TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

IN TWO PARTS• PART ONE

May • 1948

CALDWELL-CLEMENTS, INC.

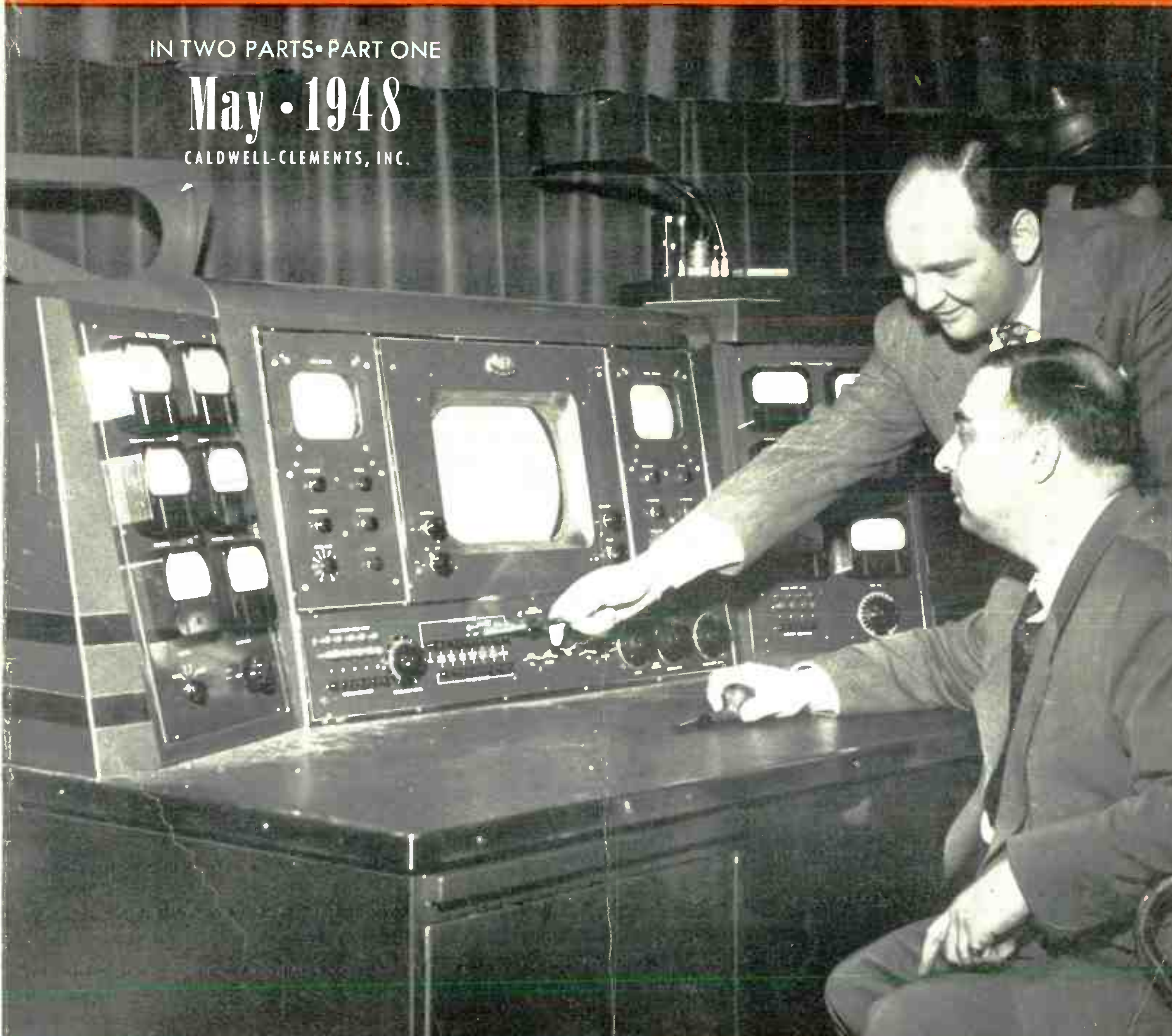
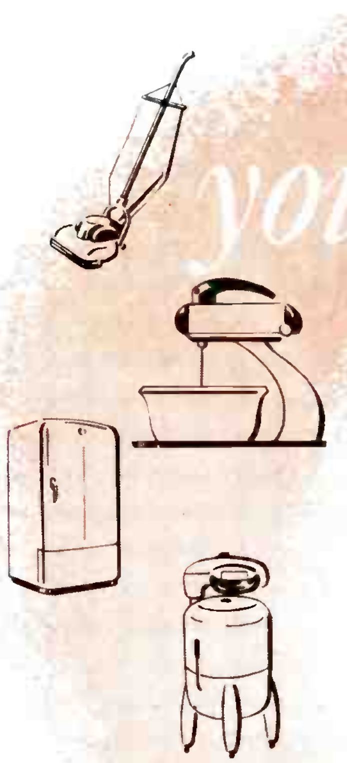
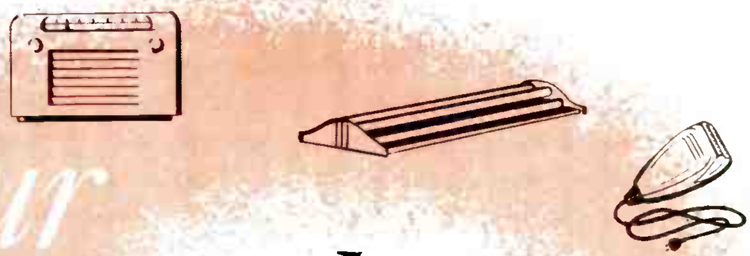


Photo: DuMont's TV Monitoring Panel at IRE Show—See Page 1

Tele-Tech's TV-Station Timetable See Part 2

ENGINEERING TECHNICS — DESIGN • MANUFACTURING • OPERATION





your

product

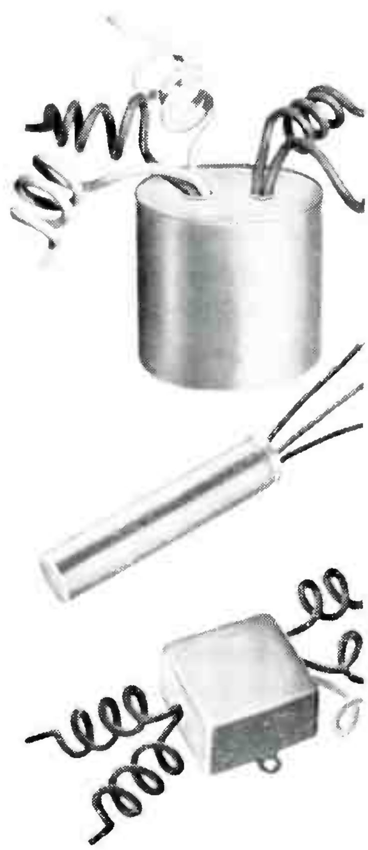
IS MORE SALEABLE WITH

CORNELL-DUBILIER CAPACITORS **CD** *Quietones* Reg. U.S. Pat. Off.

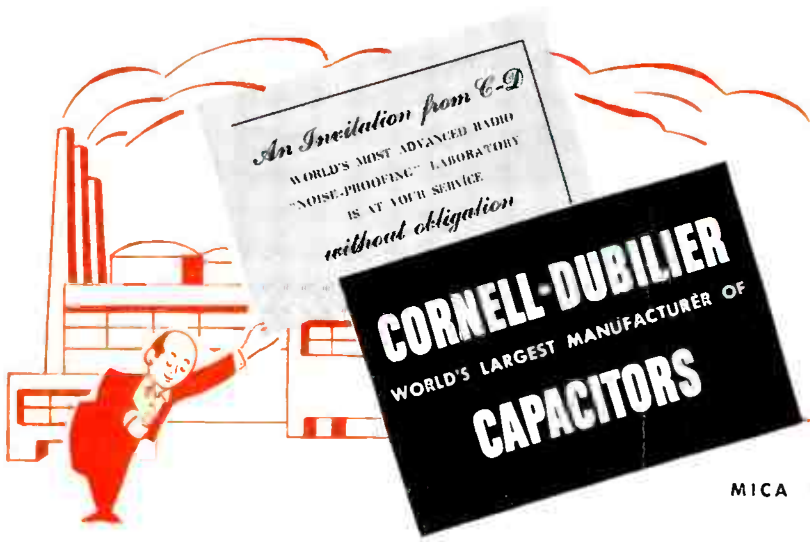
You may build the best appliance of its kind on the market – but if it sets up local radio interference—you'll have tough sledding against today's keen competition. Your customers are *demanding* radio noise-free performance in the electrical equipment they buy.

