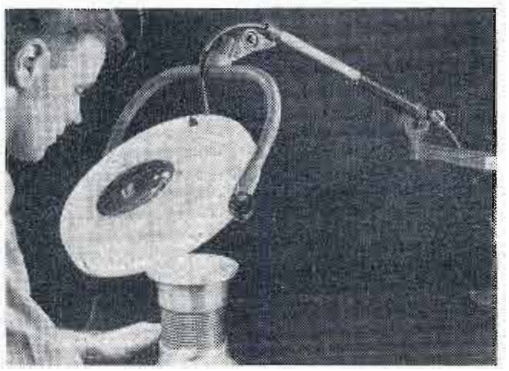
The Bowser test chamber contains no steel. It is constructed entirely of brass, copper, aluminum, rubber, bakelite, glass, wood, and fiber-glass. All motors



and electrical components are far enough away to eliminate the effects of their electrical fields. The unit produces any temperature from −112° F. to +68° F. with close control. A special inner chamber is thermally governed by vernier control that holds temperatures to ±0.1° F.—**Bowser Technical Refrigeration, Terryville, Conn.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Long Reach Magnevision

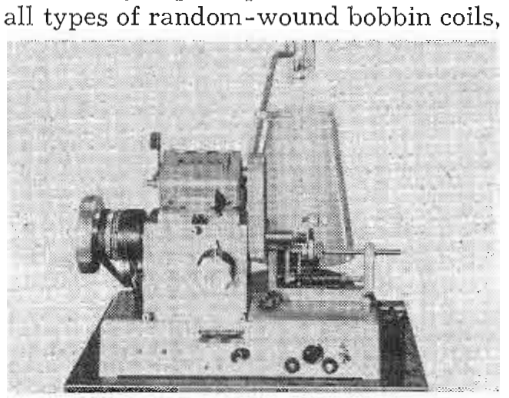
The new long reach model Magnevision, mounted on the far side of the bench, provides distortion-free magna-



fication, stereoscopic vision, and shadowless lighting for inspection and production workers on radio, electronic, and electric parts.—**Engineering Developments, Inc., West Pelham St., Newport, R. I.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Bobbin Winder

Model 38-AM, an electronically controlled high-speed precision winder for all types of random-wound bobbin coils,



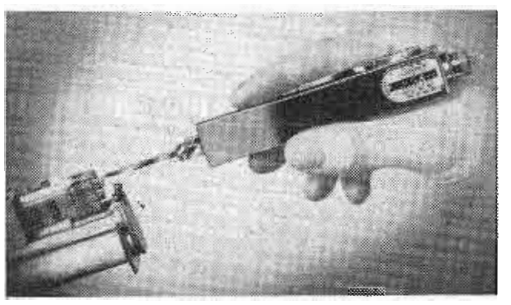
repeater coils, and solenoids has three important new features: an automatic resetting counter, which instantly resets the winding cycle by the touch of a lever; a slow-start feature, which avoids wire breakage; and, a positive stopping magnetic brake, which eliminates coil rejections by accurately winding turns and stopping automatically. When started, the winder gradually builds up to 500 rpm during the first three seconds, then shifts to run out its cycle at 10,000 rpm. Motor equipment is a ⅕ h.p. variable speed ac-dc unit designed for 115 v. operation, and a stepdown transformer is available for 230 v. ac operation. Coil sizes wound are up to 1½ in. wide and 2 in. O.D. One winding set is furnished.—**Stevens Mfg. Co., Inc., Puliski Road at Peterson, Chicago 30, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Lift Truck

The Turnabout Adjust-A-Fork hydraulic lift truck enables use of five interchangeable standard fork lengths—30 in., 42 in., 48 in., and 60 in.; and a frame adjustment provides either a 25 in. or a 27 in. position. The lowered height of the unit is 3½ in. and its lift is 4 in. The 8 in. front wheels are resinoid type and mounted on roller bearings.—**Rack Hydraulic Equipment Corp., Connellsville, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Tension Gauges

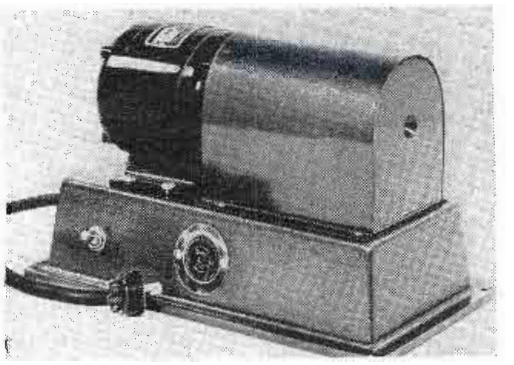
Relay springs, or any device force that opposes motion, are easily and accurately checked within the range from 4 to 2,500 grams by the tension gauges made by The General Electric Co., Ltd.



of England. Preset to the required tension by a knurled micrometer screw, only one hand is needed to apply the operating strip of the gauge to the point at which the opposing force is to be checked—such as a spring tip. Deflection of the strip with the movement of the resisting element, indicates that the force is equal to the gauge setting. The gauges are precision calibrated, and have an adjustable zero correction. The three lightest of six models are provided with interchangeable operating strips to suit the type and position of the mechanism under test.—**IMTRA Corp., 48 Charles St., Cambridge, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Rotary Wire Stripper

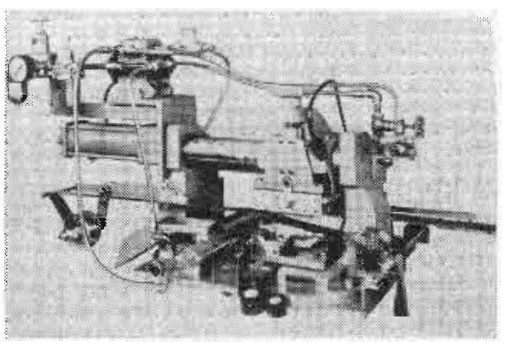
High-speed cutting, stripping and twisting of stranded lead wire is accomplished by a new rotary wire stripper.



No separate bushing inserts are needed; a standard opening accommodates all wire sizes between No. 27 and No. 12. It will strip wall thicknesses from 0.01 in. to 0.0625 whether cotton, plastic, Rock-bestos, or Vynal plastic covered. A separate toggle switch and reversible motor enables twisting wire either clockwise or counterclockwise. An adjustment facilitates stripping ends up to ¾ in. Dimensions are: 5½ in. x 10¾ in. x 6¼ in. Weight is 15 lbs.—**Tartak Electronics, Inc. 2979 N. Ontario, Burbank, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Parts Marking Machine

A new assembly has been added to the series 9AA marking machines for marking plastics, metal, or other material. Tu-

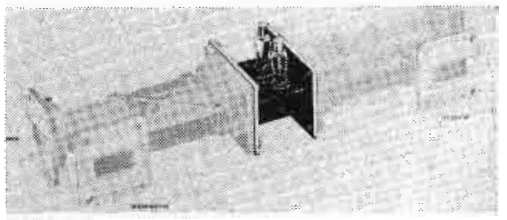


bular, cylindrical, or spherical plastic parts roll down an inclined runway and are fed to the marking die by air under 75 p.s.i. pressure, marked, and ejected. The valve controlling the feed is actuated by each stroke of the marking machine. An electric element heats the die to a thermostatically controlled temperature, and an automatic feed carries a roll leaf or color transfer tape over the part. Metal marking is accomplished similarly, but without use of the heating element or the roll leaf feed. Marking rates of 40 or more pieces per minute are obtained. The machine is furnished ready for bench mounting or on a pedestal type base.—**Acromark Co., 601 Morrell St., Elizabeth, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

NEW EQUIPMENT for Designers and Engineers

Gas-Switching Tube

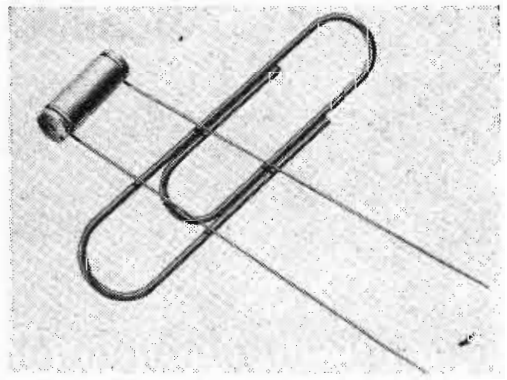
The TR dual gas switching tube is designed for operation in the 8500-9600 MC frequency band. Used with suitable



short-slot hybrid junctions it provides a simple, balanced duplexer. Sections are mounted side by side with a common wave guide wall and gas fill. Six end flange mounting holes are provided. The tube is intended for use in pressurized applications, and a special electrical and pressurizing gasket enables operation without sparking at high power levels.—**Bomac Laboratories, Inc., Salem Road, Beverly, Mass.** —TELE-TECH & ELECTRONIC INDUSTRIES.

Subminiature Resistor

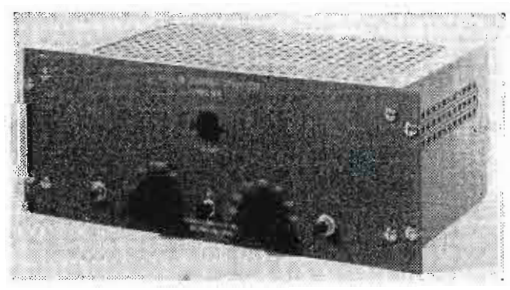
Type 1106 subminiature resistor has a 3/16 in. dia. and is 7/16 in. long. Wound with Evenohm, Karma, or equivalent,



the small unit has a maximum resistance of 100,000 ohms, and is rated at 0.10 watt. Different temperature coefficients are available with lesser resistance per spool. Specially impregnated against extreme humidity, tolerances are available to ±0.05%.—**The Daven Co., 191 Central Ave., Newark, N. J.** —TELE-TECH & ELECTRONIC INDUSTRIES.

Power Booster

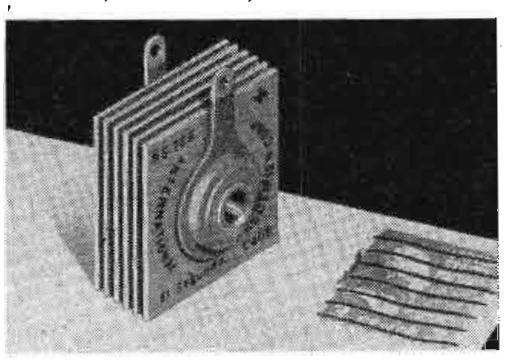
The new booster shown will increase the power output of any 10 v radiotelephone transmitter, regardless of its make, if it is operated in the 152—174 mc band. Moreover, it will considerably increase the effective range



of the equipment because it uses maximum power only when it is needed, conforming to the engineering requirements of the FCC. Desired power is selected by a dashboard switch, but the unit is activated only when the mike button is pushed. A 25—50 band unit is expected to be available soon.—**Kaar Engineering Corp., Middlefield Rd., Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Selenium Rectifiers

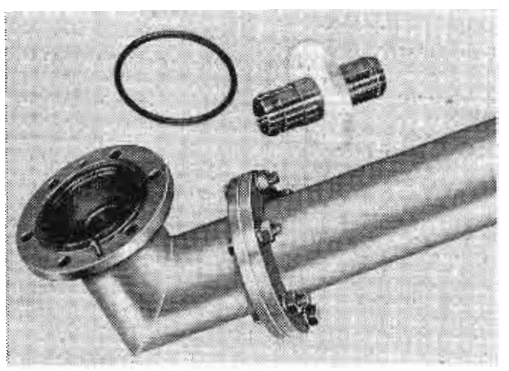
A complete line of selenium rectifiers has been developed for use in TV boosters, converters, and radio and tele-



vision sets. The units are rated for 130 v. RMS ma input for various current loads ranging from 20 through 1,000 ma. Type RS75E (illustrated) is rated as follows: 130 v. RMS maximum input; 380 v. maximum peak inverse; 75 ma maximum output current. The unit is 1 x 1¼ x ¾ in. overall. It is mounted through a No. 8 machine screw clearance hole.—**International Rectifier Corp. 1521 E. Grand Ave., El Segundo, Calif.** —TELE-TECH & ELECTRONIC INDUSTRIES

VHF Coaxial Line

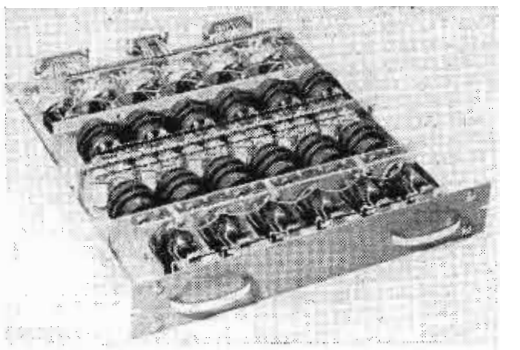
The 50 ohm VHF Teflon coaxial line, "New Series" 600, is pin-type insulated and similar in construction to previ-



ously developed microwave coaxial lines. It incorporates RTMA anchor-insulated connectors for better positioning of the inner conductors and other features that provide better VSWR and attenuation characteristics. Data covering attenuation and power handling is available.—**Products Development Co., Inc., Kearny, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Digital Attenuator

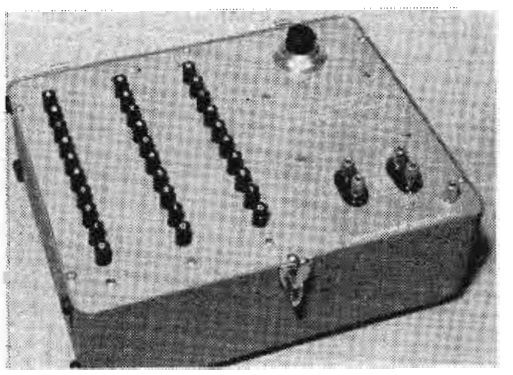
This Kay-Lab automatic digital attenuator sets servo-position potentiometers by a digital keyboard that eli-



minates hand setting. There is no limit to the number of motor-driven attenuators that can be operated from one servo-amplifier. In the unit shown, twelve motor-driven attenuators and switching relays are combined and assembled on a 17¼ x 20 in. rack-mounting tray. Twenty-one such trays are packed in an 85⅜ x 25⅝ x 24 in. cabinet. The three-position read-out system indicates the accuracy of the set. Lights show when an error is with 0.1% and when more or less than 0.2% because of faculty operation. Power required is 115 v. for either 60 or 400 cps operation. A dc reference supply or a Kay-Lab Model 122 super-regulator must be furnished by the purchaser.—**Kalbfell Laboratories, Inc., 1090 Morena Blvd., San Diego 10, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Standard Ratio Transformer

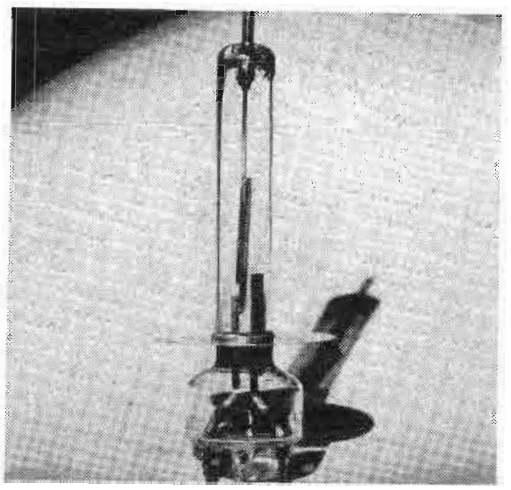
Model PT-L precision ac transformer reads the ratio between arm and winding directly by means of 3 decade push-



button switches and a ten-turn precision potentiometer. Its advantages over the resistance type potentiometer for ac use are extreme accuracy, low source impedance, and almost complete freedom from loading effects. Resolution is better than 1 part in 1 million. Source impedance at ratio arm is 7.5 ohms maximum; open circuit input impedance at ratio arm is 150 henries; input voltage E_{RMS} maximum equals 0.35 cps. Above 1 KC E_{RMS} maximum equals 350 v. Temperature has no effect on the accuracy of the transformer.—**Gertsch Products, Inc., 11846 Mississippi Ave., Los Angeles 25, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

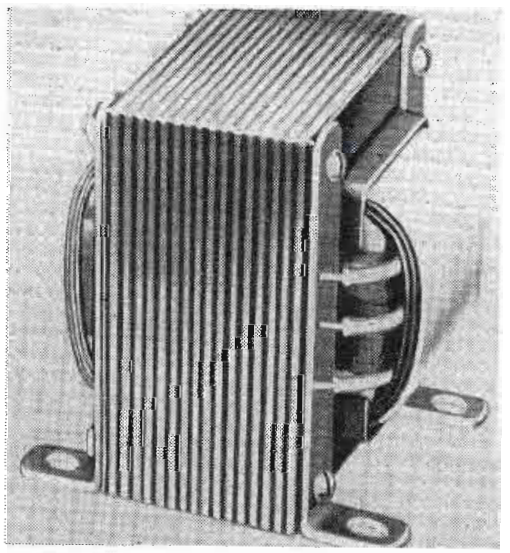
Special High Vacuum Relay

The PS-32 high voltage, high vacuum relay is 4½ in. high, has a 300 amp peak pulse current rating, a 3 μsec pulse duration, and will withstand 15 g acceleration. It is especially designed for partial oil immersion applications in switching pulse-forming networks in radar installations.—**Pioneer Electronics Corp., Santa Monica, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES



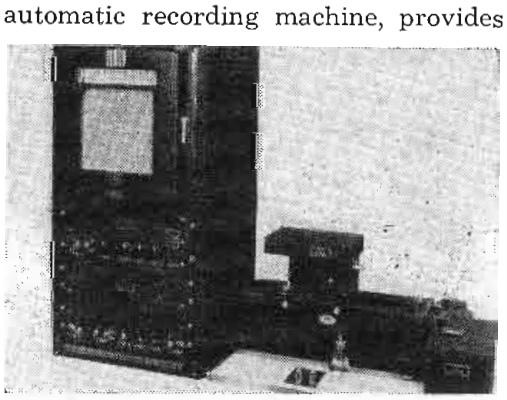
Filament Transformers

The new filament transformers for use with selenium rectifiers in industrial, laboratory, TV and power applications have been placed on the market. Included with this group are units which match the all-purpose Federal assembly kit.—**Merit Coil and Transformer Corp., 4427 North Clark St., Chicago 40, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.



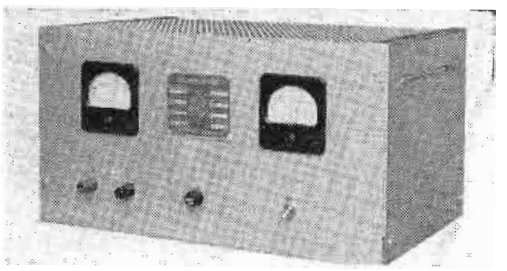
Recording Spectrophotometer

Model RS3 recording spectrophotometer converts the Beekman model DU monochrometer from a manual to an automatic recording machine, provides three vertical chart lengths, and a chart speed of two inches per min. A synchronized, motor-driven cam mechanism converts wave lengths to a linear scale. A shift enables selection of three scanning rates from 215-700 millimicrons at scans of 5, 15, and 50 min. Safety switches control both ends of the scale. Reversibility is controlled by either manual or automatic switches which operate recorder chart and wave length scales. Selected scan rate determines the length of the chart. The wave-length dial switching mechanism provides an intermittent signal to operate the recorder pen. A slit control-knob linkage corrects for the dispersion characteristics of the Beckman monochrometer. The recording spectrophotometer operates from 115 v, 60 cycle, ac current.—**Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.



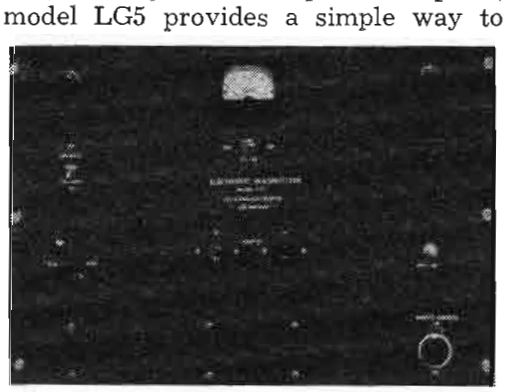
Aircraft Test Power Supply

Type G4F28B20 28 v. selenium rectifier power supply is designed for testing aircraft radio, radar, and electrical equipment and components. Laboratory units are available in 200 amps and higher. Regulation by either electronic or magnetic amplifier is within 0.25% no load to full load, and line variation is held within 10% of nominal. Recovery time is down to 0.05 secs. Ripple voltage component is 1% or better.—**Lee Electric & Mfg. Co., 2806 Clearwater St., Los Angeles 39, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES



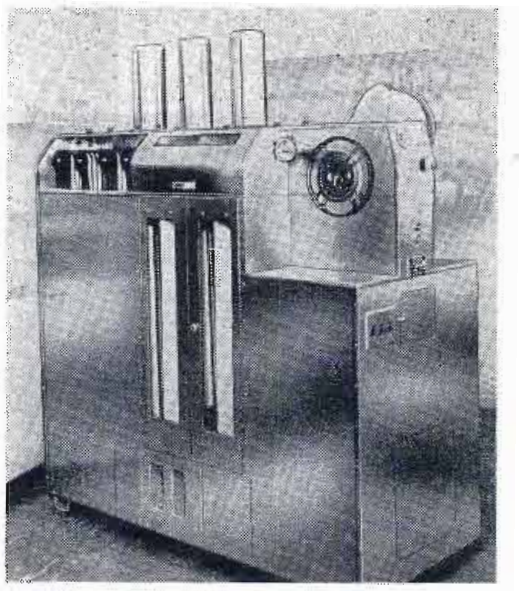
Electronic Magnetizer

Used with a few turns of wirewound coil, suitably to the shape of the piece, model LG5 provides a simple way to charge permanent magnets such as those contained in p-m motors, phono cartridges, meters, magnetrons, etc. Often magnetization can be accomplished after assembly by the unit. Operation is from a standard 110—120 v, 50—60 cps power outlet.—**Leo Klein Electronics, 2404 S. La Brea Ave., Los Angeles 16, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES



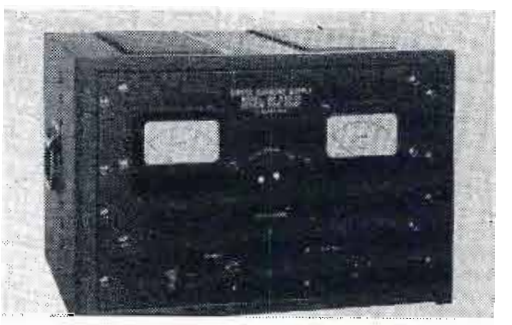
TV Film Processor

The new 16R40 motion picture processor automatically develops, fixes, washes, dries, and reels 16 mm film ready for projection. All necessary equipment—refrigeration control, recirculating pumps, critical solution replenishing system, air compressor, drain tanks, overflow system, air compressor, speed control, loading elevator, two magazines, stapler and staples—are furnished and contained in the cabinet. Film is processed at 20 to 40 ft. per min, and 1,000 ft. can be loaded in one magazine. The unit automatically compensates for film expansion, shrinkage, slippage, and breakage. Light-tight hoods enable operation in ordinary light. A darkroom is required only for loading the magazines.—**Houston-Fearless Corp., 11805 Olympic Blvd., Los Angeles 64, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES



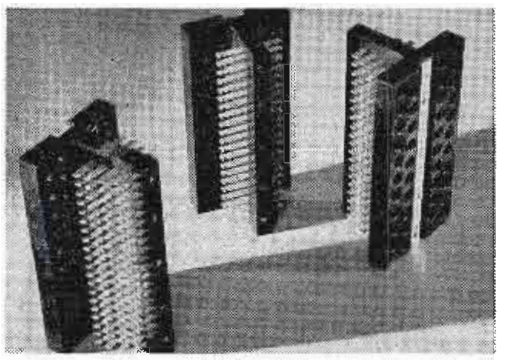
Power Supply

The new 5 to 32 v continuous 15 amp dc magnetic-amplifier regulated power supply (model MR532-15) uses no tubes. The unit has a regulation accuracy of ± 1% for dc load variations from no load to full load, and is stabilized for ac line variations from 105 to 125 v. ac. An additional feature is that the supply has a magnetic type circuit breaker on the dc side and a time-delay provision in addition to the usual on-off switch. The unit is equipped with a 4½ in. voltmeter and ammeter. It is 22 in. wide, 17 in. deep, and 14 in. high, and mounted in a bench type cabinet.—**Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES



Phenolic Terminal Blocks

Four new arrangements of phenolic terminal blocks for electronic and communication equipment are announced



which provide 40, 60, 80, or 100 pretinned double-notched terminals that are securely mounted on a base of the same material.—**Lenkurt Electric Co., San Carlos, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

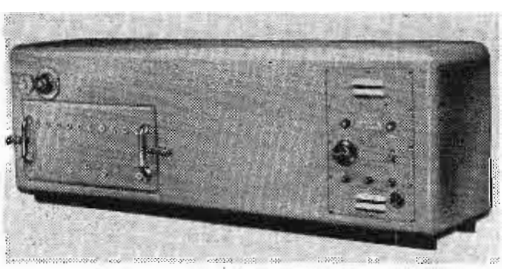
Constant Current Converter

The Model CC-60 current converter is designed to change a standard power supply to provide constant current for

transistors and other applications. Connected externally in series with the standard supply, without rewiring or other modification, the high impedance of a pentode presents a constant input voltage source impedance when operating above the knee of the IB curve. Inverse current feedback further increases the internal impedance and contributes long-term current stability. Input voltage can be fixed at any value in the range 85-300 v. Constant output current is continuously adjustable through the range 0-50 ma—the higher current is obtained at 300 v. input. Current can be regulated within 2% for voltage output variation, 0 to 100 volts. —**Electronic Research Associates, Caldwell, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Temperature Test Chamber

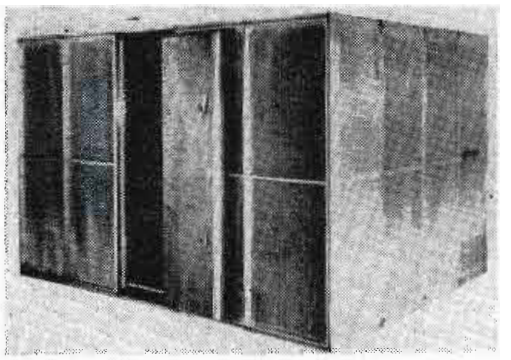
Model TC-1 temperature test chamber can be equipped with an integral thermometer for determining tempera-



ture variations between —65° F. and 275° F. Forced circulation prevents significant variations between the thermometer and the object on the test tray. Cooling is accomplished by carbon dioxide ice; heating by a high-capacity strip heater. Thermostatic control balances heat against dry ice evaporation. The unit is entirely self-contained and portable.—**Statham Development Corp., 12411 W. Olympic Blvd., Los Angeles 64, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Improved Screen Rooms

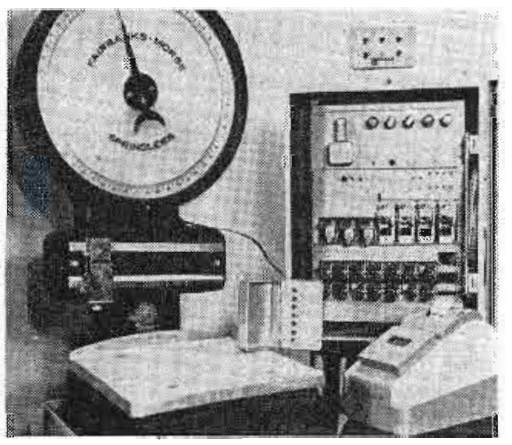
The improved Lingren double-shielded screen rooms have a sturdier construction and the metal-to-metal



contact between sections is improved. Recent tests show maximum attenuation of 141 db, as compared with the 123 db rating reported for previous models. Standard model dimensions and a new 42 ft. x 10 ft. room have been added. Panel dimensions are 31½ x 3½ x 96 in. Six power line entrances are provided. Construction is entirely portable and easily dismantled.—**Erik A Lingren & Associates, 4515-17, N. Ravenswood, Chicago, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Electronic Totalizing Scale

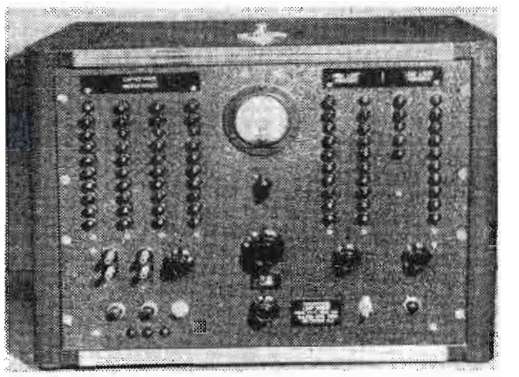
The ETS-7 records net weight readings directly from any dial scale, and enters the information into business



machines or IBM units. Weights are itemized, sub-totaled, and totaled, as desired, and printed on tape or business forms. Any number of scales or business machine units can be used simultaneously through one totalizing scale. The unit is certified by the Bureau of Weights and Measures, State of Calif.—**Industrial Electronic Engineers, 3973 Lankershim Blvd., North Hollywood Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Capacitance Limit Bridge

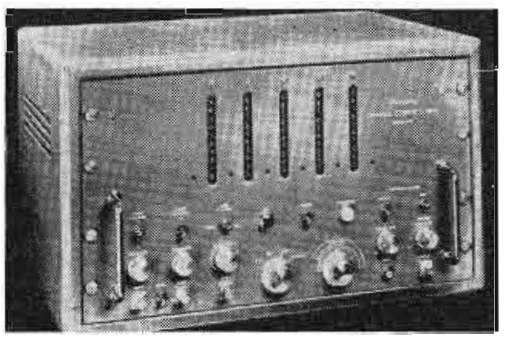
Model OS-2 precision capacitance limit bridge is designed for testing capacitors between 0.0001 μf and 1 μf un-



der JAN, RMA, and RTMA procedures at high speed. Its primary component is a Schering bridge which has a basic accuracy of ±0.3% for all ranges. Lead stray effects are reduced to less than 2 μμf by a special shield. A loss tangent control eliminates error resulting from the unknown loss component. Stated accuracy is maintained with input power variations from 175 v. to 135 v. Warm-up time is 2 min. Capacitance acceptability is given by one of three channel beacons: red for too low; green for passable; amber for too high. The transition range of beacon-switching is less than 0.04% of the nominal capacitance. The unit is capable of operation over any tolerance range with a 50%-0% lower limit and an upper limit between 0% and plus 100% of nominal.—**Gulton Mfg. Co., Metuchen, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Counter and Timer

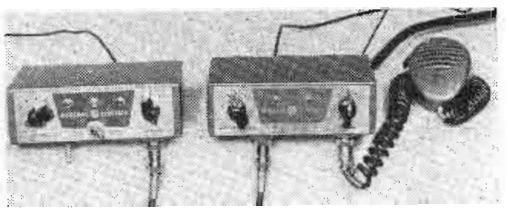
Model 550 universal counter and timer enables direct reading of time between two events, direct reading of the events



that occur during the time interval, the measurement of low frequencies, and straightforward electronic counting. Time can be measured directly from 40 μsecs to 100,000 secs with max accuracy of ± 10 μsecs. Regular or randomly distributed events can be counted at 20 to 100,000 events per sec. Results are present either in cps or secs with decimal indication. The unit scans to any multiple of 1 or 10 secs and directly tests all time base frequencies, and checks the entire operation in 2 secs. The instrument connects with the Berkeley model R-5 digital recorder systems without modification or adjustment.—**Berkeley Div. Beckman Instruments, Inc., 220 Wright Ave., Richmond, Calif.**—TELE-TECH & ELECTRONICS INDUSTRIES

Amplifier & Loudspeaker

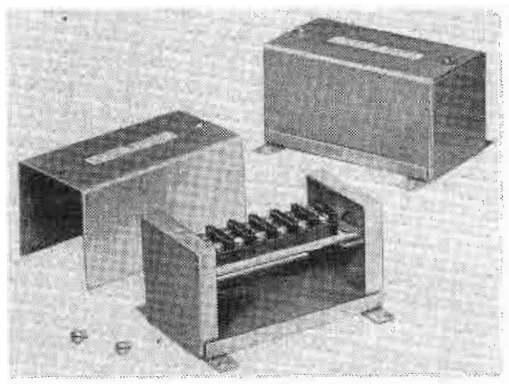
A 10 watt audio amplifier and a weatherproof loudspeaker have been announced that provide a public ad-



dress system and means to hear incoming radio messages at a distance from radio-equipped vehicles. Two types are available, the EA-3-A for 6 v operation, and EA-3-B for 12 v operation. The horn speaker directs the 10 watt audio signal over an approximate 70° angle. The 24-pound amplifier is equipped with an "off-radio P.A." switch. Harmonic distortion is less than 3% from 200 to 6,000 cps. On standby, drain from the 6 v unit is 1.2 amps. for the 12 v, 0.6 amps. With plate voltage on, the 6 v type draws 7.5 amps; the 12 v, 3.2 amps.—**General Electric Co., Electronics Div., Electronics Park, Syracuse, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Terminal Block Enclosure

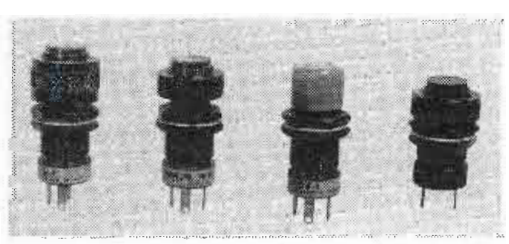
The new enclosure shown houses either the "M" or "MT" Curtis terminal blocks when mounted with from 1 to



14 terminals per enclosure. The cover is held in place by two screws; when removed, three sides of the unit open for wire connection or circuit changes. Two 7/8-in. dia. knock-outs enable either a cable or wires to be fed under the block for distribution and connection to either side. The standard blocks furnished with the new enclosure are rated 300 v, 15 amps. For the present the new units are available only in quantities of 100.—**Curtis Development & Manufacturing Co., 32 North 33rd St., Milwaukee 16, Wis.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Circuit Test Indicators

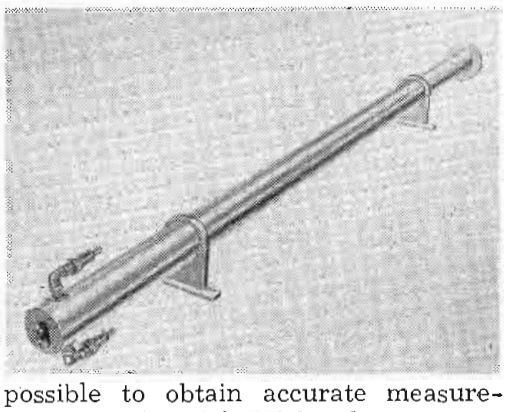
New press-to-test lights serve as safety devices and indicate lamp and circuit conditions. Pressure on the face of the indicator "breaks" the normal



circuit and "makes" a test circuit, thereby, eliminating removal of the bulb for testing either lamp or circuit. A standard two-terminal miniature companion light to the press-to-test miniatures is shown at the right. All are ungrounded and are built to conform to military specifications. All use T-1¾ lamps such as Nos. 327, 328, 330, and 331. All require a 15/32 in. panel hole. Overall lengths are from 1-13/32 in. to 1-19/32 in.—**Marco Industries Co., Anaheim, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

High-Power Water Load

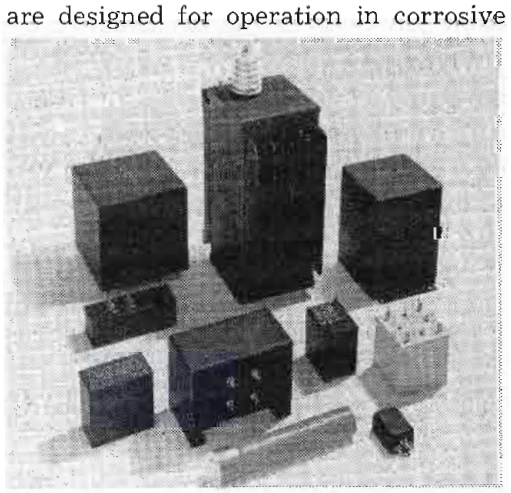
With a 3 gal. per min. water system, a rate-of-flow meter, and the new V-4042 high-power water load, it is



possible to obtain accurate measurements in the uhf TV band between 1 and 15 kw. The new equipment is a low VSWR dummy load capable of dissipating 15 kw over the frequency range 470-1200 MC. Power measurement is accomplished by determination of the temperature increase of water passing through the dummy load. The input connector of the V-4042 is a uhf flange which mates with a standard 3/8 in., 50 ohm coaxial line. Water connections fit a ½ in. I.D. rubber hose. Body dia, is 3⅛ in., length 7 ft., weight 35 lbs.—**Varian Associates, San Carlos, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Selenium Rectifiers

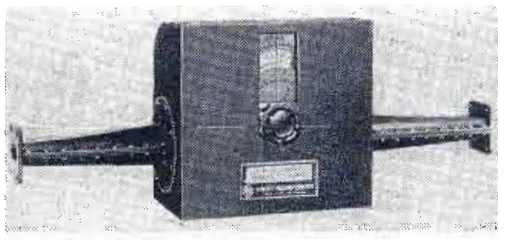
The new series of oil-immersed selenium rectifiers shown in the illustration are designed for operation in corrosive



atmospheres and high ambient temperatures, special multiple outputs, sizes, and configurations. Ratings range to 50 kilovolts at 50 amp peaks.—**Lee Electric & Mfg Co., 2806 Clearwater St., Los Angeles 39, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Wave Guide Attenuator

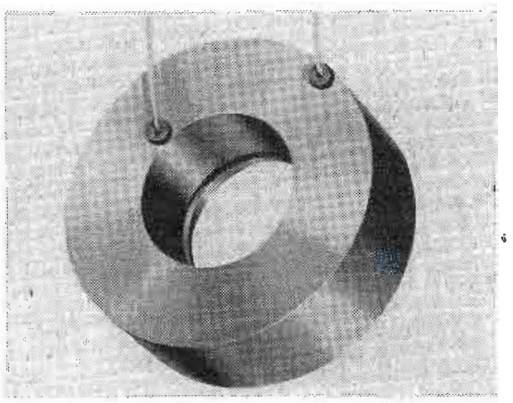
A new type of waveguide attenuator, the model X382A, gives accurate db readings that are completely independ-



ent of frequency; and phase shift is independent of attenuation setting. Accuracy is within ± 2% of db reading. Directly set and read, the attenuator requires neither interpolation nor charts. Attenuation depends on the angular position of the attenuating film rather than on its specific resistivity. Model X382A has three resistive films: one mounted within each waveguide extension, another is rotatable axially in the center section. When all three films are aligned in the same plane, there is no attenuation. Rotation of the front panel center-film knob increases attentuation as to the square of the angle of rotation. The new instrument is offered for X-band frequencies from 8,200 to 12,400 MC. Calibrated range is 0 to 50 db. VSWR is less than 1.15 throughout range. Zero setting attenuation is less than 1 db. Power can be fed at either end.—**Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Focus Coil

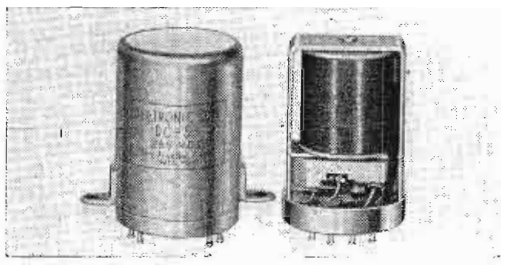
A new electromagnetic focus coil, Type F10, fits cathode ray tubes having a 1½ maximum neck dia. Applica-



tions are 18 kv accelerating potential. A 1/10 in. soft magnetic iron case is closely machined for dimensional accuracy which provides a uniform focusing field and eliminates spot distortion. External magnetic fields are also entirely eliminated by the nature of the design. The large I.D. focus gap ratio meets the requirements of the most exacting laboratory applications. Type F10 applies to a range of coil resistances of which the F10A 12,000 ohm unit is typical. This unit has the following electrical data: I-25 ma at 18 kv for a 2.5 in. focal length; E-300 v. Mechanical data: I.D. 1 9/16 in. minimum; O.D. 3⅜ in. maximum; length, 1¼ in.; front gap center, 5/16 in.—**Syntronic Instruments, Inc., 100 Industrial Rd., Addison, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Miniaturized Relay

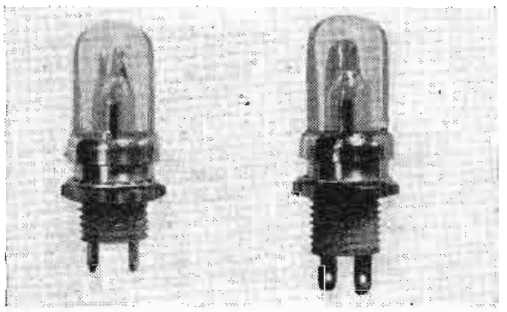
Although DC-33 double-pole, double throw, positive-action dc relay weighs only 3.62 oz., is 1.79 in. high and has a



diameter of 1.188 in., it exceeds the requirements contained in MIL-R-5757B specifications. The unit operates under 70 G acceleration, and continuous vibration from 10 to 600 cps without mechanical resonance. Its ambient temperature range is −65° C. to 125° C. Operating under rated load at 12 cps, the relay passes operations of 100,000 cps. Contact bounce is held to 250 μsecs, and contact rating is 2 amps with a 26.5 v dc resistance load. Required input coil power is less than 0.325 watts.—**Deltronic Corp., 9010 Bellanca Ave., Los Angeles 45, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Miniature Neon Indicators

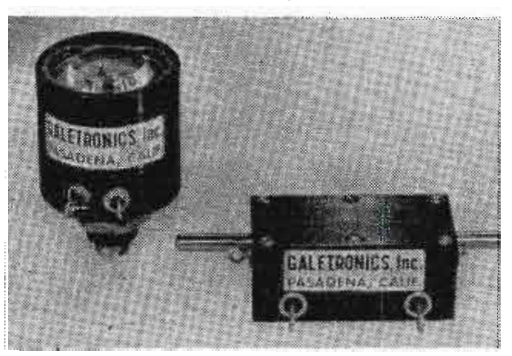
Increased use of neon lamps in electronics and avionics has led to the development of the rugged, moisture proof



mountings for the NE-2A neon lamp. The light to the right has a built-in resistance. Overall lengths are 1⅜ in. to 1-15/32 in. The panel hole required is ⅜ in. Not illustrated but available are neon indicators for use with NE-51, NE-45, and NE-58 lamps, either in the press-to-test assembly, which enables lamp or circuit testing without removal of the bulb, or non-press-to-test assemblies.—**Marco Industries Co., Anaheim, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Miniature Potentiometers

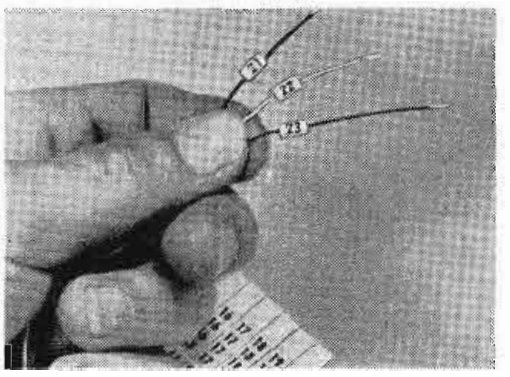
Sixteen recently-developed Galetronic RB rotary type potentiometers fit within a 2 in. square. Some of these metal, wire-wound, anodized-insert encased units are available with a resistance of 35,000 ohms, a temperature



range of 600° F, and an operating life of a million sweeps. Only 0.5 in. long and 0.5 in. in dia., they show no permanent damage at 200 G's, and withstand 1 kv RSM. Output is up to 20,000 ohms. It is expected that the new units will have many electronic applications, particularly in transistor type miniaturized circuits. Shown above is the 450,000 ohm per-inch-length resistance, 2 watt, 15/16 in. long rectilinear type model LE, and the 1.0 in. dia. 15/16 in. long 4,300 ohm per degree resistance (1,300,000 total) rotary type model RD. **—Galetronics, Inc., 2607 E. Foothill Blvd., Pasedena 8, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Coding Markers