The answer, of course, is to equip *your* products with C-D Quietones. Why Quietones? First, because they're the best-engineered noise filters – second, because they guard your product's reputation by giving long trouble-free service – third, because they're designed and built to meet manufacturers' specific needs – efficiently and economically.

Speed up sales – build prestige – boost profits with C-D Quietones. Your inquiries are invited. Cornell-Dubilier Electric Corporation, Dept. J5-8, South Plainfield, New Jersey. Other large plants in New Bedford, Brookline and Worcester, Mass., and Providence, Rhode Island.



Make Your Product More Saleable with C-D Quietone Radio Noise Filters and Spark Suppressors



MICA • DYKANOL • PAPER • ELECTROLYTIC

TV APPLICANTS and CP HOLDERS

Listed by location and corporate name as of April 19, 1948

Applicants: 205 — CPs: 67 (Includes those listed below and in Timetable)

APPLICANTS

ALABAMA
- **Birmingham:** Birmingham News; Voice of Alabama

ARIZONA
- **Phoenix:** Phoenix Television; KTAR Broadcasting Co.

CALIFORNIA
- **Bakersfield:** Pearl Lemert
- **Fresno:** Donroy Broadcasting; Calif. Inland Broadcasting
- **Los Angeles:** Don Lee Broadcasting (W6XAO) (KTSL)
- **Oakland:** KROW, INC. (See San Francisco)
- **Sacramento:** M. R. Schacker; Sacramento Broadcasters
- **San Diego:** Airfar Radio; Balboa Radio; Don Lee Broadcasting; McKinnon Publications; San Diego Broadcasting; Television Broadcasting; Video Broadcasting
- **San Francisco:** Columbia Broadcasting; Leland Holzer; Krow, Inc. (Oakland); Don Lee Broadcasting; S. H. Patterson; Television California; Television Productions KPIX, Associated Broadcasters
- **San Jose:** FM Radio & Television; Radio Diablo, Inc.; Video Broadcasting
- **San Luis Obispo:** Valley Electric
- **Santa Barbara:** KLZ Broadcasting; M. R. Sacker

COLORADO
- **Denver:** Landon Television; KLZ Broadcasting Co.; Daniels & Fisher

CONNECTICUT
- **Bridgeport:** Yankee Network
- **Hartford:** Conn. Broadcasting; Hartford Times; Travelers Broadcasting
- **Waterbury:** Nutmeg State Broadcasting

FLORIDA
- **Jacksonville:** Florida Broadcasting; Jacksonville Broadcasting Corp.
- **Miami:** Fort Industry; Isle of Dreams Broadcasting; Miami Broadcasting; Miami-Hollywood Television Corp.
- **Miami Beach:** A. Frank Katzentine
- **St. Petersburg:** Sunshine Television
- **Tampa:** Tribune Co.

GEORGIA
- **Atlanta:** General Broadcasting; Georgia School of Technology; Eurith Dickinson Rivers Jr.
- **Columbus:** Columbus Broadcasting Co.

ILLINOIS
- **Chicago:** Columbia Broadcasting; Johnson-Kennedy Radio Corp.; Sun & Times Co.; Zenith Radio Corp.; Warner Bros. Pictures
- **Rock Island:** R. I. Broadcasting Co.

INDIANA
- **Indianapolis:** Crosley Broadcasting; Indiana Broadcasting; Indianapolis Broadcasting
- **South Bend:** South Bend Tribune

IOWA
- **Davenport:** Central Broadcasting
- **Des Moines:** Central WHO Broadcasting; Cowles Broadcasting; Independent Broadcasting; Murphy Broadcasting; Tri-State Meridith Broadcasting
- **Iowa City:** State Universiy of Iowa

KANSAS
- **Topeka:** Midland Broadcasting; Topeka Broadcasters Association

LOUISIANA
- **New Orleans:** Loyola University; Miss. Valley Broadcasting; New Orleans Television
- **Shreveport:** Shreveport Television Co. Broadcasting

MASSACHUSETTS
- **Boston:** E. Anthony & Sons; Boston Metropolitan Television; Columbia Broadcasting; Mass. Broadcasting; Matheson Radio; New England Television; New England Theatres; Twentieth Century Fox
- **Fall River:** Herald News; New England Television
- **Lawrence:** Hildreth & Rogers
- **New Bedford:** E. Anthony & Sons
- **Springfield:** New England Television; Yankee Network
- **Worcester:** New England Television; WTAG, Inc.

MICHIGAN
- **Detroit:** Goodwill Station; United Detroit Theatres Corp.
- **Flint:** Advertisers Press; Booth Radio Station

MINNESOTA
- **Minneapolis:** Beck Studios (Minn. Bdcstg. WTCN-TV); Independent Merchants
- **St. Paul:** WMIN Broadcasting

MISSOURI
- **Kansas City:** KCKN Broadcasting (K.C.Kan); KCMO Broadcasting; Midland Broadcasting; New England Television; WHB Broadcasting
- **Clayton:** Evangelical Lutheran Synod
- **St. Joseph:** Midland Broadcasting
- **St. Louis:** Globe-Democrat; New England Television; Thomas Patrick, Inc.; St. Louis University; Star-Times

NEBRASKA
- **Omaha:** KFAB Broadcasting; May Broadcasting

NEW JERSEY
- **Atlantic City:** Atlantic City Television; Atlantic City World; Mid-Atlantic Broadcasting; Neptune Broadcasting
- **Trenton:** Trent Broadcasting

NEW YORK
- **Albany:** Hudson Valley Broadcasting; Press Company, Inc.; Patroon Broadcasting Co.; Meredith Publ. Co.; Van Curler Broadcasting
- **Buffalo:** Broadcasting Foundation Inc.; Buffalo Courier-Express; New England Television; WGR Broadcasting; Niagara Falls Gazette Publ. Co. (Niagara Falls)
- **Rochester:** WARC, Inc.; WHEC, Inc.
- **Syracuse:** Radio Projects
- **Troy:** Troy Broadcasting Co.
- **Utica:** Copper City Broadcasting; Utica Observer-Dispatch

NEW HAMPSHIRE
- **Portsmouth:** WHEB, Inc.

NORTH CAROLINA
- **Charlotte:** Inter-City Advertising; Surety Broadcasting; WSOC, Inc.
- **Greensboro:** Greensboro News

OHIO
- **Akron:** Allen T. Simmons (WADC); Summit Radio
- **Canton:** Brush Moore Newspapers
- **Cincinnati:** Allen B. DuMont Laboratories
- **Cleveland:** Cleveland Broadcasting; Allen B. DuMont Laboratories; United Broadcasting; WGAR Broadcasting; WJW, INC.
- **Toledo:** Maumee Valley Broadcasting; Toledo Blade
- **Youngstown:** Mansfield Radio; Vindicator Printing; WKEN Broadcasting

OKLAHOMA
- **Tulsa:** George E. Cameron Jr.
- **Oklahoma City:** WKY Radiophone

OREGON
- **Portland:** Video Broadcasting

PENNSYLVANIA
- **Allentown:** Lehigh Valley Broadcasting
- **Bethlehem:** Philco Television Broadcasting
- **Easton:** Easton Publishing
- **Harrisburg:** WABX, Inc.; WHP, Inc.
- **Philadelphia:** Daily News Television; Penna. Broadcasting
- **Pittsburgh:** Allegheny Broadcasting; Pittsburgh Radio Supply; United Broadcasting; WCAE, Inc.; Westinghouse Radio Stations; WPIT, Inc.; WWSW, Inc.
- **Reading:** Eastern Radio Corp.; Hawley Broadcasting
- **Wilkes Barre:** Louis G. Baltimore; Wyoming Valley Broacasting
- **York:** Helm Coal Co.; Susquehanna Broadcasting; Triangle Publications

RHODE ISLAND
- **Providence:** Cherry & Webb Broadcasting

TENNESSEE
- **Memphis:** Bluff City Broadcasting

TEXAS
- **Amarillo:** Amarillo Television
- **Austin:** Austin Television
- **Corpus Christi:** Corpus Christi TV Co.
- **Dallas:** A. H. Belo Corp.; City of Dallas; Texas Television; Variety Broadcasting
- **Houston:** Harris County Broadcasting; Houston Post; KTRH Broadcasting; Shamrock Broadcasting; Texas Broadcasters; Texas Television
- **San Antonio:** San Antonio Television; Southland Industries
- **Waco:** Waco Television

VIRGINIA
- **Richmond:** Larus & Brother, Inc.; Lee Broadcasting; Richmond Radio Corp.; Southern Broadcasters

WASHINGTON
- **Seattle:** Fisher Blend Station

WEST VIRGINIA
- **Wheeling:** W. Va. Broadcasting

WISCONSIN
- **Madison:** Badger Broadcasting; Radio Wisconsin
- **Milwaukee:** Hearst Radio; Wisconsin Broadcasting; Kapital City Broadcasting; WEXT, Inc.

CONSTRUCTION PERMITS

CALIFORNIA
- **Los Angeles:** KLAC-TV KMTR Radio Corp.; KTTV, Times-Mirror (STA)
- **San Diego:** KFMB-TV Gross Broadcasting
- **Stockton:** KGDM-TV E. F. Peffer

FLORIDA
- **Miami:** Southern Radio & Tele.

GEORGIA
- **Atlanta:** WSB-TV Atlanta Journal Co.; WCON-TV Constitution Publishing

INDIANA
- **Indianapolis:** WFBM-TV WFBM, Inc.

IOWA
- **Ames:** WOI-TV Iowa State College of Agriculture

KENTUCKY
- **Louisville:** WHAS-TV WHAS, Inc.

LOUISIANA
- **New Orleans:** WTPS-TV Times-Picayune Publishing WDSU-TV, Stephens Broadcasting

MASSACHUSETTS
- **Waltham:** WRTB, Raytheon Mfr. Co.

MINNESOTA
- **Minneapolis:** Northwest Broadcasting

MISSOURI
- **Kansas City:** WDAF-TV Kansas City Star

NEW YORK
- **Binghamton:** WNBF-TV Clark Associates, Inc.
- **Rochester:** WHTM, Stromberg Carlson

NORTH CAROLINA
- **Charlotte:** WBT-TV, Jefferson Standard Broadcasting

OHIO
- **Cincinnati:** WKRC-TV Cincinnati Times-Star Co; WCPO-TV Scripps-Howard Radio
- **Cleveland:** WXEL, Empire Coil
- **Columbus:** WTVN Picture Waves, Inc.; WBNT-TV, Inc.
- **Dayton:** WHIO-TV Miami Valley Broadcasting

TEXAS
- **Dallas:** KRLD-TV KRLD Radio Corp.; KBTV Lacy-Potter Television Broadcasting
- **Houston:** KLEE-TV W. Albert Lee

WASHINGTON
- **Seattle:** KRSC-TV, P. K. Leberman

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

IN TWO PARTS—PART TWO, MAY, 1948

TELEVISION TIMETABLE for 1948

STATIONS ON THE AIR: Our TV Station Timetable for 1948, presented on the following pages, is the first and only compilation of its kind ever prepared by a national publication, showing by months TV stations scheduled to go on the air commercially in 1948. Representing a complete and exhaustive study of all television licensees, STAs and CPs conducted by our research department and cross-checked against government and other original sources of information, the Timetable represents the most accurate information of its kind available. Supplementing the exclusive Timetable feature are other pertinent data regarding personnel, channels, population, sets-in-areas, etc.

STATUS OF TELEVISION STATIONS: A total of 93 commercial television stations have been authorized by the Federal Communications Commission as of April 19, 1948. Of this number 26 will be on the air this month: 7 as licensees and 19 as STAs. Applicants total 205, construction permittees total 67. Television stations are operating in 18 cities; authorized stations schedule service to an additional 24 cities in 15 states in 1948. By the end of this year, 42 cities in 28 states with a TV population of 66,868,000 will receive commercial television from 65 stations.

TV RECEIVER PRODUCTION: With an estimated 310,000 TV receivers in use at the end of April, and prediction that 600,000 additional sets will be produced by the end of the year, 910,000 operating TV receivers will be the minimum number of sets in use by year's end. Production estimates for coming years indicate there will be 3 million TV receivers by 1950.

COAXIAL AND RELAY FACILITIES: Over 2,000 miles of coaxial lines will connect Buffalo, Cleveland, Toledo, Detroit, Chicago, Milwaukee and St. Louis by Fall of this year. According to AT&T, these facilities will be extended to hook-up with New York, Philadelphia, Baltimore, Washington and Richmond by December and a Pacific Coast hook-up will be effected in time for the Jan. 1, 1949, Rose Bowl game for nation-wide television.

COAXIAL AND RELAY RATES: Tentative rates proposed but still subject to revision for television coaxial and relay services to telecasters are in the neighborhood of \$35 a month per airline mile for 8 consecutive hours daily, \$2 a month per mile for each additional hour. Terminal equipment will be approximately \$500 a month for each station for connecting television networks and \$200 per month plus \$10 per hour of use for occasional service. Rates now in effect for sound broadcasting will apply for the separate sound channel needed to complete television programming.

TRAINED SERVICEMEN: The "education" of television servicemen by the sales and distribution departments of the most prominent manufacturers of this equipment, has been largely along the line of instruction in installation. Putting in a new factory-tested set, however, is a far cry from actually servicing such a set after the "guarantee period" is over. Competent servicemen will be able to name their own wages in a short time hence.

TV ANTENNAS: Channel 13 now being utilized in some zones will be an unlucky station for many set owners by showing up the ineffectiveness of many of the patented antenna freaks that have been sold to the public. We have seen some excellent examples of wideband jobs, but many of the presently installed dipoles now serving admirably on the lower channels will have but little pickup in some of the upper bands.

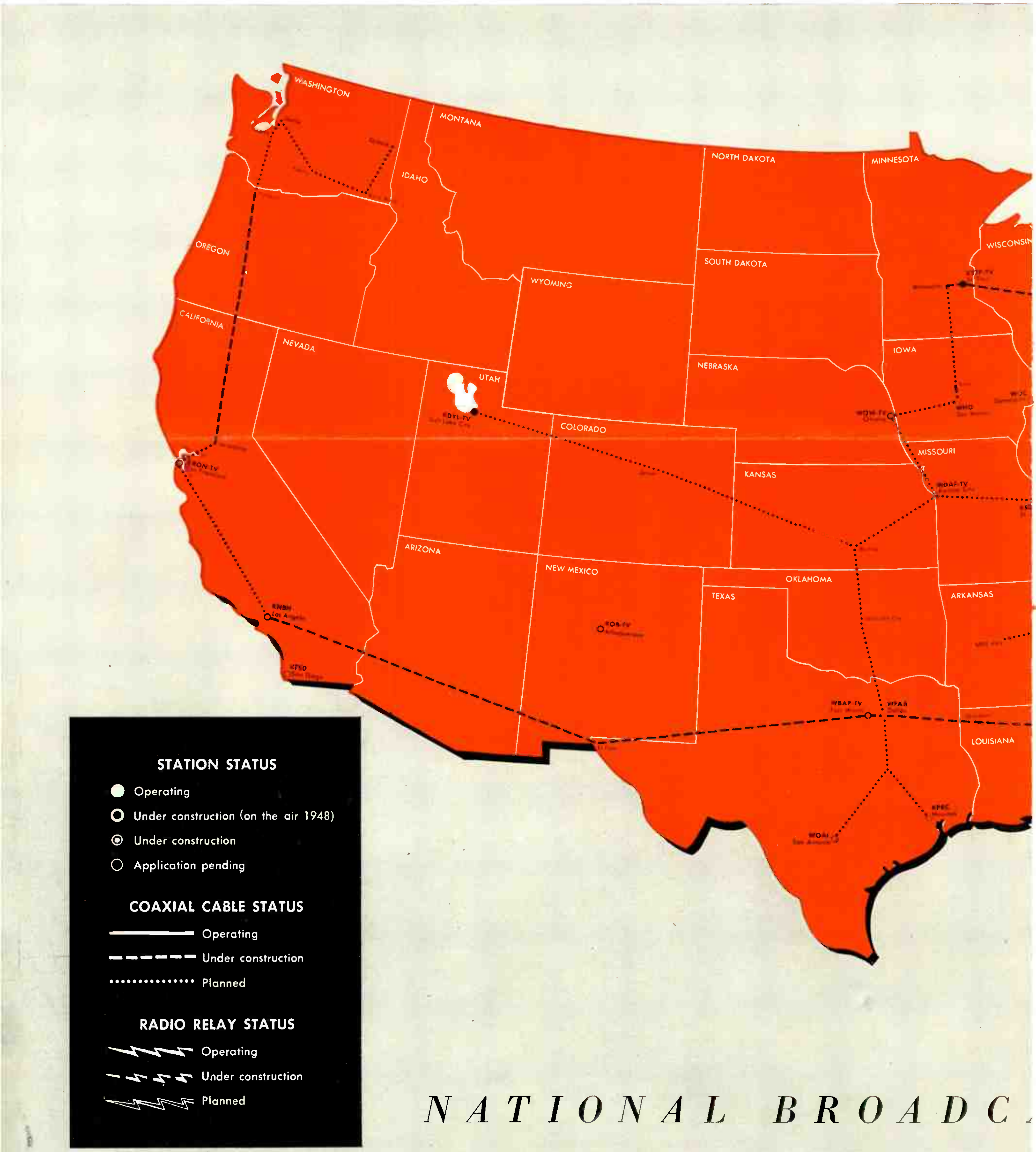
OUTLOOK FOR COLOR: While electronic color in television is no further along (as far as the layman is concerned) than it was a year ago, there has been some clarification of the problem in the matter of flicker, color breakup, etc. Lack of sufficient data on these subjects prevented the establishment of acceptable standards when the matter was temporarily tabled two years ago. Research on possible methods is still progressing in the laboratories.