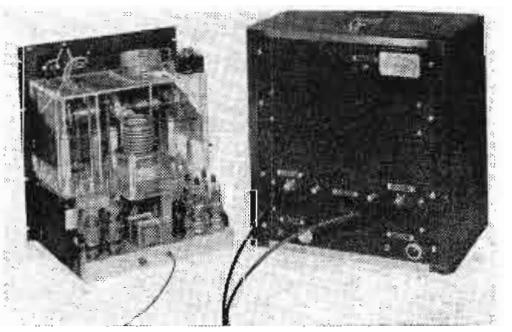
Only 3¼ in. long, these new small wire coding markers are center die cut and mounted on a pocket size card for



ready use. Any code can be removed without disturbing the remaining codes. Each card contains 68 markers. Made of tough fabric coated with a special adhesive, application requires only fingertip pressure. The new markers are moisture and grime resistant. Currently they are available in 1000 codes which include A.S.A. and NEMA Specifications.—**Westline Products Div., Western Lithograph Co., 600 E. Second St., Los Angeles, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Power Supply Units

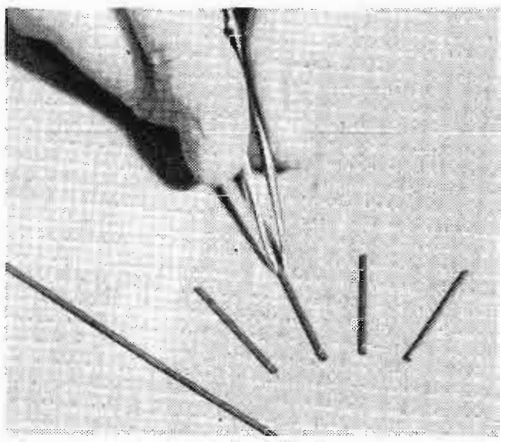
Model LAB-40 is a continuously variable unit regulated 25 to 40 kv dc which has a 4 to 6 kv focus tap for use



with flying spot recording tubes, etc. The supply has regulations of 0.5% at 1.0 ma, and is available either with locking controls or a standard knob. Model PN-60 (illustrated) provides reversible polarity r-f dc power that is continuously variable from 0 kv to 60 kv. Polarity changes are made on the front panel. Current output is 1 ma at 60 kv. Overall dimensions are 22½ x 21 x 15 in.—**Spellman Television Co., Inc., 3029 Webster Ave., Bronx, New York, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Titanium Tubing

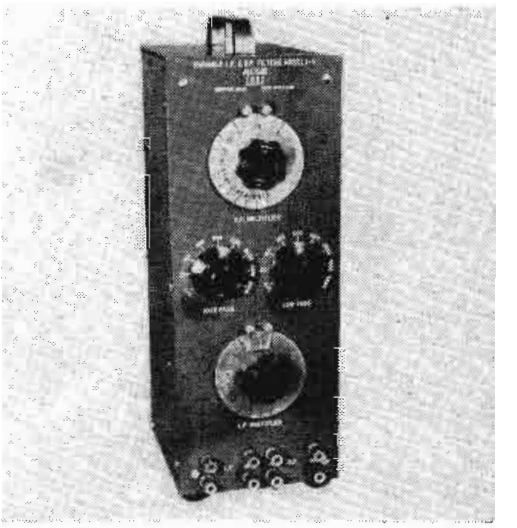
The smallest size tubing ever drawn from commercially pure titanium, it is said, has an O. D. of 0.0455 in. and a



wall thickness of 0.0025 in. Because of the difficulty encountered in cold working and heat treating this relatively new metal, production of ultra-small tubing was accomplished only by extensive research and development. One of the special practices imposed is annealing all thin-wall tubing because titanium absorbs all common gases from the atmosphere. Nevertheless, commercially pure titanium is being produced in tubing sizes from ⅛ in. to 1-½ in. O. D. in both the seamless and Weldrawn® grades.—**Superior Tube Co., Norristown, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

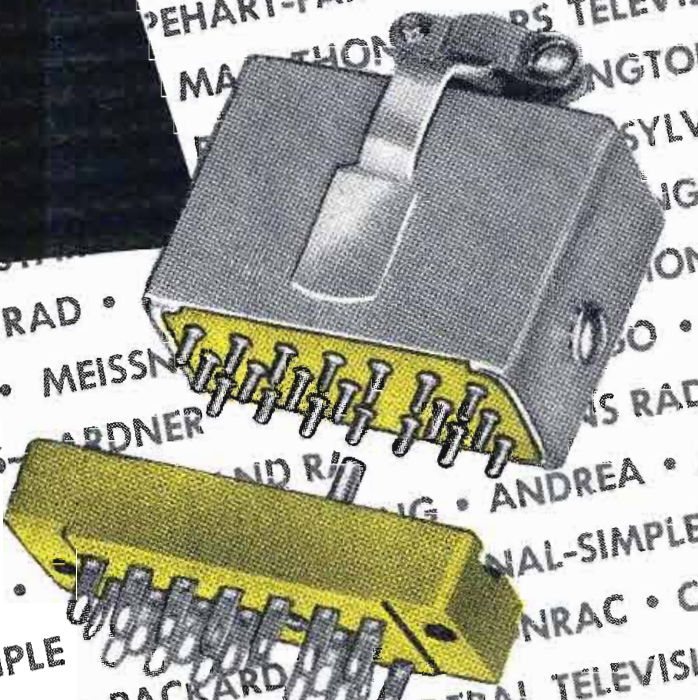
Filter Set

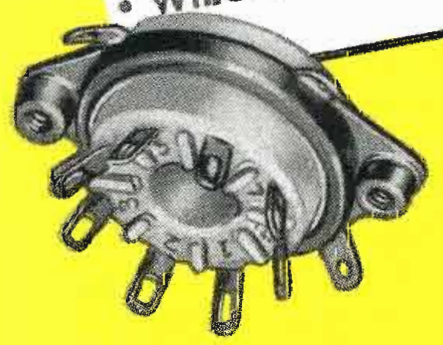
Model 1A high pass and low pass filter set has two k type sections of low pass filter and two k sections of high



pass filter in one case. The unit is switched in octave steps with continuously variable multipliers to cover the range of each octave. Cutoff frequency of both filters is adjustable from 65 cps to 20,000 cps. Pass band loss is 1 db. Attenuation outside the band 30 db or more per octave. Maximum attenuation exceeds 100 db. The filter works between 600 ohms input and output impedances and can handle a maximum of 0.1 watt. Pass bands from 65 to 20,000 cps are attainable and adjustable to ¼ octave in any portion of the spectrum. The case is 14 in. high, 7 in. deep, and 5½ in. wide. Weight is 171 lbs. **—Allison Laboratories, 419 Vista Del Ilano Dr., Whittier, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

They INSURE Performance with *QUALITY* Components THEY CHOSE CINCH





Cinch Sockets and shields to JAN Specifications.

Cinch components are available at leading jobbers—everywhere

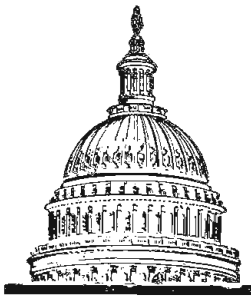
Consult Cinch for the production of any component assembly for commercial or Military use that falls within the general category of electronics parts manufacture.

Cinch
ELECTRONIC COMPONENTS

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.



WASHINGTON
News Letter

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

SPEEDS COLOR TV STUDIES—With the assignment of the monumental 697-page petition of the Radio Corporation of America and the National Broadcasting Co. embracing the standards approved by the National Television System Committee to its working staff, the FCC during July moved expeditiously under the leadership of Chairman Rosel H. Hyde towards the establishment of rules and standards for color television public service. There will be no picayunish delays on the part of the FCC in its joint goal with the television manufacturing-telecasting industry to bring about color television as a new commercial art next year, either in mid-1954 or possibly earlier. The NTSC, headed by Dr. W. R. G. Baker of General Electric, completed paper work on its industry-wide formal standards for compatible color TV.

SPEARHEADED BY PIONEER—The successful achievement of RCA in its compatible color television system epitomized the outstanding vision of undoubtedly the world's leader in radio and television—Brig. Gen. David Sarnoff, RCA Board Chairman. In his typical spirit of industry-wide cooperation, Gen Sarnoff has announced that RCA is making available all of its patents and know-how to the entire industry. Leading Senators—Tobey of NH who is Senate Interstate Commerce Committee Chairman and Johnson of Colo., former Chairman—lauded the genius and leadership of Gen. Sarnoff. The RCA Chairman's right bowers in the color TV achievements are Dr. C. B. Joliffe, RCA Vice President and Technical Director, and Dr. E. W. Engstrom, RCA Laboratories Vice President.

LOSS TO GOVERNMENT—The termination of Haraden Pratt as Telecommunications Advisor to the President is a definite and most severe loss to the Federal Government's policy-making in telecommunications and radio. Mr. Pratt, one of the world's outstanding radio engineering leaders and a former Institute of Radio Engineers President and its present Secretary, had at personal sacrifice been willing to serve the government in this capacity and had during his 20 months incumbency in the post had established a most constructive foundation for the coordination and solution of conflicts between government departments and the government and industry in telecommunications and frequency matters. The termination of Mr. Pratt's services in view of his most eminent qualifications is generally recognized as an act of ignorance—or maybe stupidity—on the part of key White House staff officials. It will be also recognized as a step backwards.

THEATER TV—No flood of applications to FCC from theater television interests for specialized common carrier theater TV transmissions in line with FCC decision ruling that theater TV is common carrier service, but that new systems must be operated on existing common carrier frequency allocations. Theater interests had sought their own band of frequencies for the service. Theater exhibitors and producers are now too busy with three-dimension and other revolutionary forms of projection of movies to devote a large part of their time and interest to theater TV development. They feel, anyway, that they won point in hearings in obtaining Bell System promise to try to provide eight megacycle theater TV transmission facilities, and in obtaining some idea of what theater TV service might cost. If the Bell System is unable to provide requested service at some future date, then a single "pilot" application is expected, through which FCC would be asked to decide public interest and other issues.

PETROLEUM, FORESTRY RADIO—A proposal for inter-industry microwave coordination between the petroleum industry, electric utilities and railroads was a highlight subject at the recent meetings of the American Petroleum Institute's Central Committee on Radio Facilities and the National Petroleum Radio Frequency Coordinating Association. The petroleum groups also decided to request the FCC to defer final action on channelizing the 952-960 mc frequency band until the industry submits its microwave plan. The Forestry Conservation Communications Association at its annual meeting considered the adoption of a plan for geographical allocations of 46 mc frequencies in that service on a national scale on a split-channel of 20 kc separation basis.

MARINE RADIO—A scheduled hearing by a House Interstate & Foreign Commerce subcommittee on a bill to amend the Communications Act to require the installation of an automatic radio call selector on US cargo ships carrying less than two radio operators, has been postponed indefinitely, subcommittee Chairman Joseph P. O'Hara (R., Minn.), announces. The bill had been introduced early in May by Rep. John W. McCormack (D., Mass.)

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington, Editor

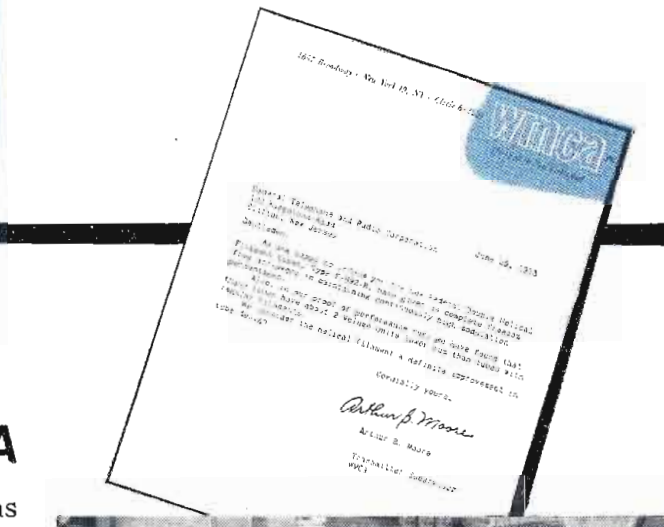
Here's the tube that gives WMCA
FREEDOM FROM ARC-OVERS—LOWER HUM!

Federal's F-892-R

with the Federal-developed

DOUBLE HELICAL FILAMENT

- *Does away with bowing*
- *Greatly increases tube performance and life*



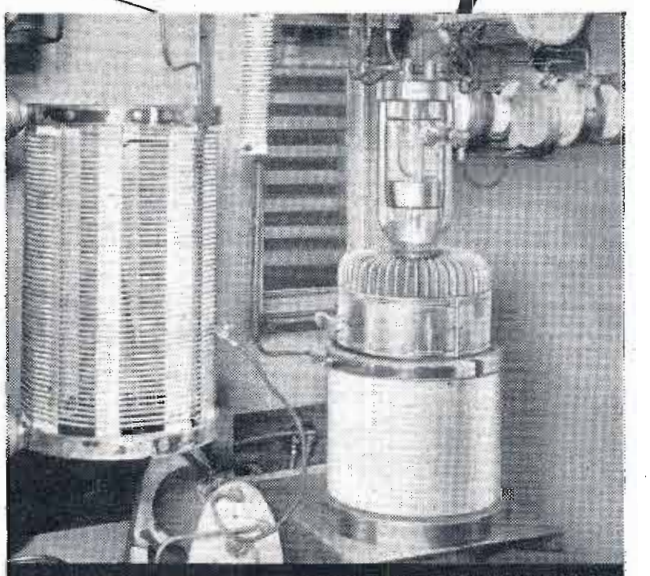
"...a definite improvement in tube design," says WMCA

Federal's Double Helical Filament—in Federal's F-892-R—has achieved an outstanding record of dependability at WMCA—America's Leading Independent Station, and First on New York's Dial.

WMCA reports that these tubes "have given us complete freedom from arc-overs in maintaining continuously high modulation percentages. Also, in our proof of performance runs we have found that these tubes have about 2 Volume Units lower hum than tubes with regular filaments."

Federal's F-892-R—wound through 360° for mechanical stability and carrying opposing electrical fields which provide improved electrical stability—definitely eliminate *bowing*—one of the primary causes of filament-to-grid shorts!

Sturdier, longer lasting and more economical, Federal's double helical filament tubes are the key to a new era of *performance quality* and *operating dependability* for 5 and 10 KW transmitters. Write for full information today, address Dept. K-366.



Federal's F-892-R installed in Power Amplifier Section of WMCA's 5000-watt Transmitter

"Federal always has made better tubes"

FEDERAL TELEPHONE & RADIO — FTR — AN IT&T ASSOCIATE

Federal Telephone and Radio Corporation

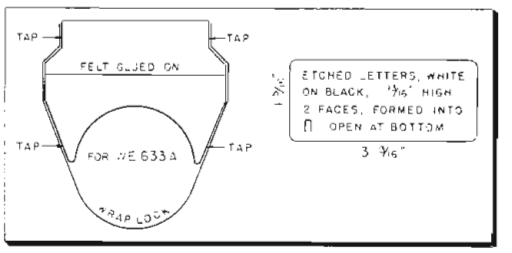
VACUUM TUBE DIVISION • 100 KINGSLAND ROAD, CLIFTON, N. J.

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

CUES for BROADCASTERS

(*Continued from page* 95)

drawing. Using the microphone itself as a pattern, ¼ inch Wraplock was formed to fit the microphone contour, drilled to match the plate holes and fastened with 6/32 screws, the bottom two screws being long enough to reach through the plate and become set screws against the



Mike call plates made of plastic for $3.50

microphone. Old turntable felt was glued to the upper part of the metal plate.

A local sign shop specializing in plastic signs made the actual call letter signs to our order at $2.00 per mike. We chose white letters against black background. The sign is double faced, spaced ⅜ inch between faces, closed at the top, open at the bottom so that it fits snugly over the plate's felt. We had network and FM letters made up too and by slipping off your regular call letters and sliding on network or FM letters you're ready for either an FM split or network origination with handsome microphone signs that photograph far better than the usual mike sign.

Single faced black plastic signs, in various sizes, are also used here to mark our field equipment. They're attached to field gear with self tapping screws in a few minutes, look neater than painted on signs, and equipment isn't tied up in a sign painter's shop for a couple of days.

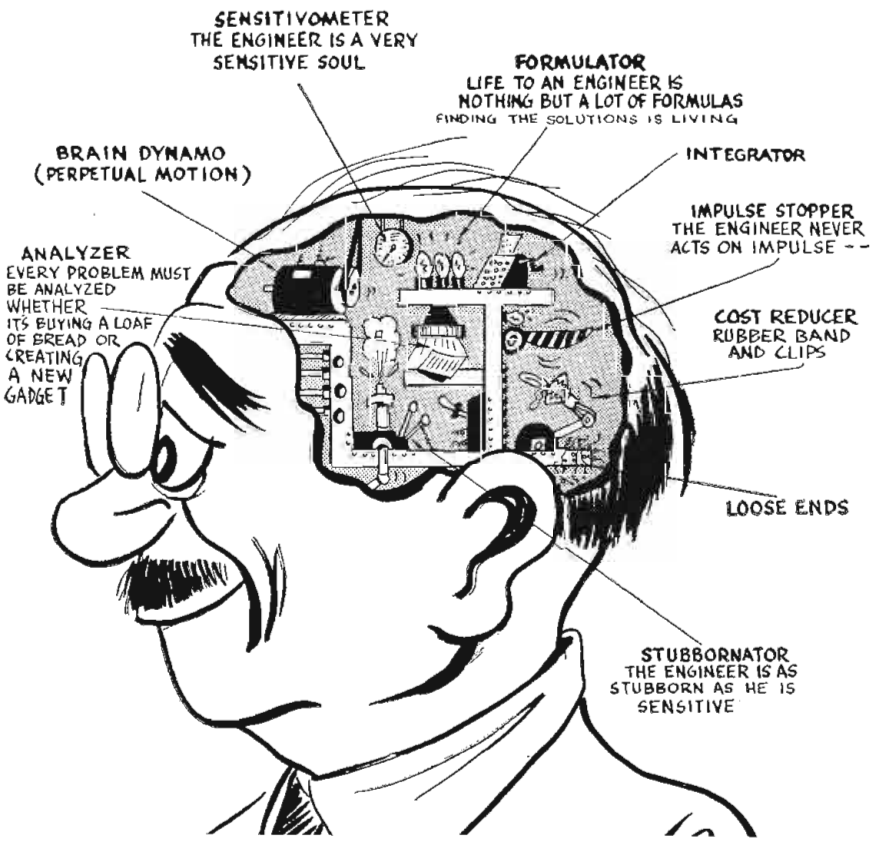
Slide Indicator

WALTER J. BUNNEL, WHIO-TV, Dayton, Ohio

IN pulling slides several hours in advance, we frequently encounter missing, broken, or duplicate slides. To enable us to by-pass these slides, and still indicate that there is a slide missing, we use several 35 mm glass squares mounted on cardboard, one side a half-inch longer than the other. This extends the indicator above normal slides, providing rapid identification. The slide number or other identification may be written with grease pencil, and erased with a cloth or Kleenex.

HOT-WEATHER PHRENOLOGY FOR ENGINEERS

Guide to the Workings of the Engineering Mind



An electronic engineering group has prepared the above chart with the aid of delicate encephlographic detectors which throw open the innermost recesses of the technical brain cells. Show this chart to your wife, your boss, your secretary or your girl-friend. Ask each how closely this comes to depicting the inner cerebral workings of your own personality. With the aid of the above diagram, let them tell you frankly, just what they think!

for the

FINEST

in recorded sound

America's leading phonograph record manufacturers use audiotape* for the original sound and audiodiscs* for the master recording

NO ONE listens to recorded sound with a more critical ear than the professional recordists who make America's finest phonograph records. Here there can be no compromise with quality.

That's why it's significant that so many of them repeatedly specify Audiotape and Audiodiscs to meet their most exacting requirements. For example, it was found that 29 of the 30 best selling records of 1952 were made from Audiodisc masters. And over 43% were first recorded on Audiotape before being transferred to the master discs.

Remember - you get this same superlative sound by using Audiotape and Audiodiscs in *your* recording work.

AUDIO DEVICES, Inc.

444 MADISON AVE., NEW YORK 22, N. Y.
Export Dept.: 13 East 40th St., New York 16, N. Y.
Cables "ARLAB"

audiodiscs
audiotape
audiofilm
audiopoints

℗ The exclusive trade-mark of Columbia Long Playing Records — Reg. U.S. Pat. Off.
** Trade Mark. Audiodiscs are manufactured in the U.S.A. under exclusive license from PYRAL, S.A.R.L., Paris*

TELE-TECH's NEWSCAST

RCA Accepts Orders for Color Equipment

Availability of compatible color TV broadcast equipment within the next year was indicated recently in an announcement by RCA that it will immediately accept orders for delivery of custom-built apparatus in the first half of 1954. The equipment will be similar to that now being used for field tests in New York. It will be designed to operate in accordance with present NTSC signal specifications. As soon as final standards have been adopted by the FCC, RCA will begin large-scale production of commercial-type color equipment.

Although it is anticipated that eventual large-scale production of equipment may involve some modification of the present prototype equipment, RCA stated, many broadcasters have indicated an interest in the early availability of custom-built equipment as means of speeding the establishment and growth of national TV programming.

It was stressed that present TV stations will be able to transmit compatible color network programs at a relatively low cost, with a minimum of additional equipment, and with full use of their present black-and-white transmitting facilities.

RCA will also make available the following complete groups of equipment for the prices indicated:

A, Color network operating equipment—$14,380.50

B. Color test equipment—$12,230.00

C. Color synchronizing equipment—$7,480.00

D. Color slide camera chain—$31,378.00

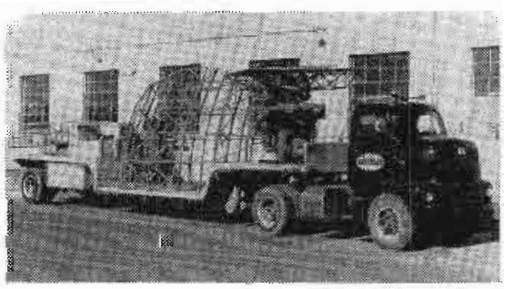
E. Color film chain—$49,398.80

F. Color studio camera chain—$66,580.40

I.T. & T. Affiliates Merge

Stockholders of International Telephone and Telegraph Corporation voted recently at a special meeting held in Baltimore, Md., to merge the corporation's principal U. S. manufacturing and research subsidiaries with the parent company. The companies affected, which will now become IT&T divisions, are: Capehart-Farnsworth Corp., Fort Wayne, Ind.; The Coolerator Co., Duluth, Minn.; Federal Telecommunication Laboratories, Inc., Nutley, N. J.; Federal Telephone and Radio Corp., Clifton, N. J.; and Kellogg Switchboard and Supply Co., Chicago, Ill.

"LOW BRIDGE" RADAR ANTENNA TRAILER

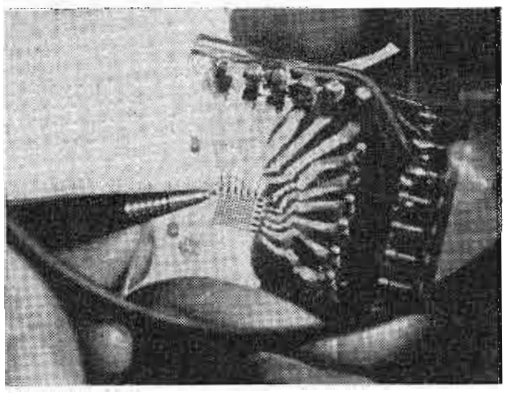


Raytheon's new 34-ft. transport trailer for carrying the SPN-6 radar antenna unit features a 12-ft. well. It permits the truck to pass under usual 14-ft. bridge clearances, thereby preventing mishap, avoiding costly rerouting.

ISA Instrument Maintenance Clinic

George A. Larsen, Chairman of the Instrument Society of America Instrument Operation and Maintenance Committee has announced that the Fifth Preconference ISA Instrument Maintenance Clinic will be operated during Sept. 18th, 19th, and 20th, the three days prior to the opening of the Eighth National Instrument Conference and Exhibit to be held in Chicago, Ill., Sept. 21-25, 1953.

BARIUM TITANATE MEMORY



Barium titanate crystal, a few thousandths of an inch thick and 1/4 in. sq., can store much binary information for indefinite period. Note fine electrodes which carry charges to crystal. Unit developed by Bell Labs should reduce size of telephone dial and computer equipment.

COMING EVENTS

Aug. 1-5—National Audio-Visual Trade Show, Hotel Sherman, Chicago, Ill.

Aug. 17-18—Symposium on Statistical Methods in Communication Engineering, Berkeley, Calif.

Aug. 19-21—Western Electronic Show and Convention, San Francisco Municipal Auditorium, San Francisco.

Aug. 25-28—APCO, 19th Annual Conference, Sheraton-Cadillac, Detroit, Mich.

Aug. 29-Sept. 6—West German Radio and TV Exhibition, Dusseldorf, Germany.

Sept. 1-3—International Sight and Sound Exposition, Palmer House, Chicago, Ill.

Sept. 1-12—British 20th National Radio & Television Exhibition, Earlscourt, London, England.

Sept. 9-12—NEMA, Haddon Hall Hotel, Atlantic City, N.J.

Sept. 13-16—AICE (Quarterly Meeting) Fairmount and Mark Hopkins Hotels, San Francisco, Calif.

Sept. 14-17—NEDA Con. & Mfg. Conf., Chase Hotel, St. Louis, Mo.

Sept. 15-17—RTMA, Hotel Biltmore, New York, N.Y.

Sept. 21-25—ISA 8th National Instrument Exhibit, Sherman Hotel, Chicago, Ill.

Sept. 28-30—9th Annual National Electronic Conference, Hotel Sherman, Chicago, Ill.

Sept. 30-Oct. 1—Aircraft Electric Equipment Conference, AIEE, New Washington Hotel, Seattle, Wash.

Oct. 5-8—URSI-IRE, Joint Technical Meeting, National Research Council and Defense Research Board, Ottawa, Can.

Oct. 5-9—74th Convention of the SMPTE, Hotel Statler, New York, N.Y.

Oct. 6-8—Fractional Horsepower Motors Conference, AIEE, Fort Wayne, Ind.

Oct. 12-14—Symposium on Simulation and Computing Techniques, Naval Air Development Center, Johnsville, Pa., and Univ. of Pennsylvania, Philadelphia, Pa.

Oct. 13-15—National Conference on Tube Techniques, Western Union Telegraph Co., 60 Hudson St., New York, N.Y.

Oct. 14-16—Machine Tool Conference, AIEE, Hotel Cleveland, Cleveland, Ohio.

Oct. 14-16—Recorder-Controller Section, SAMA, Mid-year Meeting, Seaview Country Club, Absecon, N.J.

Oct. 14-17—Audio Fair, Hotel New Yorker, New York, N.Y.

Oct. 19-21—RTCM Fall Assembly Meeting, Edgewater Beach Hotel, Chicago.

Oct. 19-23—National Metals Show, Cleveland Auditorium, Cleveland, O.

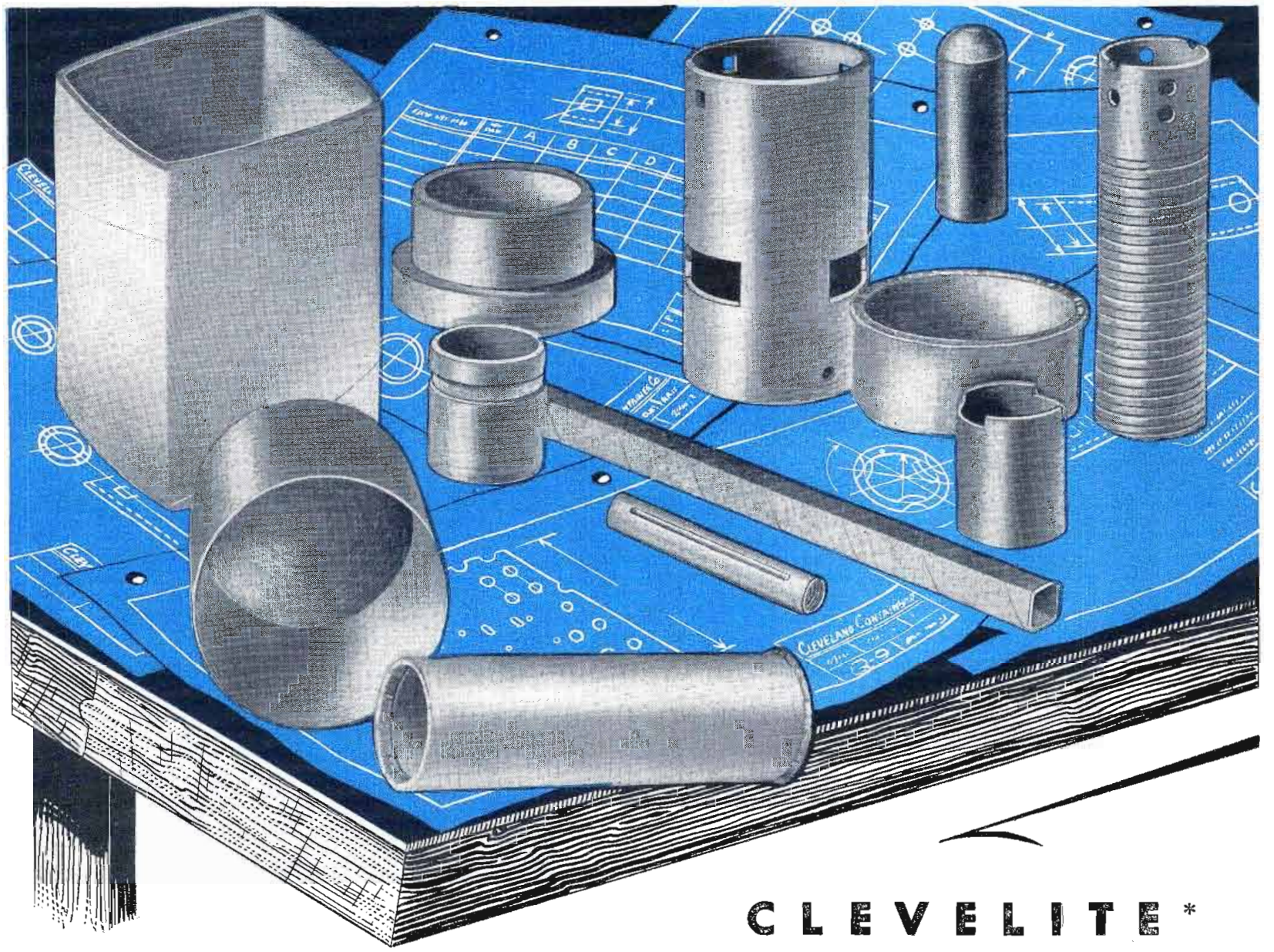
Oct. 30-31 — Semi-Annual Meeting, ASTE, Dayton Biltmore, Dayton, Ohio.

Oct. 26-28—RTMA, Radio Fall Meeting, King Edward Hotel, Toronto, Canada.

Nov. 13-14—IRE, Annual Electronics Conference, Hotel President, Kansas City, Mo.

Nov. 17-19—RTMA, Palmer House, Chicago, Ill.

AICE: Amer. Inst. of Chemical Engineers
AIEE: Amer. Inst. of Electrical Engineers
APCO: Assoc. Police Communication Officers
ARRL: American Radio Relay League
ASTE: American Society of Tool Engineers
IRE: Institute of Radio Engineers
ISA: Istrument Society of America
NEDA: National Electronic Distributors Assc.
NEMA: Nat'l Electrical Mfrs. Assoc.
RTCM: Radio Technical Commission for Marine Services
RTMA: Radio-TV Mfrs. Assc.
SAMA: Scientific Apparatus Makers Assoc.
SMPTE: Soc. of Motion Picture and TV Engineers
URSI: International Scientific Radio Union.



CLEVELITE*
LAMINATED PHENOLIC TUBING

A GRADE FOR EVERY NEED!

Diameters — wall thicknesses and lengths to meet regular or special adaptations.

IN RADIO AND TELEVISION their use is almost universal. They have high insulation resistance and low moisture absorption. Their low dielectric loss is suitable for ultra high frequency applications.

CLEVELITE is produced in seven grades.

GRADE	*APPLICATION*
E	Improved post-cure fabrication and stapling.
EX	Special grade for TV yoke sleeves.
EE	Improved general purpose.
EEX	Superior electrical and moisture absorption properties.
EEE	Critical electrical and high voltage application.
XAX	Special grade for government phenolic specifications.
SLF	Special for very thin wall tubing having less than .010 wall.

Why Pay More?
For the best . . .
Call CLEVELAND!

is more than ever before — the first choice in the electronic and electrical industries.

It combines proven performance with low cost and excellent service!

Wherever high dielectric strength, low moisture absorption, mechanical strength, low loss and good machinability are of prime importance . . . the combined electrical and physical properties of

CLEVELITE
are essential.

• • •

IMMEDIATELY AVAILABLE!

Tell us your needs.

*Reg. U. S. Pat. Off.

The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES at Chicago, Detroit, Memphis, Plymouth, Wisc., Ogdensburg, N. Y., Jamesburg, N. J.
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

REPRESENTATIVES

NEW YORK AREA R. T. MURRAY, 604 CENTRAL AVE., EAST ORANGE, N. J.
NEW ENGLAND R. S. PETTIGREW & CO., 62 LA SALLE RD., WEST HARTFORD, CONN.
CHICAGO AREA PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO
WEST COAST IRV. M. COCHRANE CO., 408 S. ALVARADO ST., LOS ANGELES

Improved Microwave Calorimeters

Sightmaster of California Co. of Santee, Calif., has announced five new microwave calorimeter versions extending from the UHF bands to as high as 90,000 MC. These units fall into two categories of instruments known as the conventional circulating liquid type and the more recently developed Zero Flow Rate type. The latter is capable of measuring down to a very few milliwats with substantial accuracy by measuring temperature rise of liquid exposed to microwave energy versus elapsed time or length of exposure.

The instrument embodies many refinements such as automatic continuous provisions to remove air in water by vacuum, combined advantages of gravity and pressure in a single provision, air detrapment provisions, priming and flushing provisions and a VSWR that is down to 1.03 or less on the 3 cm band, decreasing for the lower frequency bands. No appendages need to be used with this instrument to measure output power of any magnitude between milliwatts and 100,000 watts average power.

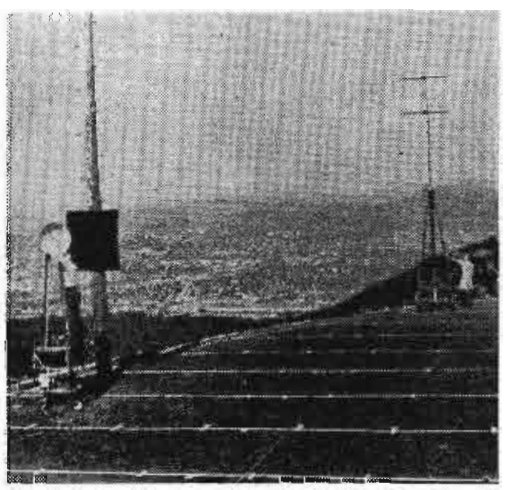
New BECO Plant

Located at 4312 S. E. Stark St., Portland 15, Oregon, the new Brown Electro-Measurement Corp. plant now has 7,500 sq. ft. of floor space as compared to previous 1,500 sq. ft. The building has been completely revamped to particular requirements such as temperature regulated checkout and standards rooms, research and development laboratory, engineering library and drafting facilities, expanded work areas for assembly and machine shop operations, plus more complete facilities for officers, shipping and storage.

Hecht Opens West Coast Office

Bernard Hecht of Little Silver, N. J., has now opened an office at 420 S. Westlake Avenue, Los Angeles. Mr. Hecht is a specialist in Quality Control for companies engaged in the production of electronic equipment.

MOUNTAIN TOP ANTENNA RANGE

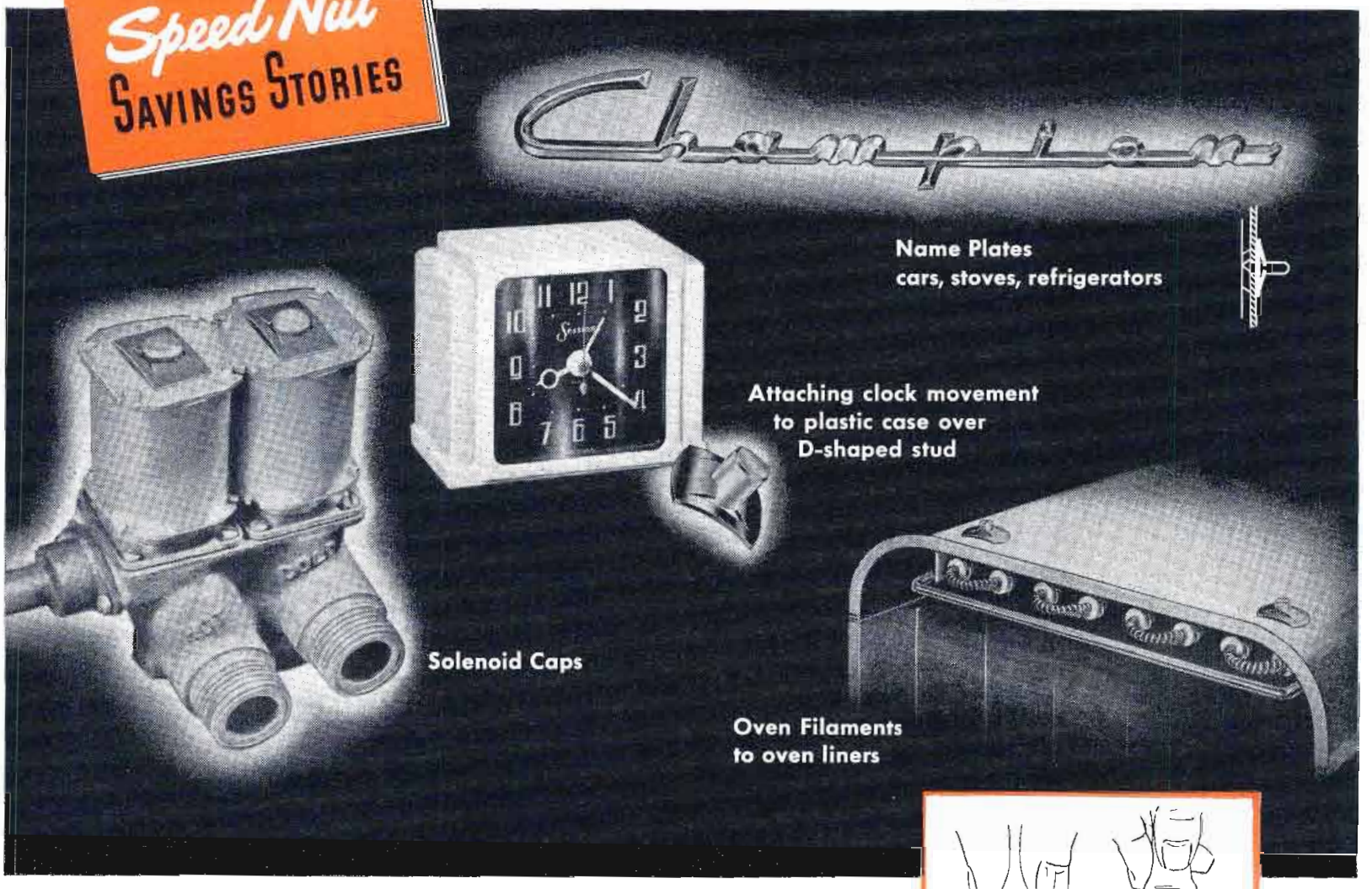


Radiation pattern range is one of four such areas set up by Microwave Engineering Co. atop Mt. Lee overlooking Los Angeles. The two-year old company headed by B. J. Rutherford tests antennas and radomes, designs special units.

TINNERMAN ®

Speed Nut SAVINGS STORIES

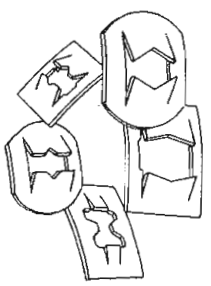
FASTEST THING IN FASTENINGS®



NEW Tinnerman Push-On SPEED NUTS®

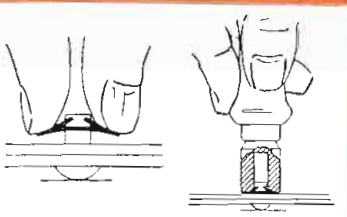
...for wide range of applications

– PRICE SAVINGS AVERAGE 25%!



● Tinnerman, originators of Push-On type SPEED NUTS, offers this new C12000 Series at substantial savings! Large volume, high speed production, plus years of engineering and manufacturing experience make this economy possible! These new lightning-fast Push-Ons are available in a complete range of popular sizes, with rust-resistant finish, for round, D-shaped or rectangular studs. A unique feature, exclusive with Tinnerman Push-Ons, is their use over D-shaped studs where removability is desired.

Call or see your Tinnerman representative for full, cost-saving information about these new, low-priced Push-On type SPEED NUT brand fasteners.



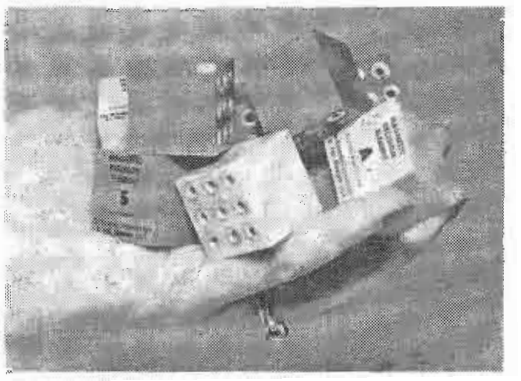
NEW C12000 Push-On SPEED NUTS

...are one-piece, self-locking, spring steel fasteners. Start by hand...zip down over integral studs, rivets, tubing, nails, any unthreaded parts; bite lock on smoothest, hardest surface!

Send today for copy of "Greater Savings Than Ever with C12000's"; also FREE Production Samples! Write: TINNERMAN PRODUCTS, INC., Dept. 12, Box 6688, Cleveland 1, Ohio. *In Canada:* Dominion Fasteners Ltd., Hamilton, Ontario. *In Great Britain:* Simmonds Aerocessories, Ltd., Treforest, Wales. *In France:* Aerocessoires Simmonds, S. A. – 7 rue Henri Barbusse, Levallois (Seine).

Magnetic Decision Elements

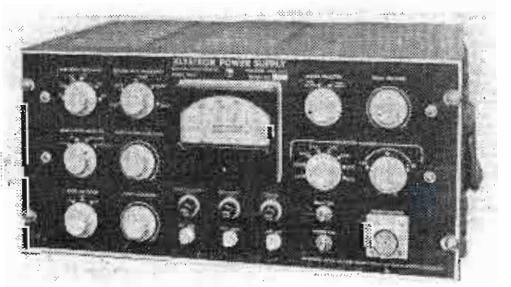
Two new building blocks, termed "S" and "A," occupy only one cu. in., nevertheless, they are completely basic, flexible elements with which it is possible to build the entire arithmetic, program, control, and memory sections of any digital computor. This whether it is a



serial or parallel system, or whether the computer is a simple flip-flop or binary, a large-scale general purpose instrument, or a digital differential analyzer. Magnetic Decision Elements contain no electron tubes or transistors. Synchronization and power drive is derived from a central 200 KC, two phase, clock pulse generator. The information flow rate is 100 KC. Static storage in each element makes it possible to switch off power completely and retain all information indefinitely, including the operations of dynamic arithmetic. Therefore, the "S" and "A" elements can be used as the complete foundation for digital computing systems.—**The Minnesota Electronics Corp., St. Paul 1, Minn.**—TELE-TECH & ELECTRONIC INDUSTRIES

Klystron Power Supply

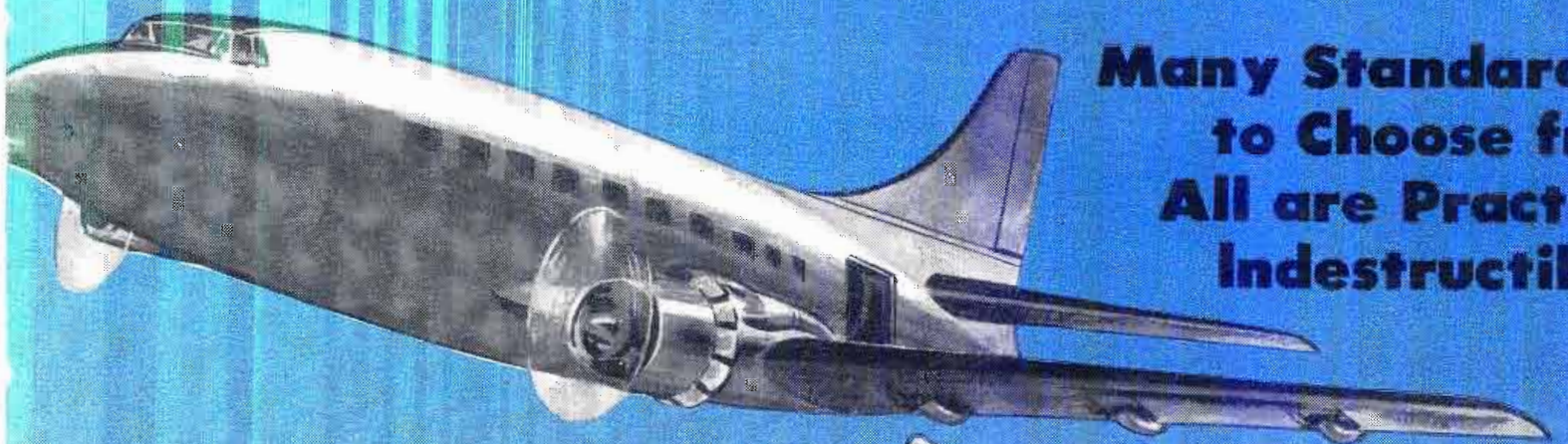
The new Klystron power supply, model TVN-11, supplies beam, reflector, filament, and modulation voltages for operating low-power, reflex-microwave, oscillator tubes. Beam voltage is



continuously variable from 225 to 500 v. Reflector voltage is continuously variable from 25 to 875 v. with a ripple content under 2.5 mv and regulation better than 1.0%. The sawtooth regulator operates from 10 to 60 cycles. The square-wave modulator permits amplitude modulation from 500 to 5,000 cycles. Both modulators are continuously variable in frequency when calibrated front panels are employed. Modulators can be synchronized either from external signals or from power line frequency. Power output is taken from an AN type connector. Dimensions are: 9 x 20-½ x 12 in. **Browning Laboratories, Inc., 750 Main St., Winchester, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

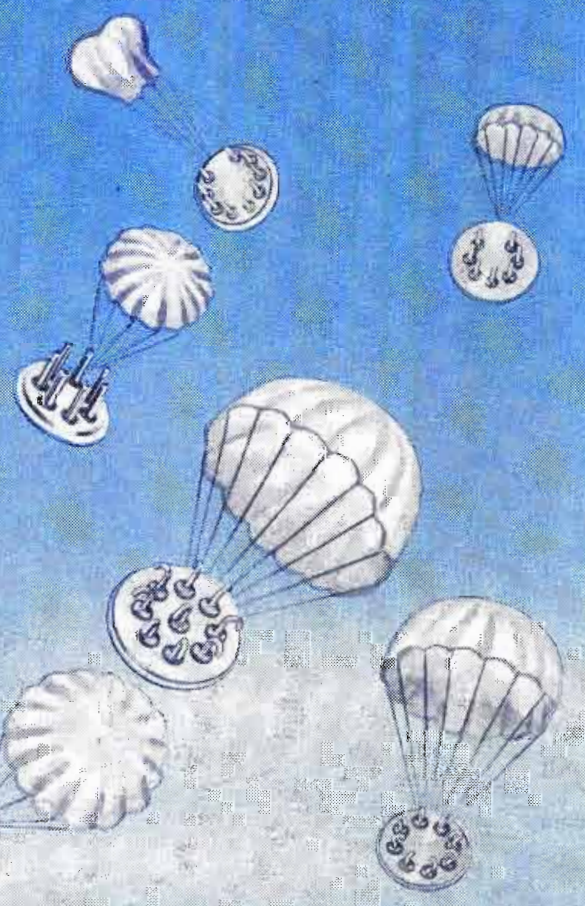
Super-rugged for toughest applications

E-I COMPRESSION TYPE HEADERS

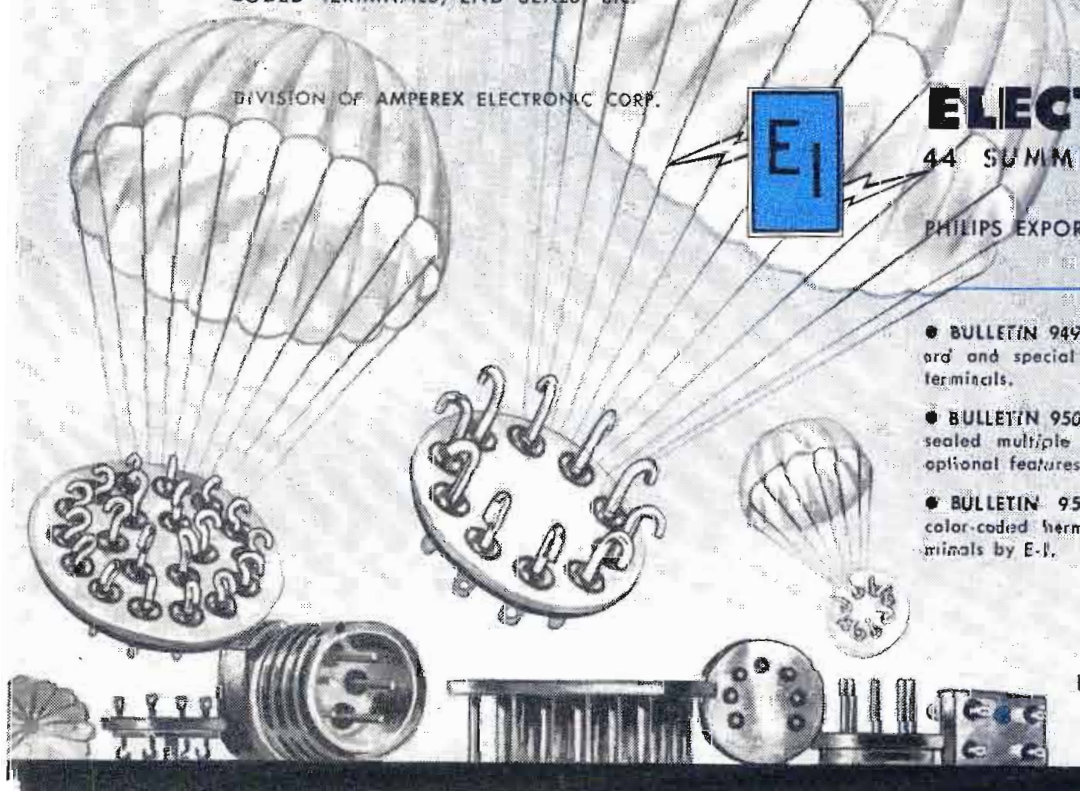


Many Standard Types to Choose from... All are Practically Indestructible!

A NEW SERIES! Made by an exclusive E-I process and featuring non-flexing solid metal blanks. No stampings are used. The glass remains under constant compression and is, therefore, extremely strong and difficult to place under stress. These new compression types offer far greater resistance to shock and vibration, maximum immunity to humidity and are tin-dipped for easy soldering.



E-I . . . YOUR HEADQUARTERS FOR HERMETICALLY-SEALED MULTIPLE HEADERS, OCTAL PLUG-INS, TERMINALS, COLOR CODED TERMINALS, END SEALS, etc.



DIVISION OF AMPEREX ELECTRONIC CORP.

E1

ELECTRICAL INDUSTRIES

44 SUMMER AVENUE, NEWARK 4, NEW JERSEY

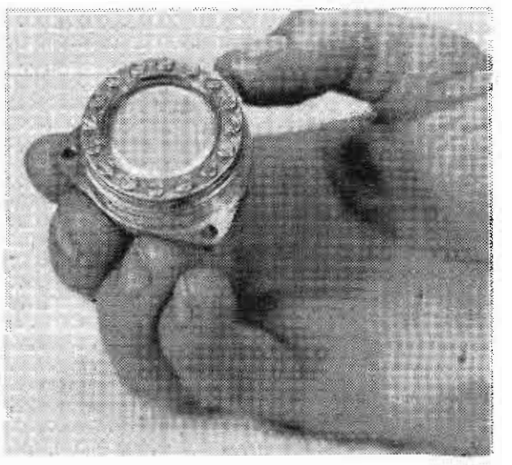
EXPORT AGENTS:
PHILIPS EXPORT CORP., 100 EAST 42nd STREET, NEW YORK 17, N. Y.

Write for these Catalogs

- **BULLETIN 949-A**—Covering standard and special hermetically sealed terminals.
- **BULLETIN 950-A**—On hermetically sealed multiple headers with many optional features.
- **BULLETIN 953** — On individual, color-coded hermetically sealed terminals by E-I.
- **BULLETIN 954**—Featuring end seals for condensers, resistors, and other tubular components.
- **BULLETIN 960**—Describing super-rugged compression type headers of revolutionary design.
- **SPECIAL TYPES** — Custom designs for unusual terminal requirements. Request quotations.

Capacity Microphone

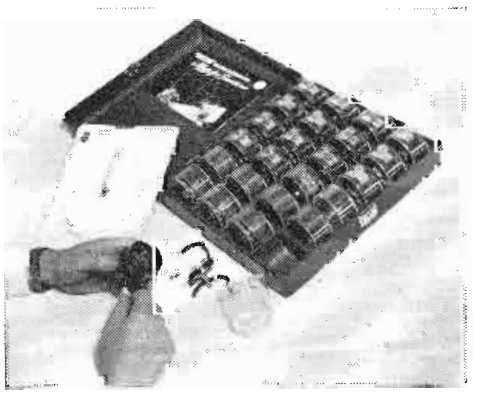
The Model D-42 microphone is said to exceed the requirements of the U. S. Army specification, 71-2519. Its response is flat within 1 db from DC to 12.5 kc,



and usable beyond 25 kc. The unit has a 25 mmfd nominal capacity, and will operate at levels in excess of 170 dbm (180,000 bars), and withstand repeated 200 "G" shocks. The microphone will operate over temperature variations from —32° F. to +300° F. without damage. Because the bronze diaphragm support and the beryllium diaphragm have the same expansion coefficient, the temperature sensitivity of the D-42 is negligible. **International Research Associates, Div. of IRESCO, Inc., 2221 Warwick Ave., Santa Monica, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Disc Calculator

A disc calculator which computes the combined potentiometer resistance and shunt resistor values in converting a linear potentiometer to a non-linear function is a component of the new "Pot-Kit Servocalculator". A value corresponding to a minimum increment of resistance is readily found on the C scale. Four graph-determined increments of resistance change between taps



are located on the rotor which is locked or aligned with a hair line opposite an arrow. This gives the value of the R shunt scale. The value of the shunt resistor to the desired total resistance provides the actual ohmic value of the shunt resistor to be connected across the respective section.—**Servotrol Co., Eastern Branch Office, Framingham Centre, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

This famous trademark has dual significance: Hallmark of quality in hermetic seals, it is also the symbol of HERMETIC's earnest desire to make such units available to industry at prices that make sense.

HERMETIC recognizes the importance of price to industry. Therefore, it makes every effort to keep prices in line . . . without *subordinating its own high quality standards.*

To maintain these long recognized standards, every phase of production, every operation, is supervised by specially trained engineers. And, more inspectors, more inspections, more testing equipment are used to check electrical and mechanical characteristics . . . including the ultimate mass spectrometer test.

It is because of this quality and wide acceptance that HERMETIC now manufactures the largest line of hermetic seals in the world . . . and has produced more innovations than any other supplier in its field. Little wonder that HERMETIC has received generous endorsements from our country's Services and from industry.

Moreover, the HERMETIC line has grown increasingly. New developments, advanced design and quality standards, which enhance the value of every control on which HERMETIC headers are used, have attracted more and more buyers.

Now is the time for you to check with HERMETIC to find out how these headers can be adapted to your particular products. Send for your FREE copy of HERMETIC's colorful, informative 32-page brochure, the most complete presentation ever offered on hermetic seals.

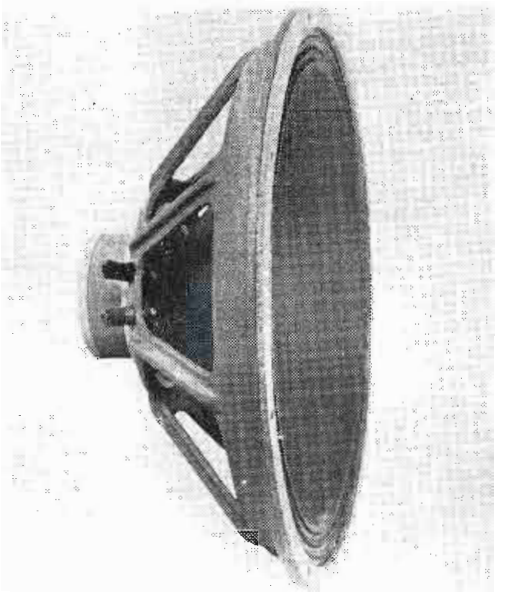
Hermetic Seal Products Co.

33 South Sixth Street, Newark 7, New Jersey

FIRST AND FOREMOST IN MINIATURIZATION

Improved Woofer

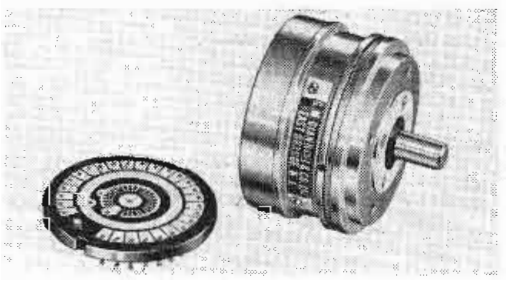
The outer compliance of the cone of the 18 in. Model CS-518 woofer is treated with Pyralin to improve edge dampening and reduce distortion caused by cone



breakup. The unit has a 2½ lb. Alnico V magnet, and a 2 in. voice coil. Specifications are: frequency response, 30-4000 cps; impedance, 12 ohms; maximum power input, 25 watts; cone resonance, 27 to 31 cps.—**C. S. Manufacturing Co., 4089 Lincoln Blvd., Venice, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Switching Commutator

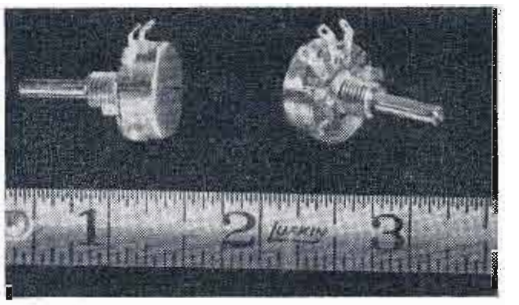
The multi-channel, rotary, mechanical, high speed, switching commutator shown is designed for radio and wire telemetering, multi-channel switching,



and automatic rapid-rate sampling. At 5 rps, it has an operating life of at least 100 hrs. The unit is designed to give clean electrical make and break, and either "make before break" or "break before make" can be supplied. In a specific design with a 27-contact outer circuit with one terminal, and a 28-contact inner circuit with two terminals, the commutator will perform under 50G steady acceleration, and under 10G's vibration up to 1,000 cps.—**G. M. Giannini & Co., Inc., 117 E. Colorado St., Pasadena 1, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Bushing-Mounted Control

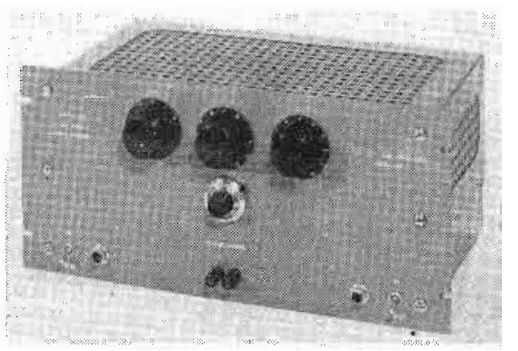
Model 3, a new subminiature control, will be the smallest bushing-mounted control, yet to be made available. The unit is still undergoing development. Totally enclosed and capable of being sealed for potting, the new control has withstood salt spray tests of 100 hrs. and temperatures of at least 150° C. The new unit will be available in all standard linear and log tapers. It will be mounted



with a ¼ in. —32 bushing and its shaft will be ⅛ in. in dia. No definite date has been set for production samples—**Centralab Div., Globe-Union, 900 Keefe Ave., Milwaukee 1, Wis.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Meter Calibrator

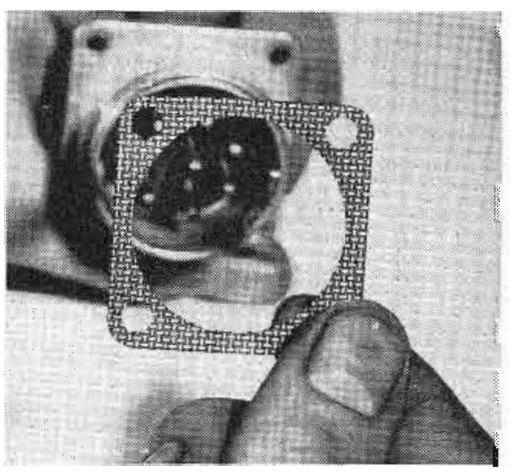
Model 123 meter calibrator is a precision source employing the circuitry of the Kay-Lab dc power supplies. The unit produces an absolutely calibrated dc voltage that is essentially indepen-



dent of input line voltage and output load variations. The circuit compares the output voltage with an internal standard cell. Model 123 affords absolute calibration to 0.1%. Output voltage is 1 to 300 v. variable in 1 v. steps. Power requirements are 105 to 125 v., 75 watts.—**Kalbfell Laboratories, Inc., 1090 Morena Blvd., San Diego, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Gasket Material

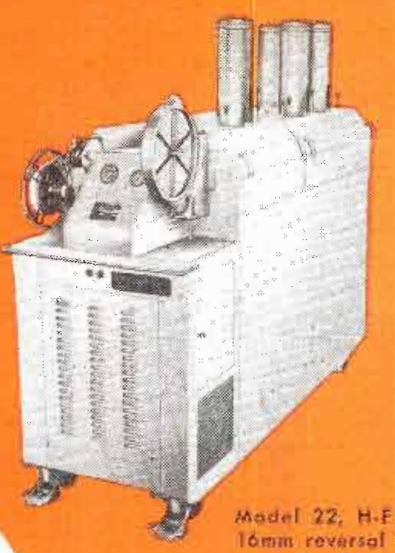
A new highly-conductive gasket material consisting of Neoprene-filled aluminum wire screening has been placed on the market. The interstices of the screening are filled with the synthetic rubber, then both surfaces are



buffed to provide uniformity in gauge and assure good electrical contact. The conductivity of the aluminum enables static charges to drain rather than become "trapped."—**Vulcanized Rubber & Plastics Co., Morrisville, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

98% of all U.S. TV stations use Houston-Fearless equipment

Houston-Fearless TV Crane, Model TC-1, offers extreme versatility. Camera lens can be raised quietly, from 3'-6" to 9'-6" while dollying.



Model 22, H-F developer for 16mm reversal films. It is self-contained, easy to operate, entirely automatic, daylight operating. Adaptable to negative, positive or 35mm films.

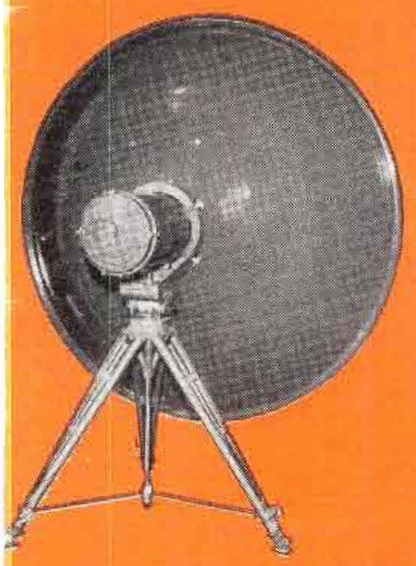
Smoother BETTER SHOWS

are produced with

HOUSTON-FEARLESS EQUIPMENT

Top flight television showmanship is dependent not only on capable writers, producers and cameramen, but also on reliable studio equipment that will produce any desired camera effect smoothly and quietly with a minimum of effort . . . and on efficient film processing equipment that opens vast new sources of program material. That's why 98% of all U.S. television stations, as well as motion picture studios in Hollywood and throughout the world, rely on Houston-Fearless for matchless quality, proved performance and absolute dependability.

Model PD-3 H-F TV Camera Pedestal raises camera quickly, easily by lifting on steering wheel. Rolls smoothly for dolly shots. One man operation.



Houston-Fearless microwave parabola mounted on H-F tilt head and tripod. Also available in power-driven models operated by remote control.

In addition to building many models not shown here, Houston-Fearless offers extensive engineering and manufacturing facilities to produce special television and photographic equipment for your particular requirements. Write for information and catalogs.

H-F Panoram Dolly provides countless camera effects . . . raising, lowering, panning, tilting, and dollying. Smooth and steady.

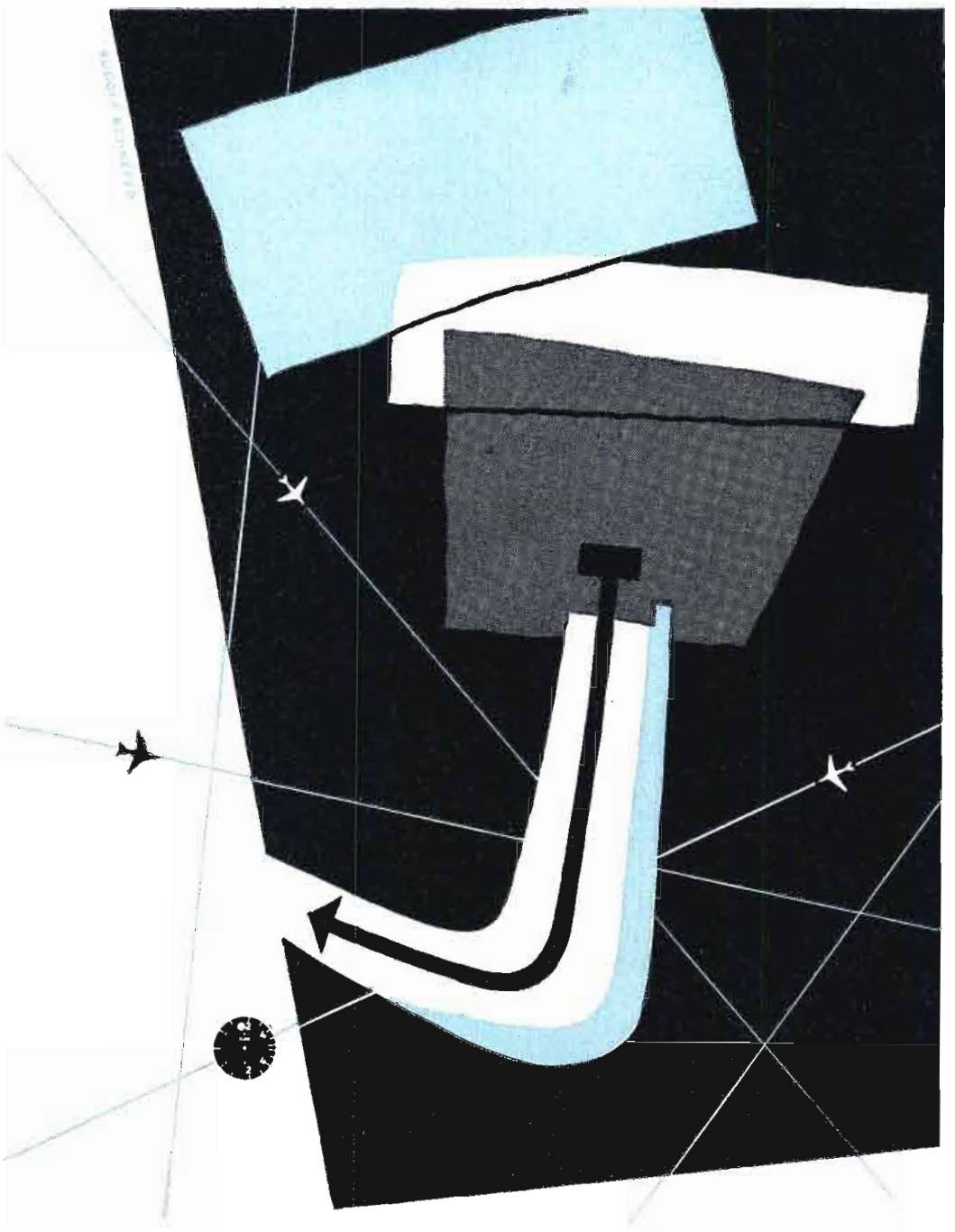
Television's finest portable camera mount. Houston-Fearless friction head, all-metal tripod and tripod dolly. For studio or field use.

The HOUSTON FEARLESS Corporation

THE HOUSTON-FEARLESS CORP.
11805 West Olympic Blvd.
Los Angeles 64, Calif.

Please send catalogs on ☐ Friction Head ☐ Tripod
☐ Tripod dolly ☐ Panoram dolly ☐ TV Cranes
☐ Camera pedestals ☐ Film Processors
☐ Parabolas ☐ Remote control parabola

Name..... Title.....
Station or firm.....
Address.....
City..... Zone... State.....



Cybernetics

(*Continued from page* 65)

ical structure and may exist in a stable or unstable state.

(3) Physiological disorders are essentially "circuit" problems while psychological disorders are "field" problems.

(4) Entropy in its energy and information senses is involved in the natural ending of the life processes, all other factors being healthy.

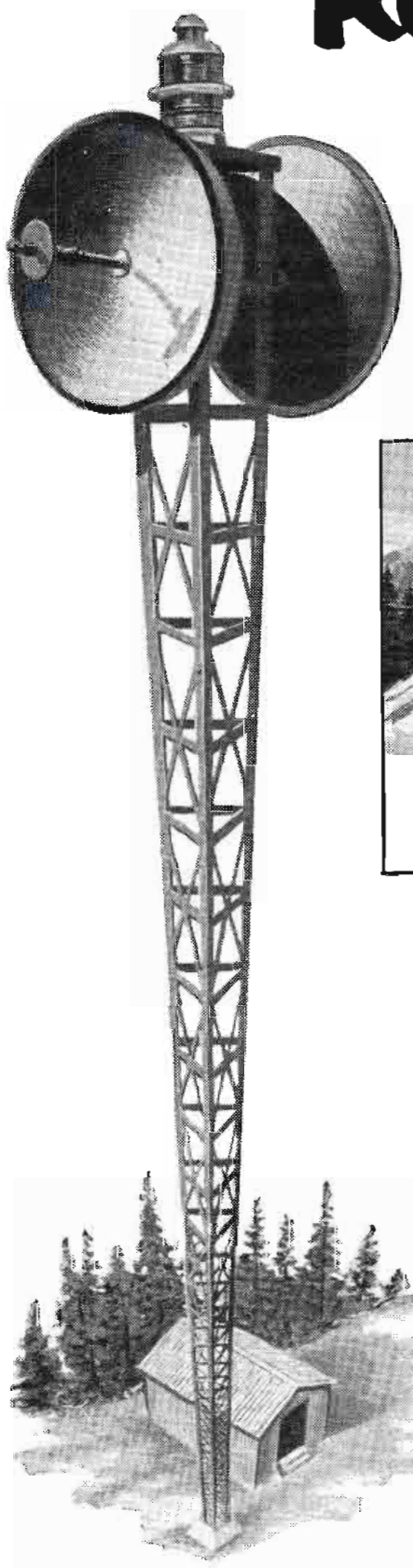
No claim is made of the completeness of these analogies but study of these circuitry reveals artificial behavior such as to produce a linear approximation which is sufficient in many needs, to understanding the real behavior. For example, Fig. 1 shows a block diagram of a simple heart simulator, designed by the Dutch mathematical physicist Van der Pol in 1932, whose output when read on an electrocardiograph looked remarkably close to a normal human heart. The disorders of this simple analog computer can give some relevant information to the researcher in heart disease. The study of the functional psychoses, manic and depressive, schizophrenia and paranoia lend themselves to analogy by a logical digital computer coupled to an analogy feedback mass of circuitry as described in the design of a diagnostic computer. (See Bibliography)

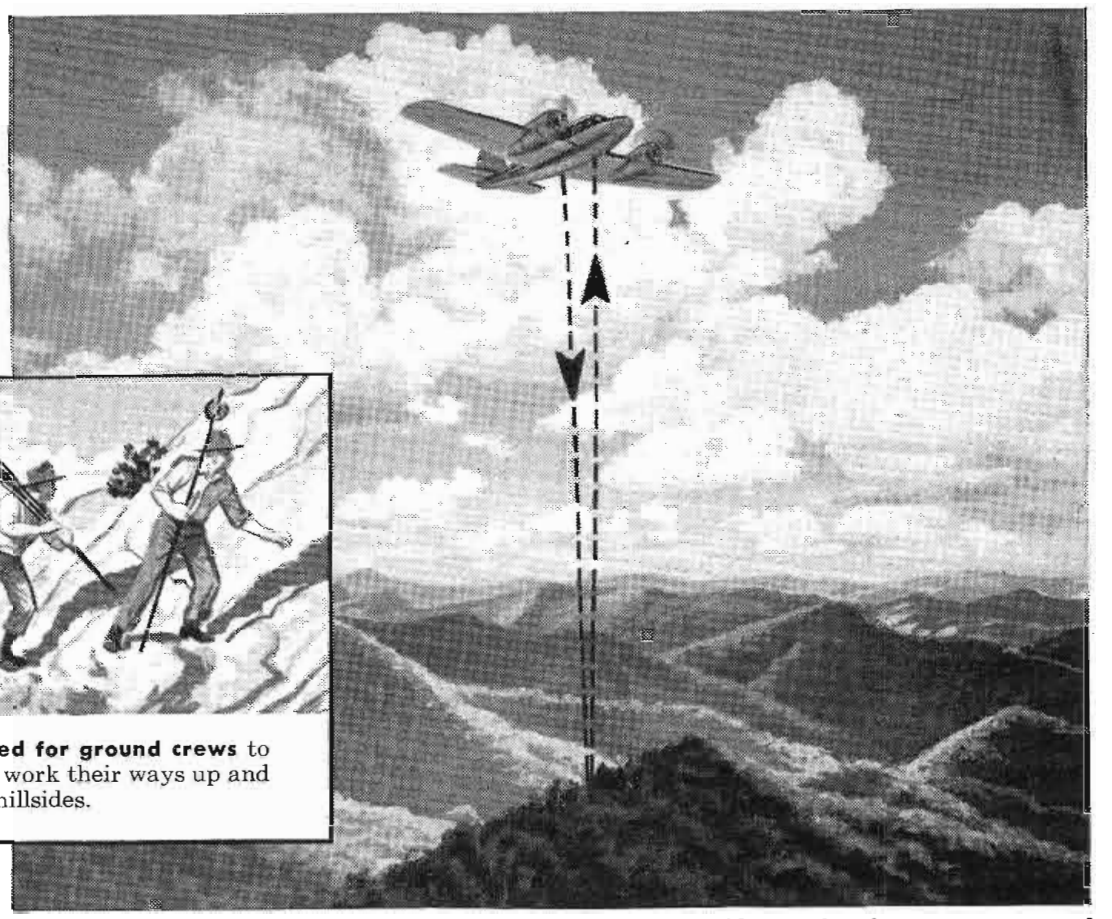
The Automatic Factory

An ultimate objective of many a cyberneticist is the design and development of a robot logical computer and servo system capable of independent operation save for raw materials, which will synthesize at high speed and efficiency the finished products, tools and machinery of the coming age. This can even include a machine that will reproduce itself. The realization of such a goal should be quite soon since such factories offer great strategic advantage in waging war, a most overworked profession. A nation of decentralized robot factories with independent power sources can minimize strategic interdiction, has no manpower or labor shortage or strife and can wage war most effectively. The sociological, economic and political consequences of these factories are the great problems of the future but today it is possible to build the automatic factory. Fig. 2 shows a general block diagram of a production synthesizer or automatic factory without power supply.

(*Continued on page* 134)

RCA MICROWAVE





No need for ground crews to slowly work their ways up and down hillsides.

Radar signals provide precise data on contour of earth beneath proposed path of a microwave beam.

RCA AERIAL SURVEY speeds installation ... insures accuracy

For the ultimate in microwave planning, RCA offers the important advantages of fast, accurate aerial survey.

Flying a simulated path of the microwave beam, ground elevations are charted by continuous readings from a vertical radar system. Recording instrumentation enables the survey team to plot an accurate route—and an *alternate route*—at high speed. By direct observation and aerial photography these experts select the most economical, easily accessible sites. An unobstructed microwave route is plotted in a fraction of the time normally required—without the premature publicity that often results from surveyors' operations.

For dependable communication, proved on existing systems, call an RCA Microwave Specialist at the nearest Regional Office, or MAIL COUPON.

• • •

Check RCA 2-way radio for proved dependability in mobile communications.

And remember, only RCA can provide the nationwide service facilities of the RCA Service Company.

RADIO CORPORATION of AMERICA

COMMUNICATIONS DIVISION **CAMDEN, N. J.**

Communications Division
Radio Corporation of America
Dept. 119T, Building 15-1
Camden, N.J.
Please send me your free booklet on:

- ☐ RCA Microwave
- ☐ RCA 2-Way Radio
- ☐ Send an RCA Communications Specialist

Name_____

Title_____ Company_____

Address_____

City_____ Zone_____ State_____

If a suitable power source, say of the nuclear type, could be supplied so no outside energy supply is involved, the factory is complete. Fig. 3 shows such a supply.

The basic block shows the main components of the production synthesizer to be a logical analyzer, large scale memory, decision switching circuitry, digital-to-analog conversion equipment and coupling, a command error function generating system of trigger and discriminator devices, coupled servo systems and power machinery and finally, a monitor system to exercise firm control. The monitor also forms the main closed servo loop and determines overall system behavior.

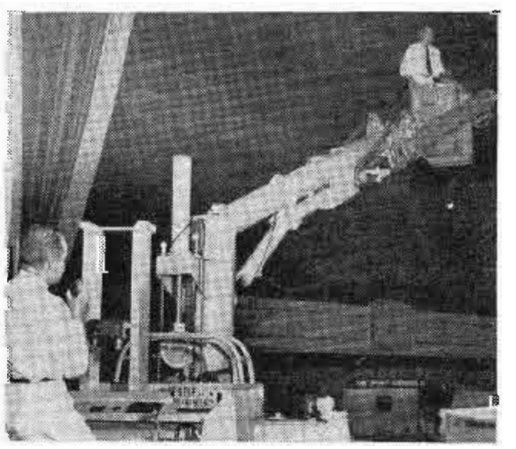
Basic Unit Functions

1. *Logical Analyzer:* This is the fundamental input device consisting of a quantizer system, general switching and discriminator circuitry whose chief purpose is to convert all inputs into pulse trains of coded digital signals for distribution to coincidence and comparator circuitry in the memory block. The amount of alternative channels which will contain spare parallel loops will be a function of channel priority.

2. *Large Scale Memory and Predictor Networks:* These will consist of a magnetic drum or other large scale memory or both and will keep in its storage system the history of the entire factory, its past behavior, its faults and merits, routine and alternative decisions and a library of previous knowledge on components. These will be under continuous scan and comparison with input commands and will generate decision functions for transmission to the power circuitry. The predic-

(*Continued on page* 136)

RADIO for INDUSTRY

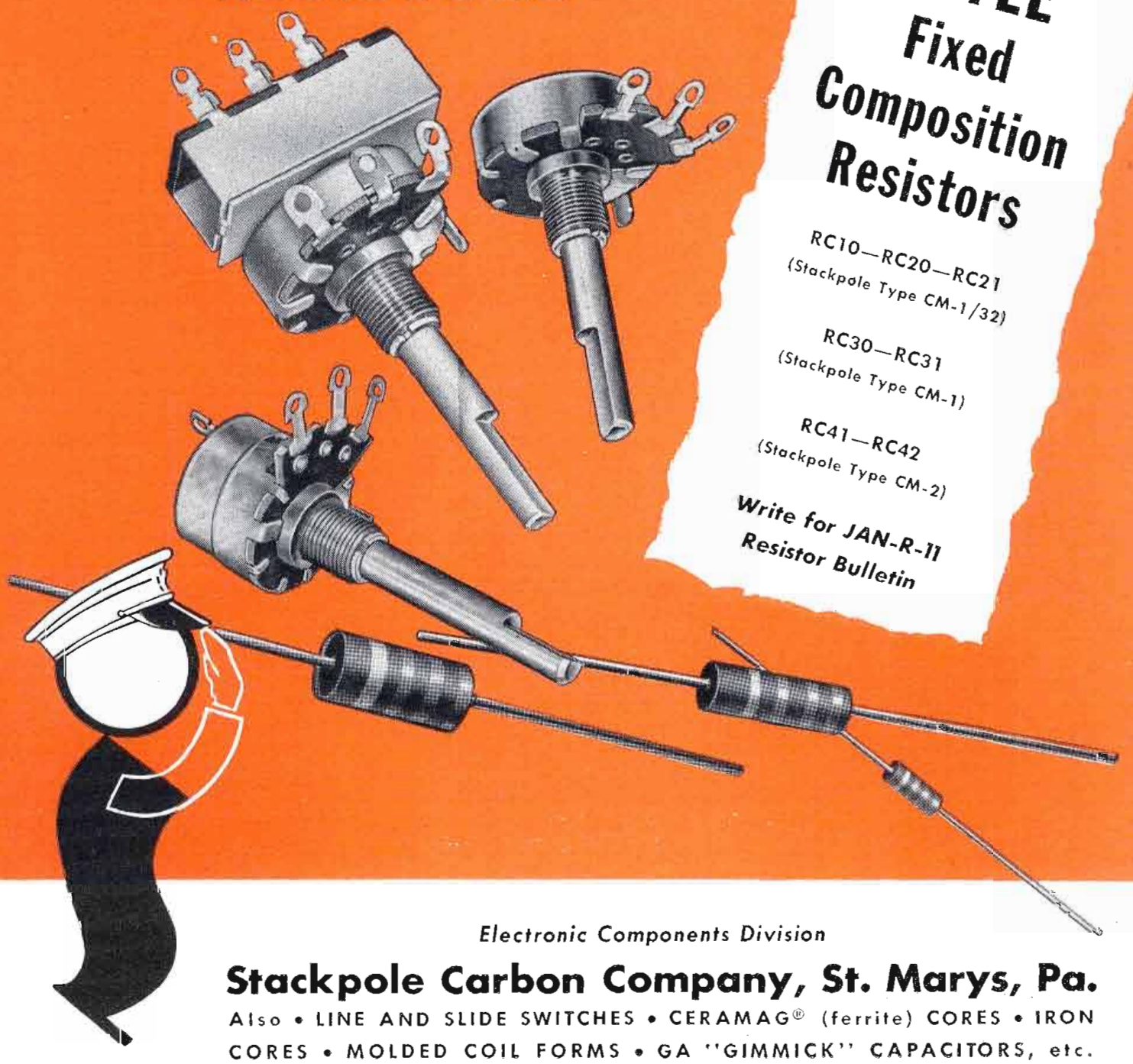


General Electric two-way radio facilitated conversations between eight mobile radio-telephone equipped vehicles at the recent Materials Handling Exposition in Philadelphia. Shown above is the Yale and Towne Tey Boom in operation, two-way radio controlled from the GE dispatcher's booth.

A GOOD NAME TO REMEMBER WHEN YOU NEED DEPENDABLE COMPONENTS... *faster!*

STACKPOLE

FIXED and VARIABLE RESISTORS



JAN-R-11 STYLE Fixed Composition Resistors

RC10—RC20—RC21
(Stackpole Type CM-1/32)

RC30—RC31
(Stackpole Type CM-1)

RC41—RC42
(Stackpole Type CM-2)

Write for JAN-R-11 Resistor Bulletin

Electronic Components Division

Stackpole Carbon Company, St. Marys, Pa.

Also • LINE AND SLIDE SWITCHES • CERAMAG® (ferrite) CORES • IRON CORES • MOLDED COIL FORMS • GA "GIMMICK" CAPACITORS, etc.

tion system is a velocity or higher order type to speed up routine operation and shorten alternative or new decision time.

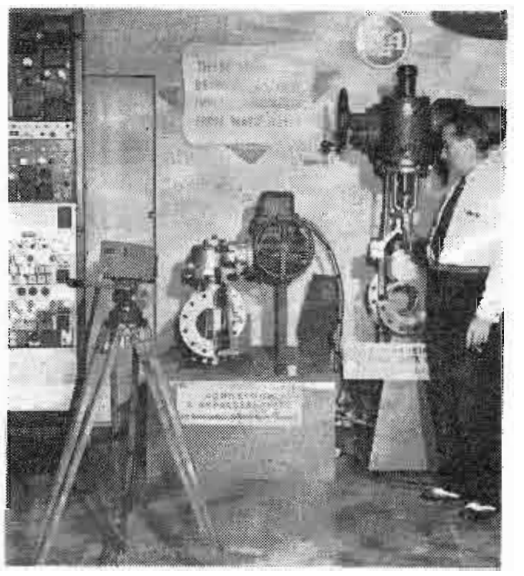
3. *Digital-to-Analog Converter:* The converter is composed of a decision integrator, discriminator and trigger circuitry. Digital decision functions are integrated into continuous functions, shaped by the discriminator and assigned a trigger unit. The trigger unit operates a command input to an error function generator.

4. *Error Function Generator, Servo Systems and Gates:* The error function generator produces on proper trigger a signal of such amplitude and frequency as to produce operation of selected servo systems and associated coupling gates. Each servo system is a closed loop operational unit including power machinery, coupling networks variable through gated circuits receiving decisions from the memory.