TV RECEIVER PRICE TRENDS: Average retail price of receivers in volume production during 1947 was approximately \$400. This figure is expected to drop to \$300 for 1948 and to \$200 in 1949 with a considerable volume of sales in the \$150-\$175 price class. Newest of the low-priced sets will be on the market shortly at \$149.95 and a \$99 receiver has been promised by one manufacturer for this spring.

TELEVISION MANUFACTURERS: More than 100 manufacturers have indicated they will be in the business of making television receivers by the end of 1948. To date, about 65 firms are offering approximately 134 models, including kits. Some makers are featuring only one model; others have as many as eight. The price range is wide, running from about \$150 to more than \$2500.

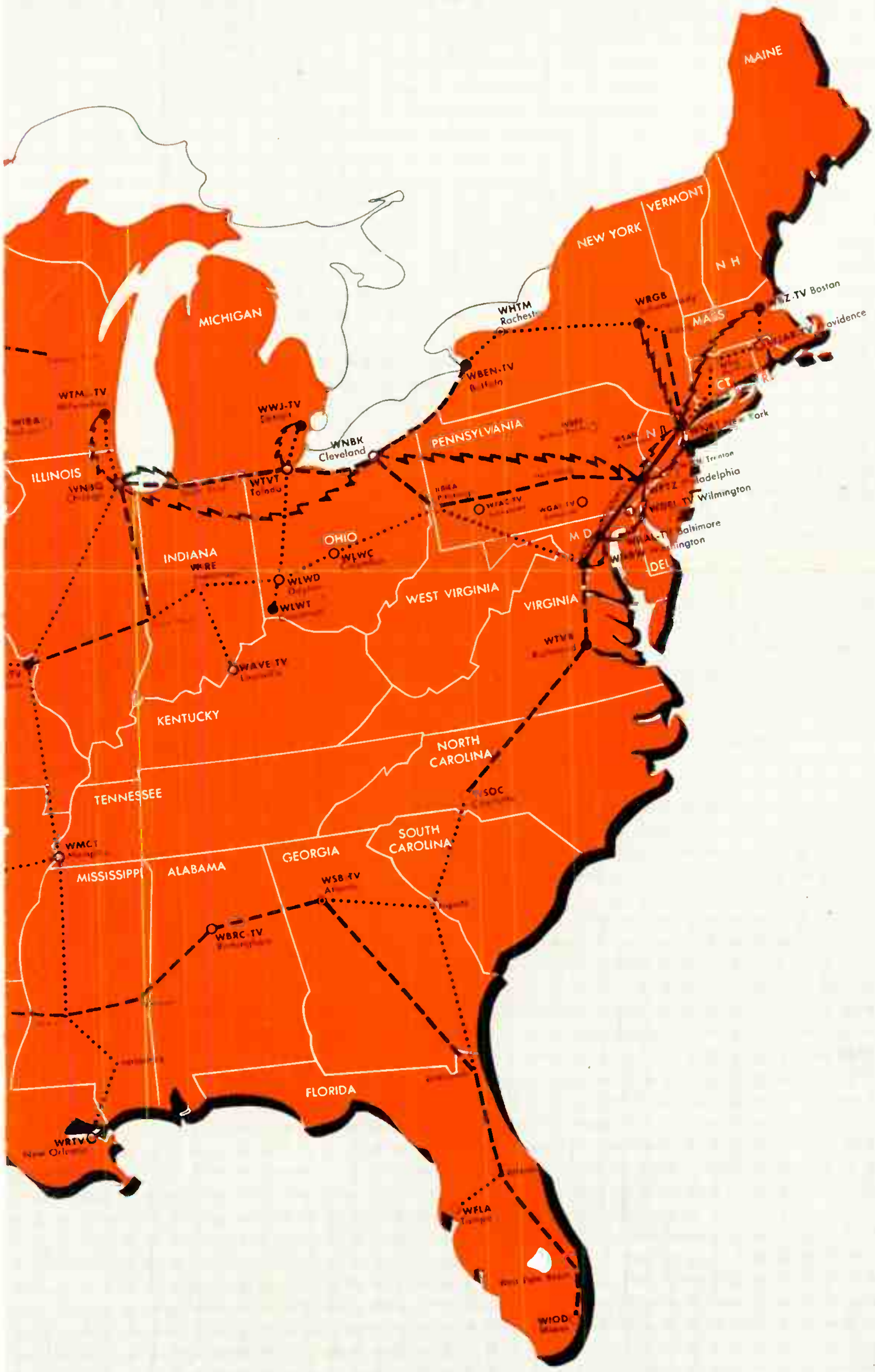
COMPILATION of the television industry facts herewith has been made under the direction of Stanley Gerstin, assistant publisher of Tele-Tech, aided by B. V. Spinetta, head of research for the Caldwell-Clements, Inc., publishers of Tele-Tech, Radio & Television Retailing and Electronic Industries & Instrumentation.

NBC Television Network–



NATIONAL BROADC

Stations on the air in 1948



"This . . . is NBC Television"

Those magic words of the new television era sound out a dozen times a day for almost two million video viewers over 200,000 sets in the area now covered by NBC's Eastern Television Network. And hundreds of thousands of other viewers enjoy NBC programs over stations not yet connected with the Network—stations that show NBC programs by rapid-service film.

1948 will see thirty-two NBC-affiliated video stations on the air. Fourteen are telecasting now, and of those fourteen, five are joined in a network—America's first and largest network in television.

By the end of 1948, NBC's Midwestern Television Network will not only be in operation, but will be hooked up with the East. Result: America's No. 1 Television from the great entertainment centers of the East and Midwest—New York and Chicago—will entertain and thrill multiple millions of viewers, from the North to Dixie, from the Atlantic to the Mississippi and beyond. And in the meantime, NBC is building its own station in Los Angeles as the anchor point for a third television network on the Pacific Coast. By 1950 NBC Television will be coast-to-coast.

Close to three times as many manufacturers as there were eight months ago are in production now—and still the public demand for sets exceeds supply. The picture looks bright for bigger set sales, a rapidly expanding audience, more and better television programs. Today, over 36,000 sets are being produced per month. Close to a million receivers will be installed by the end of this year—with some five viewers per set in homes, upwards of twenty in public places. And the great bulk of viewers will be reached by the combined Eastern and Midwestern Television Networks of NBC.

★ For the finest programs in television . . .

★ For the largest operating network in television.

★ For the biggest audience in television . . .

★ For the greatest continuous expansion in the field of video . . .

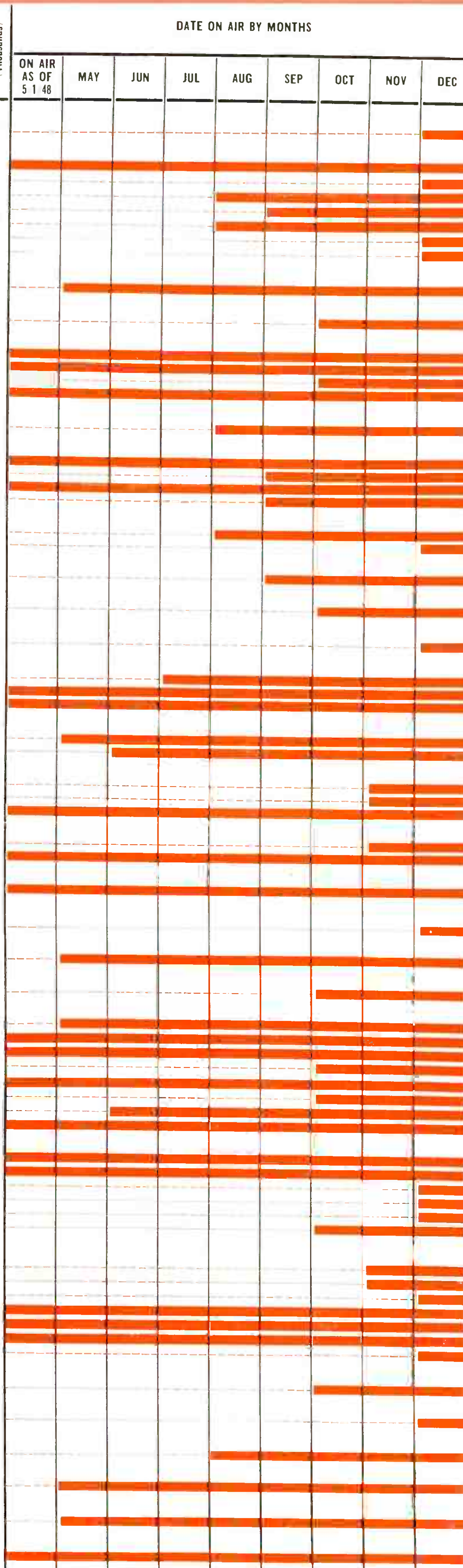
This . . . is NBC Television

ASTING COMPANY, NEW YORK

AMERICA'S No. 1 NETWORK . . . FIRST IN SIGHT AND SOUND

TV TIMETABLE—STATIONS ON THE AIR IN 1948

STATE and CITY	CALL LETTERS	CORPORATE NAME	GENERAL MANAGER	CHIEF ENGINEER	CHANNEL No.	STATUS	ESTIMATED SETS NOW IN AREA‡	POPULATION 50-MILE RADIUS (Thousands)
ALABAMA								
Birmingham	WBRC-TV	Birmingham B stg.	Eloise S. Hanna	G. P. Hamann	4	CP	*	580
CALIFORNIA								
Hollywood	KTLA	Television Prod.	Klaus Lansberg	R. M. Moore	5	STA	16,000	2,500
Los Angeles	KECA-TV	American B stg.	Clyde Scott	T. B. Palmer	7	CP	16,000	3,600
Los Angeles	KFI-TV	Earle E. Antony	W. B. Ryan	H. Blatteeman	9	CP	16,000	3,600
Los Angeles	KNBH	National B stg.	S. N. Strotz	H. J. Buck	4	CP	16,000	3,700
Riverside	KARO	B stg. Corp. of Am.	W. L. Gleeson	Stan Reynolds	1	CP	18,000	3,500
San Francisco	KGO-TV	American B stg.	G. V. Grubb	A. E. Evans	7	CP	*	2,250
San Francisco	KRON-TV	Chronicle Publ. Inc.	Charles Thieriot	R. A. Isberg	4	CP	*	2,500
CONNECTICUT								
New Haven	WNHC-TV	Elm City B stg.	J. T. Milne	V. DeLaurentis	6	CP	1,800	673
DELAWARE								
Wilmington	WDEL-TV	WDEL, Inc.	J. G. Walsh	J. E. Mathiot	7	CP	*	2,373
DIST. OF COL.								
Washington	WMAL-TV	Evening Star	K. H. Berkeley	Frank Harvey	7	STA	9,000	2,500
Washington	WNBW	Nat'l B stg.	F. M. Russell	Donald Cooper	4	L	9,000	2,500
Washington	WOIC	Bamberger B stg.	T. C. Streibert	J. R. Poppele	9	CP	9,000	2,500
Washington	WTTG	Allen B. Dumont	Walter Compton	M. M. Burleson	5	STA	9,000	3,000
GEORGIA								
Atlanta	WAGA-TV	Liberty B stg.	J. E. Bailey	P. B. Cram	5	CP	*	1,000
ILLINOIS								
Chicago	WBKB	Balaban & Katz	Capt. W. C. Eddy	A. H. Brolly	4	L	16,700	4,705
Chicago	WENR-TV	American B stg.	E. R. Borroff	E. C. Horstman	7	CP	16,700	4,705
Chicago	WGN-TV	Chicago Tribune	F. P. Schrieber	C. J. Meyers	9	STA	17,000	5,100
Chicago	WNBQ	Nat'l B stg.	I. E. Showerman	H. C. Luttgens	5	CP	17,000	5,100
INDIANA								
Bloomington	WTTV	Sarkes Tarzian	D. S. Phares	†	10	CP	*	250
Indianapolis	WWHB	Wm. H. Block Co.	M. Lindley	†	3	CP	150	750
IOWA								
Ames	WOI-TV	Iowa State College	R. B. Hull	Louis Lewis	4	CP	*	410
KENTUCKY								
Louisville	WAVE-TV	WAVE, Inc.	Nathan Lord	Wilbur Hudson	5	CP	*	772
LOUISIANA								
New Orleans	WRTV	Maison Blanche	H. Wheelahan	†	4	CP	*	1,200
MARYLAND								
Baltimore	WAAM-TV	Radio Telev. of Balti.	Norman Kal	Jack Braun	13	CP	6,000	1,100
Baltimore	WBAL-TV	Hearst Radio	H. C. Burke	Geo. Jacobs	11	STA	6,000	1,100
Baltimore	WMAR-TV	A. S. Abell Co.	E. K. Jett	C. G. Nopper	2	STA	6,000	1,500
MASSACHUSETTS								
Boston	WBZ-TV	Westinghouse Radio	W. C. Swartley	W. H. Hauser	4	STA	*	3,042
Boston	WNAC-TV	Yankee Network	Linus Travers	I. B. Robinson	7	CP	*	2,750
MICHIGAN								
Detroit	WXYZ-TV	King Trendle B stg.	J. G. Riddell	C. F. Kocher	7	CP	7,000	2,580
Detroit	WTVO	Fort Industry	R. G. Elvin	Paul Frincke	2	CP	6,800	2,400
Detroit	WWJ-TV	Evening News Ass'n	H. Bannister	E. J. Love	4	STA	6,800	2,400
MINNESOTA								
Minneapolis	WTCN-TV	Minn. B stg.	F. VanKonynenberg	J. M. Sherman	4	CP	500	1,200
St. Paul	KSTP-TV	KSTP, Inc.	S. E. Hubbard	J. N. Fricker	5	STA	640	1,700
MISSOURI								
St. Louis	KSD-TV	Pulitzer Publ.	G. M. Burbach	J. E. Risk	5	STA	5,500	1,500
NEBRASKA								
Omaha	WOW-TV	WOW, Inc.	J. J. Gillin, Jr.	J. Herold	6	CP	*	800
NEW JERSEY								
Newark	WATV	Bremer B stg.	I. R. Rosenhaus	F. V. Bremer	13	STA	146,500	13,500
NEW MEXICO								
Albuquerque	KOB-TV	Albuquerque B stg.	Roger Baker	G. S. Johnson	4	CP	*	150
NEW YORK								
Buffalo	WBEN-TV	Buffalo Evening News	C. R. Thompson	R. J. Kingsley	4	STA	300	1,010
New York	WABD	Allen B. DuMont	L. Phillips	S. Patremio	5	L	150,000	11,302
New York	WCBS-TV	Columbia B stg.	L. W. Lowman	P. Wittlig	2	L	150,000	11,302
New York	WJZ-TV	American B stg.	M. B. Grabhorn	G. O. Milne	7	CP	150,000	12,000
New York	WNBT	Nat'l B stg.	Carleton Smith	O. B. Hanson	4	L	150,000	11,677
New York	WOR-TV	Bamberger B stg.	T. C. Streibert	J. R. Poppele	9	CP	150,000	12,000
New York	WPIX	News Syndicate	Robert L. Coe	T. E. Howard	11	CP	140,000	12,000
Schenectady	WRGB	General Electric	G. E. Markham	W. J. Purcell	4	L	2,000	1,500
OHIO								
Cincinnati	WLWT	Crosley B stg.	J. R. Duncan	R. J. Rockwell	4	STA	2,000	1,140
Cleveland	WEWS	Scripps-Howard	J. C. Hanrahan	J. B. Epperson	5	STA	2,000	1,150
Cleveland	WNBK	Nat'l B stg.	V. H. Pribble	†	4	CP	2,000	1,500
Columbus	WLWC	Crosley B stg.	J. R. Duncan	†	3	CP	*	1,000
Dayton	WLWD	Crosley B stg.	J. R. Duncan	†	5	CP	*	950
Toledo	WTVT	Fort Industry	A. Y. Flanigan	Wm. Stringfellow	13	CP	500	700
PENNSYLVANIA								
Erie	WDTE	Dispatch, Inc.	Edward Lamb	†	12	CP	*	500
Johnstown	WJAC-TV	Johnstown Tribune	†	N. L. Straub	13	CP	*	758
Lancaster	WGAL-TV	WGAL, Inc.	C. R. McCollough	J. E. Mathiot	4	CP	*	750
Philadelphia	WCAU-TV	WCAU, Inc.	G. B. Larson	J. G. Leitch	10	STA	27,000	3,000
Philadelphia	WFIL-TV	Triangle Publ.	R. W. Clipp	L. E. Littleton	6	STA	27,000	3,000
Philadelphia	WPTZ	Philco Telev. B stg.	E. B. Loveman	R. J. Bowley	3	L	27,000	3,300
Pittsburgh	WDTV	Allen B. Dumont	†	†	3	CP	*	2,500
RHODE ISLAND								
Providence	WJAR-TV	Outlet Corp.	†	†	11	CP	*	1,711
TENNESSEE								
Memphis	WMCT	Memphis Publ.	H. W. Slavick	E. C. Frase	4	CP	*	650
TEXAS								
Fort Worth	WBAP-TV	Carter Publ. Corp.	G. Granston	R. C. Stinson	5	CP	*	720
UTAH								
Salt Lake City	KDYL-TV	Intermountain B stg.	S. S. Fox	J. M. Baldwine	2	STA	300	225
VIRGINIA								
Richmond	WTVR	Havens & Martin	W. B. Havens	W. H. Wood	6	STA	1,000	327
WISCONSIN								
Milwaukee	WTMJ	The Journal Co.	W. J. Damm	Phil Laeser	3	STA	2,050	1,000