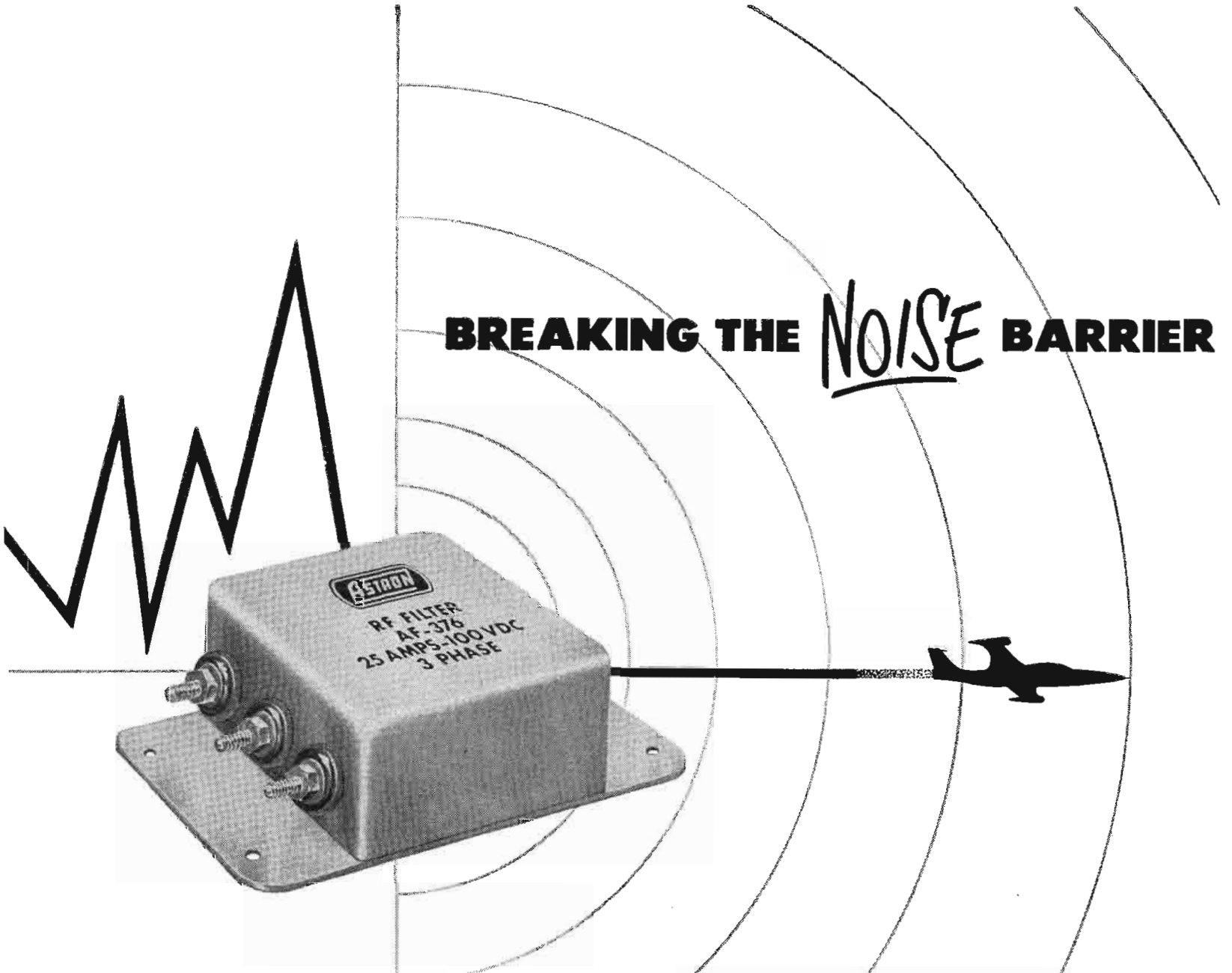
5. *Action Integrator and Monitor:* The action integrator smooths the output and produces evaluative behavior so the monitor can exercise evaluation. The monitor then provides close and automatic supervision, relaying inaccuracies and failure for repair and as the alarm for major disorders.

6. *Nucleonic Power System:* The nucleonic power supply is an independent, relatively long term power system employing different types of radiators and a rejuvenating pile. It must be emphasized that though at first glance the system seems to be capable of perpetual motion, a close examination of the physical system

TV for PIPE LINES



At the recent International Petroleum Exhibition (Tulsa, Okla.), RCA Victor Div., Radio Corp. of America demonstrated electronically-controlled pipe line operation. A two-way RCA microwave relay system, operating on four FCC-assigned channels, provided simultaneous two-way telephone conversations, remote equipment signals, and two-way television pictures for the visitors.



For conformance to Radio Interference Specification MIL-I-6181 and other applicable government specifications covering radio noise suppression.

MIL-I-6181

- **In Less Space**
- **With Less Weight**

*Metallized paper capacitor sections for the maximum in subminiaturization; special paper and foil and metallized paper capacitor sections for operation to 125°C.

RF INTERFERENCE SUPPRESSION FILTERS

When *you* must break the noise barrier, look to ASTRON—the manufacturer *best qualified* to meet your exacting needs in RF Interference Suppression Filters.

Astron is now supplying the top names in the aircraft and electronics industries. Astron has extensive experience in filter design and technique for extreme high altitude and high temperature operation, as well as for extreme variations in atmospheric pressure. All Astron filters are *ruggedized* to withstand severe vibration and shock. Maximum attenuation with unusually small size and light weight is made possible by use of special capacitor sections*, specially wound inductances, and other special components and engineering techniques. The desirable characteristics of low impedance and low voltage drop with minimum heating are retained and *improved* in these subminiaturized filters. Write today for complete details, outlining your specific requirements.

ASTRON manufactures a complete line of dry electrolytic capacitors, metallized paper capacitors, plastic molded capacitors, standard and subminiature paper capacitors and RF interference filters for every radio, television and electronic use.

DEPEND ON—INSIST ON

ASTRON CORPORATION — **255 GRANT AVENUE, EAST NEWARK, NEW JERSEY**

Export Division: Rocke International Corp., 13 E. 40th St., N.Y.C.
In Canada: Charles W. Pointon, 1226 Gerrard St. East, Toronto.

will show this is not the case. As shown in Fig. 3, the system has four channels in the main.

The Alpha and Beta Channels provide a source of high positive and low negative direct current voltage respectively. Self regulation is inherent in long half-life radiators over periods of time. The alpha or beta radiator is placed in an evacuated chamber and its radiation focused electronically to strike a collector. The collector would then assume a charge depending on the striking polarity and in sufficient cascade should produce usable power.

The Gamma channel would heterodyne gamma radiation with X-ray radiation and with suitable frequency division produce useful radio-frequency energy. The Neutron channel would accelerate neutrons and fire them into fissionable material. Suitable selection of targets would provide additional sources for itself and the other three channels.

Automatic Fire Control

The basic problem of an adequate automatic fire-control system is the maximization of the probability of kill. This function is dependent on several factors in the main; (1) system reliability, (2) system accuracy, (3) weapon effectiveness and (4) target vulnerability. The system designer can do much to control the first two factors and a little in the third. The fourth factor has only a slight order of prediction in that the enemy will change this factor in a closed loop manner. So it is clear that though a cybernetical approach through the methods of Operations Research, this factor can be evaluated to some limit. However, full consideration would be beyond the scope of this article. An inner loop can be removed and examined as an example of current application. Fig. 4 is such an inner loop without automatic range tracking.

The pilot's transfer function is omitted for simplicity. Target dynamics are fed to a geometry comparator which then determines the parameters of line-of-sight and range. Line-of-sight is then fed to the automatic tracking loop, which compares it to the radar line-of-sight, the error signal driving the gimbals so the antenna follows the target continuously. The gimbals in turn send angular changes to the automatic pilot which in the case of a fixed weapon aircraft (as this is) adds the prediction derived from the computer and drives the control surfaces to fly a tracking flight path in

Why Hughes Diodes have set

A NEW STANDARD OF RELIABILITY

Reliability in a germanium diode is determined principally by permanent freedom from the two major causes of diode failure—moisture penetration of the diode envelope, and electrical instability under extreme operating conditions.

HUGHES GERMANIUM DIODES are designed to prevent such failures through two exclusive features:

1. **Fusion Sealing**—The glass-to-metal seal, proved in billions of vacuum tubes, is incorporated to full advantage in diode manufacture by the Hughes-developed process of fusion sealing at high temperature. The result is a rigid *one-piece* glass envelope making moisture penetration impossible.

2. **100% Testing**—One hundred per cent testing insures the satisfactory operation of **HUGHES DIODES** under adverse conditions of moisture, temperature, vibration and severe shock. Hughes testing procedures *invite* instabilities to occur prior to shipment and assure rejection of every defective diode. *Each* **HUGHES DIODE** is humidity-cycled, temperature-cycled, JAN shock-tested, and electrically tested under vibration.

Reliability of **HUGHES DIODES** has been proved in airborne military electronic equipment for navigation, fire control and guided missiles. The same high standard required for these uses is your insurance against costly shutdowns, high maintenance expense and time losses.

Specify **HUGHES DIODES** wherever reliability is essential.

HUGHES GERMANIUM DIODE ELECTRICAL SPECIFICATIONS AT 25° C.

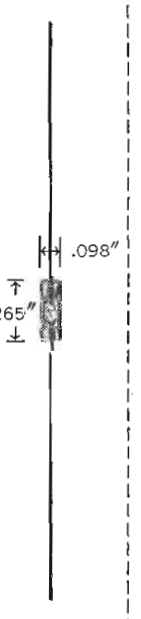
Description	RTMA Type	Test Peak Inverse Voltage* (volts)	Maximum Inverse Working Voltage (volts)	Minimum Forward Current @ +1 v (ma)	Maximum Inverse Current (ma)
High Peak	1N55B	190	150	5.0	0.500 @ −150 v
	1N68A	130	100	3.0	0.625 @ −100 v
High Back Resistance	1N67A	100	80	4.0	0.005 @ −5 v; 0.050 @ −50 v
	1N99	100	80	10.0	0.005 @ −5 v; 0.050 @ −50 v
	1N100	100	80	20.0	0.005 @ −5 v; 0.050 @ −50 v
High Back Resistance	1N89	100	80	3.5	0.008 @ −5 v; 0.100 @ −50 v
	1N97	100	80	10.0	0.008 @ −5 v; 0.100 @ −50 v
	1N98	100	80	20.0	0.008 @ −5 v; 0.100 @ −50 v
High Back Resistance	1N116	75	60	5.0	0.100 @ −50 v
	1N117	75	60	10.0	0.100 @ −50 v
	1N118	75	60	20.0	0.100 @ −50 v
General Purpose	1N90	75	60	5.0	0.800 @ −50 v
	1N95	75	60	10.0	0.800 @ −50 v
	1N96	75	60	20.0	0.800 @ −50 v
JAN Types	1N126**	75	60	5.0	0.050 @ −10 v; 0.850 @ −50 v
	1N127†	125	100	3.0	0.025 @ −10 v; 0.300 @ −50 v
	1N128‡	50	40	3.0	0.010 @ −10 v

*That voltage at which dynamic resistance is zero under specified conditions. Each Hughes Diode is subjected to a voltage rising linearly at 90 volts per second.
**Formerly 1N69A. †Formerly 1N70A. ‡Formerly 1N81A.

In addition to RTMA *types,* HUGHES DIODES *are also supplied 100 per cent factory-tested to special customer specifications.*

See our exhibit
Booth 407
WESTERN ELECTRONIC SHOW & CONVENTION
Civic Auditorium
San Francisco, Calif.
August 19-21

Fusion sealed in glass *for electrical stability*



actual size

Semiconductor Sales Department

Hughes

AIRCRAFT COMPANY
CULVER CITY, CALIFORNIA

Chicago *New York City*

Address inquiries to Dept. T

a selected pattern of attack. This pattern may be a collision course or pursuit curve depending on the armament. The line-of-flight will be fed to the prediction circuitry for generation of prediction angles in all degrees of freedom. Information on past experience and present flight conditions will be stored in the memory which will furnish decisions to the pattern discriminator for any input. Coordinate conversion form line-of-flight information is necessary for proper target coordinate evaluation. Range information is processed in the normal radar sense with time-to-go, the firing decision parameter a function of the pattern selected. A weapon and ballistics memory is provided for storage of tables and constants which are function of the armament type.

An important moral of this article is that the cyberneticist will find application in every field. Control loops exist in economics, sociology, medicine as well as physics and engineering. The criterion for stability in these former systems, linear or no, is far more important than Nyquist's criterion and holds the key for real human progress and the minimizing of the probability of human obsolescence.

Barrett, Eric and Post, Geoffrey, "Introduction to Some Principles of Applied Cybernetics," *Journal of Psychology,* July 1950, pp 3-10.

McCulloch, Warren S., "The Brain as a Computing Machine," *Electrical Engineering,* June 1949, pp 491-493.

Neilsen, K. L. and Heyda, J. F., "Mathematical Theory of Airborne Fire Control," NavOrd Report 1493, July 1951, Govt. Printing Office.

Post, Geoffrey, "The Design of a Diagnostic Computer," paper presented Colorado-Wyoming Assoc for Advancement of Science, Boulder, Colo. May 1952

Rea, James B., "Analysis of Systems for Automatic Control of Aircraft," *Journal of the Inst. of Aero. Sciences,* Abstr. 1951.

Van der Pol. B., "The Heart as a Relaxation Oscillator," *Phillips Telefunken* (Netherlands), 1932.

Weiner, Norbert, *Cybernetics,* John Wiley and Sons, 1948.

License Arrangements

National Research Corp., Cambridge, Mass., has announced acquisition of approximately 25% of the outstanding stock of Leybold-Hochvakuum-Anlagen G.M.B.H., Köln, Germany. A minority interest in the company is held by Sachtleben A.G., a jointly-owned subsidiary of I. G. Farben Metallgesellschaft.

Leybold-Hockvakuum-Analagen are concerned with the industrial application of high vacuum technology in impregnation, distillation, dehydration, coatings, and vacuum metallurgy. License arrangements have been concluded whereby the Equipment Div. of National Research Corp. has the exclusive U.S. manufacturing rights for equipment developed by the German concern, and the latter gain non-exclusive sales rights throughout the world for products made by National Research.

TYPE 1183-T
TV Station Monitor

Now In Use By Nearly Every TV Station

Standard Equipment with Transmitters of ch Leading Manufacturers as RCA, GE, DuMont

In Regular Production

Highest Stability

Less Than 0.1% Distortion For 25 kc Swing

Accurate, Visual and Aural Carrier-Frequency Indication

Reliable Modulation-Level Monitoring

Only Routine Maintenance

Convenient to Use

in T-V Monitoring Equipment

The Type 1183-T T-V Station Monitor in regular production—deliveries current to meet "on the air" schedules. Price: from $2830 to $2905 depending on frequency bands.

Large-scale illuminated meter continuously indicates frequency deviation of aural transmitter in terms of highly stable crystal oscillator. Zero correction for crystal oscillator easily accessible from panel, to compensate for long-time drift.

Visual transmitter frequency deviation is continuously indicated by this large scale meter, in terms of the same master crystal.

Modulation in both percentage and db is indicated continuously on this meter. Panel switch selects either peak, or indicates both peaks simultaneously. Meter ballistics meet FCC requirements.

it's Dependability that Counts!

Since the beginning of broadcasting, G-R has pioneered in the design and manufacture of monitors of all types. Almost all of the 2424 Radio Broadcast Stations now on the air are equipped with G-R Monitors.

This experience has provided the necessary engineering and manufacturing background to anticipate all of the station needs for high quality, dependable, accurate and trouble-free T-V Monitors. Months of "post-freeze" operation in all of the leading v-h-f and u-h-f stations has proven the reliability, accuracy and convenience of the new G-R Monitor.

★ *Two large-scale, illuminated meters continuously indicate frequency deviation of aural and video transmitters in terms of a highly stable crystal oscillator. Modulation in both percentage and db is shown on another meter; panel switch selects either peak, or indicates both peaks simultaneously*

★ *High Stability; Visual Monitor ±500 cycles*
Aural Monitor ±1000 cycles

On all VHF channels, the above accuracy is guaranteed for at least thirty days — at the lower UHF frequencies (channel 14), the period is over sixteen days — on channel 83, the period is ten days or more

★ *High-fidelity audio output for distortion and noise-level measurements, and for audio monitoring — residual noise level is down 70 db or better for 25 kc deviation*

★ *Overmodulation alarm for aural transmitter — lamp flashes when modulation exceeds predetermined level set by dial*

★ *Sensitivity for both Aural and Visual inputs. High Impedance Input (VHF) — 1 volt or better. Low Impedance (UHF) — 500 mw or less*

★ *Excellent signal-to-noise ratio through channel 83*

★ *Separate heater inputs allow direct connection of crystal oven to station standby power*

★ *Pilot lamp indicates adequate r-f input level*

★ *Terminals are provided for connecting remote center-frequency and modulation meters and over-modulation indicators*

★ *Counter-type discriminator has excellent linearity over ±100 kc range — overall distortion is less than 0.1%, insuring accurate distortion measurements and center-frequency indications even under heavy modulation*

★ *New cabinet arranged for maximum heat dissipation and easy installation or removal for servicing*

GENERAL RADIO Company
275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.
90 West St. NEW YORK 6 920 S. Michigan Ave. CHICAGO 5 1000 N. Seward St. LOS ANGELES 38

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

Medical Research

(*Continued from page* 63)

els in excess of 150 db. Employes working in these high noise fields without ear protection may have a permanent loss of hearing at frequencies above 1,000 cps. (Fig. 4.) Regardless of the frequencies predominant in high level noise, the evidence seems to be that the greatest trauma to auditory perception is encountered around the 4 kc region of the ear. Effort is being concentrated on providing an exposure meter which will indicate a safe sound pressure level to which a person can be exposed without partial impairment of hearing. There are many factors to be considered in this exposure meter, since time of exposure and the frequency distribution of the sound must be taken into consideration.

Noise control of jet engine testing cells has become a compulsory part of factory testing. Factories are usu-

Fig. 5: Condenser microphone for measuring noise levels up to 220 db. Various sensitivities obtained by varying diaphragm thickness

ally located in areas far from residential sections, but progressively these areas are built up and complaints of the residents require adequate noise control. Present acceptable daytime sound levels can approach a value of 72-75 db and nighttime levels a value of 60-65 db before complaints will be received.

An engine at 5 feet will develop aprpoximately 160 db sound pressure level at full power. Some engine plants have as many as 50 individual testing cells in operation simultaneously and the sound pressure level is raised to 177 db. Exhaust stack treatment, tunnels, ducts and resonators are used to provide various degrees of attenuation. The cost of providing attenuation is between

(*Continued on page* 144)

this TV set IMPROVES WITH AGE

Five years old next week—and now better than ever. When the original tube wore out it was replaced with a Rauland. Now pictures are brighter, sharper, clearer. Another Rauland success story—your cue to sell *improvement* through *replacement* with Rauland—and chalk up plus business.

THE RAULAND CORPORATION 4245 NORTH KNOX AVENUE
CHICAGO 41, ILLINOIS · MULBERRY 5-5000
ZENITH SUBSIDIARY

Burton-Browne advertising

$500.00 and $1,000.00 per db, and at least 50 db of attenuation at 100 cycles is required. Higher powered engines are being developed and it is anticipated that in the near future the initial noise will be increased by a factor of 5-10 db.

The Altec condenser microphones used for measuring these high noise levels are rated for a maximum sound pressure level of 140, 180, 200 and 220 db. The different sensitivities are obtained by varying the thickness of the diaphragm. Fig. 5 is a photograph of the microphone.

In propeller-driven, military aircraft, the noise level at the pilot's position is 115 db as a maximum. While this is not immediately traumatic, prolonged exposure may result in permanent loss of hearing in the frequency range of 3 to 6 KC. In the case of jet engine noise at the pilot's position, experience at this time is insufficient to indicate the magnitude of the loss of hearing, but it would probably be somewhat less than in propeller-driven aircraft.

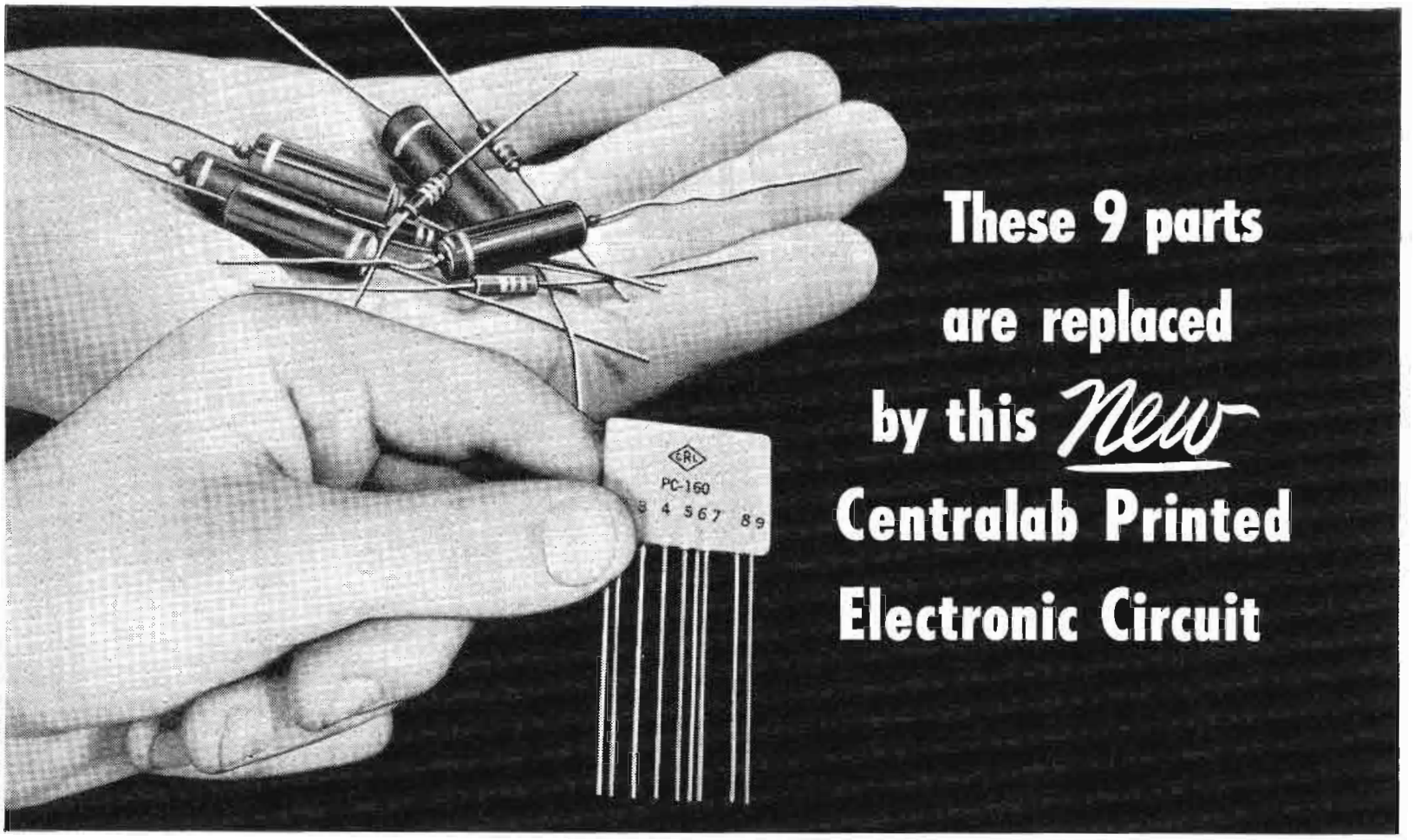
Aircraft Sound Problems

Plane handlers, ground crew or flight deck personnel are subjected to noise levels ranging up to at least 150 db. This indicates immediate need for protective devices which will attenuate sound levels at least to semi-comfort level. This varies with individuals. However, it is physically impossible to attenuate sounds reaching the middle ear mechanism more than 30 to 35 db. This is due to the vibration reaching the middle ear by bone conduction. There is some observational evidence that the sonic frequencies present in jet aircraft noise have some effect physiologically which has been demonstrated as an effect on muscle tonus. 160 db sound pressure level is equal to 1 watt/sq. cm. A person when exposed to such a pressure will experience effects of intense heat generation. As an example, the burning sensation felt between the interface surfaces of the fingers.

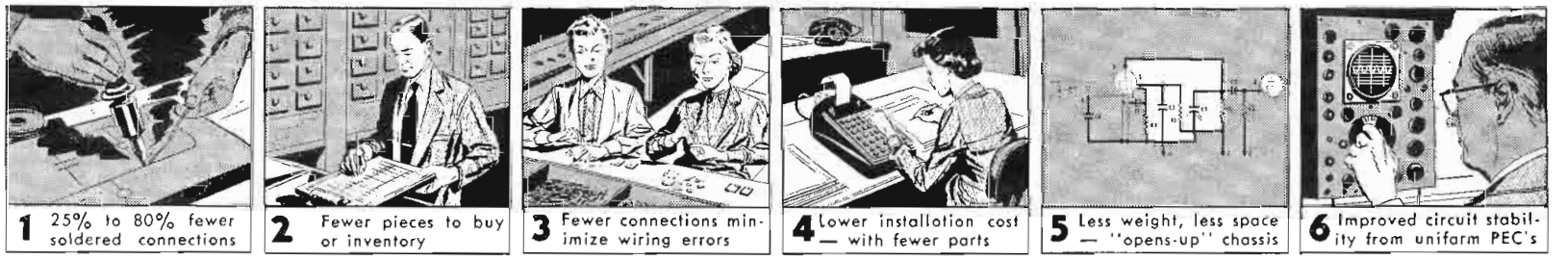
Noise levels are probably approaching a point where the present protective devices are completely inadequate, and it may be impossible to design protective devices which will not hinder the performance of the worker.

To summarize, it is indicated that sound pressure levels will gradually increase with larger engines, and even today there is no adequate protection for personnel. This is particularly true of operations in the limited space available on the flight

(*Continued on page* 146)



For scores of applications — Centralab Printed Electronic Circuits assure 6 tremendous SAVINGS in design, production and performance



ANY way you look at them, Centralab Printed Electronic Circuits mean more money in your pocket. No other modern electronic development offers you *six* such tremendous time and cost-saving advantages for low-power applications.

Pioneered and completely developed by Centralab, these resistor-capacitor combinations in complete or partial circuits are extremely economical to use. Many times, the *first cost of PEC's* is less than the components they replace.

As for versatility — there are more than 30 standard circuits already tooled for you. There is a tremendously wide range of sizes and capacities available to you.

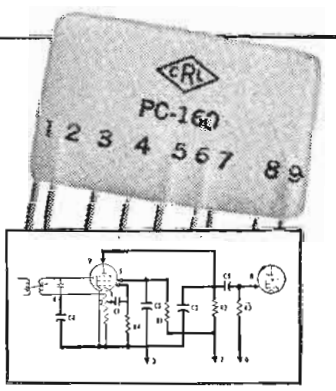
If you have a special circuit problem, we'll even design custom plates at nominal cost where volume warrants. *No wonder 25,000,000 PEC's are in use today!* No wonder scores of manufacturers say it's *good business* to specify and use Centralab Printed Electronic Circuits. Send coupon for full details.

Another Centralab first!
NEW PENDET

— a complete pentode detector and audio coupler circuit that replaces 9 parts . . . eliminates 9 soldered connections.

Talk about compactness—this new Pendet really has it! You get 4 resistors and 5 capacitors screened and fired to a *single* Ceramic-X plate. It replaces 9 conventional components. Only 9 connections are required instead of the usual 18.

Think what this terrific PEC "package" can do in simplifying installation and cutting manufacturing costs of ac, dc and portable receivers. Get complete information on this new PC-160 Pendet NOW. Check No. 42-149 in coupon.



Pendet couples the combination detector and first audio pentode tube to the audio output tube. Plate is only 1-5/16" x 7/8" x 11/64" thick. Leads are 2-1/2" long. Capacitors are 450 vdcw, 800 vdc test. Resistors are 1/5 watt.

Centralab

A Division of Globe-Union Inc.
Milwaukee 1, Wisconsin
In Canada, 635 Queen Street East, Toronto, Ontario

CENTRALAB, A Division of Globe-Union Inc.
938-H E. Keefe Ave., Milwaukee 1, Wisconsin

Please send the following bulletins: ☐ 42-149, ☐ PEC guide No. 2. I'd also like a copy of Centralab's new Electronic Components Catalog No. 28.

Name.....Position.....

Company.....

Address.....

City.....State.....

deck of aircraft carriers. In military situations on the flight deck of aircraft carriers. In military situations where communication is vital, the limit is fast being reached where the noise level makes any auditory communication impossible.

The intense noise levels are not only apparent in aircraft operations but in other phases of the military as well, such as helicopters, tanks, certain places in ships, submarines, rapid fire high calibre anti-aircraft, etc.

Some authoritative opinions seem to feel that a good portion of medical research should go into the continued study of acoustic trauma. These studies would be greatly implemented by including an electronic-acoustical engineer as a member of the staff.

Sea Rescue Radio

A new emergency-type portable lifeboat radio, so designed and constructed that even a person without any knowledge of radio can operate it, has been developed by the Marine Div. of Mackay Radio and Telegraph Co., an IT & T associate.

Geared to the needs of marine-disaster survivors, the transmitter-receiver operates on International Distress frequencies in the 500-KC and 8364-KC bands. A special device takes over the moment the set is placed in automatic operation and transmits alternate signals on both 500- and 8364-KC. searching vessels use these signals to pinpoint the location of the lifeboat by means of direction finders. The equipment may also be operated manually by an experienced radio operator for transmission and reception of messages on either frequency.

Self-contained lifeboat transmitter-receiver expedites rescue at sea, and provides facilities for sending and receiving SOS on two bands

The unit incorporates a two-band receiver and a built-in, hand-cranked generator that eliminates the need for storage batteries. The entire unit, weighing only 56 pounds, will float if dropped into the water.

Under present FCC regulations, it is reported that most ocean-going cargo vessels of 500 gross tons or more will be required to carry this type of emergency equipment after Nov. 19, 1953.

RAYTHEON

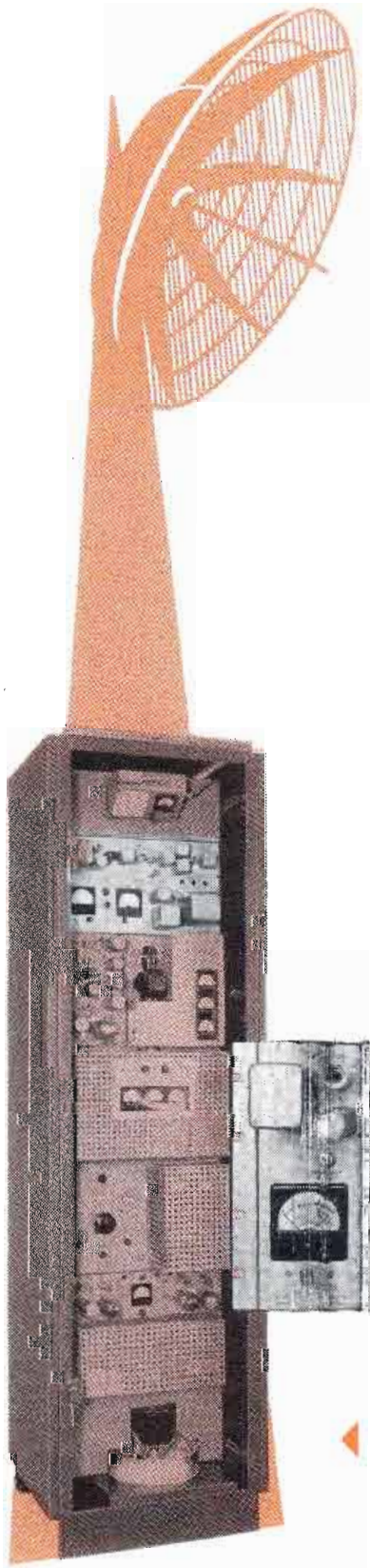
first again with the finest in television microwave

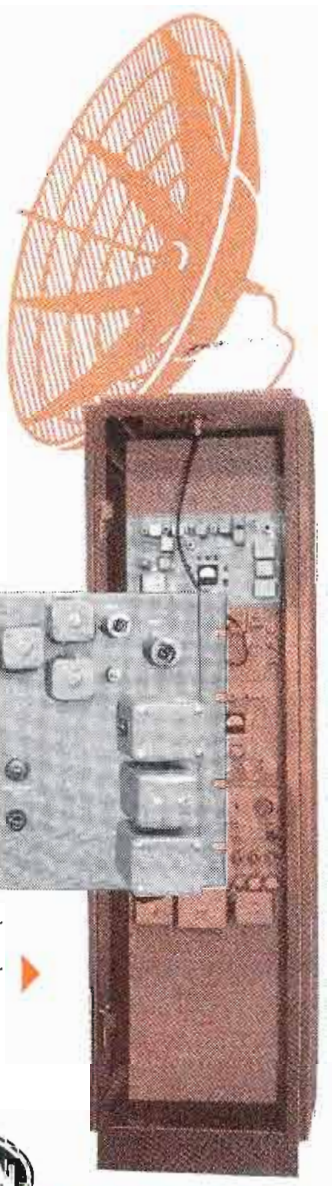
Magnalink 2000 mc

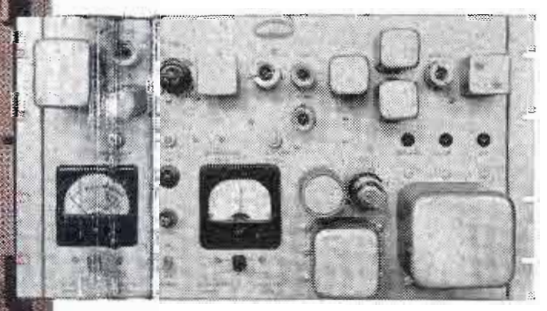
now *meets full FCC specifications for STL*

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

The first multiplexed audio-video equipment to meet full FCC specifications for STL, Raytheon Magnalink, because of its high power, also permits flexibility through the use of 100 ft. of RG-14U for normal applications, difficult remotes or STL. Combinations of RG-14U and ⅞″ coax may be used for greater height between the equipment, housed indoors, and the parabola (no limitations on length of coax at receiver installation). Passive reflectors may be omitted for normal installations, thus eliminating their cost, but may be used where maximum radiated power is required.

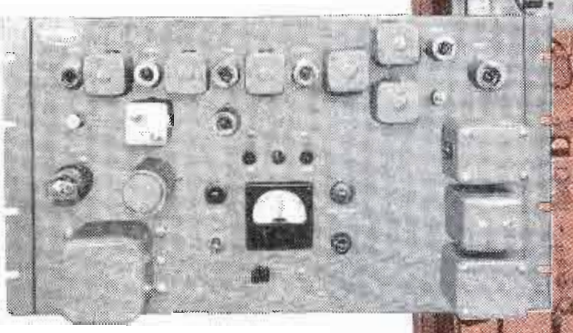






Sound Subcarrier Transmitter

◀ MTR 50 Microwave Transmitter



Sound Subcarrier Receiver

MTR 50 Microwave Receiver ▶

Specifications and FCC Filing Data Available

Write for full information

Magnalink 50 watt power and the superiority of 2000 mc propagation characteristics permit spanning greater distances than previously thought possible. Greater fade protection, simplified all channel field tuning and polarization change merely by rotating feed are but a few of the advantages offered by Raytheon's powerful Magnalink equipment — specifically designed for industry's STL, inter-city and long distance remotes. For the right equipment to fill your microwave requirements, for economy and operating convenience, investigate Raytheon's complete line of microwave equipment.

SPECIALISTS IN MICROWAVE FOR TELEVISION

RAYTHEON®

Excellence in Electronics

RAYTHEON

MANUFACTURING COMPANY

Equipment Sales Division
Dept. 6270 TL
WALTHAM 54, MASSACHUSETTS

Modulation Indicator

(*Continued from page* 103)

indicate small changes about the assigned frequency. This is accomplished by bucking out the current that normally would flow with a 3.5 KC intermediate frequency and using a zero center meter calibrated from —1.5 KC to +1.5 KC deviation. As the transmitted frequency then drifts up or down, the difference frequency increases or decreases and the meter deflects accordingly. To maintain an accurate bucking current, it is obtained from the same constant-current source which is used to generate the pulses supplied to the bridge rectifier. Referring to Fig. 5 again, the bucking current is seen to be given by

$$I_b = I_0 R_1 / (R_1 + R_2)$$

If this bucking current is chosen to be equal to the meter current at some frequency, then

$$I_0 R_1 / (R_1 + R_2) = 2 I_0 RCf$$

From this the frequency at which the meter reads zero is

$$f = R_1 / 2RC (R_1 + R_2)$$

This equation shows that the stability of the intermediate frequency at which the meter reads zero carrier

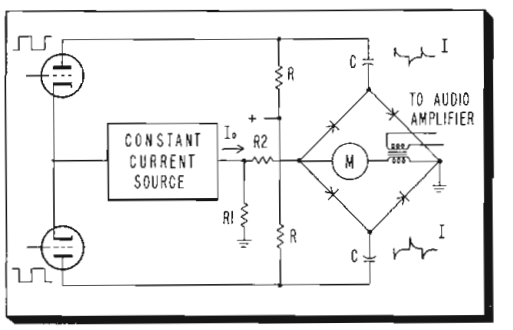


Fig. 6: Aural pulse counting discriminator

deviation does not depend on any tubes, regulated voltages, or tuned circuits, but is solely dependent on a group of resistors and capacitors. The pulse counting discriminator therefore is ideally suited for use in a frequency monitor where accuracy and dependability are of prime importance.

Monitor Aural Section

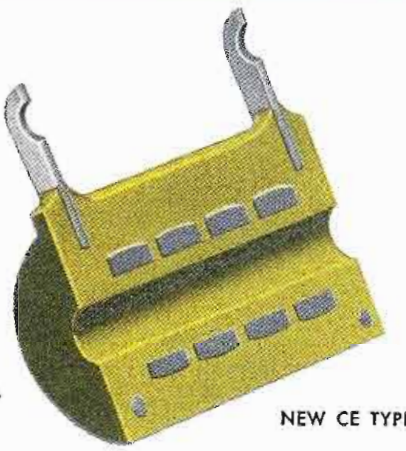
The aural section of the monitor is similar to the visual section, but necessarily somewhat more complex since, in addition to providing an indication of the carrier frequency, it also provides monitoring circuits for the aural modulation.

As in the visual section, the aural transmitter's r-f input is mixed with the multiplied frequency of the reference oscillator. Since mixing with

(*Continued on page* 150)

16 years of experience

. . . and know-how goes into your purchase of a Cinema resistor. . . . . .



NEW CE TYPE

Accurate wire wound resistors in the new Cinema CE type are hermetically sealed to surpass the requirements of MIL R-93A. Investigate the use of the new CE resistor in your applications. Contact your local Cinema Engineering Company factory representative, or write direct today for literature.

IN NEW YORK
Audio & Video Products Corp.
730 Fifth Ave. • PLaza 7-3091

EXPORT AGENTS
Frazar & Hansen, Limited
301 Clay Street
San Francisco, Calif., U.S.A.

CINEMA ENGINEERING CO.
1510 W. VERDUGO AVE, BURBANK, CALIF.

the visual transmitter carrier produced 3.5 KC, mixing with the aural carrier produces 4.5035 MC., because the aural carrier is 4.5 MC above the visual carrier. However, a lower i-f is more convenient when squaring type i-f amplifiers are used, so a second mixer is used to beat the 4.5035 MC signal from the first aural mixer with 4.3535 MC from another internal crystal oscillator. This produces an i-f of 150 KC which includes in full the modulation swing applied to the transmitter.

After being amplified and squared, the i-f is applied to the same type pulse-counting discriminator as before. Because of the broader tolerance on the aural transmitter frequency, this meter is calibrated to indicate from —6 KC to +6 KC deviation.

In addition to operating the aural carrier deviation meter, this discriminator, Fig. 6, also is used to de-

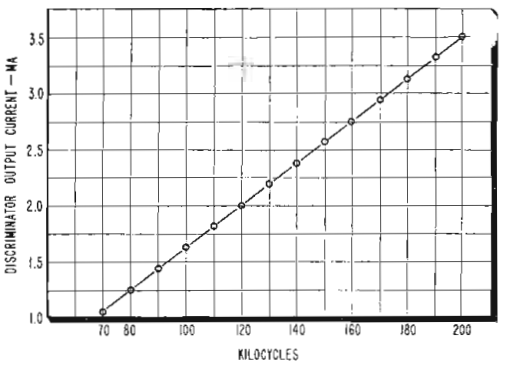


Fig. 7: Response curve of aural discriminator

modulate the FM signal to produce the audio signal for measuring the percent modulation and for monitoring and measuring purposes. To do this, the primary of an audio transformer is connected in series with the meter. This transformer drives an amplifier which is stabilized with feedback through a tertiary winding. Thus the primary presents a very low impedance which has negligible effect on the deviation meter performance.

Although the average frequency of the intermediate frequency is that indicated on the meter, this frequency swings above and below the average at the rate of the aural modulating frequency. This causes the instantaneous d.c. component of the current through the meter and through the transformer to be proportional to the amplitude of the modulation swing, and to vary at the modulating frequency. The high frequency pulses are removed by suitable bypassing across the transformer.

Since the audio output of the aural discriminator is to be used to measure the distortion present in the transmitter output, it is quite important that the discriminator be

(*Continued on page* 152)

HICKOK

Choice of the Experts

Model 650

Universal Video Generator

Hickok, through 42 years of uninterrupted quality production has pioneered and developed numerous well-known electrical and electronic equipments now recognized as standards for the industry.

The newest Hickok contribution is the Model 650 Universal Video Generator. It accurately and rapidly localizes trouble in any stage of a TV receiver. It's use accomplishes in minutes tasks that normally take hours.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10514 Dupont Avenue • Cleveland 8, Ohio

very linear over a range corresponding to the maximum modulation swing of approximately plus and minus forty kilocycles. As discussed before, the pulse-counting type discriminator is inherently very linear. Fig. 7 shows a plot of discriminator output current versus frequency over the full modulation range. With this degree of linearity it is possible to measure distortion as low as ¼% at full 100% modulation.

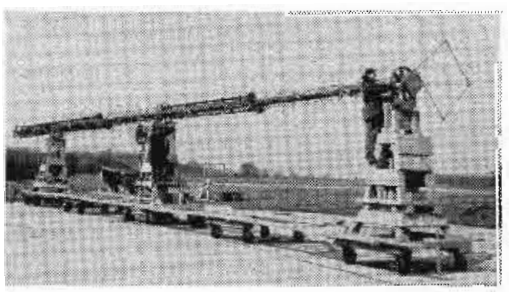
Modulation Indicator

The amplitude of the audio voltage is proportional to the modulation swing. This voltage is amplified and applied to a peak reading voltmeter, calibrated to indicate percent modulation. When the d.c. voltage developed in the voltmeter circuit exceeds a preset level, it triggers a thyratron which flashes a peak modulation indicator. The output of the voltage amplifier is also passed through a standard 75 μ sec de-emphasis network and is available for noise and distortion measurements and program monitoring.

Physical Layout

Since the monitor is in daily use, operating convenience is a very important consideration to operating personnel. The monitor has been designed with this feature particularly in mind. All operating adjustments may be made from the front panel. A five-position front panel switch re-connects the three indicating meters to check proper operation of many of the monitor circuits. Provision is made for the use of remote meters and peak modulation lamp, in addition to those on the front panel. Longer life of components and more stable operation is obtained by using a forced-air cooling system. The entire monitor is built as a single unit 12¼ in. high, occupying a minimum of rack space and providing a small, convenient size for installation and maintenance.