1948 Totals: 65 TV stations on the air in 42 cities and 28 states (incl. D.C.) will program to estimated 910,000 receivers and a population 66,868,000

†Personnel not named or appointments pending
*No sets in area or reliable figures not available
‡Figures based on Station-Distributor reports. Cumulative total not given beyond 4/9/48.

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

Formerly the TELE-communications TECH-nical Section of ELECTRONIC INDUSTRIES

MAY, 1948

Editorial Contents

PART ONE:

PART TWO:

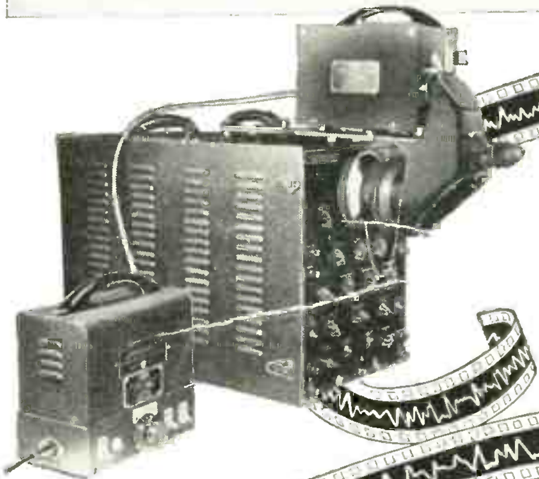
COVER: Garo Ray, vice-president of WNHC-TV, New Haven, Conn., is being shown the finer points of DuMont's television monitoring panel during the March IRE Show in New York by Harold E. Taylor, Sales Manager, Transmitter Equipment Sales. WNHC-TV, a DuMont affiliate, goes on the air commercially this month.

CALDWELL-CLEMENTS, INC., Publication Office, Orange, Conn., Editorial and Executive Offices 480 Lexington Avenue, New York 17, N. Y., Tel. Plaza 3-1340

Publishers also of ELECTRONIC INDUSTRIES & INSTRUMENTATION and RADIO & TELEVISION RETAILING

100 feet of film is a lot of film to handle . . . yet it's done conveniently with

DU MONT OSCILLOGRAPH-RECORD EQUIPMENT

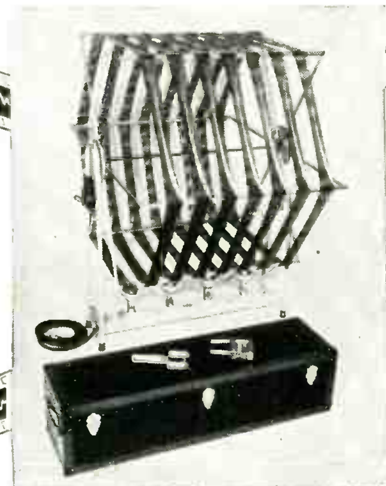


Film rolled on spools is easily inserted and removed when making oscillograms with Type 314 Oscillograph-record Camera. Up to 100 feet of 35-mm. film is readily accommodated by this camera designed for both single-frame and continuous-motion recording of oscillograph patterns.

CAT. NO. 1217-E (f/2.8 coated lens) .... $ 980.00
CAT. NO. 1366-E (f/1.5 coated lens) $1,155.00

And after exposing the film, the Type 2512 Motor-driven Processing Unit is available for developing the entire 100-foot roll with minimum of bother and without danger of scratching the emulsion. Merely insert film in processing unit and start the motor. Provision is made in this unit for adding and pouring off processing solutions.

CAT. NO. 1372 (115 volts 50-60 cps) **$231.00**



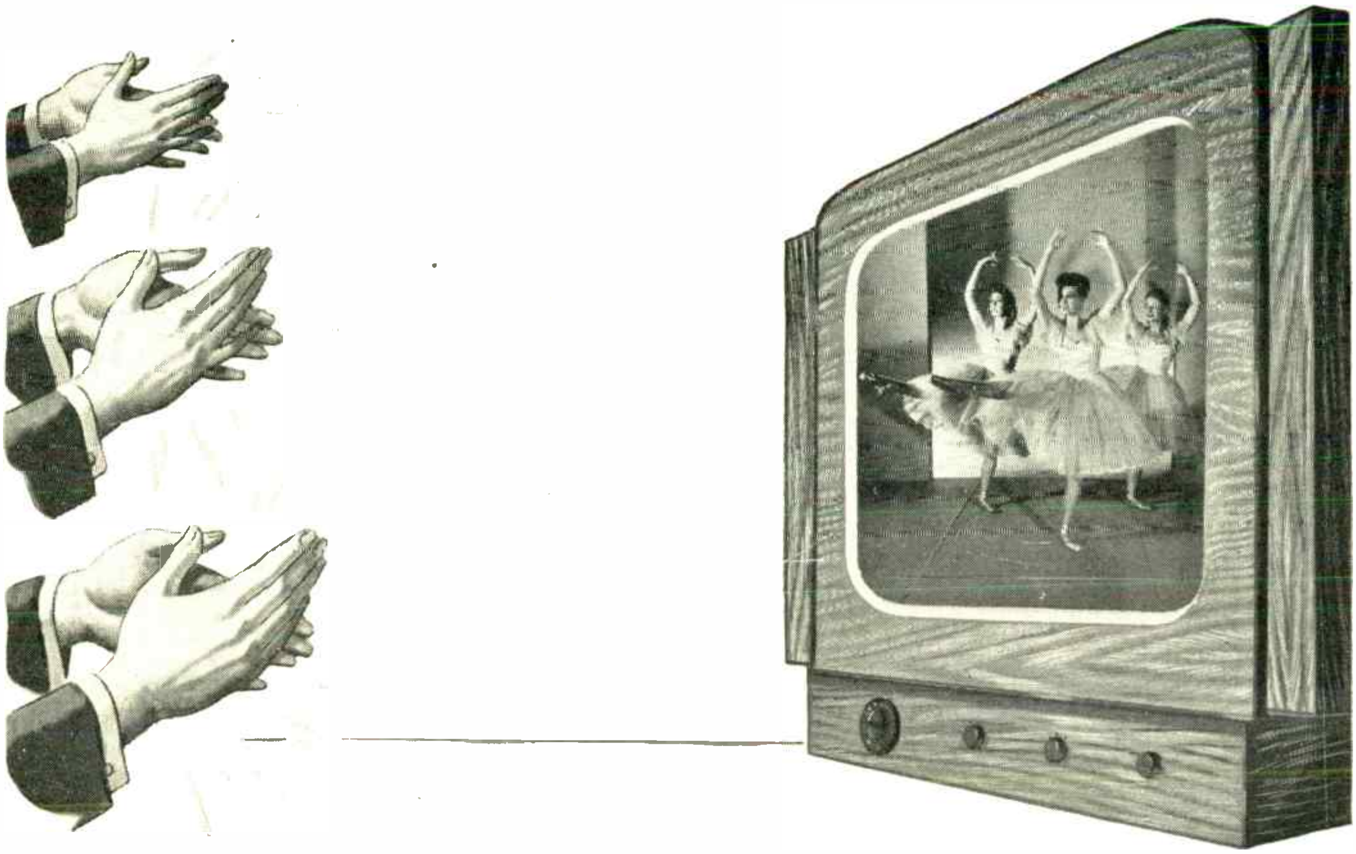
For utmost convenience in drying processed film, the Type 2514 Portable Drying Rack accommodates up to 200 feet of film at one time, automatically unwinding and rewinding the film during the drying process. For maximum convenience, the unit is folded when not in use. A carrying case is provided.

CAT. NO. 1375 (115 volts 50-60 cps) **$232.00**

DU MONT CATALOG SENT ON REQUEST

DUMONT *Precision Electronics & Television*

ALLEN B. DUMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: ALBEEDU, PASSAIC, N. J., U. S. A.



ATV LEAD-IN LINES

Get Good Receptions!

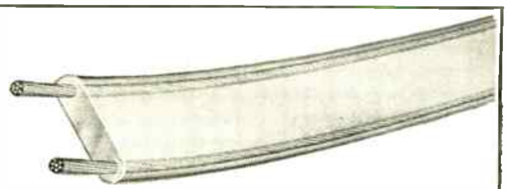
YOU WILL BE MORE CERTAIN to get the best receptions from your television or FM set when you specify ATV* lead-in lines.

The effects of attenuation and impedance mismatch on FM and Television reception are minimized by Anaconda Type ATV lead-in lines.

The satin-smooth polyethylene insulation of Type ATV line sheds water readily, thus avoiding subsequent impedance discontinuities. This material also has exceptionally high resistance to corrosion. Count on Anaconda to solve your high-frequency transmission problems—with anything from a new-type lead-in line to the latest development in coaxial cables.

48446

**An Anaconda Trade-Mark*



A TYPE ATV LEAD-IN FOR EVERY NEED

Anaconda offers a complete selection of Type ATV lead-in lines for 75, 150 and 300 ohms impedance unshielded and shielded lines of high impedance. For an electrical and physical characteristics bulletin, write to Anaconda Wire and Cable Company, 25 Broadway, New York 4, New York.

ANACONDA

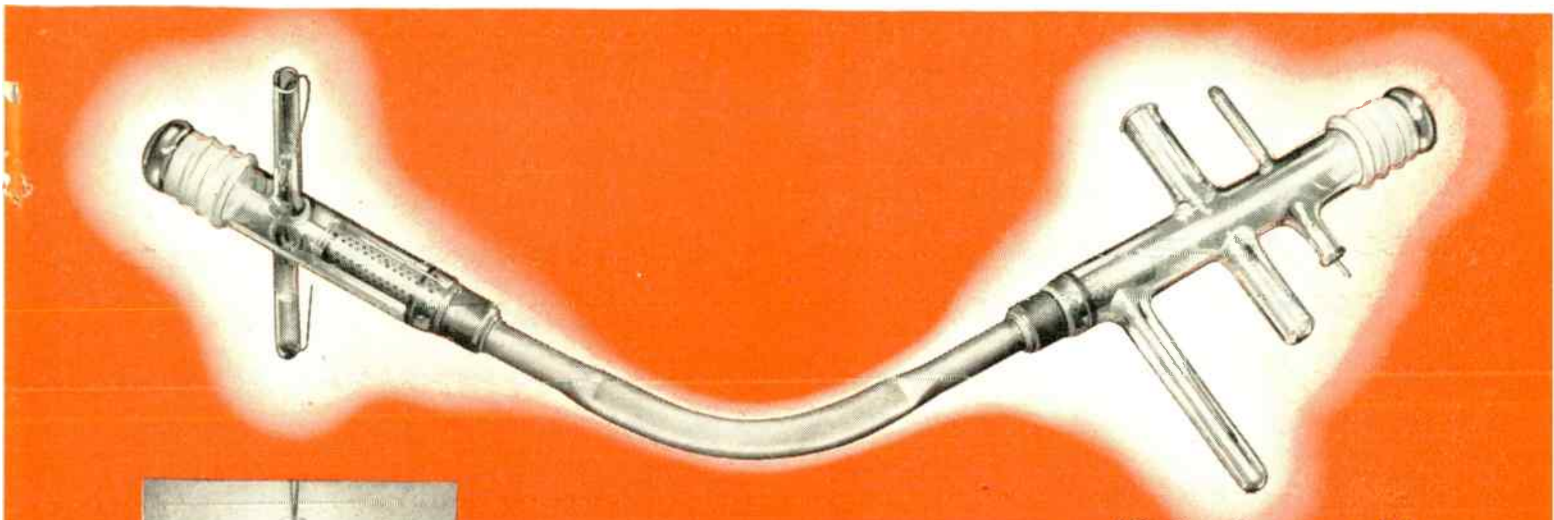
Anaconda Wire and Cable Co.

TELE-TECH

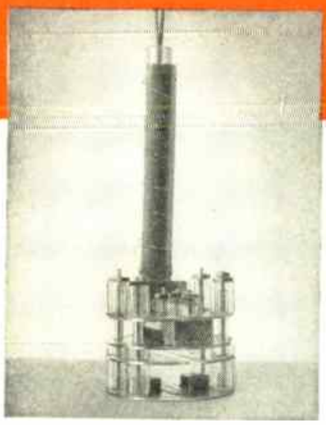
TELEVISION • TELECOMMUNICATIONS • RADIO

Tele-Tech*, May 1948, Vol. 7, No. 5. Regular price per copy 25 cents. Published Monthly by Caldwell-Clements, Inc., Publication Office Orange, Conn., Editorial, Advertising and Executive Offices 480 Lexington Ave., New York 17, N. Y. Direct all subscription inquiries to Orange, Conn., or to 480 Lexington Avenue, New York 17, N. Y. M. Clements, President; Orestes H. Caldwell, Treasurer. Subscription rates: United States and possessions, $3.00 for two years. Canada (Canadian Funds Accepted) $4.00 for two years. Pan American Countries $5.00 for two years. All other countries $7.50 for two years. Entered as second class matter June 9, 1947, at the Post Office at Orange, Conn., under the act of March 3, 1879. Copyright by Caldwell-Clements, Inc., 1948. Printed in U.S.A. *Reg. U.S. Pat. Off.

URANIUM U-235 detector employs NICHROME V* exclusively



60° Mass Spectrometer Tube



Ionization Source

Mass Spectrometer—Model M60 (Process & Instruments, Brooklyn, N. Y.)

THE Mass Spectrometer, which has played vital roles in the discovery of U-235 and its subsequent applications in fields of atomic energy and cancer research, is one of the most important measuring instruments of the modern age. Its ability to crack molecules and then sort them according to mass makes it unique for analytical purposes.

Materials entering into its construction must be superlatively stable, assuring the highest degree of accuracy at all times, and retain their characteristics unfailingly throughout a long life of trouble-free service.

Specifications for the metal used in the Ionization Source and Collector System typify the super-critical requirements that have to be met. The metal must be:

(a) non-magnetic (i.e. remain unmagnetized in the presence of the powerful magnet used in the Mass Spectrometer);

(b) able to withstand temperatures of approximately 665°F. in a vacuum of 10^{-7} mm. mercury *without deformation or evaporation;*

(c) non-porous, and non-absorbent of gases;

(d) easily machined, drilled, tapped, threaded, and spot welded;

(e) available in wire, sheet and rod forms.