SUPERTURNSTILE ANTENNAS

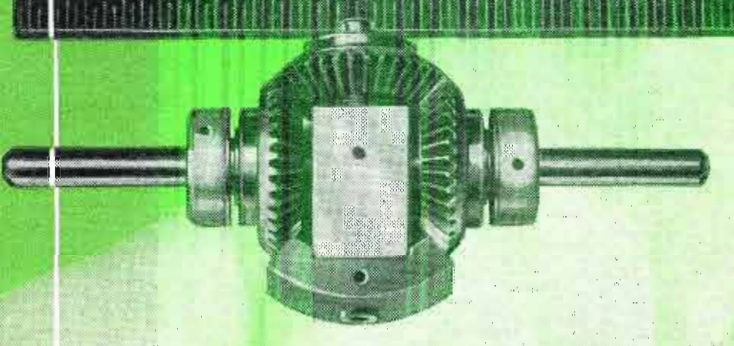


Stations operating in channels 2 to 13 are obtaining deliveries on the new RCA high power superturnstile antennas with 50 kw input ratings requiring 6 or 12 sections. Each section of these turnstiles consists of four radiators mounted at 90° intervals around the pole. A coaxial transmission line feeds the radiator center at low impedance to virtually eliminate the detrimental effects of ice formation.

electronic gearing

Electronic Gears and Gear Drives by

WESTERN GEAR WORKS



Do you have a problem involving the design of gears or gear drives for electronic application? For operation of servo-mechanisms, computors, adjustment of radar or other antenna systems, for auto-tune transmitters? Do you require "just ordinary" gearing or extremely accurate "precision class" gears?

Whatever your need, whatever the type gear or gear train, you will find the engineering assistance and complete facilities available at Western Gear Works. Specialists who know and understand your problems are ready to go to work for you. Your inquiries are invited; write, wire or telephone us now, at Western Gear Works, Executive Offices, Post Office Box 182, Lynwood (Los Angeles County), California, Telephone NEvada 6-2161.

Illustrated are a few typical examples of electronic gearing designed for customer requirements.

Good Gears Since 1888 — 5 Plants to Serve You

Plants — 417 Ninth Ave. S., Seattle 4, Washington
2660 E. Imperial Highway, Lynwood (Los Angeles County), California
1035 Folsom St., San Francisco 3, California
Belmont (San Francisco Peninsula), California
117 N. Palmer St., Houston 3, Texas

Representatives — N. 2605 Division St., Spokane, Washington
930 S. E. Oak St., Portland 14, Oregon
Room 212, Ross Bldg., Denver 2, Colorado
500 South Ervay Street, Dallas, Texas
Engineering & Machinery Ltd., 1366 W. Broadway, Vancouver, B. C.

WESTERN GEAR WORKS

Manufacturers of **PACIFIC-WESTERN** Gear Products

Pacific Gear & Tool Works

Plants: Seattle
San Francisco
Belmont
(S. F. Peninsula)
Lynwood
(Los Angeles County)
Houston

8302

THE ENGINEER

As a Social, Economic & Moral Force*

By HERBERT HOOVER
Former President of the United States

As a profession, engineering has both joys and sorrows.

The engineer has the fascination of watching a figment of his imagination emerge, with the aid of science, to a plan on paper. Then it moves to realization in cement, metal or energy. Then it brings new jobs and homes to men. Then it adds to the security and comfort of these homes. That is the engineer's high privilege among professions.

The engineer, however, does have woes. His work is out in the open where all men can see it. If he makes a mistake, he cannot. like the doctor, bury it in a grave. He cannot, like the architect, obscure it by trees and ivy. He cannot, like the lawyers, blame it on the judge or jury. He cannot, like the politicians, claim his constituents demanded it. Nor can he, like the public official, change the name of it and hope the voter will forget. Unlike the clergyman, he cannot blame it on the devil.

Worse still, if his works do not work, he is damned. That is the phantasmagoria which haunts his nights and dogs his days. He goes to bed wondering where the bugs are which will inevitably appear to jolt his performance. He awakens at night in a cold sweat and puts something on paper that looks silly in the morning.

And the world mostly forgets the name of the engineer who did it. The credit goes to some fellow who used other people's money to pay for it. But the engineer, himself, looks back at the unending stream of goodness that flows from his successes with a satisfaction that few other professions can know.

Engineer as an Economic Force

Most people are not aware of it, but the engineer is also a political, economic, as well as social, force.

I asserted one time that he is the fellow who really dissolves monopolies, redistributes the wealth, and dismantles political platforms. Over our history of men, one generation after another have been elected to office by being sequently "agin" the monopoly of canals, or railroads or anthracite coal or kerosene oil or slums or the utility grabbing of water power. These were no doubt great evils. But I ask you who really remedied these evils? It was the engineer. He upset the canal monopoly with the railways; he upset the railways with the automobile, the airplane and the pipeline. He upset the anthracite monopoly with coke; he upset kerosene oil with the electric light and he assured that

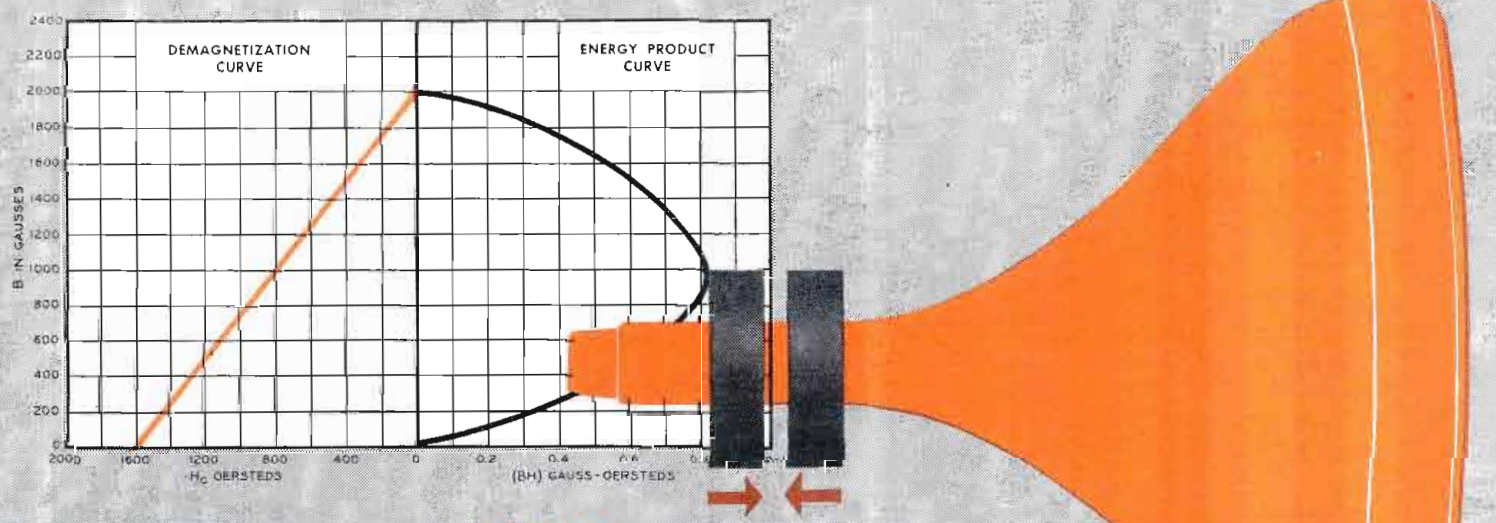
* Mr. Hoover, himself a mining engineer and a native Californian, made these remarks before a recent engineering gathering.

(*Continued on page* 156)

NEW!

MAGNADUR

A NEW PERMANENT MAGNET MATERIAL . . .



. . . AND HERE IS A NEW METHOD OF FOCUSING CATHODE RAY TUBES

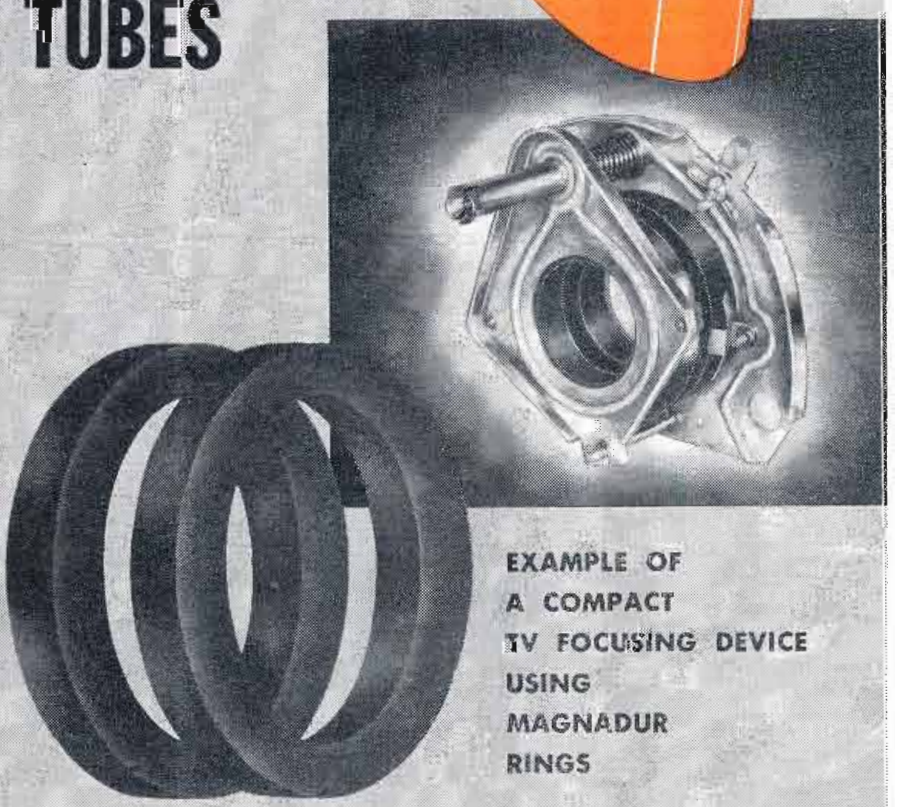
Here is another Ferroxcube "first": a permanent magnet material with outstanding magnetic characteristics—*and no critical materials are involved in its manufacture*. Magnadur's extremely high coercive force and unusually high resistance to demagnetization permit entirely new magnet designs.

Magnadur will be produced in a variety of shapes. Production for the current year is concentrated on Magnadur toroids —developed specifically for TV focusing ring magnets.

Magnadur focus rings provide a real answer to TV focus problems. The double lens system, which is focussed by adjusting the relative position of two toroidal magnets, reduces stray fields to a minimum and provides a highly symmetrical field. Maximum sharpness and spot symmetry are assured.

Technical information will be sent upon request. Ferroxcube engineers are at your service for consultation. We'll be pleased to have you call or write.

SEND FOR BULLETIN



EXAMPLE OF A COMPACT TV FOCUSING DEVICE USING MAGNADUR RINGS

FERROXCUBE CORPORATION OF AMERICA

• *A Joint Affiliate of Sprague Electric Co. and Philips Industries, Managed by Sprague* •

233 EAST BRIDGE STREET • SAUGERTIES, NEW YORK

most of the streams would remain as scenery by making cheaper power with steam. Who makes possible the escape from the slums? It is the engineer with his parkways, his bridges, his satellite towns. Who provided leisure for the housewife to play canasta and attend political meetings? It was the engineer with his household gadgets. Sometime the engineer will be needed to put the truth into propaganda. But I am getting off the track of amiability.

I hardly need add that it was the engineer who distributes the wealth by creation of mass production and his many other devices to reduce costs of production. He brings the prices of a thousand gadgets to the level of everybody's pocketbook. Thus all men become equal before gadgets.

High Ethical Standards

The training of engineers instills character in those who would join its ranks. High ethical standards are the essential of all professions, engineering included. Technology without intellectual honesty does not work. These are the reasons you have seen no engineers before the Kefauver Committee. Nor in the headlines which these days pour forth from Grand Juries and District Attorneys' offices. The engineers merit only to sit on juries.

And now after all this exposition surely you will agree that the engineer is an antidote to evil and the bearer of blessings. I hope you will also agree that he is worthy of your attention.

But here we meet a great national problem. We do not have enough engineering teachers and we do not have enough students to carry on the nation's work. And we do not have enough research facilities to assure the needed flow of new inventions and improvements.

Our engineering graduates have dropped from 50,000 in 1950 to 38,000 last year. We need 60,000 a year to supply national needs.

And may I depart from our immediate purpose to make a suggestion? One reason for this drop is that a young mechanic with three years of training, during which he is paid, can earn more take-home pay after taxes than a young engineer with six years of training and three years more of experience. Too often the financing of such training is too expensive for his Dad. Could not more "somebodies" give more scholarships to needy boys who are willing to put in nine years with little reward?

Laboratories Needed

But to return to our mission here, you are proposing not only an aid to education but also to research.

The job of the engineer is to take the discoveries of pure science and convert them into use for the good of mankind. To this end he needs laboratories.

At one time we got our inventions

(*Continued on page* 158)

Technical House Organ

"Applied Mechanics" is a new technical house organ published by The Indiana Steel Products Co., Valparaiso, Ind., producers of permanent magnets. The magazine is sent without charge to scientists, engineers, technicians and others interested in the use of these products. The purpose of the publication is to assist engineers in the design and application of permanent magnets in electronics, radio, sound equipment, instruments, control equipment, generators and motors, etc.

Safety Films Directory

The 1953-54 edition of the National Directory of Safety Films just published by the National Safety Council lists 963 motion pictures and slide films. All agencies known to the Council were consulted in an effort to make the directory as complete as possible in first aid, fire prevention, and civil defense. Supplements will be published quarterly. Copies are available at 75 cents each from the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

Two Transformer Companies Merge

Addison Holton, president of Essex Wire Corp., recently announced the consolidation of Chicago Transformer Div. of Essex Wire with Standard Transformer Corporation, Chicago. Both Companies have been tranformer manufacturers for years.

The consolidation will be known as Chicago Standard Transformer Corporation. Mr. Holton is president; Arni Heggason, vice president; J. J. Kahn, vice president; L. S. Racine, vice president; W. F. Probst, secretary; M. A. Roesler, treasurer.

Lady Engineer Heads Printed Circuit Project

Miss E'lise Harmon, an outstanding physicist, heads printed circuit activities of Aerovox Corp. in New Bedford, Mass. She was previously employed at NBS, Naval Research and Army Ordnance. Project is in pilot production stage

The Engineer

(*Continued from page* 156)

from the genius in the garret. Poverty, however, does not clarify thought. Nor does it provide a laboratory. Bread and butter diet has been discarded as the mother of invention. Today these gifts come from long years of organized search and experiment. Therefrom like the cell-by-cell growth of plants, fact builds upon fact until there comes forth the blossom of discovery, the illuminating hypotheses or the great generalization. And finally it finds fruition of a multitude of inventions and improvements in living. And it increases the power of a people to pay government debts.

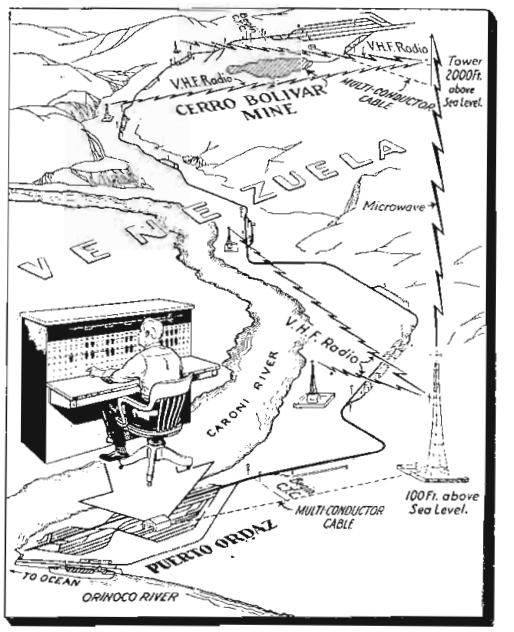
This reminds me that there is one road to rapid recovery of the nation from our present burden of rearmament. That is to increase our productive power by new technologies and new inventions.

And there are spiritual consequences of research. From them comes the unfolding of beauty, the ever-widening boundaries of thought. Here is the invocation of veracity of thought in a world sodden with intellectual dishonesty. From its discoveries comes the lifting of men's minds beyond the depressing incidents of the day. Here is confirmation of a Supreme Guidance in the Universe, far above man himself.

Today the nation needs more and more research and more and more engineers.

Microwave Control of R.R. Switches, Signals

Before long microwave channels will be "working on the railroad," too. After conclusive tests made by Union Switch & Signal division of Westinghouse Air Brake Co. in cooperation with Radio Corp. of America, Western Union, and The Pennsylvania R. R., a system for remotely controlling switches, signals, and interlockings will be applied on the 90-mile railroad con-



Soon the operator seated at the Union Switch and Signal control panel in the Orinoco Mining Co. yards in Venezuela will be able to control traffic movements over the entire 90-mile company railroad, merely by pushing buttons

structed in Venezuela by the Orinoco Mining Co., U.S. Steel subsidiary.

It is expected that the project will materially reduce operating problems encountered in moving ore from the company's Cerro Bolivar 400-million-ton mine reserve to the Puerto Ordaz terminal. Through use of the US&S centralized traffic control and special RCA transmitters and receivers, single-track, two-way traffic will be governed by VHF radio waves transmitted from Puerto Ordaz. Code indications sent through a multi-conductor cable to the large lower righthand tower in the illustration will control the passing sidings nearest the port. There, modulated to VHF radio waves, the indications will be transmitted to the towers and equipment at the two sidings.

Indications to govern the mine sidings and yard will be sent to the lower tower and modulated to activate the microwave channel to the large tower in the upper righthand corner of the illustration. And, after demodulation, they will be transmitted to the electronic equipment at the siding and yard. All six towers will be equipped with transmitters and receivers, and the switches and signals will be electronically controlled.

Better Storage Battery Cap

R. F. Sadler, president of Industrial Research Inc., recently announced the availability of the "Hydrocap" storage battery cap—the result of an intensive, four-year research and development program in the electronic laboratories of the University of Miami.

Heart of the new battery cap is its built-in palladium catalyst which captures 95% of any escaping water and keeps the battery filled at safe level 8 times longer than has been possible. Under normal conditions escaping hydrogen and oxygen are responsible for 80% the liquid loss of a battery. The new cap captures corrosive sulphuric fumes which keeps the battery acidity at proper efficiency and thus protects cables, holders, wiring, and terminals from corrosion. The result is fewer short circuits and less power failure. Prolonged over-charge boils battery water, corrodes grids, and destroys storage ability. Normally, the new caps operate warm to the touch. If they become hot about 200° F., the voltage regulator of the car in which they are installed needs adjustment. Heeding this warning can eliminate 60% of the battery failures, it is claimed.

"Scotch" Price Reductions

Prices have been cut 7 to 22% on two types of "Scotch" sound recording tape —Nos. 101 and 111 in 300, 2,400, and 4,800 foot lengths. Prices also were reduced for most empty tape boxes and combination empty tape boxes and reels for these tape lengths. "Scotch" leader and timing tape No. 43 in 150 in. lengths was increased from 50 to 60 cents. Other line prices are unchanged.

UNITIZED ASSEMBLY LINES

This information was prepared by Dr. Cledo Brunetti while Associate Director of the Stanford Research Institute. Dr. Brunetti is presently Director of Engineering Research and Development at General Mills, Inc.

Over the past decade, industry has been watching in a mildly interested but wary manner the development of mechanized methods of producing electronic circuits. Dozens of laboratories have engaged in investigating various processes for applying circuits and components to various types of surfaces in an effort to cut costs, reduce rejects, and achieve other desired advantages. While progress was achieved, many of these investigations played out. All too often a mechanized technique has been applied to a portion of the electronic circuit which constituted a very small part of the complete equipment.

Some laboratories have boldly attempted to carry the automatizing of the manufacturing process to the assembling of a complete equipment or the principal parts of an equipment. This would have led to a worthwhile achievement were not the advantages to be gained by automatizing jeopardized by insistence of the designers in utilizing a specific printing or other automatic applicating technique either developed in their laboratories.

A practical answer to mechanization is provided by L. K. Lee, head of the Advanced Techniques Lab. at Stanford Research Institute, who has introduced into electronic assembly a concept of unitized automatic production lines which merits attention. He envisages a mechanized electronic production line made up as a series of integrated versatile production machines. The machines are considered as functional building blocks for the line. This is in fact an extension of unitization employed in the design of electronic equipment itself.

Under Lee's concept each of the machines in a line has a certain function in producing the complete electronic equipment. For example, one machine can provide base plates. These are fed to the second machine which applies conductors. The third machine applies resistors, etc. The term "machine" need not imply a complex and expensive mechanism. In some cases it might be a simple hopper feed and a means for stapling a component onto the base plate.

Consider assembling the resistors to the circuit. When the resistors are to meet rigid specification, possible only with prefabricated components, an immediate solution is to hopper feed and staple the resistor into the circuit followed by soldering the terminals. If wider tolerances are possible, this particular block of the assembly line can be a spray gun or a stencilling unit applying resistor material to the circuit on the plate. As the art advances to the point where the resistors may be sprayed or stamped on to the plate with materials and methods that meet rigid specifications, a machine to do this can be substituted for the old machine without seriously affecting the remainder of the line.

Rather than adapt a machine to the component being manufactured, often the design of the component can be changed to adapt it to the machine. Neither the product design nor the fabrication process must be held inviolate. Some redesign of each is necessary in order to make automatic production economically feasible. The proper approach to mechanization is to think of an equipment in terms of the function it is to perform and design that equipment physically so that it is adaptable

(*Continued on page* 162)

Traveling Ticket Offices

West Coast transportation buyers were recently introduced to the traveling ticket office by Trans World Airlines. The company's purpose in inaugurating this new service is to promote the conveniences of TWA's 30,000-mile system of national and international air routes among the industrial workers and suburban travelers in the expanding environs of Los Angeles and San Francisco.

Two one-ton trucks, decorated in the familiar Super Constellation grey and white, are equipped to sell transportation and confirm reservations to any part of the world when a special panel is converted into an outside ticket counter. Each mobile office contains a public address system that incorporates a wide-angle University loudspeaker of the latest Cobreflex design. Model H-623 Bogen amplifiers facilitate broadcasting announcements and advertising —even classical music.

The units are also equipped with a radio-telephone for verifying world-

TWA ticket agent uses radio telephone to confirm reservations inside mobile ticket office

reservations, a hold-up proof cash compartment and safe, a comfortable seat for the agent, and an upholstered bench for customers. By processing passengers at the time of ticket purchase, TWA officials expect to save time and avoid confusion at the airport at plane departure time.

Of course he's using Soundcraft Recording Tape

...it's micro-polished*

Perfect reproduction — that's the reason why more and more engineers today demand Soundcraft Professional Recording Tape.

Soundcraft is the only professional tape that is Micro-Polished. The only tape that is polished, buffed and re-polished by a special process to produce a surface that is mirror-smooth, completely free of even the most minute irregularity. The results of Micro-Polishing are apparent to any sound engineer:

Lower distortion
Uniformity of output
Improved high frequency response
Better head contact
Less friction, longer head life

Soundcraft Professional Recording Tape incorporates all the features developed by Soundcraft research engineers during the last two years: **pre-coating** to insure better adhesion, prevent curling and cupping — **dry lubrication** to eliminate squeals. The 7″ reel has the 2¾″ hub, eliminating torque problems and resulting in better timing. All this, plus a splice-free guarantee on all 1200′ and 2500′ reels.

Why settle for less than the best? Next time, insist on Soundcraft Professional Recording Tape. It's Micro-Polished!

REEVES SOUNDCRAFT CORP.

*PATENT APPLIED FOR

WRITE FOR FREE INFORMATION

10 East 52nd Street, Dept. P-8, N. Y. 22, N. Y.

to automatic production. An automatic production line can be made up of a combination of functional machine units, such that a change of product would only require rearranging the units to form a new line. Some changes in dies and fixtures and materials-handling equipment may be required.

The approach taken must be determined as much by economic factors as by technical feasibility. Previous attempts to automatize the fabrication of electronic equipment such as by the Sargrove machine in England, failed to recognize the seriousness of the economic factors. Hence, this highly specialized machine which could turn out a two tube broadcast receiver by the tens of thousands had to be dismantled when the market for this particular product disappeared. The machine had become an economic liability due to its inflexibility.

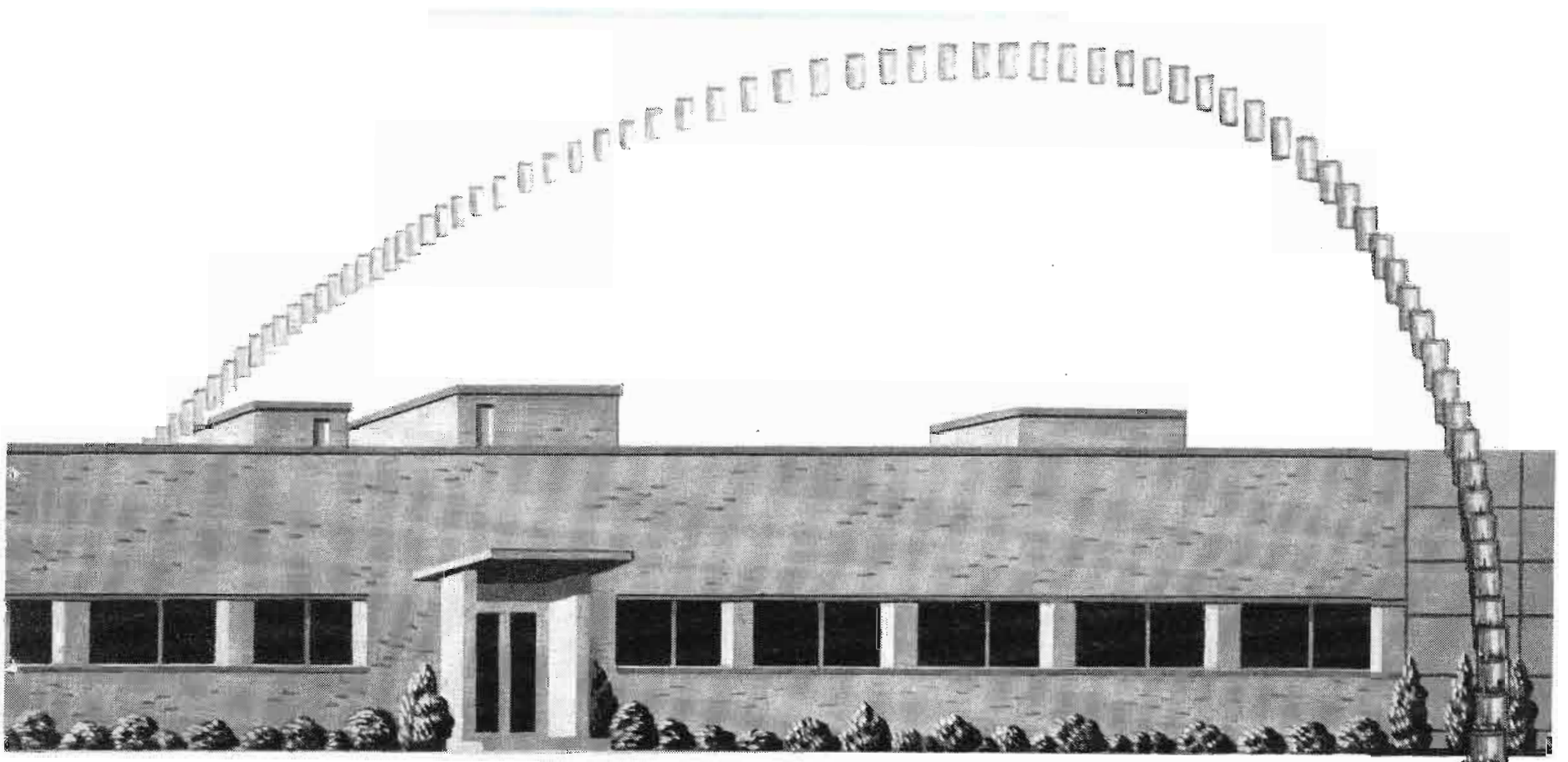
Production Line

Advantages of synthesizing a production line by the use of versatile production machinery with automatic materials handling equipment include:

1. A line made up of a series of individual machines, rather than a single specialized automatic machine doing the whole job is less expensive.
2. The individual units are simpler and because of flexibility can be mass produced and sold to equipment manufacturers.
3. As the art improves, new units can be substituted or the individual units rearranged with the necessary additions and deletions (a single machine for inserting a fixed component such as a resistor can be replaced by a machine applying printed resistods).
4. The individual units will have longer life, due to flexibility and less obsolescence than a single specialized automatic machine.
5. A combination of such units will be more economical to use for the automatic production of smaller runs.
6. In most operations machines can work to closer tolerances than human beings.
7. They make few mistakes, hence require less inspection.
8. They operate around the clock.
9. They release otherwise applicable manpower.

The electronic industry which amounts to around a $5 billion annual business and employs close to 400,000 workers is far from having reached its peak. The advent of electronic computers as information handling machines in business, the transistor with its attendant opening of the field of factory controls to electronics, the unfreezing of TV, and many other developments presage a large increase in demand for electronic equipment.

It is impractical to meet this expansion by an equivalent increase of working population. Automatic assembly is the indicated solution for it can also bring increased speed of production, reduced costs, improved quality and many other advantages.



SUPERIOR PERFORMANCE CHARACTERISTICS
RELIABILITY ACTUALLY INCREASED

- temperature compensated
- hermetically sealed
- fast starting
- high resonant frequency
- unusually insensitive to shock and vibration

CHARACTERISTICS

Range	420 degrees/sec.	40 degrees/sec.
Resolution	better than 0.05 degrees/sec.	better than 0.005 degrees/sec.
Linearity	approximately 0.1%	
Sensitivity	5.6 volts RMS AC output at 420 degrees/sec.	5.6 volts RMS AC output at 40 degrees/sec.
Resonant Frequency	85 CPS	30 CPS
Nominal Damping	0.5 critical	0.5 critical
Motor Excitation	6.3 volts, 400 cycles, 2 phase, 3 watts 26.0 volts, 400 cycles, 2 phase, 4 watts	
Pickoff Excitation	6.3 volts, 400 cycle	
Starting Time	15 seconds	
Max. Operating Linear Acceleration	60 G any axis	20 G any axis

ENVIRONMENTAL CONDITIONS

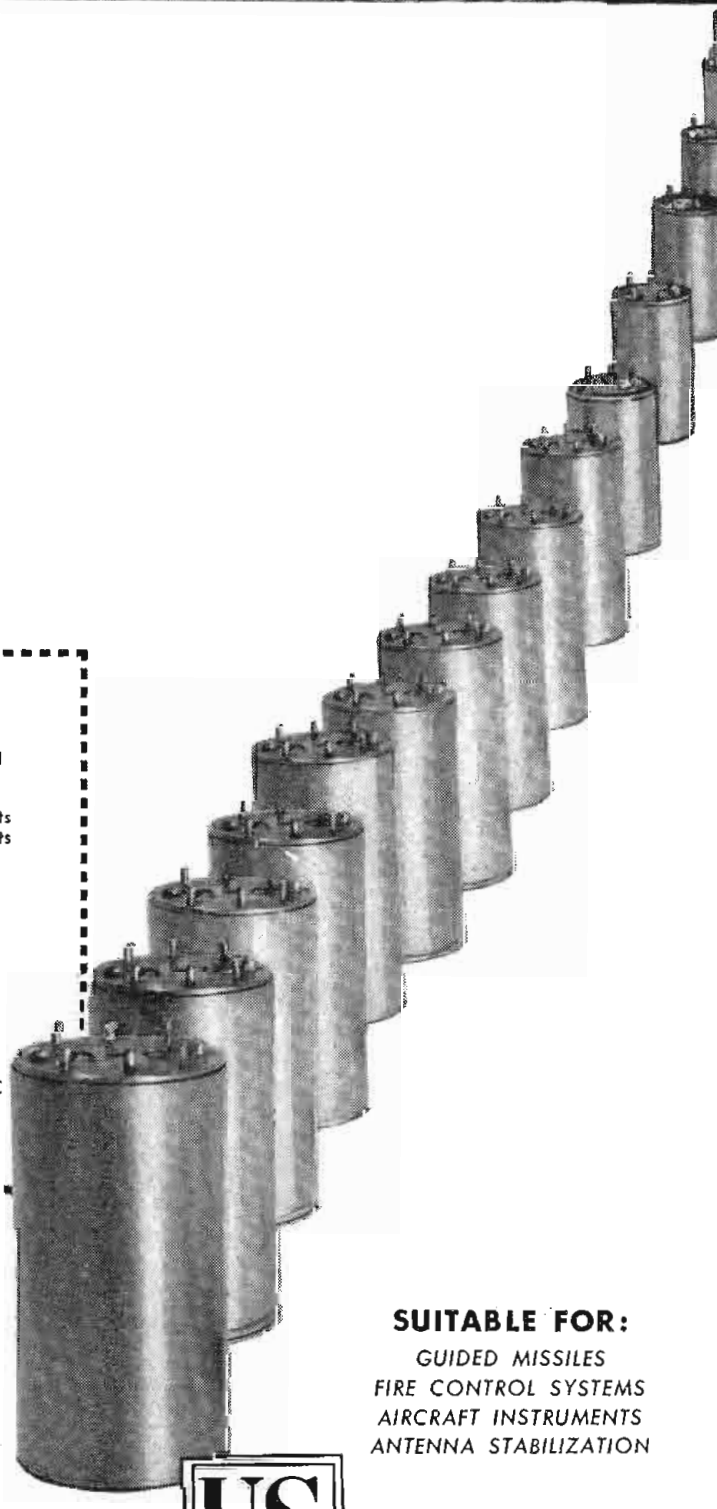
Altitude — 0-60,000 feet
Temperature Operating Range — −55C to 85C
Max. Survival Shock Acceleration — 1000 G any axis
Tested Operating Life — over 1000 hours
Max. Vibration (0-300 CPS)...5 G any axis

VARIATIONS IN DESIGN POSSIBLE TO MEET SPECIFIC REQUIREMENTS
INQUIRIES INVITED. Write to Dept. E

The United States Time Corporation

500 FIFTH AVENUE, NEW YORK 36, N. Y.

Main Plant — Middlebury, Connecticut
Other Plants — Waterbury, Connecticut; Little Rock, Arkansas, Abilene, Tex., Dundee, Scotland



ACTUAL SIZE

SUITABLE FOR:
GUIDED MISSILES
FIRE CONTROL SYSTEMS
AIRCRAFT INSTRUMENTS
ANTENNA STABILIZATION

US TIME

LETTERS

(*Continued from page 8*)

and particularly of the advertising that may be emitted.

Sometime within the next three months the Government will issue what is termed a 'white paper' which it is expected will state quite definitely exactly what may or may not be done. The five conditions under which the new stations may be established already have been set forth. They are:

1—The number of stations under any one ownership or control would be limited.

2—The number of stations licensed at first would not be large and they would be of low power and limited range.

3—A controlling body would advise the Postmaster-General on the issue of licenses and would see that programmes conform to standards laid down. It would have power to call for a script before presentation, to warn a station which had offended, and to recommend the suspension of a license.

4—The owner and operator of a station, whose license would be at stake, and not the provider of programmes or the sponsor, would be responsible for broadcasts.

5—The license or the controlling body might specify the maximum number of hours the station should operate, any restrictions on the advertising of products and the time and place to be allotted to advertising matter in any programme.

41 to 66 MC; Later UHF

The British draw a well defined distinction between 'Commercial' and 'Sponsored' television. It is stated that in the case of a 'Commercial' station the operator of the station must assume complete responsibility for everything that is Broadcast. In a 'Sponsored' broadcast on the other hand it is the advertiser who must assume responsibility for the character of the broadcast as well as the advertising that it may include.

The present B.B.C. television transmitters all operate in the band of frequencies between 41 and 66 megacycles. Although, as stated, nothing has been decided yet regarding what part of the spectrum will be allocated to the new commercial stations, B.B.C. engineers assume that it will be necessary to go into the ultra high frequency bands. Under these circumstances, which appear almost inevitable, it will be necessary for manufacturers to produce adapters so that existing receivers may cover all frequencies in use. Such adapters, it is estimated, will cost in the neighbourhood of $28 to $32.

STANLEY P. MCMINN

St. Ermin's Hotel
Westminster, London S.W.I.
July 3, 1953

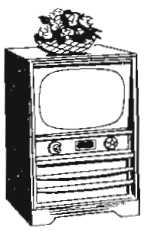
Editors' Note: Mr. McMinn's name will be very familiar to many of the readers of this magazine, since he served for a number of years as Managing Editor of Tele-Tech and of its predecessor Electronic Industries. He resigned much to the re-

PROGRESS REPORT

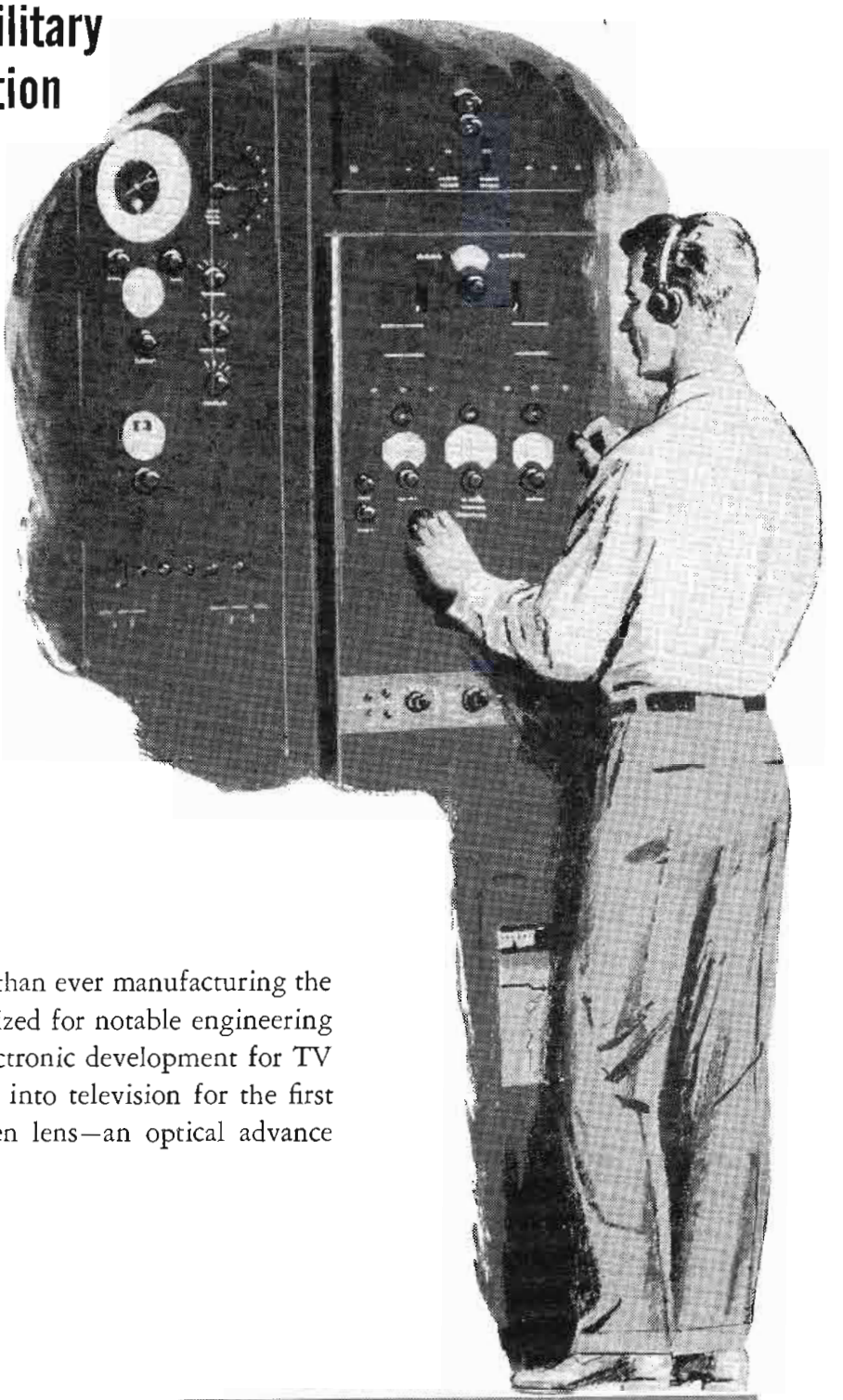
FROM A WESTERN LEADER IN ELECTRONICS

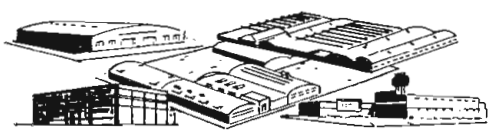
now expanding in both military and commercial production

ELECTRONICS FOR DEFENSE. Today at Hoffman, we are actively engaged in the design, development and large-scale production of precision electronics for all the armed forces. Current assignments include: communication receivers and transmitters, air-sea rescue transceivers, radar, sonar and fire-control equipment. And our new Commercial Division is now readying a full line of products for the civilian market.



HOFFMAN EASY-VISION* TELEVISION. We're busier than ever manufacturing the West's most popular TV receiver. Hoffman is recognized for notable engineering "firsts" in television. Example: Hoffman's newest electronic development for TV —Trio·phonic Hi-Fi—high-fidelity sound engineered into television for the first time. Also, the famed Hoffman Easy-Vision* golden lens—an optical advance increasing the pleasure of prolonged viewing.





GROWTH BASED ON PERFORMANCE. The proved quality of Hoffman products, both military and civilian, explains why Hoffman is a western leader in electronics—a company employing 3,500 people, among them nearly 500 top-level engineers, in its seven modern plants in Southern California and Kansas City. In size and sales, facilities and abilities, Hoffman is now at the highest point in its history.

Hoffman

RADIO CORPORATION

Easy-Vision* Television
Electronics for Defense

LOS ANGELES • KANSAS CITY

**Trademark*

LETTERS

gret of the publishers, to go into the commercial radio business in Florida, but has now again taken up his residence in New York City at 460 W. 24th St.

National Selenium Situation

Editors, Tele-Tech:

As you will note from the enclosed letter we are trying a new method of reclaiming selenium from defective rectifiers. We shall appreciate it if you will publish this information in your magazine, either in its entirety or parts.

Your cooperation in this matter will benefit the electronic industry and help us to give better service this fall.

Sarkes Tarzian, Inc.
Rectifier Division

G. EANNARINO
Director

Letter addressed to Mr. Karl Hassell, Zenith Radio Corp., 6001 Dickens Ave., Chicago 39, Ill. states:

"We wish to advise that yesterday we had a day-long meeting with Joe Abeles of the Kawecki Chemical Company and he informs us that the supply of selenium removed from the ground in 1953 will be no greater than in 1952.

Since fall requirements for rectifiers of all types will increase the present consumption rate we realize that something must be done to add to the available supply. We have reason to believe that approximately 4,000,000 pounds of selenium are available in the form of defective out of warranty selenium rectifiers that are now in scrap piles of manufacturer and distributor service shops. We are willing to buy reject rectifiers, regardless of make, in order that we might reclaim the 10% weight, selenium contained in the scrap. The payment will be in the form of credit issued against future purchases.

We will allow 2½ cents on each rectifier rated at 150 milliamperes or less and 5 cents each on rectifiers rated at 200 milliamperes or more. Transportation charges by the cheapest way will be allowed on shipments of 50 pounds or more.

Your cooperation in helping us to get the defective rectifiers will benefit the electronic industry and help us to give you better service during the fall rush."

Color-TV Detail in Red, Blue & Green

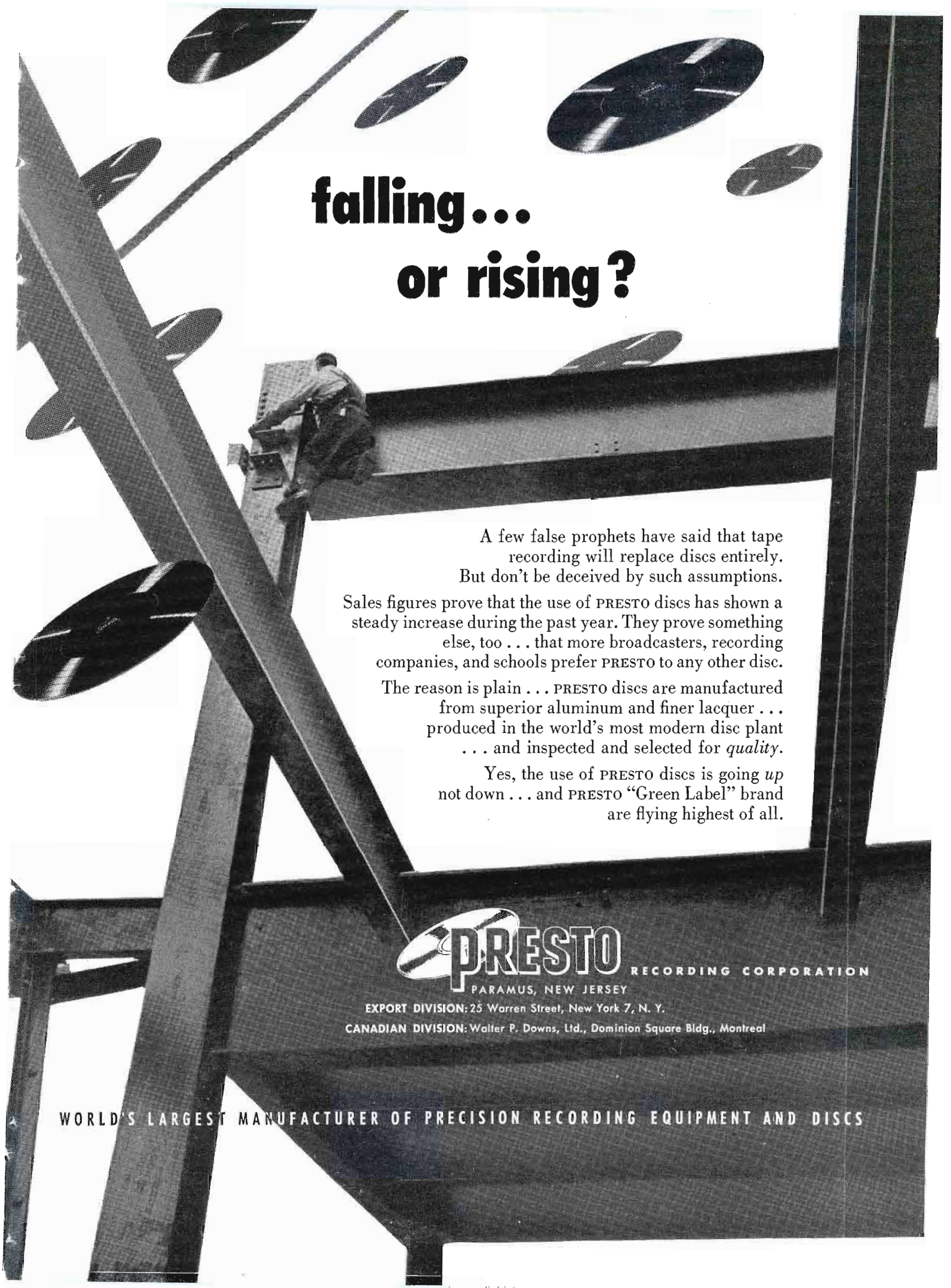
Editors, TELE TECH:

Our laboratory is doing development work in color television, so we were very much interested in the portion of your article in the April, 1953 issue of Teletech concerning color-TV research.

The notion that equal detail in the three primary colors is not necessary for a satisfactory picture, is of interest to us. You mention that the bandwidth of some of the colors can be reduced; for instance red detail can be reduced to 2/5 of the green detail, and the blue reduced to 1/5 of the green detail. Why do you choose to transmit most of the detail in the green? Transmitting most of the detail in the red might offer some advantage to our Chromatron reproduction but we wish to know more about the reason one can choose green to carry most of the detail.

J. M. ROSENBURG
Chromatic Laboratories,
West Coast Development Div.,
703 37th Ave., Oakland, Calif.

EDITORS' NOTE: Before replying to your letter we have taken time to search for published articles on the amount of bandwidth reduction allowable in color television before observable detail is affected. We have not found any reports of fundamental studies. However to our knowledge R. D.



falling... or rising?

A few false prophets have said that tape recording will replace discs entirely. But don't be deceived by such assumptions.

Sales figures prove that the use of PRESTO discs has shown a steady increase during the past year. They prove something else, too . . . that more broadcasters, recording companies, and schools prefer PRESTO to any other disc.

The reason is plain . . . PRESTO discs are manufactured from superior aluminum and finer lacquer . . . produced in the world's most modern disc plant . . . and inspected and selected for *quality*.

Yes, the use of PRESTO discs is going *up* not down . . . and PRESTO "Green Label" brand are flying highest of all.

PRESTO RECORDING CORPORATION

PARAMUS, NEW JERSEY

EXPORT DIVISION: 25 Warren Street, New York 7, N. Y.

CANADIAN DIVISION: Walter P. Downs, Ltd., Dominion Square Bldg., Montreal

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS

Kell, RCA Labs., Princeton, N. J., was the first to announce this helpful fact of band reduction.

In describing his simultaneous color system he mentions on page 861, Proceedings I.R.E., Sept. 1947, that a 4.5-mc channel is used for green and for red, but the channel width can be cut to 1.3 mc for blue without reducing the quality of the color picture.

The article in TELE-TECH for April, 1953, to which you refer, mentioned the reduction in channel width which work at the Bell Labs. indicated was possible. We have been unable to find any published articles by Bell Labs. to supplement these statements made on the witness stand in an FCC hearing by Mr. W. H. Doherty, Director, Electronic & Television Research, Bell Labs. Inc., Murray Hill, N. J. We suggest that you write directly to him for more information, also to Mr. Kell at RCA Labs.

You ask why green is the color in which maximum detail is transmitted. We believe this is because of the increased acuity of the eye over this portion of the spectrum. It is here that the eye can distinguish more detail than in the blue or red. Have you made the test of observing the finest detail readable from the usual TV resolution chart when illuminated with light of the three colors mentioned? Green gives greater detail.

IRC Buys Gorman Manufacturing Corp.

Charles Weyl, president, International Resistance Co., Philadelphia, has announced the company's recent purchase of the Gorman Manufacturing Corp., Los Angeles, Calif. The Los Angeles concern which specializes in the manufacture of "Encapsulated" wire wound resistors will continue the production of its present line under the management of Henry C. Gordon, president.

License Agreement

Jersey Specialty Co., Inc., Little Falls, N. J., recently announced that it had been granted the right to manufacture 300 ohm twin-tubular lead TV cables under the Amphenol patent, No. 2,543,696.

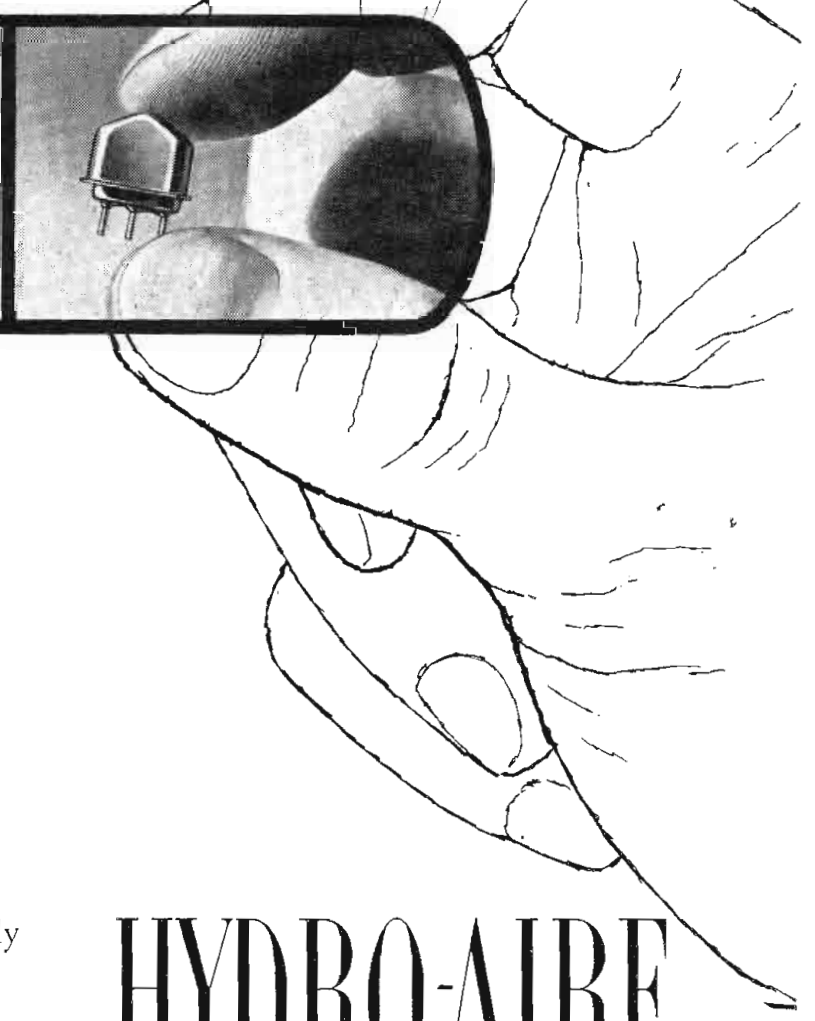
The new JSC tubular wire makes it possible to obtain high quality pictures on any low loss TV set of the entire range of UHF and VHF channels. Peter Hagedoorn, president, predicts that the acquisition of the license will increase company transmission cable production to 5 million ft. a week.

DuMONT RECEIVES AWARD

At the annual dinner of the New York Chapter of the New York Society of Professional Engineers, June 12, in New York City, Dr. Allen B. DuMont (center), president of Allen B. DuMont, was presented with an award for distinguished service to the American people in the communications field by H. Gregory Shea. Rodney D. Chipp, director of engineering of the DuMont Television Network stands at the right.

Your inquiries are invited... by

THE NEW SOURCE OF TRANSISTORS



If you are planning or producing products in the electronic field, which require the use of vacuum tubes, there is great promise that production costs and unit size can be materially reduced by the utilization of the new Germanium transistors. Hydro-Aire will soon be producing the new contact type transistors in large quantities ready for immediate delivery. Features of these new transistors include a hermetically sealed case and a unique arrangement of the contact wires. which increases shock resistance and produces greater uniformity. Hydro-Aire's Electronic Research and Development Section is also working on transistor applications for the aircraft industry as well as the commercial field...and would appreciate the opportunity of working with you in adapting transistors to *your* particular products. Write today for complete information.

HYDRO-AIRE *Inc.*
SUBSIDIARY OF CRANE CO.
Burbank, California

West Coast

(*Continued from page* 61)

quite another. The nature of our industrial activities is such that any area can easily outproduce the immediate needs of a restricted market. After all, once you have made 5,000 widgets and "debugged" them, it isn't much more difficult to make 10,000 or 50,000 or 100,000. Since the pressure to expand is economically dictated, the quest immediately begins for the absorption of additional production capacity. To do this usually means the penetration of distant markets. For any industry this can only be done if the product involved has a "high value per pound" so that the shipping cost is a small part of the price. For such equipment, competition in New York by a manufacturer in California is possible and indeed has already been effectively done in more lines than most people suspect. The Los Angeles area, for example, ranks exceptionally high nationally in the production not only of aircraft and aircraft parts, but in pumps and compressors, refrigeration equipment and machinery, heating and plumbing equipment, canned seafood, household furniture, printing and publishing and others.

We are engaged nationally in a mighty activity to miniaturize electronic equipment, decrease its weight, increase its versatility, reliability and effectiveness. The aircraft industry has been a strong stimulus in this direction. Every 100 lbs. of dead weight represent an annual loss of revenue to commercial airlines of perhaps $20,000. To this industry miniaturization is of great import.

The direction dictated by these developments leads to producing equipment with a higher and higher value per pound and therefore naturally attractive to Western industrialists. Even more effective in its influence on the development of the Western electronic industry is the vast expansion of guided missiles activities. Here we are now faced with the development of an enormous variety of equipment in the name of national security which will profoundly influence our peaceful future. Consider the direction of these developments; it requires about 8/10th of a second for a human to see, recognize and begin to react to an object. For a missile traveling at 3,000 mph anything within 5,000 ft. will be passed before the "pilot" can move a muscle to alter his course. At this speed, by the time a pilot sees and recognizes an

(*Continued on page* 174)

DON'T JUST LONG FOR IT!

Success begins when longing stops and action starts! The important thing for engineers in these times is to look to the future. Do you feel that perhaps there might be a place for you in an industry that offers exceptional advantages today, and even greater opportunity for tomorrow? Longing won't get it for you!

Perhaps you are not employed at your highest skill. At Westinghouse, top management philosophy dictates that every engineer be provided with challenging assignments . . . that management potential be quickly recognized and developed . . . and that inventive abilities be stimulated and encouraged.

For many years, Westinghouse has been setting the pace for the electronics industry. Westinghouse engineers have profited from this . . . in the form of excellent pay . . . liberal patent awards and stock-purchasing plans . . . and all of the usual personal security benefits, plus!

Opportunities exist for men with experience as—

TRANSFORMER DESIGN ENGINEERS

ELECTRONIC TEST EQUIPMENT ENGINEERS

TECHNICAL WRITERS

MECHANICAL DESIGN ENGINEERS (ELECTRONIC EQUIPMENT)

SERVOMECHANISM ENGINEERS

DON'T just long for these things . . . write us today and tell us about yourself. We'll reply by return mail.

Dept. TA

Westinghouse

ELECTRIC CORPORATION

109 WEST LOMBARD ST., BALTIMORE 1, MD.

object, he will be past it *although he will still think it is in front of him.* To cope with such problems the electronic industry has been called upon to develop new equipment, instruments, controls and to design and create new gadgets than can sense, think, remember, calculate and react more rapidly, effectively and reliably than any human being. It is but one step from this kind of equipment to the development of automatic devices for every conceivable activity. The day is not far off when the electronic computor for example will occupy a dominant position not only in our industry but our everyday lives.

Electronic devices are increasingly being called upon to count, inspect, measure, analyze and control all sorts of industrial processes. The rather crude machines we now have for sorting, weighing and packaging are only a beginning. Such basic technical trends dictate that we continue developments in these directions with ever-increasing intensity. The needs of Western industry have hardly been touched. We are entering the age of automaticity and in this the electronic industry has a brilliant future. Since the direction of these developments is more reliant upon today's research activities than upon present production capacity and since the West is becoming an enormous reservoir for diversified skills of every conceivable type, its future role as a leading electronic area is assured. Also, with the development of jet transport in the next generation there will be a significant shift of research and development activities to the West.

Some figures may be worthwhile: last year, I am told, the government alone purchased over $4 billion of electrical equipment in the United States. While the West supplied but a few percent of the total production of electrical equipment, perhaps as much as 15% to 20% of the money spent in the United States on electronic research was spent here.

This enormous stimulus is only beginning to be felt in the growth of the Western electronic industry and will profoundly affect its future non-military development. Industrially this area has labored under a 100-year handicap to industry developed in the East. In scientific and electronic developments, it suffers no such handicap. To this must be added the vitality of a youthful industry and the adventurous spirit of its leaders. They are relatively unhampered by tradition; even the air seems different. If these are the elements for successful growth, the continued development of the Western electronic industry is certain.

Specify! PHILCO
TV RELAY EQUIPMENT

CHECK THESE EXCLUSIVE FEATURES:

1. **HIGHEST PICTURE FIDELITY**—True repeater concept—unexcelled for single and multiple hops. Same circuitry as in TV network equipment.

2. **WIDEST FREQUENCY RESPONSE**—This and other design features assure transmission of all proposed color signals.

3. **SYSTEM COMPATIBILITY**—Designed to meet specifications for network interconnection.

4. **HIGHEST EFFECTIVE RADIATED POWER**—For greater dependability—7.5 kw or more in the 6000-7000 mc band.

5. **FIXED OR PORTABLE OPERATION**—Recessed chassis units in portable weather-proof cabinets—can be mounted in standard cabinets or racks.

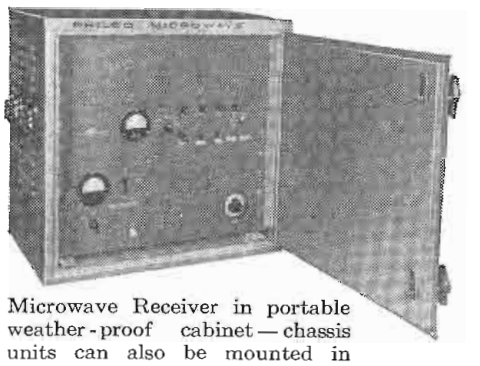
6. **LOW MAINTENANCE COST**—Conservatively rated components—Equipment designed for continuous unattended operation.

7. **RELIABILITY**—Utilizes highest quality tubes and components, power circuit breakers—built-in 50/60 cycle operation.

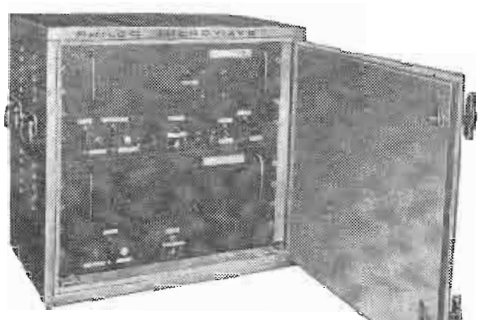
• • • These are only a few of the *extra* values in Philco Microwave Equipment. Be years ahead, and specify Philco TV Relay Equipment, designed and built by the world's leading manufacturer of microwave relay equipment.

For further information write to Department T, today.

New, lightweight parabola, tripod, and tilt head designed for ease of mounting.



Microwave Receiver in portable weather-proof cabinet—chassis units can also be mounted in standard racks or cabinets.



Rugged power supply units in portable cabinet—can also be mounted in standard racks or cabinets.

PHILCO *Famous for* QUALITY *the World Over*

PHILCO CORPORATION

GOVERNMENT & INDUSTRIAL DIVISION • PHILADELPHIA 44, PA.

Reactance Chart

(*Continued from page 69*)

R.T.=0.04 μs
D=0.3 μs

A. Find the intersection of the vertical line R.T.=0.04 μs and the horizontal line Z_0=500 ohms.

This occurs at L=9.37 μh and 37.5 μμf.

The following equations have been solved: (Fig. 3A)

$$f=1/(\pi\sqrt{LC}) \quad R.T.=\frac{0.35}{f_N}$$

Note: At this intersection, $L=L_s/2$ and $C=C_s/2$. Therefore, the intersection should be found where Z_0=500 ohms, L=18.75 μh, and C=75 μμf come together.

This has determined that the line will be either of the circuits shown in Fig. 3A with an unknown number of sections.

B. Find the intersection of the vertical line T.C.=0.3 μs with the horizontal line Z_0=500 ohms.

This occurs at L=150 μh and C=600 μμf.

The following equations have been solved: (Fig. 3B)

$$\text{Delay (RC)}=1/2\pi f$$
$$f=1/(2\pi\sqrt{L_TC_T})$$

Dividing L_T by L_s and C_T by C_s should yield the number of sections of the line. The equation being:

$$N=L_T/L_s=C_T/C_s$$

C. Find the intersection of L=18.75 μh and C=75 μμf. This occurs at 4.2 MC. A vertical line upward through this point crosses the LxC line at 1.5×10^{-15}.

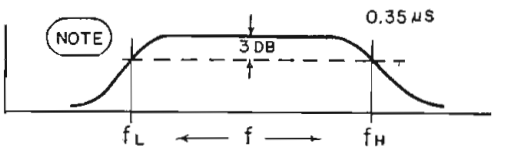
The velocity of propagation is found by: (Fig. 3C)

$$U=1/\sqrt{LC}$$

This is 2.58×10^8

Note 1. The use of Rise Time as a function of high frequency response is an item coming into use more and more frequently. See: M.I.T. Rad. Lab. Vol. 18, p. 80 for verification of equation.

Note 2. Unfortunately, low frequency information could not be put on the chart



without undue crowding. However, approximate rules-of-thumb are as follows:

For 10% tilt of a square wave the following hold:

$$RC = 5/f_{\text{square wave}}$$
$$f_{\text{square wave}} = 10\pi f_L$$

Dividing the title percentage required by a factor requires dividing f_L and multiplying R_gC_c by the same factor.

KAUS Receives CP

The Cedar Valley Co., operators of radio station KAUS, Austin, Minn. has received its construction permit to operate on Channel 6. Call letters will be KMMT. Shipment of a 5 kw Du Mont VHF TV transmitter with associated station and studio equipment to Cedar Valley Co. was recently announced by Allen B. Du Mont Labs., Inc.

GE Offers Color TV Broadcast Equipment

In a letter to district sales managers, the General Electric Commercial & Government Equipment Dept. has listed the costs and delivery dates of equipment for broadcasting color TV programs. The letter emphasized that the regular GE transmitter and antenna will transmit satisfactory NTSC signals with only very minor changes to existing equipment, no additional equipment being necessary.

The equipment is divided into three phases, each capable of being added to the previous one as conditions permit. Phase I is for local stations wishing to rebroadcast network color programs. Amplifiers and associated units are listed at $13,800, and test equipment at $5,000. Availability is first quarter of 1954.

Phase II is for originating slide/film color programs. They are divided into three types of services: for slide projection only, $39,500; for 16 mm film projection only, $49,500; for slide and 16 mm projection, $68,500. To these amounts should be added the $18,800 for basic Phase I equipment. Estimated availability is the second quarter of 1954.

Phase III covers the studio camera channel and associated switching equipment for originating live color programs. It is offered at $69,500. Adding this cost to the sum of the first two phases, the grand total is $156,800 for all equipment needed by an existing station to handle network color programs, and originate slide, film and live broadcasts. Availability of Phase III is expected during the fourth quarter of 1954.

RDB Conference on Tube Techniques

A national conference on tube techniques will take place in New York City October 13-15 in the auditorium of the Western Union Telegraph Co. at 60 Hudson St. Papers for this conference are now being solicited and all papers and abstracts should be addressed to Dr. Harold Jacobs, Thermionics Branch, Evans Signal Laboratory, Belmar, N. J.

Further information can be obtained by writing Harold J. Sullivan, Panel on Electron Tubes, Committee on Electronics, Research & Development Board, 346 Broadway, New York 13, N.Y.

New RTMA Publications

Two new publications have been distributed to members of the RTMA. The first is a descriptive folder entitled "Engineering for Industry," which describes the activities of the RTMA Engineering Dept. The second is the first issue of a periodic bulletin called "Engineering Committee Progress," which presents the activities of the technical committees. Further information may be obtained from the RTMA office at 489 Fifth Ave., New York 17, N.Y.

PERSONAL

Carroll E. Frank, formerly with Motorola Research, Inc., is now associated with the Radar Laboratory, Hughes Research and Development Laboratories, Culver City, Calif. **Donald R. Mathews** has joined the same organization. Mr. Mathews was formerly associated with Ipsen Industries, Inc. and Ipsenlab of Rockford, Ind.

Dr. Willard Geer, currently associate professor of physics at the University of California, inventor of one of the

Dr. Willard Geer

three recognized tubes used in color TV, has been appointed color consultant on TV and military applications for both Hoffman Radio Corp. and Hoffman Laboratories, Inc., Los Angeles, Calif. search Laboratory.

King Dendy will specialize on delay lines and pulse transformers for the Guthman Company, Chicago, Ill. He was formerly head of research and development for PCA Electronics, Inc., Santa Monica, Calif.

Robert J. Stahl, formerly chief engineer of Color Television Inc., has become consulting engineer to Dalmo Victor Co., San Carlos electronics firm, to advise on electro-mechanical problems and patent matters. At one time, Mr. Stahl served as chief engineer of the Berkeley Scientific division of Beckman Instruments, Pasadena, Calif.

J. Harvey Pickett has been made chief engineer of the Aerovox Capacitor Div., of Aerovox Corp., New Bedford, Mass. Before his New Bedford appointment, Mr. Pickett was chief engineer of Aerovox Canada Ltd. in Hamilton, Ont. There he took prominent part in Canadian radio-electronic engineering activities which included service in the Canadian Government Standards groups and the chairmanship of the Hamilton Chapter of the IRE.

Edward G. Spencer, specialist in microwave spectroscopy and magnetic

resonance, has joined the staff of the ordnance electronics division of the National Bureau of Standards.

Ralph R. Stubbs has been made assistant chief engineer of General Instrument Corp. and will have headquarters at the company's home plant in Elizabeth, N. J. Following the war years, Mr. Stubbs became a member of the Westinghouse engineering staff where he specialized in TV design and was manager of the ultra high frequency development group. He was design engineer for Hoffman Radio, Los Angeles, when he accepted his post with General Instrument Corp.

James L. von Harz, recently named assistant to Elof Sandstrom, board chairman and works manager of Oak Mfg. Co., Chicago, Ill., will be in charge of the company's new factory at Elkhorn, Wis. The new production unit will feed the Chicago and Crystal Lake, Ill. plants.

John S. Brown has been appointed director of engineering for the Andrew Corp., Chicago, Ill. He is now responsible for all phases of the company's

John S. Brown

engineering and development program. **Lawrence R. Krahe** was appointed head of the advance development group of the company and made responsible for the administration of the 420-acre antenna development center at Orland Park, Ill.

William MacIntyre Shakespeare has joined the Glenco Corp., Metuchen, N. J. The company manufactures ceramic capacitors, piezoelectric transducers, non-linear dielectrics and printed circuits. Mr. Shakespeare will be in charge of a group assigned to the development of new ceramic compositions and new casting techniques.

W. Walter Watts, vice president in charge of technical products of RCA, has been elected a director of Hydrocap Eastern, Inc., Philadelphia, Pa.

Irving A. Abend has been appointed head of the Applications Engineering Dept. of General Ceramics & Steatite Corp., Keasbey, N. J. He was formerly chief engineer of the Freed Radio Corp.

Joseph M. Kirshner has joined the staff of the Ordnance Electronics Division of the National Bureau of Standards to investigate the theoretical

PERSONAL

aspects of guided missile fusing. From 1948 until he joined the NBS, Mr. Kirshner investigated the behavior of electrons in gases at the Naval Research Laboratory.

E. Finley Carter has been appointed vice president and technical director of Sylvania Electric products Inc., and **Howard L. Richardson** has been named

E. Finlay Carter

vice president in charge of engineering operations. In his new capacity, Mr. Carter will furnish Sylvania's management and engineering groups with technical counsel. A holder of a number of patents covering electronic devices, he joined Sylvania originally as a consulting engineer. Mr. Richardson will assume the operating responsibilities executed by Mr. Carter as vice president in charge of engineering.

Howard L. Richardson

Martin Blumberg, formerly a research associate in electronics at Stanford University, has joined the Radar Laboratory of Hughes Research and Development Laboratories, Culver City, California. Other Hughes appointments include: **John D. Carroll,** and **Virgil J. Gergen.** now associated with the Field Engineering Dept.; **E. H. Graham,** a former member of the Air Force Flight Test Center, is now with the Hughes Guided Missiles Laboratory.

John M. Pearce, former president of Phebco, Inc., and **Douglas R. G. Williams**, former works manager of Arma Corp., have joined American Machine

John M. Pearce

& Foundry Co., electronics division, Boston, as director of engineering and factory manager, respectively. Mr.

Douglas R. G. Williams

Pearce has been active in radio and electronics since 1925. Mr. Williams, the new factory manager, will be entirely in charge of the AMF electronics division.

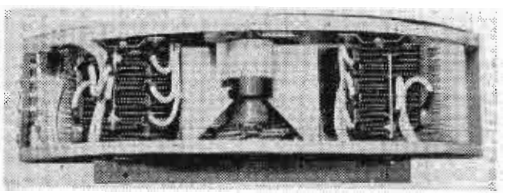
Neal McNaughten, radio and television engineer and consultant on broadcasting problems, has joined the RCA Victor Div. Radio Corp of America, as administrator of the broadcast market planning section of the Engineering Products Department. Mr. McNaughten will supervise the long-range planning of all aspects of the company's broadcast business. Before joining RCA, since 1949, he had been director of engineering for NARTB.

Dr. L. J. Brady, formerly with the process development department of General Aniline and Film Corp., has been made director of research of Ferroxcube Corp. of America, Saugerties, N.Y.

Philip J. Herbst, veteran RCA Victor engineer, has become head of the communications engineering section of the company's Engineering Products Department to direct the design and development of RCA two-way mobile radio communications and microwave equipment.

Airborne Transformer-Rectifier

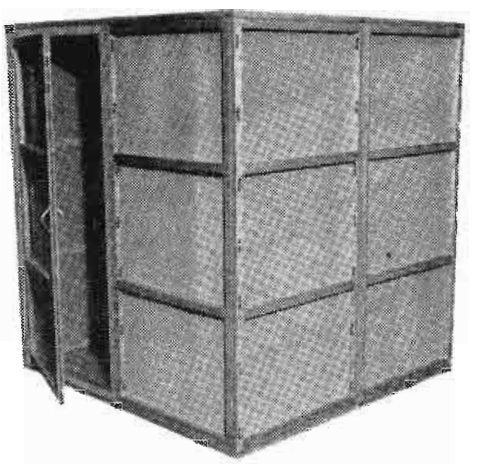
A new series of airborne transformer-rectifiers for 28 v. aircraft dc power systems have current ratings up to 200



amps. These units are designed in accordance with the environmental and electrical requirements of MIL specifications, and are said to enable considerable savings in space and weight and be more efficient than dc generators presently used.—**Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.** —TELE-TECH & ELECTRONIC INDUSTRIES

Shielded Enclosures

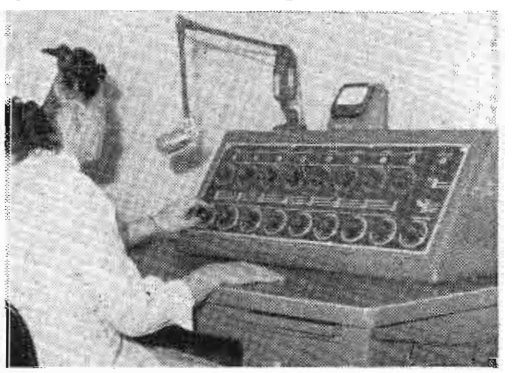
A line of galvanized single-shielded enclosures for suppressing r-f radiations from induction heating, dielectric



sealing, diathermic, and other industrial and laboratory equipment has been announced which provides more than 40 db attenuation from 14 KC to 400 MC and 66 db at standard vhf television frequencies. Each panel is a kiln-dried, white pine framework covered with a layer of 22-mesh galvanized steel screening. Standard floors are ¼ in. plywood with a capacity of 300 lbs. per sq. ft.—**Ace Engineering & Machine Co., 3644 N. Lawrence St., Philadelphia 40, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Security Sound System

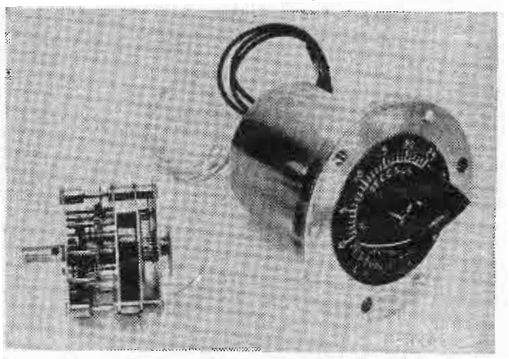
Whenever the sound of a disturbance or shout approaches a preset noise level, it will trip an alarm in the O'Brien security sound system. Intelligence thus transmitted through the console of the system enables the operator to locate



the trouble and determine its nature, and also, to instruct or command those in its immediate area. The system consists of strategically-located, cast-iron housed microphones, a thyratron-operated relay, and the console. The unit shown is in use in a state hospital for the criminal insane.—**O'Brien Electric Corp. 6514 Santa Monica Blvd., Hollywood 38, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Mechanically-Wound Timer

The Masco mechanically-wound timing device enables pre-setting any time-delay interval between 1 and 30 seconds. The interval is started by a mechanical



inertia switch which operates when an acceleration of 3 to 4 Gs is reached during missile launching. At the end of the interval, the timer closes a switch in the missile electrical system. The instrument operates in a temperature range from —50°C through +80°C plus within the altitude range 0 to 70,000 ft., and will withstand 30 Gs in any axis with a maximum of 50 Gs in launching direction. The unit has an overall dia. of 2½ in., is 1¾ in. long, and weighs 8 oz.—**Masco Products Co., 2119 Sepulveda Blvd., Los Angeles 25, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Cathode Ray Tube

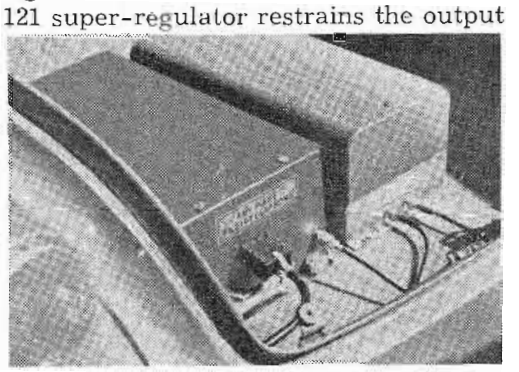
Type 72RA, 7-in., 2-gun, cathode ray tube is designed for use in dual-channel oscilloscopes having high sensitivity. Two traces may be simultaneously presented on the tube face for accurate comparative studies of independent phenomena. It employs electrostatic focus, deflection, and shielding against cross talk, and also, a post accelerator intensifying electrode. All deflection plate connections are brought out through the tube neck to minimize inter-electrode capacitance. The tube comes coated with PI phosphor, but other standard phosphors can be supplied.—**Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Side Band Filters

A new series of filters which can replace the more expensive and hard-to-get crystal filters in commercial single side-band receiving equipment has been announced. It is said that the new filters employ a new approach in the form of a 25 kc if system.—**Burnell & Co., 45 Washburton Ave., Yonkers, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

Chopper Stabilizer

Model 122B chopper stabilizer designed for use with the Key-Lab model 121 super-regulator restrains the output



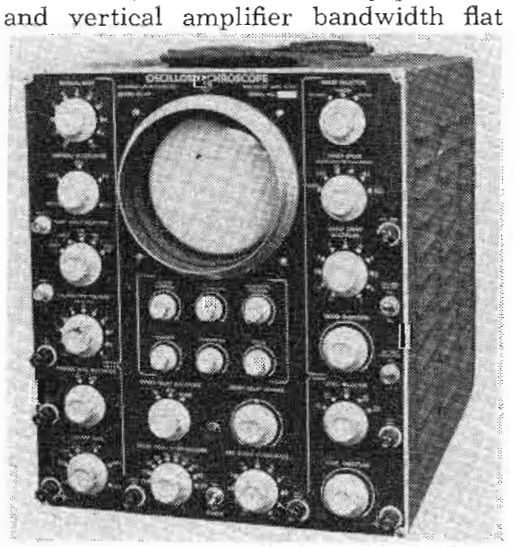
voltage of ordinary power supplies to standard cell stability. The circuit of the unit compares a fraction of the output voltage with a standard cell, and a corrective generated ± 30 v, 5 ma, polarized signal is fed back to the power supply under regulation. The desired output voltage is calibrated by a precision attenuator to an absolute accuracy of 0.1%. Long time drift is maintained to an accuracy of 0.1%; short time drift to a few parts per million. The equipment finds application in the computing field, laboratories concerned with strain gage work, magneto-meters, and standards establishment.—**Kalbfell Laboratories, Inc., 1090 Morena Blvd., San Diego 10, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Non-Linear Resistors

A new line of non-linear resistors, called "Varistors," have been introduced to the market for applications in in circuits where sharp variation of resistance is required with applied voltage. The units are available in 5 cell sizes and a variety of enclosures. Having an unusually low shunt capacitance, they are effective in r-f circuits. The new line is designed to conform with MIL and JAN specifications covering shock, humidity, vibration, temperature cycling, solder pot, and fungus resistance.—**International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Oscillosynchroscope

The Model OL-23 oscillosynchroscope features 4,000 v. accelerating potential and vertical amplifier bandwidth flat

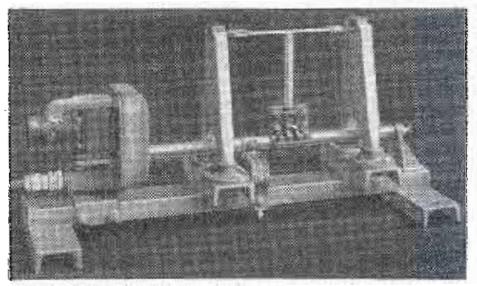


from 5 cps to 10 MC. It has a sensitivity of 0.15 v, peak-to-peak, per in., and triggered or recurrent sweeps from 0.1 μsecs per centimeter to 0.011 secs per

centimeter. Video delay line enables observation of rising wave front of pulses. A built-in generator produces output triggers from 50 to 5,000 pps. A continuously variable delay circuit allows the sweep to be delayed from the triggering source by 5-10,000 μsecs under any triggered condition. Amplitude measurement can be made by square wave calibration voltage, 0-100 v, with 5% accuracy. Sweep controls are calibrated for time measurements to the same accuracy. Mechanical features include a machined aluminum bezel, and illuminated ruled screen, and an interior cooling blower. The instrument is supplied for a 115/230 v. operation at an input of 300 watts. Height, 15¾ in., Width 13¼ in., Depth 22 in.—**Browning Laboratories, Inc., 750 Main St., Winchester, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Shorting Switch

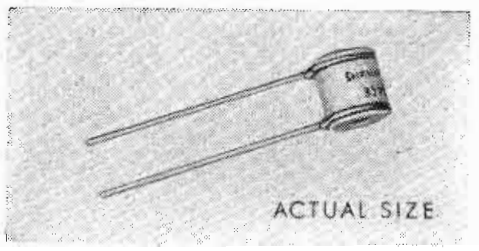
A new hf shorting switch for two-wire open transmission lines with 12 in. spacing has recently been introduced



which can be used for short circuiting two or more frequency tuning stubs, shorting transmission line accept-reject circuits, or grounding high voltage ac or dc circuits. The Steatite-insulated shorting bar is controlled by a low voltage dc motor with limit switches and an electro-mechanical brake that stops the motor instantly at the end of a stroke. The mechanical motor-switching arm link disengages automatically so that the switch can be hand operated in the event of power failure. The unit is conservatively rated to handle 30 kv wire-to-wire or 15 kv to ground.—**Trylon Tower Div., Wind Turbine Co., West Chester, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Subminiature Resistor

Type 16, a tiny 0.1 watt resistor, can be non-inductively wire-wound in any value to 150,000 ohms. Closer than 1.0%



tolerances are available; and, when impregnated with Shallcross BX, the type 16 will withstand prolonged high humidity; less severe applications require lacquer. The unit is mounted either by its radial wire leads, or by an axial No. 2 clearance hole in its steatite bobbin.—**Shallcross Manufacturing Co., Collingdale, Pa.** — TELE-TECH & ELECTRONIC INDUSTRIES.

$4,000 Fellowship for Young Engineers

A $4,000 fellowship, one of the largest of its type, was recently announced by President Deane W. Malott of Cornell University. The award will be made each year after 1953 to encourage advanced study for young engineers whose talents mark them as future leaders in science and engineering.

According to the donor (Ford Instrument Co., Long Island City, N. Y.), winners will have complete freedom to study in any branch of electrical or mechanical engineering, engineering physics, or mechanics and materials. The fellowship will bear the name of Hannibal C. Ford, retired founder of Ford Instrument Co.

Radio Newsroom Study

The National Association of Radio and Television Broadcasters is forwarding questionnaires to all AM and independent FM broadcast stations in the United States to determine current trends in news-gathering, editing, and broadcasting.

Processing, correlation, and interpretation of the findings will be conducted by the NARTB research department under the direction of Richard M. Allerton, department manager. The questionnaire is divided into two sections, one is being directed to the station manager, the other to the news director.

As We Go To Press . . . .

Meetings Related to WESCON

Several meeting having interest related to WESCON will be held in the San Francisco Bay region around the time of the big meeting (Aug. 19-21). These include:

Aug. 17-18: Communication symposium on the Berkeley campus of the U. of Calif. It is jointly sponsored by the University Dept. of Engineering, Office of Naval Research, and IRE Professional Group on Information Theory.

Aug. 18-19: Joint Electron Tube Engineering Council meets at the Mark Hopkins Hotel, San Francisco.

Aug. 19: Survey of magnetic tape recording sponsored by the Audio Engineering Society, National Shorthand Reporters Assoc., and Federal Court Reporters.

A special exhibit of historical electronic items relating to engineering developments in the West will be on display for the first time at Stanford Research Institute.

In Los Angeles, a classified symposium will be held by the IRE Professional Group on Airborne Electronics. It will follow a similar meeting at UCLA jointly sponsored by the Research and Development Board and the U. of Calif.

Variable Inductors

(*Continued from page* 75)

reduced. This reduction is proportional to the permeability of the core materials. Fig. 1 also shows that a greater variation in (μ') is obtained when using higher permeability materials.

The first step in the design of a miniature inductor is the selection of proper material, which may have to be machined in order to obtain the desired shape. Powdered iron, if that be the material chosen, requires special care in machining since it is a soft abrasive material. It has been found that carbide tipped drills are excellent for drilling holes in this material since regular high speed drills dull very rapidly, and are therefore not suitable for this type of work. For cutting and grinding a small abrasive wheel may be used very effectively. The particles resulting from the grinding process must be immediately removed from the atmosphere before they have a chance to settle on any part of the machinery. Since these particles have abrasive properties they will damage the machinery unless proper precaution is taken. By attaching a large vacuum hose to the work it is possible to draw the dust away as soon as it is formed.

Use of Ferrite

The core material mentioned thus far is limited to powdered iron. By using the new ferromagnetic material know as ferrite,[5, 6] which possesses a much higher permeability as compared with powered iron, it has been found that the volume of the inductor may be reduced as much as 700%, while at the same time increasing the Q of the coil by 200%[7]. These figures for reduction of volume and improvement of Q are typical at low frequencies in the vicinity of 100 KC. For higher frequencies, the gain is not at great. Manufacturers have been developing ferrite for high frequency application, and this material may be available in the near future[8]. Presently there are many types of ferrite available,[9] with each possessing a special property which makes it superior for a particular application. Although ferrite is extremely difficult to machine, it can be readily molded into the desired shape. The use of molding techniques enables the ferrite cores to be produced economically. A comparison is shown in Fig. 2 between a ferrite core coil and a powdered iron core coil of the same construction and volume.

(*Continued on page* 188)

As mentioned previously there are two basic methods available for varying the value of inductance, i.e., variation of the number of turns or the effective permeability. A design is shown in Fig. 3 in which the inductance is varied by changing the number of turns. This is accomplished by shorting out any given number of turns by means of the threaded brass shorting cylinder, which can be turned in either direction thereby increasing or decreasing the number of turns. Shielding is accomplished by means of a powdered iron cylinder which is placed over the inductor and attached to the shorting cylinder. This powdered iron cylinder not only serves as a shield but also increases the inductance and the value of Q. This inductor has an inductance range from 0.70 to 1.41 μh, with a Q variation from 76 to 138 as shown in Fig. 4, where Curve A shows the change in Q, and Curve B the change in inductance as the number of turns are varied. The reason that the plot of inductance appears essentially as a straight line, rather than a parabolic curve, is that a very small percentage of the total number of turns were used, and thus only the lower portion of the entire curve is shown.

Changing Permeability

Another method used for varying inductance is by changing the effective permeability. A design for one method of accomplishing this is shown in Fig. 5. In this design a powdered iron core 3/16 in. long by 1/8 in. in diameter was chosen, a slot of 1/16 in. wide by 1/32 in. deep was then cut in the cylinder and the coil was wound in this slot. By thus placing the coil it is effectively imbedded in the powdered iron, thereby providing two distinct advantages. First there is inherently good shielding, and secondly the form factor of this configuration is such that it provides an inherently high effective permeability (μ′) and generally a high value of Q. A powdered iron cylinder with a screw attachment that can be turned in either direction is placed over the slot, thereby covering either the entire slot, or any portion of it desired. By moving this cylinder over the slot the air gap is varied, thus changing the effective permeability and the value of inductance. The results obtained with this design as the air gap is varied are shown in Fig. 6 for both a ferrite and a powdered iron core. As mentioned previously the higher the permeability of the core material the greater the variation in the value of inductance. This is graphically de-

picted in this figure, which shows that the ferrite material, which has a much higher permeability than powdered iron, also has a much greater variance. For both these materials the value of Q is fairly constant over the entire range, the Q for the powdered iron being about 90 and for the ferrite material about 110.

The amount of coupling between two adjacent unshielded coils at varying distances is shown in Fig. 7 for both a conventional coil and a coil wound in a slotted powdered

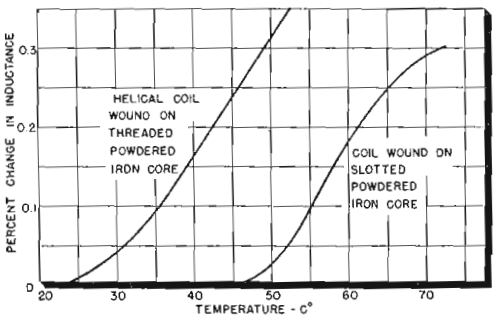


Fig. 8: Total temperature coefficient

iron core. It is seen that there is less coupling between coils when the coil is wound in a slotted powdered iron core rather than in the conventional way. When the powdered iron sleeve completely covers the coil in the slot, as in the maximum inductance case, there is zero coupling which is as expected.

The percent change in inductance due to temperature variation is shown in Fig. 8. This is an overall comparison of the two designs discussed. The apparent percent change in inductance is much greater for the design that utilizes changing the number of turns than for the case where permeability is varied. In the first case the inductor was measured at a much higher frequency for it is a low value inductor. It must be borne in mind that the temperature coefficient of the core material is a function of frequency and as the frequency increases the temperature coefficient also increases. The results shown in this figure are partially attributable to these phenomena.

REFERENCES

1. E. S. Purington, "Simplified Inductance Chart," *Electronics*, Sept., 1942.
2. V. G. Welsby, "Development of Dust Cored Materials," *Electronic Engineering*, Oct. and Dec., 1943.
3. G. O. Altmann, "Carbonyl Iron Powders," *FM-TV*, Sept., 1949.
4. W. J. Polydoroff, "Powdered Magnetic Cores," *Tele-Tech & Electronic Industries*, Feb., 1953.
5. H. A. Goldsmith, "Ferromagnetic Ceramics," *Product Eng.*, April, 1951.
6. C. L. Snyder, E. Albers Schoenberg and H. A. Goldsmith, "Magnetic Ferrites," *Elect. Mfg.*, Dec., 1949.
7. P. S. Darnell, "Miniaturized Components for Transistor Application," *Proc. of Symposium Progress in Quality Electronic Components*, May, 1952.
8. Ferroxcube Engineering Bulletin No. FC-518.
9. Ephraim Gelbard, "Magnetic Properties of Ferrite Materials," *Tele-Tech & Electronic Industries*, May, 1952.

Parallel-Z Calculations

(*Continued from page* 93)

happens, no problem exists and the construction proceeds in the normal manner. Secondly, a simple auxiliary construction can be employed when the parallel tends to intersect that portion of the circle which is off the paper.

Referring to Fig. 5, let $\overrightarrow{OZ_1}$ be the long vector, which lies outside the 20-in. diameter circle, and let $\overrightarrow{OZ_2}$ be situated such that a parallel through Z_1 intersects off the paper the circle which passes through Z_1. Lay off $(-Z_2)$; i.e. extend $\overrightarrow{OZ_2}$ backwards to the point where it intersects the circle through Z_2. Draw a straight line through this point and Z_1 and intersect it with a perpendicular to $\overrightarrow{OZ_2}$ erected at the origin. Let this point of intersection be labelled P'_1. It can be shown that P''_1 lies on the straight line through Z_2 and the inaccessible point P_1, which is required in locating Z_p. Therefore, P'_1 can be used in place of P_1 to establish this line. Since Z_2 lies inside the 20-in. diameter circle, the second part of the construction follows the standard pattern.

There exists also a possibility that Z_p may fall outside the 20x20-in.

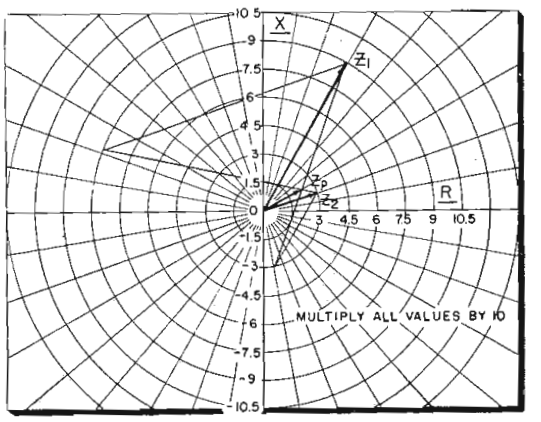


Fig. 8: Problem in Fig. 3 solved on Keuffel & Esser 359-31 polar-coordinate graph paper

area, while both P_1 and P_2 lie well inside of it. This situation arises when the two parallel impedances are high-Q reactances which are almost in resonance, so that the resultant impedance is much larger in magnitude than either component. This fact does not interfere at all with the procedure of (a) to (c), which should be carried out in the regular manner, except that the final two lines fail to intersect inside the limits of the standard sheet. Since their directions are available, however, the construction can be completed without much difficulty up to a substantial magnification of

$|Z_p/Z_i|$. Divide the intercepts of these two lines along the X-axis by a suitable scale-factor, e.g. 5 or 10, and translate the two lines to positions such that the new intercepts are utilized and the two translated lines intersect on the sheet. If the scale factor is designated as "k" and the point of intersection of the translated two lines is designated as Z'_p, then the actual value of Z_p is kZ'_p. In other words, $R_p = kR'_p$ and $X_p = kX'_p$, where R'_p and X'_p are the components of Z'_p and are read off from the diagram. Fig. 6 illustrates the procedure.

It should be emphasized that the need for the auxiliary constructions, if any, is not at all inherent in the "concentric-circle" method. They are introduced exclusively for the reason of keeping the size of the sheet for a given accuracy to a minimum, in order to realize convenience in use.

Graph paper substitutes

It is possible to perform the "concentric-circle" construction on commercial polar-coordinate graph paper, provided that limited accuracy is not objectionable. Steps (a), (b), (c), are executed in the same way as when using the special graph paper of Fig. 2. But when Z_p is obtained, two lines parallel to the R and X axes are passed through it in addition, in order to be able to read off R_p and X_p along these axes. The effort of drawing two additional lines when polar-coordinate paper is used may be compensated in some cases by having a direct indication of the phase angle of Z_p. The problem solved in Fig. 3 is repeated in Fig. 8 on Keuffel & Esser Co. No. 359-31 polar-coordinate paper to illustrate how this paper can be utilized in this special application.

Since polar-coordinate paper is ordinarily not manufactured in sheets larger than 8½x11 in. (useful area 7x10 in), only limited accuracy is obtainable. It may be a very useful substitute for the special graph paper of Fig. 2, however, when it is necessary merely to estimate the effect of combining certain impedances in parallel.

When the directions of Z_1 and Z_2 are identical or opposite, the "concentric-circle" construction can not be carried out in the standard form because all construction lines coincide with the line on which Z_1 and Z_2 are located. This phenomenon is inherent in the special situation and not the fault of the "concentric-circle" method. Should Z_1 and Z_2

(*Continued on page* 192)

have the same phase angle, or differ in phase by 180° in the case of opposite reactances, it is obvious that Z_p will also lie on the line passing through O, Z_1, and Z_2. Therefore, the two-dimensional impedance plane is reduced to a one-dimensional line. In algebraic terms, calculation with real numbers replaces calculation with complex numbers. If Z_2 is in phase with $Z_1 = R_1 + jX_1$, or differs from it by 180°, then it must be equal to $Z_2 = mR_1 + jmX_1$, where "m" is a real number. Therefore, the resultant of the parallel combination of these two impedances is:

$$Z_p = m/(1 + m) \quad (R_1 + jX_1)$$

It may be argued that since the calculation of Z_p involves only real numbers in this special case, there is hardly a need for a geometrical solution. There is a measure of truth to this, but it is worthwhile to know that the "concentric-circle" diagram can be used to solve also the case of two similar impedances connected in parallel. Since in this category are included the parallel connection of two resistances, two inductances or capacitances, and an inductance and a capacitance, the occurrence of "similar-impedance" cases is not infrequent.

Construction

The pertinent construction will be described in connection with Fig. 7. Let the line on which Z_1 and Z_2 lie be designated as *a*. Choose another line *b*, which has an arbitrary direction but passes through the origin, and let the two parts into which it is divided by the origin be considered as *b'* and *b"* respectively. Draw a parallel to *a* through the point of intersection of *b"* with the circle passing through Z_2 and intersect it with a parallel to *b* passing through Z_2. This is the point S. The line connecting S with the point of intersection of *b'* and the circle passing through any Z_1 on *a* intersects *a* in Z_p, which corresponds to the parallel connection of Z_2 and this particular Z_1. In principle it does not matter which segment is made *b'*, and which is made *b"*. For a given pair of Z_1 and Z_2, the point S may be derived from either Z_1 or Z_2.

In general it is advantageous to let *b* coincide with the R- or X-axis. In this case, only two lines are required to complete the construction when Z_1 and Z_2 are not pure resistances or reactances. The parallel combination of two resistances can be solved by drawing only a single line, provided *b* is allowed to coincide with the X-axis. Similarly, the parallel combination of two reactances can be solved by a single

line, provided b is allowed to coincide with the R-axis.

When Z_1 lies outside the 20" diameter circle because $\overrightarrow{OZ_2}$ is much smaller than $\overrightarrow{OZ_1}$, the line b should be located such that it intersects two of the four sectors of the circle passing through Z_1. Also, accuracy is improved when the point S is derived from Z_1 rather than from Z_2.

The constructions in this section are similar to the three-line nomograms used to combine resistances or reactances in parallel. However, they do supply the resistance and reactance directly when Z_1 and Z_2 are complex and in phase, which is not true for nomograms.

The derivation of the "concentric-circle" construction will be made available to interested readers upon written request on company letterhead.

REFERENCES

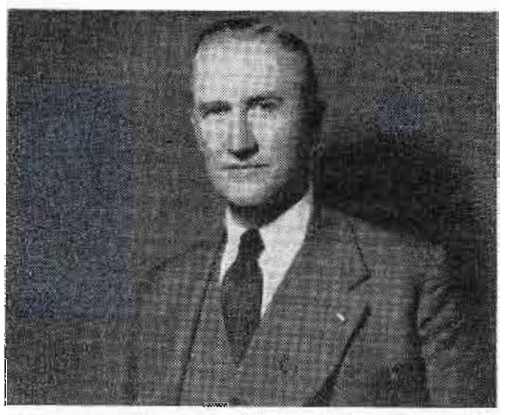
1. John L. Clarke: "Graphical Solution of Impedances in Parallel" (letter), Electrical Engineering, January 1938, p. 41.
2. N. H. Barker: "Impedances in Parallel," Electrical Review (London); January 7, 1944; p. 20.
3. C. R. G Reed: "Impedances in Parallel" (letter), Wireless Engineer, January 1951, p. 32.

NARTB Opposes Senate Bill 1396

The board of directors of the National Association of Radio and Television Broadcasters has adopted a resolution opposing the pending Senate Bill 1396.

The resolution contends that, if enacted, the bill would deny broadcasters the privilege of open, competitive negotiation to broadcast baseball games; place Congressional authorization on restrictive agreements denying to broadcasters the right freely to negotiate for broadcast rights with the owner on an individual basis; deprive large numbers of the public of the opportunity to see baseball broadcasts—especially major league games.

NEW FTL PRESIDENT



Major General Edmond H. Leavey, U. S. A. (retired) has been elected president of Federal Telecommunication Laboratories, Inc., research associate of International Telephone and Telegraph Corp. General Leavey, who has been corporate vice president since he joined the corporation, November 1952, fills the vacancy created by the recent death of Vice Admiral Carl F. Holden.

Single Sideband

(*Continued from page 98*)

DA36 - 039 - SC - 1542239 - PH - 52-91-4202) by Hoffman Labs., Inc., a research and developmental subsidiary of the Hoffman Radio Corp. See Fig. 1. The basic circuit elements of the converter are shown in the block diagram, Fig. 2. The input to the converter is taken from a receiver having a standard i-f frequency between 445 and 465 KC. This input frequency is then beat with a local oscillator which produces a converter i-f of 100 KC. As can be seen in the diagram, the 100 KC is then fed to three bandpass filters. One of these selects the frequencies in the carrier upper sideboard (100.01-106 KC), a second selects the frequencies in the lower sideband (94-99.99 KC), and the third selects the converted carrier frequency of 100 KC. The carrier reconditioning circuit amplifies the suppressed carrier and builds it up to its original strength. The reconditioned carrier is then introduced into the lower and upper sideband circuits, after filtering, and the intelligence demodulated to be fed, through amplifiers, to the carrier terminating equipment. Another oscillator is provided as a complete substitute for the transmitted carrier. The oscillator may be used, under certain conditions, when carrier suppression at the transmitter has caused the carrier to disappear altogether.

In the CV-157/URR(XC-1), the upper sideband may ordinarily carry six channels of teletype transmission, while the lower sideband carries a voice circuit. An infinite number of other arrangements may be used, such as facsimile and voice, twelve teletype channels, etc.

AFC Circuit

Key factor in the single sideband system of communication is the precise control of the suppressed carrier since the upper and lower sideband filters are extremely selective. A shift in the carrier of 100 CPS will cause the output of the USB and LSB filtering stages to drop by as much as 30 db. In the CV-157/URR-(XC-1), a phase comparison circuit is utilized to actuate a drag cup motor controlling the frequency of the local oscillator. The circuit will correct for carrier drift of as much as ±2 KC and will maintain carrier accuracy within ±1.5 CPS. Since it is located at the end of the communication system, the AFC circuit will compensate for transmitter as well as receiver frequency drift.

Interferometer

(*Continued from page* 84)

diffracted into a first order. An aperture following the third crystal passes only the doubly diffracted first-order ray of the beam transmitted by the first crystal and the doubly diffracted first-order ray of the beam diffracted by the first crystal. The total path of these twice-diffracted, once-transmitted rays is similar to a parallelogram with two very acute angles. A magnetic or electrostatic field gradient across the two paths produces a path difference that is observable as a shifting of the interference fringes.

Because the electron beam must pass through three crystals, their thickness cannot exceed a few hundred angstroms, which makes the utilization of naturally occurring crystals almost prohibitive. Fortunately, it is possible to grow oriented layers of metal by evaporation on a foreign crystalline substrate. The process is known as epitaxy.

Aligning and Testing

In the course of aligning and testing the interferometer, two difficulties are encountered. One is due to the use of diffraction as a beam splitting mechanism; the other results from the low intensity of the exit beam. Interferometers using diffraction both for beam splitting and beam deflection are capable of forming a higher-order fringe in a non-monochromatic light. This "achromatic" property is fortunate in that it relieves the stringent necessity for power-supply stability over long exposures of the electron optical instrument. On the other hand, it has the disadvantage of limiting the application of the instrument to problems in which the coherence properties of the source are of no interest. Consequently, the instrument in its present form may be used for wavelength determinations or field gradient investigations, but may not be used as an interferometric spectrometer for the study of electron emitters. Different interferometric arrangements are necessary for the study of coherence phenomena and are currently being investigated.

The second difficulty, a very low beam intensity, arises because only a small part of the total beam diffracted at each of the three crystals is utilized. The initial intensity is limited by the small apertures of the objective lens, the fineness of the 50-micron mesh upon which the crystal is mounted, and the maximum temperature the crystal can withstand. At maximum beam intensity the electron optical parts could be operated to give a direct electron optical magnification of about 700 diameters. The resolving power of the instrument under these conditions is limited to fringe spacings of the order of 1000A both by the electron optical system and by the grain of the photographic emulsion.

(*Continued on page* 198)

The original photographic record of interference showed 154 fringes with a mean spacing of 1650 angstroms. By using a light-optical analogy, the difference between the two paths in the electron interferometer was calculated to be of the order of 6000 wavelengths. This preliminary value indicates that previous evaluations of the length of the electron wave train, based on diffraction experiments, should be extended by a factor of 30.

Cellular Construction

A novel approach to the problem of connecting components and tubes to printed circuitry has been proposed by Dr. P. J. Selgin of NBS. It is a solderless assembly method using small replaceable units without plugs or connectors. The individual molded cells are ⅞ in. high, ½ in. wide, and ¼ in. thick. Each has three contacts, one on top and two on bottom, and contains one or two resistors, capacitors or inductors.

The cells are grouped together in building blocks, each block comprising two tubes and 12 cells held in a compact bundle by a screw and spring contact assembly. The cells' bottom terminals are held in firm contact with the printed circuit pattern by the pressure applied to the top terminal of each cell by the spring contact when the screws are fastened to the printed base plate.

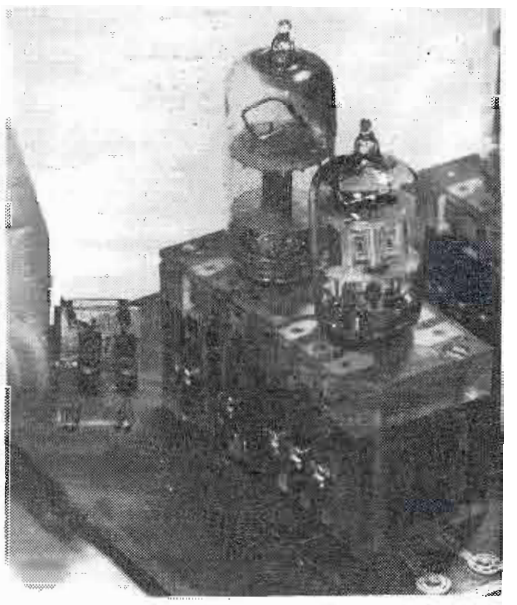


Fig. 8: Closeup shows details of "cellular" technique being investigated for Navy to make equipment more compact, reliable, simpler

The two-tube block is considered an optimum-sized subassembly. They are rugged, easy to handle, potentially inexpensive and measure only 2¼ x 1 x 1$\frac{3}{16}$ in., exclusive of tubes. Any number of blocks can be mounted on a base plate of sufficient area. Simple replacement by loosening a few screws facilitates maintenance. An experimental nine-tube cellular circuit has been constructed at NBS and appears to confirm the practical possibilities of this type of construction.

Frequency Deviation

(*Continued from page 85*)

components are not critical, but stable elements reduce maintenance problems. The dc bridge resistors in the indicator circuit are of adequate wattage and sufficiently well ventilated to avoid changes in resistance from overheating. The tank coil in the plate circuit of the first stage is set to resonate at the center or reference frequency and has a Q of about 60 when adjusted on a meter external to the circuit. The quadrature-grid tank coil also resonates near the center frequency and has a Q of 100 when measured out of the circuit. Because the quadrature tank determines the reference frequency of the deviation meter, it is enclosed to protect it from harsh handling and from being overheated by neighboring power resistors.

The circuit has two inherent disadvantages: (1) Because the current flow in the grid of the first 6BN6 is limited, the input impedance of the meter varies with the level of the input signal and has a minimum value of about 10,000 ohms. This relatively large minimum is generally acceptable, but a low-output impedance driver, such as a cathode follower, may be used when necessary as a buffer between the signal source and the deviation meter. (2) Like many other discriminators, the NBS unit shows considerable interaction between discriminator adjustments. This often requires a tedious and prolonged initial aligning procedure; however, the operation need be performed but once when the meter is to be used at one fixed frequency.

One of the NBS frequency deviation meters was used during a 1600-hour continuous life test to determine the difference between the local and signal oscillators in two 30-MC receivers. At the conclusion of the examination the deviation meter showed a change of less than 200 cycles, which was probably due to changes in the crystal oscillators of the receivers. No adjustment to the deviation meter was necessary after the initial calibration.

Tuner Parts Packed in Moth Balls

Motorola, Inc., Chicago, packs silver-plated component parts of r-f coaxial tuners in the home variety of paradichlorobenzene moth balls during the pre-assembly period because lacquer coating and tarnish interfere with efficient induction-heater soldering.

To keep the parts free from fungus, tarnish and sulphur bearing atmosphere, the parts are stored in the protective vapor. Then, parts and moth balls are transferred to an operator's "pick-box". By keeping the parts thus in moth ball vapor until the many soldering operations are performed, the necessity for replating the tune cavities for appearance is entirely eliminated. The protective lacquer is applied after soldering and assembly.

Potentiometers

(*Continued from page* 90)

Fig. 6a shows the corresponding low goniometer curve.

It is to be noted that in the determination of a normalized goniometer curve, the slope of the normalized curve is largely dependent upon the shape of the linearity error curve in the region of maximum error. It can be seen by examination of the linearity error curves for the two potentiometers (Fig. 2B) that in the case of curve "B," pronounced points of greatest error are exhibited, while curve "A" is flatter throughout and shows no outstanding point of maximum error. When making calculations for a normalized goniometer curve for potentiometer "B," the pronounced points of greatest error may be missed if too few check points are used. This would result in a sharply declining normalized goniometer curve which would indicate a less accurate observed linearity error. On the other hand, inasmuch as there is no pronounced point of greatest error in curve "A," linearity error calculations for this potentiometer could use fewer check points, and still provide reliable results because of the greater flatness of curve "A."

Normalized Curves

Note that the normalized goniometer curves "C" and "D" in Fig. 3 lie close together, as do "E" and "F" in Fig. 4. As might be expected curves "E" and "F" are considerably higher than "C" and "D." The curves in Fig. 4 are for potentiometers with higher resistance (50,000 ohms as against the 25,000-ohm potentiometers plotted in Fig. 3); thus the ratio of linearity error to resolution error is much higher, and correspondingly the normalized goniometer curves are higher. Another possible factor is the differences encountered due to variation in resistance and core wires, since the two pairs of potentiometers were wound from different spools of wire.

An example in which the normalized goniometer curves from two apparently identical potentiometers do not lie very close together is found in curves "G" and "H" in Fig. 5a. This again can be explained by the ratio of linearity error to resolution error. Note that in Fig. 5b the linearity error of potentiometer "H" is about 10 times as great as that of potentiometer "G"; also, curve "G" is slightly more jagged than curve "H." Thus, "H" has a much higher

ratio of linearity error to resolution error and a correspondingly higher goniometer curve. Likewise, in comparing the linearity error curves of "H" in Fig. 5b and "J" in Fig. 6b, both have the same general shape, but "J" is much more jagged. Obviously, "J" has a large resolution error; hence its normalized goniometer curve (Fig. 6a) is lower than that of "H."

Laboratory Tests

A laboratory test was made on several 24-point linearity error curves, and the results indicated that fair predictions could be made as to what shape the normalized goniometer curve of a particular potentiometer would take. It was considered that this procedure might be useful in determining which potentiometers should be checked at more points in order to obtain a good estimate of their linearity errors.

Of particular interest is the overall picture developed from this research. This picture is perhaps better displayed in the form of a group of six curves encompassing the results obtained from the approximately 3000 linearity error calculations made during the course of the investigation. Use of these curves, shown in Fig. 7, offers for the first time a method of predicting accuracy of linearity error calculations. Their use also enables a reasonably accurate estimate of the percentage of potentiometers which will fall within linearity error requirements.

For example, using the curves shown in Fig. 7, it is seen that if each of a group of potentiometers is checked at 80 points, 95% of the calculations made will show an observed linearity of at least 81% of the true linearity error; if just one potentiometer were checked, the calculation would have 95% chance of showing an observed linearity error of at least 81% of the true linearity error.

Number of Check Points

In all probability, the greatest value in the use of the curves shown in Fig. 7, will be to determine the number of check points necessary to use in observed linearity error calculations in order to assure the fact that any group of potentiometers will exhibit linearity characteristics set forth in different specifications. For example, a specification requires the potentiometers for a control system have a ±0.5% linearity error;

(*Continued on page* 202)

also, because of cost problems, it is desired to have as small amount of rejects from the purchaser as possible. Examination of the curves shows that if 90 points are checked, 98 per cent of the potentiometers that have observed linearity errors of $\pm 0.4\%$ (80% of $\pm 0.5\%$) will have a true linearity error of ± 0.5 or better.

The curves shown in Fig. 7 have been reproduced with a sufficient degree of accuracy to provide a usable statistical reference. Their proper use should save production engineers considerable time in ascertaining the accuracy of linearity error as calculated from any predetermined number of check points.

Error Values

Generally speaking, results of this investigation indicate that linearity error values, as calculated from point-by-point data, are far less reliable than is generally believed, because usually too few points have been checked. In many instances it has been common practice to use only from 20 to 50 check points to calculate linearity error. Results of the investigation just completed show that when this small a number of check points is used, the resulting calculated linearity error may be only 50% to 65% of the true linearity error. This is particularly well illustrated by curve "B" in Fig. 2a, curves "C" and "D" in Fig. 3, and by curve "G" in Fig. 5a. Because of these findings, the conclusion has been reached that if the calculated linearity error is to remain within 10% of the true linearity error, approximately 250 check points must be used in the calculations.

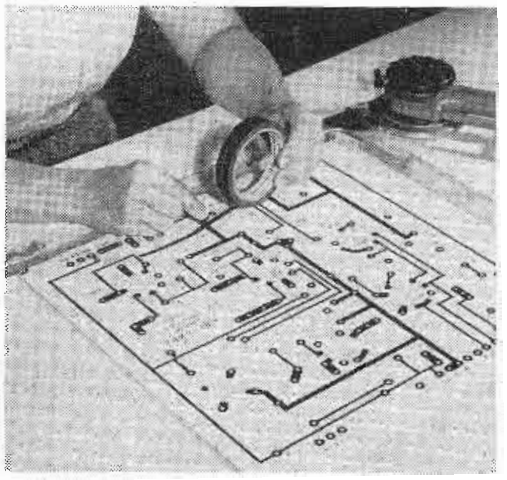
RECEIVER NO. 10,000

Hammarlund Manufacturing Co., Inc., New York, recently completed the final test on the 10,000th SP600 professional communications receiver. The widely-used unit has been incorporated in many famous installations since 1950—such as the Presidential Communications Car, the Voice of America, at MARS headquarters, and at the National Bureau of Standards.

Economical Etched Circuit Method

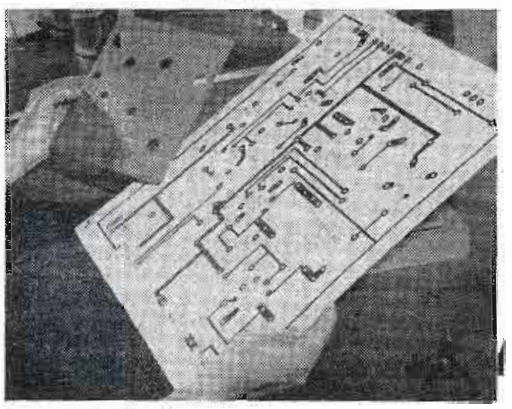
When small quantities of etched circuit boards are manufactured, the initial layout by the draftsman often proves to be the major expense involved. Under conventional procedures, a copy of the etched board is laid out at two to three times scale. Varying widths of conducting lines, eyelet holes, and other terminal arrangements are laid out on standard ink drawings. Besides being expensive, these drawings are difficult to change in case of drafting error or circuit modification.

To reduce this cost preliminary to the preparation of silk screen or photo-etching negatives, Kalbfell Laboratories



Draftsman makes a change in the master "drawing" used to produce etched boards by simply attaching another piece of black tape.

of San Diego, Calif., has developed a "tape and glue" layout method for producing master "drawings." First the board is laid out roughly with pencil on heavy white cardboard. Various conducting lines are marked on the board with electric black tape. Printed terminal and eyelet holes are glued to the board at the indicated points. The process is rapid, and changes are easily made. Then the board is reproduced in black ink on white paper by photo-li-



Comparison of sample etched board with master layout made with tape and glued-on terminals.

thography. The black taped lines are reported to be of more consistent density than those obtained with ordinary drawing inks.

Etched boards produced by the novel system are used in a number of Kalbfell instruments bearing the "Kay-Lab" trademark. Included among these are the firm's Micro-Miker, Decade Amplifier, and Digital Attenuator.

UHF Water Load

(*Continued from page* 73)

thermometers or water fittings and be radiated, possibly disturbing other measuring equipment nearby.

The completed water load has proved to be a highly useful instrument. The VSWR is less than 1.15 over the frequency band from 470 to 1200 MC. Expressed another way, the reflected power is at least 23 db down from the power incident on the load. The load has absorbed more than 15 kw of continuous power at several frequencies from 470 to 890 Mc. The upper power limit is not known because enough power to induce breakdown has not been available. The response of the load to changes in r-f power level is rapid, the thermometers reaching equilibrium in less than 30 seconds. Thermal insulation and impedance match are so good that the accuracy of the load is guaranteed better than 2% for power levels between 1 and 15 kw.

The author wishes to express his appreciation to A. B. Vane and E. G. Bourgeois for their helpful suggestions and experimental assistance.

1. "High-Power UHF Klystron," *TELE-TECH & ELECTRONIC INDUSTRIES,* Oct. 1952, page 60.

Senate Recommends Global TV Study

A recommendation that the government consider "the feasibility of linking the Atlantic nations and much of the non-Communist world . . . in vast television networks," has recently been presented to President Eisenhower by a Senate Foreign relations subcommittee.

The subcommittee reported that such a project could become a reality in a comparatively short time. It was also noted that the State Departmen's International Information Administration "scarcely recognized" the potential use of TV.

It may be recalled that TELE-TECH & ELECTRONIC INDUSTRIES pioneered for the acceptance of this concept in an open letter to the President, published in the August 1952 issue. In succeeding issues (Oct. 1952, Nov. 1952) more detailed plans for a world-wide TV-communications network were outlined.

Following this successful industry presentation, the editorial staff of TELE-TECH & ELECTRONIC INDUSTRIES prepared a similar article for publication in *Look* magazine (Jan. 27, 1953). With these plans receiving increasing study—and acceptance—in high level government and industry quarters, we may look forward to a global TV system for military and commercial use in the next several years.

Selenium Rectifier

(*Continued from page 97*)

60 ma in half-wave circuits. However, units of higher current rating may be obtained as "specials" from the manufacturer.

The requirements and demands of the aircraft industry for compact and lightweight power supplies initiated the volume production of the low-current, high-voltage selenium rectifier cartridges shown in Figs. 3, 4 and 5. They are available in half-wave current ratings (35° C ambient) of 1.5 ma to 60 ma having a

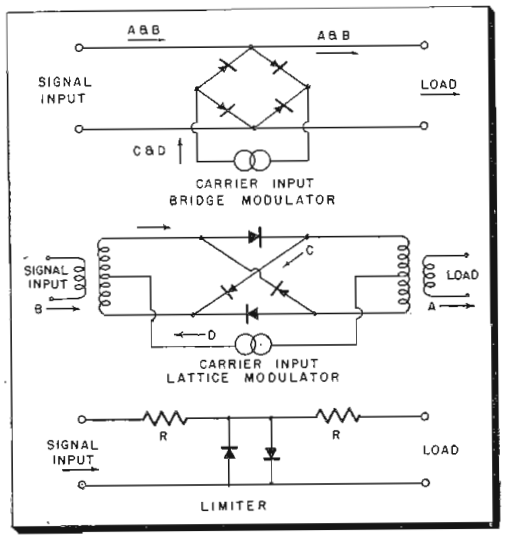


Fig. 6: Rectifier circuit applications. Letters A, B, C, D indicate spectra in various branches

body diameter of ¼ to 1¼ in. respectively. The voltage range of these units below the 70 ma rating is 20 to 4000 v. dc. with a maximum overall length of 9 in., and are furnished in various voltages. The 70 ma unit is also produced in a 6000 v. dc size which is approximately 14 in. in length.

The above low-current, high-voltage cartridges are supplied as half-wave units. By suitably connecting into bridge, center-tap, and series parallel circuits, practically unlimited voltage and current ranges may be achieved. For example, by using voltage multiplier circuits with a number of these units connected in series, voltages of 100 kv may be obtained. These cartridges are ideal for use in circuits demanding low load currents at voltages higher than usually delivered by common power supplies.

New Detectron Plant

Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif., manufacturers of precision electronic detection equipment, have announced the completion of a new plant which provides the company with greatly enlarged facilities for research and development.

Transistor Receiver

(*Continued from page 79*)

The air-cored mixer inductance L_1 is tapped at two points on each side of the center at which the oscillator excitation is connected. These taps provide approximate impedance matching for (1) the antenna, (2) the diode loading, and (3) the r-f tuning capacitor. A pair of 1N54A germanium diodes are connected as a balanced mixer feeding the 5-MC i-f signal to the first i-f transformer. The conversion loss is approximately 2.3.

The collectors are supplied through individual L-C filters from the common —22½ volt supply. Similarly, the emitters have individual L-C filters decoupling them from a common —1½ volt bias supply. Series 1500 ohm resistors limit the emitter current per stage to less than

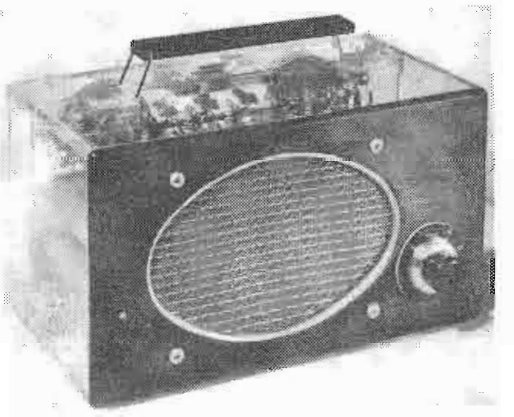


Fig. 3: Front view of experimental receiver

1 ma. The average gain per stage is about 11 db or 3.6 times. The overall gain is 67 db. or 2200X.

Limiting due to overloading takes place in the final stages when receiving strong signals. The action is not strong enough, however, to give all the noise reduction which might be desirable in a less experimental design.

The FM detector consists of a pair of 1N34 germanium diodes used in a conventional discriminator circuit. A conventional slug-tuned transformer T_7 was used. It was tapped to match the last i-f transistor.

The audio system uses a two-stage emitter-follower amplifier with RCA 2N34 junction transistors. This provides impedance reduction suitable for driving the push-pull output stage consisting of a complementary-symmetrical pair of experimental, power, junction transistors. In order to power both PNP and NPN output transistors from a common battery, a split-primary output transformer T_8 was used. Each primary has a step down ratio of 11.5 to 1 to the secondary which feeds a 3.2 ohm voice coil. The audio system has an overall

power gain of 46 db and delivers 75 mw maximum undistorted output to the speaker.

Since the receiver is an experimental model, a light hearing aid battery having a special formula is used. The total collector current drain of 60 ma permits about ten hours operation. The 6 ma total emitter drain is an extremely light load for the penlight cell.

The receiver operated satisfactorily over the FM band under normal strong-signal conditions, even with only the internal collapsible antenna. There were some features which could, perhaps, have been improved by better design; others would have benefitted from transistors with better performance. Nevertheless, the receiver, as the first of its kind, showed the utility of transistors for FM reception and represents another landmark in the gradually expanding field of these new solid-state devices.

Corporate Purchase

Gorn Electric Co., Stamford, Conn., has acquired the assets of the former International Connector Corporation of Paterson, N.J. The equipment of the latter company will be moved to Stamford. There production of electrical connectors and other devices will be continued under the name of Gorn Electronics, Division of Gorn Electric Co. Research and development facilities and production equipment will be expanded and the number of employees increased according to Mr. Martin Gorn.

100 KW ERP for KTBC-TV

Station KTBC-TV, Austin, Tex., owned by Texas Broadcasting Corp, and network-affiliated with ABC, CBS, DuMont, and NBC, went on the air June 9 with the first 5,000 lb. RCA high-band VHF transmitter and very high gain antenna to be installed in the nation.

The 12-section super-turnstile antenna is the first of its type to achieve an effective radiated power of 100 kw. According to Ben Hearn, station chief engineer, the new unit provided its expected full power output of 10 kw peak visual power and 6 kw aural power.

Accident-Prevention Course Offered

The fall term, evening program, in industrial and traffic-accident prevention training offered the Center for Safety Education, New York University, Washington Square, N. Y., begins September 21, 1953. Present curriculum permits students to enroll for eleven courses required to obtain a Certificate in Industrial Safety, or a Certificate in Traffic Safety.

News of MANUFACTURERS' REPS

Technical Services Co., 150 Causeway St., Boston 14, Mass. has been named technical sales representative for the Eureka "Snapper" thermal time delay relay in the New England area by The Thermal Relay Div. of Eureka Television Tube Corp., Hawthorne, N. J.

Howard Levy, formerly sales manager of Oak Ridge Products, has become a member of Land-C-Air Sales Co., 42 Oak Ave., Tuckahoe, N. Y.

Leon L. Adelman has been appointed representative in the New Jersey and Metropolitan New York areas to handle the entire high fidelity, TV, speaker, and phonograph cabinet line manufactured by River Edge Industries.

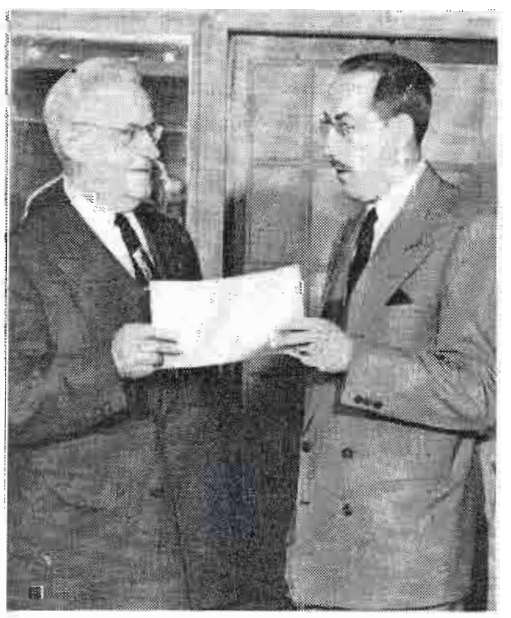
Dan J. Connor Co., 1346 Suburban Station Bldg., Philadelphia 3, Pa. has incorporated as the "Danco Corporation." Personnel will remain as before and Dan J. Connor will continue as president.

L. H. Harriss, of the L. H. Harriss Sales Co., 383 Brannan St., San Francisco 7, Calif., has been appointed sales representatives for Radio Merchandising Sales, Inc. for Northern California and Nevada.

Frank A. Emmet Co., 2834 W. Pico Blvd., Los Angeles 6, Calif., will represent Radio Merchandising Sales, Inc. in the sale of antennas and accessories in Southern California, Southern Nevada, and Arizona.

Larshan Inc. has been appointed sales representatives for California, Nevada, and Arizona by General Ceramics and Steatite Corp., Keasbey, N. J. Mr. Arthur W. Charrett of the Larshan

REP SERVICE AWARD



Morris F. Taylor, founder of Morris F. Taylor Co., Silver Springs, Md. is shown presenting P. A. Boyd a sales service award commemorating his 15-year association with the company. "Perc" Boyd is a real old timer. He was one of the original staff of KDKA, Pittsburgh, Pa., America's first commercial broadcasting station.

sales engineering organization will handle the complete General Ceramics line of technical ceramics, porcelain and Steatite insulators, coil forms, etc. He may be addressed at P.O. Box 955, Santa Monica, Calif.

Charles Vermilye Co., formerly of 500 Fifth Ave., New York, N. Y., has moved its offices to 3440 Wilshire Blvd., Los Angeles 5, Calif.

J. T. Hill Sales Co., Los Angeles, has been appointed Arizona and Southern California representative for Wald Mfg. Co., Grove City, Pa., manufacturers of soldering guns, pencil irons, and accessories.

Ealy & Hastings, electronic manufacturers' representatives, have moved to their new building at 4440 Lankershim Blvd., North Hollywood, Calif.

Neely Enterprises, Hollywood electronic engineering representatives with five western branches, have added John Davis, professor of electrical engineering, University of New Mexico, and Bruce Savory, former electronic buyer for Hughes Aircraft and Northrop Aviation, to the company staff. Mr. Davis is associated with the Albuquerque branch. Mr. Savory heads the order department and expediting at Hollywood headquarters.

Brook Electronics, Inc. has appointed Stanley K. Wallace, Lutz, Fla., to represent the company in Alabama, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. Antle & Smith, Dallas, Texas, will cover Texas, Oklahoma, Arkansas, and Louisiana. Oregon, Washington, Idaho, and Montana will be covered by Richard R. Legg, 6625 SE 76th Ave., Portland 6, Ore.

William B. Pray, head of W. B. Pray Sales of Wellesley Hills, Mass. has been appointed New England representative of The Rauland Corp., Chicago, Ill., TV tube manufacturers. The territory was formerly covered by Joseph Thatcher who died several months ago. Mr. Pray is a former president of the New England Chapterof "The Representatives."

The Stephens Mfg. Corp., Culver City, Calif., has appointed A-N-B Specialties Co., West Richfield, Ohio, headed by Neal Bear, representative for the Tru Sonic line of loud speakers and capacitor and wireless microphones in Kentucky, Ohio, West Virginia, Western Pennsylvania, and Michigan.

The Kittleson Co., manufacturers' engineering representatives, Los Angeles, have been appointed by Waveforms, Inc., New York City, producers of voltmeters, oscillators, and other test equipment, to cover California, Arizona, New Mexico, Nevada, and Colorado.

Frank A. Emmet Co., Los Angeles, will represent Phaostron Co., South Pasadena, California, producers of meters, relays, resistors, etc., in Southern California and New Mexico.

Richard R. Legg Co., Portland, Ore., has become factory sales representative for distributor and industrial accounts in the Pacific Northwest territory for Insuline Corp. of America, Long Island City, N.Y.

Preset

(*Continued from page 83*)

is applied to a system of six cascaded presettable decimal counting units. Each unit consists of a four tube scale-of-10, a coincidence amplifier and nine single-throw switch stacks that are actuated by a push button mechanism. A tenth (zero) push button is added to clear the unit. An output is obtained for any desired count by depressing one of the numbered pushbuttons. See circuit diagram in Fig. 5.

The decimal counting unit consists of four binaries that are connected in cascade forming a scale-of-16 which is permuted to a scale-of-10 by two R-C feedback networks. The circuit operates as a binary counter up to the count of four. On the count of four the third stage is triggered, sending a pulse through the first feedback network triggering the second stage. Since it requires two inputs to trigger the second stage, this is the equivalent of adding two input pulses, and the count stored in the unit corresponds to a binary count of six. On the count of six (which is the equivalent of eight in a binary counter) the fourth stage is triggered, sending a pulse through the second feedback network triggering the third stage. This has the same effect as if four additional input pulses had been applied and the unit has the binary count of twelve stored in it. The unit again operates as binary counter for the remaining four pulses required to reset it to zero. Therefore, by internally adding the equivalent of six input pulses, the scale-of-16 has been permuted to a scale-of-10.

Coincidence Amplifier

The coincidence amplifier consists of four triodes and their associated circuitry. Identical resistor dividers are connected between each of the four stages of the counting unit and −150 volts. The division ratio is chosen so that when a resistor connected to −150 is shorted, its corresponding triode will be cut-off at all times. However, if the short is removed by depressing one of the pushbuttons the division ratio is such that the triode will follow the plate of the binary to which it is connected. Since the plates as well as the cathodes of the four triodes are connected together, coincidence is obtained when all four tubes are at plate current cut-off.

In the counter, the coincidence plates of all six counting units are

connected together and a plate load resistor is added. Its resistance is much larger than the plate resistance of one of the triodes so that the transient obtained when all the triodes are cut-off is much larger than those obtained when the number of conducting tubes changes.

The number to be preset is selected by depressing the corresponding button on each of the decimal counting units. When any number other than zero is depressed and the unit is reset to

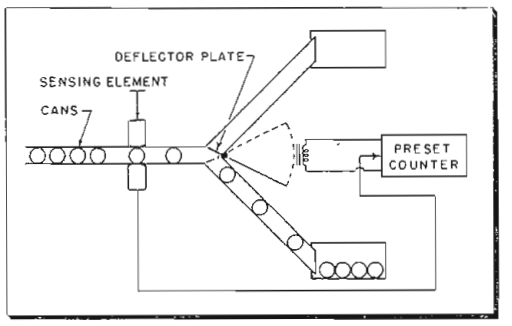


Fig. 6: System for automatic packaging using a preset counter and sensing element

zero, at least one coincidence triode will be conducting. As the count progresses the number of conducting triodes varies in such a way that when the preset count is reached all triodes are cut-off and a large positive transient is obtained.

Output Circuit

An inverter-amplifier, one-shot multivibrator, cathode follower and relay drive tube make up the output circuit. Connections among these circuits differ for each of the three functions. In general, however, the inverter-amplifier inverts the output of the coincidence amplifier. Its output is used to drive a one-shot multivibrator and to supply the gating voltage for the electronic gate.

The multivibrator supplies a pulse output and when desired, drives both the cathode follower reset tube and the relay drive circuit. When electronic reset is used, about 15 μsec is required which is short enough to allow the instrument to recycle at rates up to 40,000 cps.

This instrument may be used, with suitable, accessories to control a multitude of processes automatically. Typical of these are: batching and packaging control for objects such as candy bars, bottle tops, cans, bottles, etc.; controlling coil-winding equipment; cutting stock to precise lengths; determining over-shoot of motors, controlling speed of motors.

(*Continued on page* 212)

Fig. 6 shows the two basic components required for automatic packaging, i.e., the preset counter and the sensing element. The sensing element is used to generate a change in voltage each time an object passes and is mounted directly on the endless belt.

A deflector is mounted directly behind the sensing element and is used to select which container is to be filled. Each time the predetermined number of objects are counted, the deflector is actuated. One package is being filled while a second package is moved into position to be filled. Because of its flexibility, the counter can be set to any desired count.

When an accurate frequency is applied to the input of the preset counter it can be used as a variable time-interval or time-delay generator. An application of such a time-interval generator is in electronic tachometry systems where it may be desirable to compensate for different gear ratios and the number of teeth in pick-up devices by controlling the time used to take the readings.

Controlling Two Processes

In places where it is desired to control two processes simultaneously, a dual preset counter that is similar to the one described, except that it has two coincidence amplifiers and output systems, can be used. In this instrument two numbers are preset. When the first preset number is reached an output is emitted and the instrument continues counting. When the second preset number is reached, the operation of the instrument is the same as the one described.

"CORDLESS MICROPHONE"

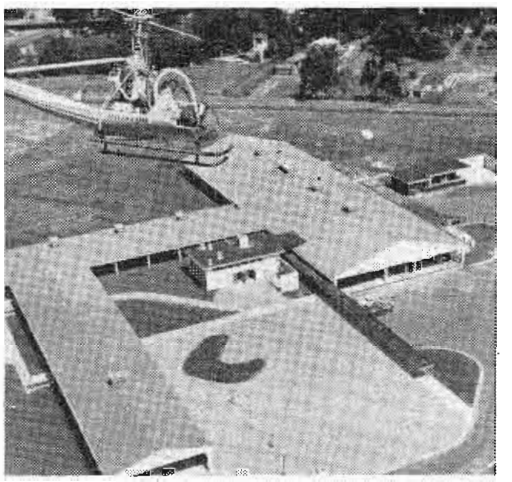
Edward R. Taylor, vice president of Motorola, Inc., demonstrating a new, hand-held "cordless microphone" to the business leaders attending the recent 1953 National Sales Executives 18th Annual Convention in Atlantic City. Actually, the "microphone' is a compact radio transmitter tied into the public address system. The unit was licensed to operate on a frequency of 154.57 MC. With ranges up to two miles, auditorium size is not a problem.

WESCON Exhibitors

(Continued from page 78)

Brown Electro-Measurement Corp.	1106
Brush Electronics	925-926
Burgess Battery Co.	1029
Burlington Instrument Co.	707
Bussman Mfg. Co.	1512
The Calidyne Co.	921
Cal-Tronics Corp.	403
Cannon Electric Co.	505
Cascade Research Corp.	1113A
Central Scientific Co. of Calif.	112
Centralab A Div. of Globe Union, Inc.	901
Channel Master Corp.	1303
Chicago Transformer Div. Essex Wire Co.	218
Cinch Mfg. Corp. Howard B. Jones Div.	1308-1309
Cinema Engineerinig Co.	823
Clarostat Mfg. Co.	1417
Clary Multiplier Corp.	120
Clear Beam Television Antenna Co.	1204
Sigmund Cohn Corp.	1310
Coil Winding Equipment Co.	1317
Cole Instrument Co.	903
Collins Radio Co.	210-211
Color Television, Inc.	212
Computer Research Corp.	109-110
Condenser Products	1411
Consolidated Engineering Corp.	514
Consolidated Vacuum Corp	513
L. L. Constantin & Co.	304
Corning Glass Works	716
Crosby Laboratories, Inc.	409
Cubic Corporation	1104-1150
Dale Products, Inc.	227
Dalmo Victor Company	213
The Daven Co.	207
Joe Davidson & Associates	101-102
De Jur Amsco Corp.	219
Robert Dollar Co.	418
Drake Electric Works, Inc.	904
Dressen-Barnes Corp.	1507
Allen B. DuMont Labs., Inc.	603-604
Eitel-McCullough, Inc.	701-702
Elco Corp.	2178
Electro Engineering Works	808
Electro-Mechanical Specialties Co.	1410
Electro-Voice, Inc.	622
Electronic Assoc., Inc.	1104-1105
Electronic Engineering Assoc., Ltd.	709
Electronic Engineerinig Co. of Calif.	520
Electronic Instrument Co., Inc.	1304
Empire Devices, Inc.	1315
Engineering Research Assoc. Div. of Remington Rand, Inc.	119
Erie Resistor Corp.	920
Fairchild Camera and Instrument Corp.— Potentiometer Div.	106
Federal Telephone and Radio Corp.	1301-1302
The Filtron Sales Corp.	608
Fusite Corp.	1506
General Ceramics & Steatie Corp.	1515
General Electric Co| Apparatus Sales Div.	911-912
General Electric Co. Electronics Div.	915-916
General Fuse Co.	1306
General Radio Co.	913-914
Gertsch Products, Inc.	815-816
Girard-Hopkins	721
Globe Industries, Inc.	104
Gonset Co.	222
Gorman Mfg. Corp.	411
Grant Pulley & Hardware Co.	402
The Hammarlund Mfg. Co., Inc.	1021
Heinemann Electric Co.	108
Herman E. Held	908
Helipot Corp.	613
James P. Hermans Co.	524
Hermetic Seal Products Co.	1601
Hewlett-Packard Co.	1111-1112
J. T. Hill Sales Co.	605-606
Hoffman Radio Corp.	723-724
Harvey Hubbell, Inc.	1418
Huggins Laboratories	917
Hughes Aircraft Co.	407
Hycor Co., Inc.	1017
Hytron Radio & Electronics Co.	1201
Indiana Steel Products Co.	1604
Inet, Inc.	412
Insulation and Wires, Inc.	1001
International Rectifier Corp.	910
International Resistance Co.	523
Jennings Radio Mfg. Corp.	1202
Howard B. Jones Div. Cinch Mfg. Corp.	1308-1309
Kaar Engineering Corp.	907
Karp Metal Products Co., Inc.	1006-1007
Kay Electric Co.	1005
Ketay Mfg. Corp.	417
Kings Electronics Co.	121
Kittleson Co.	710-711
James Knights Co.	609
Laboratory for Electronics	922
James B. Lansing Sound, Inc.	714
Harry A. Lasure Co.	1010

(Continued on page 214)



Varian Associates' new Palo Alto research, development, and administrative building photographed at low level with helicopter from nearby Hiller Helicopter plant. This brand new electron-device facility will be a feature of the Peninsula microwave field trip during the 1953 WESCON (Western Electronic Show and Convention), August 19-21st, San Francisco, Calif.

Production Expansion

PCA Electronics, Inc., 2180 Colorado Ave., Santa Monica, Calif., announce that the acquisition of additional plant facilities, equipment, and personnel enables them to produce filament and plate transformers and chokes in accordance with MIL-T-27. The new line complements the popular line of miniature pulse transformers made by this company.

Safety Handbook

The National Safety Council's new 94-page "Handbook of Accident Prevention for Business and Industry" contains detailed information on such subjects as: plant layouts, materials handling, housekeeping, machine guarding, electrical hazards, first aid, fire prevention, and personal protective equipment. It also explains how the small business can obtain the assistance of service and insurance organizations, governmental agencies, trade associations, and professional societies.

BULLETINS

Miniature Bushings

A complete line of miniature feed-thru bushings is displayed with full engineering data, dimensional drawings, and specifications in catalog No. 153 released by Thor Ceramics, Inc., 225 Belleville Ave., Bloomfield, N. J.

Electroforming

A well-illustrated booklet published by Bone Engineering Corp., 701 W. Broadway, Glendale 4, Calif., tells what electroforming is, where it is used, and discusses the advantages of the process.

Movie Lights

Catalog C, issued by Mole Richardson Co., 937 N. Sycamore Ave., Hollywood 38, Calif., presents complete power distribution data, and helpful globe and illumination tables covering the specialized movie lighting equipment made by that company.

Magnetic Amplifier Power Supply

Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif., recently announced the release of a new 8-page bulletin, No. L453, covering their magnetic amplifier regulated power supplies for laboratory testing applications.

Quality Control

"Quality Control—Some Monroe Short-Cut Statistical Methods" is the title of a practical working manual on production control published by Monroe Calculating Machine Co., Inc., Orange, N. J.

Research

The steps and services undertaken in development engineering projects are subjects treated in a four-page folder released by Designers for Industry, 2915 Detroit Ave., Cleveland 13, Ohio.

Electronic Tubes

The latest condensed 20-page electronic tube catalog of Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y., is available at that address.

Selenium Rectifiers

Five new catalog-sheets covering Richardson-Allen selenium rectifiers are available at Wesley Block and Co., 39-15 Main St., Flushing, N. Y.

Metal Case Capacitors

A new 20-page catalog on "Glasseal" capacitors, (PG-3) is available at the Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J. It contains complete engineering data, performance curves, styles, sizes, and capacitance and voltage listings for subminiature units.

Regulated Power Supplies

Kepco Laboratories, 131-38 Sanford Ave., Flushing 55, N. Y. offer an attractively-printed 5-page folder which presents the ratings of 20 voltage regulated power supplies for industrial and research use.

Switches

A 16-page catalog (C-11) published by Wells Sales, Inc., 333 W. Chicago Ave., Chicago 22, Ill., illustrates and describes more than 15 types of regular and miniature switches.

Sulfur Compound Recorder

The measurement and control of sulfur compounds is discussed in bulletin CEC 1810B, released by Consolidated Engineering Corp., 300 North Sierra Madre Villa, Pasadena 15, Calif.

TV Components

Catalog Tr-53, just released by Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif., lists over 500 TV compo-

(*Continued on page 219*)

the switch is ON to

GUARDIAN®

APPROVED

Interchangeable

AIRCRAFT CONTROLS

MOTOR STARTERS
CONTROL STICK GRIPS
GUN FIRING
BOMBING
FLYING MISSILES

AIRCRAFT DESIGN ENGINEERS can allow for continuously changing power and performance requirements through the complete *interchangeability* (on the same mounting base) of this new line of Guardian Aircraft Relays. Standard spacing of mounting bracket holes provides extreme flexibility. **It's the way to meet new control specifications without changes in frame drawings!** Units range from single pole, single throw (time delay available) to four pole, double throw contact combinations, with ratings from 10 amperes to 50 amperes at 28 v., D.C. All sealed in accordance with MIL-R-6106. Weights: from 7.5 ounces to 20.8 ounces. Write for Bulletin 1 AR.

200 Ampere Solenoid Contactor

NOTE THE PRECISE ALIGNMENT OF MOUNTING HOLES!

25 Amp S.P.D.T. | 10 Amp 3 P.D.T. | 10 Amp 4 P.D.T. | 10 Amp S.P.D.T. | 10 Amp 2 P.D.T. | 10 Amp 3 P.D.T. | 50 Amp S.P.D.T. | 10 Amp 3 P.D.T. | 10 Amp 2 P.D.T.

Specify from Guardian's complete range for every advantage of quick interchange!

GUARDIAN G ELECTRIC

1607-J W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

PRECISION DELAY LINE

For INSTRUMENTATION
COLOR TV • COMPUTERS
PULSE FORMING NETWORKS, Etc.

Laboratory type, variable in additive increments of .02 microseconds each. Lumped constant type of instrument with total maximum delay of 1.0 microseconds measured at 1/2 amplitude with a rise time of 0.05 microseconds measured at 10% and 90% amplitude.

Characteristic impedance, 50 ohms. Maximum peak voltage, 500. Individual switches each control a step of 20 coils and 20 coudensers (1% mica). Low attenuation a feature. Compact, only 2½" x 3" x 4½" overall.

In production and moderately priced at $75.00.

Manufactured by **MAY ENGINEERING COMPANY**

6055 Lankershim Blvd. N. Hollywood, Cal.

. . . the swing is to

TELE-TECH

TELE-TECH's growth has been phenomenal. The tremendous increase in advertising pages reflects the advertisers' knowledge of the selling power of TELE-TECH. Just look at the facts.

Year	Advertising Pages	Percentage Increase
1950	425 pages	
1951	716 pages	68% over 1950
1952	1078 pages	154% over 1950
1953*	1424 pages	336% over 1950

* 1st half projected for entire year

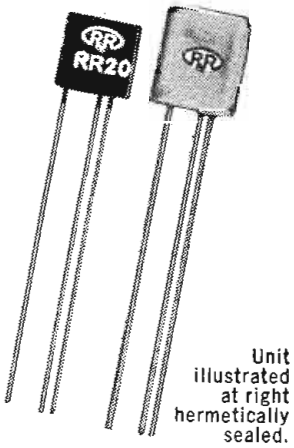
Caldwell-Clements, Inc., 480 Lexington Ave., New York City 17

Germanium Transistors and Diodes

FOR EVERY PURPOSE!

PNP JUNCTION TRANSISTORS

Tiny, stable high gain units, most economical of power, may be soldered in place or socketed in a recommended RTMA transistor socket. They are suitable for audio amplifiers, servo amplifiers and transformer coupled carrier amplifiers. Available in plastic or hermetically sealed in metal and glass.



Unit illustrated at right hermetically sealed.

PNP JUNCTION TRANSISTORS
(Typical Characteristics at 25° C—Grounded Emitter)

TYPE NO.	RR14‡	RR20‡	RR21‡
Collector Voltage—volts	—1.5	—1.5	—15.0
Collector Current—ma	—0.5	—0.5	— 3.0
Ico—Microamp.*	10	10	30
Current Amplification	25	40	25
Power Gain—db	30	40	—
Noise Factor—db (1 Kc)	22	22	—
Power out—mw (10% Dist.)†	—	—	20.0

* Ie = 0, Vc = —1.5 volts.
†With 1000 ohm driving impedance and 5000 ohm load.
‡RR14H, RR20H and RR21H are hermetically sealed types.

JUNCTION POWER DIODES

WITH THESE DISTINGUISHING CHARACTERISTICS:

- *Very low forward drop*
- *Low reverse leakage*
- *Tiny*
- *Hermetically sealed in metal and glass*

Useful in power supplies, magnetic amplifiers and telephone systems, etc., they have the characteristics of large plate-type power rectifiers and size and weight of a small circuit component.

POINT CONTACT TRANSISTORS

Available in a variety of stable controlled types suitable for both fast and medium speed switching circuits and high frequency amplifiers. Advanced mechanical design for economical production. . . . Heat conducting metal case; standard basing, choice of solder-in or plug-in.

Coming . . .

PHOTO TRANSISTORS

. . . To operate power relay with one junction transistor as DC amplifier.

JUNCTION POWER TRANSISTORS

. . . For audio power up to 2 watts.

Our engineers will be glad to offer suggestions regarding your Germanium Diode and Transistor applications without obligation. Write to Dept. T-1.

Seletron and Germanium Division

RADIO RECEPTOR COMPANY, INC.

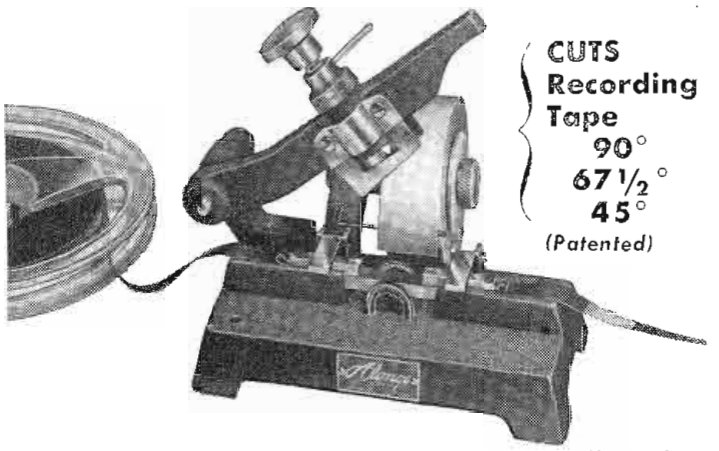
Since 1922 in Radio and Electronics

SALES DEPARTMENT: 251 WEST 19TH STREET • NEW YORK 11, N. Y.
FACTORY: 84 NORTH 9TH STREET • BROOKLYN 11, N. Y.

NOW available for prompt delivery . . .
The NEW "ALONGE"

NON-MAGNETIC
Recording Tape Splicer

Makes a perfect splice in seconds!



CUTS Recording Tape
90°
67½°
45°
(Patented)

The only ***NON-MAGNETIC*** Recording Tape Splicer that makes editing easy. Pays for itself in time saved—for it is the fastest-acting precision splicer.
The *cutting arm* has *three* knives: The *center knife* is directional and can be pivoted and set to cut either at perfect 90°, at 67½°, or at 45°. The *spring pads* hold the recording tape firmly in place as the *side knives* cut the splicing tape to the exact width of the recording tape . . . Precision machined, beautifully finished; lightweight, rugged.

Write for complete details.

ALONGE PRODUCTS, INC. • 163 West 23rd Street New York 11, N. Y.

TV LENSES

WORLD'S LARGEST STOCK

Coated Hi-resolution Lenses for every TV need — wide angle, normal, telephoto — 1¼ to 20" . . . . Cooke, Zeiss, Ektra, Carl Meyer, B & L, Wollensak, Ross, Astro, etc. All accessories, baffle rings, counter-balances, fittings. Foc. mounts fit RCA, Du Mont, GE Image Orth. Special mounts for GPI and others. Expert fitting service. *LOWEST PRICES.* 15 day FREE TRIAL. *Unconditional Guarantee.*

SERVING TV SINCE 1936 . . .

FREE! TV LENSE BULLETIN and PRICE LIST

BURKE & JAMES, Inc.
321 So. Wabash Avenue (T) Chicago 4

ENGINEERS:

TV Color Tube Opportunities

Leading Tube Manufacturer has several engineering positions opening in the West in design and development on color picture tubes. Write giving full resume to Box A-853.

TELE-TECH

480 LEXINGTON AVE. NEW YORK, N. Y.

Here's BIG HELP IN TERMINAL WIRING!

The correct wire to correct terminal every time!

The New JONES FANNING STRIP

Connections are made through Fanning Strip, on bench or anywhere apart from barrier strip, and quickly slipped into assembly.

Designed for use with Jones Barrier Terminal Strips Nos. 141 and 142, for 1 to 20 terminals.

9-141 Barrier Strip

9-161 Fanning Strip. Pat. applied for.

Simplifies and facilitates soldering. Insures positive correct connections. Saves time. Ideal for harness or cable assembly. Strong construction: Brass terminals, cadmium plated. Heavy bakelite mounting.

Jones HOWARD B. JONES DIVISION
CINCH MANUFACTURING CORPORATION
CHICAGO 24, ILLINOIS
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

21,000

engineering

circulation

the most effective circulation in the electronic industry

TELE-TECH & ELECTRONIC INDUSTRIES

CALDWELL-CLEMENTS, INC.

480 Lexington Ave., N. Y. 17, N. Y., PLaza 9-7880

BULLETINS

nents, toroids, and pulse, transitor, and miniature transformers. It also has a geophysical section.

Angular Position Encoder

Bulletin No. 109 describes and presents engineering data covering the model 14310 angular position encoder which can be attached to Minneapolis-Honeywell, Leeds & Northrop, or Bristol potentiometers to present digital data from tape from a Clary printer; and model 14311, which operates a standard type card punch system. Both units are manufactured by G. M. Giannini & Co., Pasadena 1, Calif.

Tube Brazing Alloys

Western Gold & Platinum Works, 589 Bryant St., San Francisco 7, Calif., presents characteristics and performance data on the more widely used vacuum tube brazing alloys in catalog V-121.

Ionization Gauge Tube

Bulletin A-006-043 describes the type L-3032 ionization gauge tube used to monitor pressure in high vacuum production processing in the range from 10^{-4}—10^{-7} mm Hg. Bulletin A-008-043 describes model 4301 ionization gauge amplifier with built-in power supply, range switches from 10^{-4} to 10^{-8}, a full-scale leak-check range, and outgassing heater. Both units are manufactured under Phillips Laboratories, Inc. patent license by Litton Engineering Laboratories, San Carlos, Calif.

Ferromagnetic Cores and Switches

Electronics Components Div., Stackpole Carbon Co., St. Marys, Pa., has released two attractive bulletins. Bulletin RC-9A discusses the physical properties, electrical advantages, and applications of ferromagnetic "U" cores and presents covering curves, diagrams, and formulae. Bulletin RC-9B illustrates and describes both line and slide switches, and includes drawings and specifications of various types in each switch class.

Resistors

Catalog data bulletin C-1, the 12-page brochure published by International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa., comprehensively covers the features, characteristics, coating, dimension, derating, insulation, windings, and specifications of tubular and flat power wire wound resistors.

Miniature Relays

Bulletin no. PR1 presents actual scale drawings, characteristics, and performance data covering the series PR 9100 armature type sensitive miniature relays manufactured by Phaostron Co., 151 Pasadena Ave., S. Pasadena, Calif.

VU Meter

The advantages of visual recording control and a description of the model 10 VU meter made by Tapemaster, Inc., 13 W. Hubbard St., Chicago 10, Ill., are presented in bulletin 110.

Filters

Burnell & Co., Yonkers, N. Y., have released a two-page folder which describes a new series of single side-band filters and presents their frequency response curves.

Square Wave Generator

Performance specifications of square wave generator model 43A are presented in a bulletin released by Electro-Mechanical Research, Inc., Ridgefield, Conn.

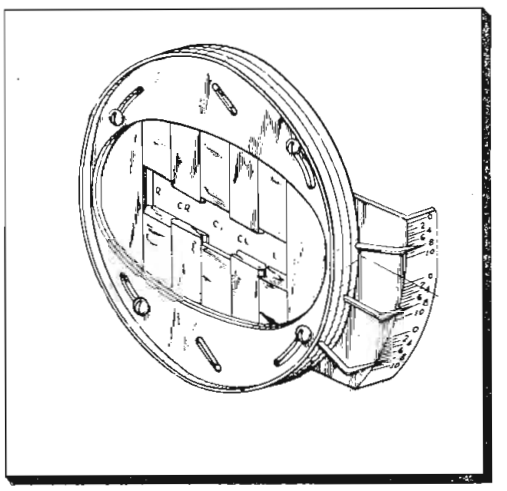
Inductors

Torocoil Co., 1374 Mobile Court, St. Louis 10, Mo., has released two new bulletins: one describes the characteristics of a new line of precision decade inductors; the other presents the frequency characteristics, temperature affect, quality factor, and unit size of their standard line of toroidally-wound, powdered-molybdenum permalloy inductors.

Image Forming System for TV and Film

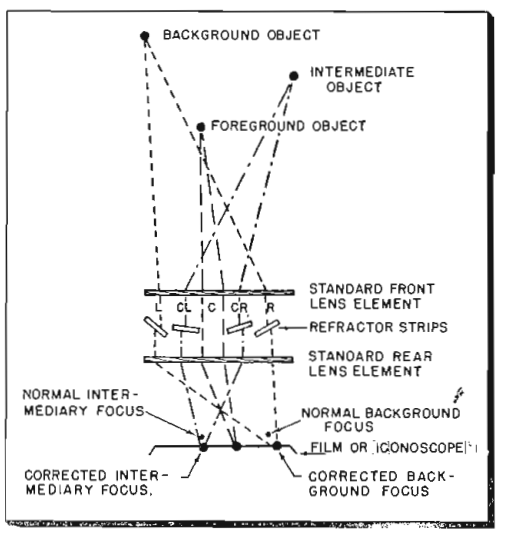
A new departure in optical systems is reported to produce enhanced illusions of depth and roundness in TV and film pictures. No viewing glasses or TV receiver modifications are required. The entire operation is performed at the camera lens by a light gate iris and arrangement of refractor strips, which control the light going to the conventional film or iconoscope.

The system was invented and patented by Melville Terwilliger, 6500 Yucca St., Hollywood 28, Calif., and is trademarked under the name "Inspacian." The image relief effect has the trademark "Depthdimension." It is available as a complete package on a contractual basis.



Light gate iris with several adjustable leaves which control the amount of light which is allowed to pass through optical system. Up to 600 measured gradations are available for each leaf which divides the Inspacian aperture

The instrument, as installed on a motion picture camera, measures 12 x 12 x 6 in. It utilizes schematic variations of image sharpness to blend modifications of image forms to heighten the appearance of space and solidity.



In operation, Inspacian relies on matched pairs of vertical refractor strips (CL-CR and L-R) to modify the focus of the divided portions of the light beam which pass through them. This allows images in different planes to be thrown in or out of focus to heighten depth illusion

(*Continued on page 222*)

TEAMED TO EXPLOIT ACCURACY

BECO MODEL 855-A1
OSCILLATOR AMPLIFIER

- Specifically designed to afford full utilization of outstanding accuracy and range of Beco Model 250-C1 Impedonce Bridge.
- Complete operation of the 250-CI Bridge from A.C. power.
- Highly stable oscillatar, accurate to within 1% of nominal frequency.
- Maximum convenience. Visual null indication. No batteries.

BECO MODEL 250-CI
IMPEDANCE BRIDGE

- Features Beco Dekadial for accurate resistance, capacitance, inductance. Readings to four significant figures.
- The most accurate, widest ronge Impedonce Bridge available.
- Compact, light, portable. 9" x 11" x 11" over all.
- Wide range:
  Resistance — 1 milliohm to 11 megohms.
  Capacitance — 1 $\mu\mu$f to 1100 μfs.
  Impedance — 1μh to 1100 henrys.

BECO **DEKADIAL**
36 feet of scale length with 38,000 discreet increments
ACCURACY — Resistance: ±0.1%; Capacitance: ±0.25%; Inductance: ±1.0%.

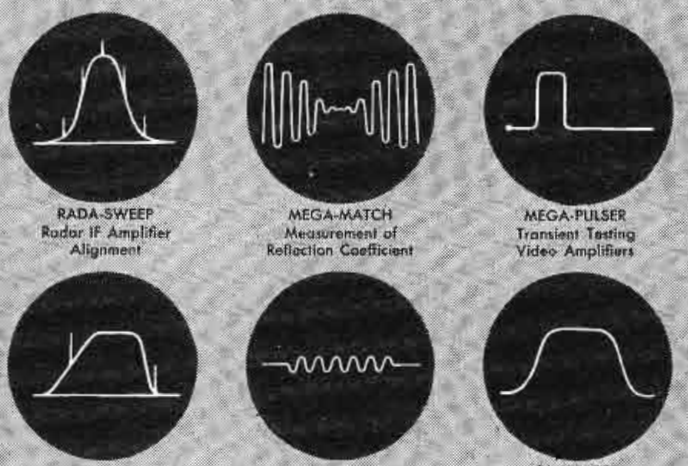
- ♦ Model 855-A1 Oscillator-Amplifier $170
- ♦ Model 250-C1 Impedance Bridge $340
- ♦♦ Team $510

Write for Literature and Name of Local Sales Representative

BROWN ELECTRO-MEASUREMENT CORP.

4312 S. E. Stark St.
Portland 15, Oregon

NEED INSTRUMENTS TO SOLVE ELECTRONIC PROBLEMS?...



RADA-SWEEP
Radar IF Amplifier Alignment

MEGA-MATCH
Measurement of Reflection Coefficient

MEGA-PULSER
Transient Testing Video Amplifiers

MARKA-SWEEP RF-P
TV Tuner Alignment

RADA-PULSER
Radar IF Transient Testing

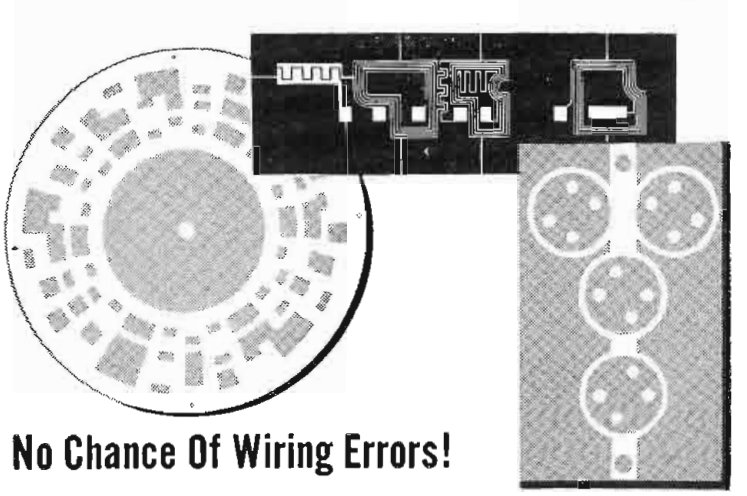
CALIBRATED MEGA-SWEEP
Wide Range Sweeping Oscillator
Single Dial Tuned

CONSULT THIS LATEST 64-PAGE CATALOG

Write FREE

KAY ELECTRIC CO.

14 MAPLE ST. PINE BROOK, N. J.



No Chance Of Wiring Errors!

Print your product's electrical circuit on SYNTHANE copper-clad laminated plastic and you eliminate expensive wiring and wiring errors. Fast and relatively inexpensive, this process permits quick changes in circuits without retraining assembly workers. Easily punched, sawed, and drilled, copper-clad SYNTHANE also combines these properties: high strength, light weight, low inertia, corrosion-and-heat resistance, and high insulation. To learn more about the role of copper-clad SYNTHANE in electronics, mail this coupon today.

SYNTHANE

Manufacturers of laminated plastics
SHEETS
RODS • TUBES
MOLDED-MACERATED
MOLDED-LAMINATED
FABRICATED PARTS

SYNTHANE CORPORATION
11 River Road, Oaks, Pennsylvania

Gentlemen:
Please send me information on SYNTHANE laminated plastics' use in "printed"circuits.

*Name*_____
*Address*_____
*City*_____ *Zone*___ *State*_____

ARMSTRONG ON MICROWAVES

(*Continued from page 57*)

The only satisfactory continuous wave generator available for the frequency with which he was working appears to have been the Barkhausen Kurtz type; but the available tubes, when pushed for power, proved to have a life measured by minutes. Marconi had new tubes developed, adjusted to fit into circuits and to operate reliably with increased power. With several units in parallel, he appears to have obtained an effective power of the order of 10 watts. His receiver made use of an electron oscillator arranged for superregeneration. The gain of the parabolic reflectors used was given at 8 decibels.

With that equipment, which must have required the same consummate skill to handle as the original coherer spark equipment, he once more found that difference between experimental fact and accepted theory which he had encountered twice before.

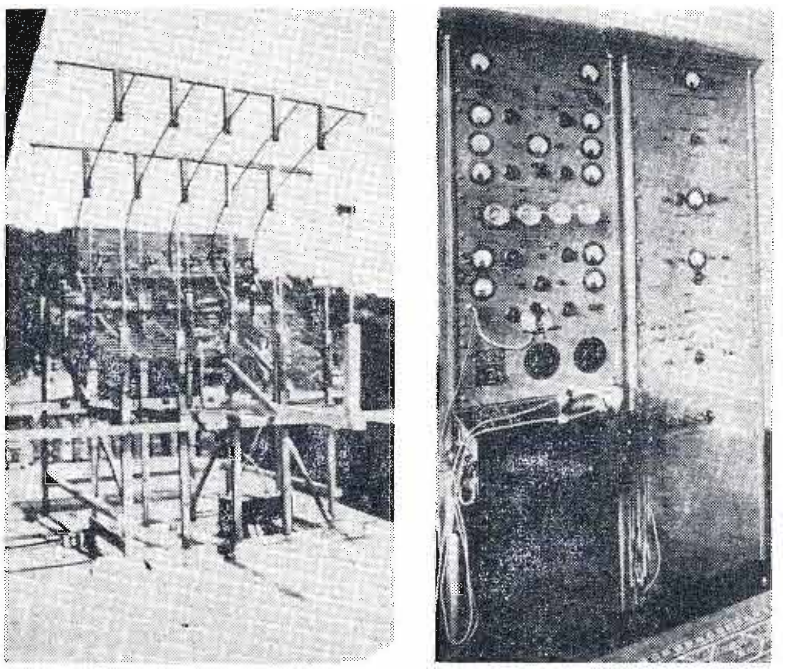
EVEN A MILE BELOW "LINE OF SIGHT"

Having installed his transmitting equipment atop Rocca di Papa, an elevation of some 2,500 feet above the Mediterranean, he steamed away on the "Elettra" through areas of varying signal strength, receiving the last faint signals at a distance of 125 miles, where the receiving antenna was at least one-half mile below line of sight transmission. Continuing on to Golfo Aranic, Sardinia, he disembarked the receiving equipment and installed it on the tower of the signal station at Cape Figari, 340 meters above sea level. Although the distance was 168 miles, and the receiving station over a mile below line of sight, 100% intelligible speech was received during the strong periods of the signal, which varied in strength from completely intelligible reception to inaudibility in slow deep fades.

Marconi announced his discovery of the bending of the waves, but it was received with skepticism. The line of sight theory of transmission of centimeter waves was too firmly ingrained to be disturbed by one experiment, even when the experimenter was Marconi himself. I well remember that my own reaction to his announcement at the time was similar to that when the rumor of the discovery of the "daylight wave" was in the air. It was against the laws of nature as I knew them, and hence it was not conceivable that it could be true.

TWENTY YEARS LOST

Perhaps some of the rigidities of the mind of the engineer would be eased a bit by more frequent reference to a few words set down some centuries ago—



Marconi microwave transmitter (left) and control apparatus (right)

"There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy." (Hamlet) Today, we know Marconi was right; but nearly two decades passed before the words of his prophecy at the time came true. Ill health and the end of his career terminated further exploration of the new mode of transmission; but he left the vision, and his own words present it as he saw it. In the conclusion to his paper* he said:

> "In regard to the limited range of propagation of these microwaves, the last word has not yet been said. It has already been shown that they can travel round a portion of the earth's curvature, to distances greater than had been expected, and I cannot help reminding you that at the very time when I first succeeded in proving that electric waves could be sent and received across the Atlantic Ocean in 1901, distinguished mathematicians were of the opinion that the distance of communications, by means of electric waves, would be limited to a distance of only about 165 miles. H. M. Poincare—Notice sur la telegraphie sans fil. Annuaire pour l'au 1902 des bureaux des longitudes—Paris."

When we remember the low power available for transmission and the crudeness of the equipment with which Marconi accomplished the 168 mile transmission, and consider the incomparably superior equipment that has been available to us from the technical developments of World War II, the wonder is that his prophecy went so long unheeded, and that the investigations of the past few years were so long deferred.

Certain it is that, with the tools at hand, we have taken a long time to catch up with the prophecy.

* Presented before the Royal Institution of Great Britain, December 2, 1932.

IMAGE FORMING SYSTEM

(*Continued from page 220*)

In operation, Inspacian establishes from separation of the images by subdividing the light from the observed scene. Each segregated strand of light keeps its general place within the main light beam of the camera, but is provided its own separate control, of its own intensity, duration and focus. This is accomplished by an unusual light gate iris and second focus structure.

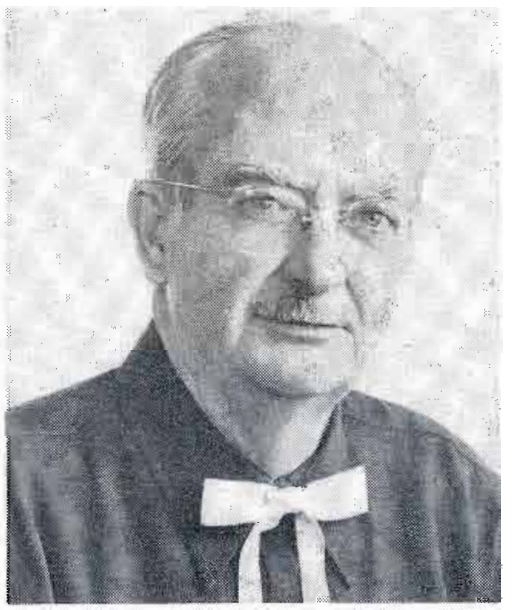
By employing individually movable aperture leaves, the iris permits a certain amount of light to pass through for a particular subdivision of the light beam. Between the standard front and rear lens elements, the light passes through matched pairs of vertical refractor strips which modify the beam's focus. Since there are several strips, each one independently adjustable according to a calibrated scale, various foreground and background planes may be thrown in or out of focus separately or concurrently. If an ultra-sharp picture were desired, foreground, intermediate and background could all be in focus at the same time.

The scene may be viewed with fixed adjustments of intensity and focus, may be modified by manual changes, or altered according to any desired time pattern by a rotating modulator. Therefore, moods and depth illusion may be created in almost limitless abundance, providing a most versatile tool for motion pictures, photography and TV.

INDUSTRY NEWS

Clarostat Mfg. Co., Inc., Dover, N. H. have announced the appointment of Jacob J. Repetto as assistant sales manager. He will be responsible for organizational supervision of company sales activities and report to I. J. Youngblood, vice president in charge of sales. Mr. Reppeto has contributed a number of patents covering Clarostat resistance devices during his ten-year association with the company.

Dr. Ralph L. Power, who entered radio from a USC professorship, and was a newspaper radio editor and manager of two press-owned stations, resigned from Hoffman Radio Corp., Los Angeles, in July after having been editor of that organization's "Transmitter" for a decade. On his return



Dr. Ralph L. Power

from a freighter trip around South America, Dr. Power will continue to head his Los Angeles public relations office which handles the accounts of representatives and such manufacturers as Gertsch Products, Inc., Cinema Engineering Co. (Aerovox Corp.), James B. Lansing Sound, Inc., and Helipot Corp. Dr. Power is executive sec-treas of the Los Angeles chapter of "The Representatives."

Carborundum Co., Niagara Falls, N. Y., recently announced the following staff changes in the Abrasive Sales Div., George H. Dennison has been made Buffalo district sales manager and William G. Kettner, Jr., made assistant to the office manager for the New York sales district. C. R. Strong has been transferred to the Peoria, Ill., territory; and F. H. Garske, Jr., A. G. Ott, and J. H. Spehr will service the Wisconsin territory. M. I. Johnson, was made general salesman in the Buffalo District. G. A. Tanner has been made general salesman of the St. Louis district. H. A. Johnson has been assigned the South

(*Continued on page* 224)

INDUSTRY NEWS

Texas coated abrasive territory, and S. E. H. France, who formerly serviced that area has been transferred to the New York sales district. H. W. McGarr has been transferred to the Chicago district, and R. D. Hulben and C. R. Strong will serve the Des Moines-Davenport district.

Dr. William R. Burwell, president of Brush Electronics Co. and Clevite Corp., Cleveland, Ohio, recently, became a member of the board of directors of Stanford Research Institute, Stanford, Calif. From 1937 to 1951, Dr. Burwell was chairman of Brush Development Co. and president and director of Brush Laboratories. His other directorships include Associated Industries, Wheeling Steel Corp., Cleveland-Cliffs Iron Co., and Clevite Corp.

Donald H. Kunsman has been elected a vice president of the RCA Service Co. He will be in charge of the Consumer Products Service Div. Mr. Kunsman joined RCA Service Co. in 1949 as assistant to the president. The following year he was appointed budget manager for the company, and later, elected treasurer and controller. Also announced was the election of Gerald W. Phister as treasurer and comptroller of the company.

Gerald E. Mortensen has been named office sales coordinator for the Greater New York territory of General Ceramics & Steatite Corp., Keasbey, N. J. He will assist Harold Landsberger in charge of New York sales. Mr. Mortensen was formerly with the Perth Amboy office of General Cable Corp.

A. Cameron Duncan has been named merchandise manager of the Home Instrument Dept., RCA Div., Radio Corp. of America. He will be responsible for merchandise and production planning for RCA Victor TV, radio receivers, and Victrola phonographs. **Joseph J. Kearney** has become East Central renewal sales manager for RCA radio batteries, the post vacated by Mr. Duncan.

C. D. (Jim) Pitts, radio and sound engineer, has been made a field sales representative for RCA broadcast equipment and will assist David Bain in the company's Washington, D. C. office. According to the announcement by the Engineering Products Dept., RCA Victor division, Mr. Pitts has served as shipboard radio operator for the Radiomarine Corp., as test engineer for Electrical Research Products, Inc., and as recording engineer with RCA Victor.

James B. Charters has been named vice president and general manager of the Motorola-Detroit Co. He has been associated with the Motorola organization for nine years, having functioned first as sales manager and more recently as branch manager.