"Of all available metals" states Process & Instruments Inc., of Brooklyn, N. Y., makers of Mass Spectrometers, "Nichrome V most satisfactorily meets all these requirements and hence, with the exception of the tungsten filament, is exclusively used by us in the construction of the Mass Spectrometer. In addition, a Nichrome heating element is used for outgassing the Spectrometer Tube of absorbed moisture".

If *you* have particularly exacting specifications to meet, consult with us. There are more than 80 Driver-Harris alloys specifically designed to fill the requirements of the Electrical and Electronic Industries. The fruits of our 48 years of specialized research experience are at your service.

Exclusive Manufacturers of Nichrome

Driver-Harris Company

HARRISON, NEW JERSEY

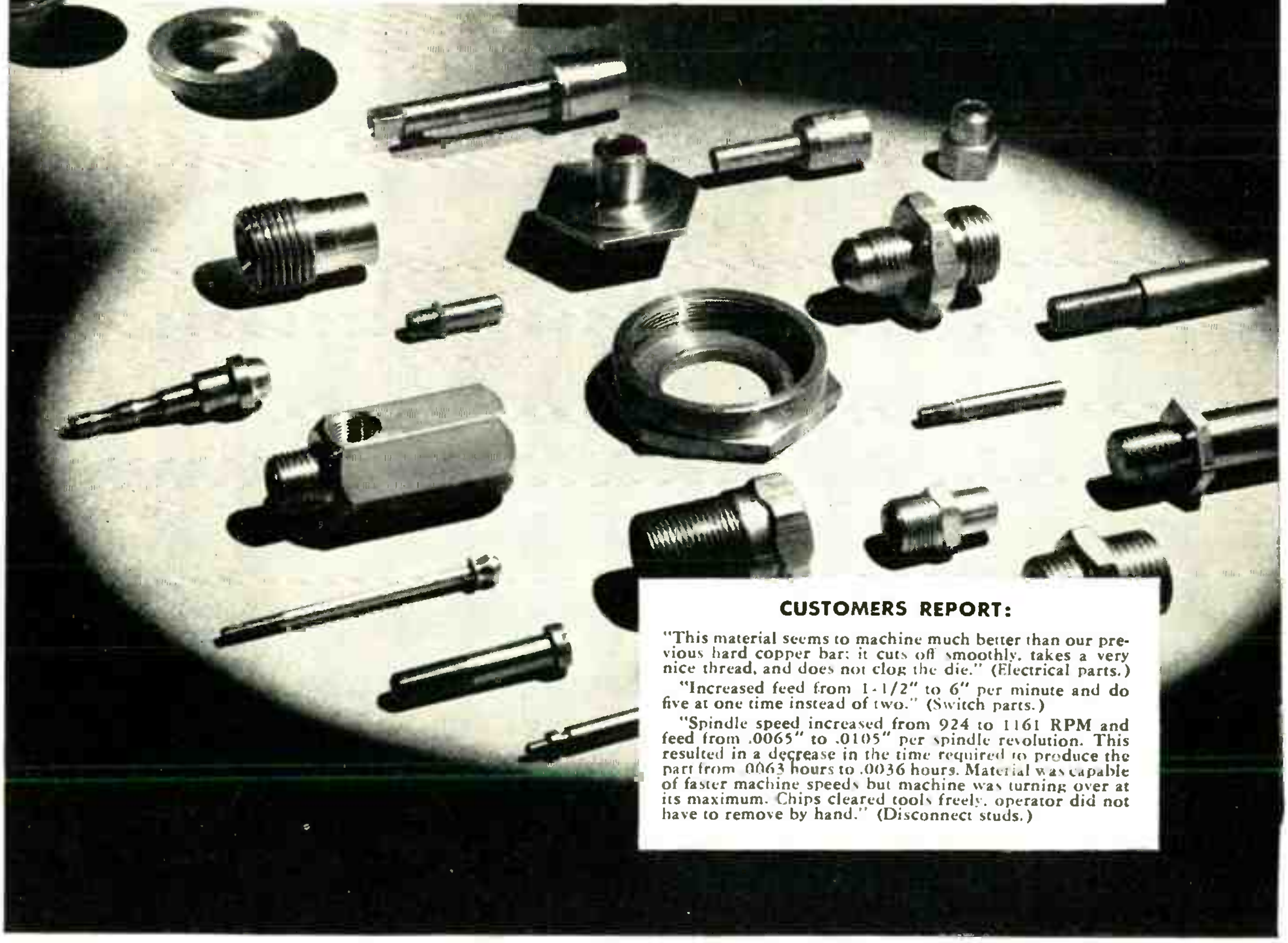
BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco, Seattle

Manufactured and sold in Canada by

The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

SPECIAL PURPOSE ALLOYS SINCE 1899 — D H — TRADE MARK REG. U. S. PAT. OFF.

*T.M. Reg. U. S. Pat. Off.



24 great newspapers select

Television by RCA

RCA has everything you need to get started NOW!

Overwhelming acceptance of RCA equipment marks the swift progress of television from coast to coast.

Already a substantial percentage of broadcasters and newspapers have ordered RCA transmitters. Most of these stations are being *completely* RCA equipped, from super-sensitive cameras to high-gain antennas.

Many of these telecasters are already on the air with regular programs—or on an experimental basis. Other stations are receiving shipments of RCA equipment that will put them on the air very soon. And by the end of 1948, high-definition *RCA television* should be within the reach of 49,000,000 people.

Why is *RCA television* so far in the lead? Here are a few of the reasons: (1) Everything needed to get on the air is in quantity production at RCA *now;* (2) All equipments embody the very latest technical advances in the art; (3) Designs are flexible . . ."add-a-unit" construction makes them equally applicable to the very small or the very large station; (4) Facilities can be gradually and *economically* expanded as television audiences grow . . . without obsolescence of original equipment; (5) Equipment is easy to operate and reliable.

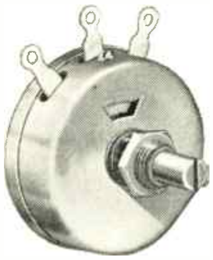
As you know, television is moving fast. What are *your* plans? Will you be the first to bring this new public service to your community . . . utilize its tremendous audience impact for newscasting, advertising, and circulation building? We'll be glad to help you get started with complete planning information and cost data. Write Dept. 87-E.

TELEVISION BROADCAST EQUIPMENT
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

ONLY SO BIG...

TYPE C—*Only 1¹⁄₃₂" in diameter. Full two watts normal rating (entire element) for continuous operation.*



TYPE M—*Normal rating of 4 watts. Diameter 1⅝". Insulated for 1,000 volt DC breakdown to ground.*

TYPE E—*Dissipates 7 watts. Diameter 2⁵⁄₁₆". Supplied with grounded contact arm.*

. . . they have everything you want in a wire-wound control!

Size is always an important matter when you're designing products like radio and television receivers, testing equipment, light dimming devices and miniature motor controls. That's why Mallory makes its wire-wound variable resistors good *and small*—the type C control being the smallest two-watt control of its kind available today.

On the plus side, too, is the fact that all Mallory wire-wound controls are designed for maximum heat dissipation. In addition, the M and E types are metal-enclosed to provide electrostatic shielding . . . all types are tapered with extreme accuracy (linear taper tolerance is within 3%) . . . precision-wound to give extremely long, noise-free service. A special feature of the M and C type controls is a spring clamp which maintains positive pressure between silver-plated terminals and silver element terminations, insuring extremely low terminal resistance.

The M type Variable Resistor is also available in a complete line of Mallory T and L Pad Attenuators, designed to provide impedance matching in audio circuits or resistive networks to secure maximum power transfer and minimum distortion.

It's a story on a par with that of so many other precision electronic products—

YOU EXPECT MORE AND GET MORE FROM MALLORY

P.R. MALLORY & CO. Inc.
MALLORY RESISTORS
(FIXED AND VARIABLE)

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

ASTATIC BRINGS YOU A TRULY REVOLUTIONARY DEVELOPMENT

THE MAGNETO-INDUCTION PICKUP

Yes, this is it! An entirely new concept in record-reproduction engineering. A radically new pickup cartridge that opens broad new vistas of listening pleasure . . . offers unchanging faithfulness and quality of reproduction that is stable and trouble-free.

The Astatic Magneto-Induction Pickup represents the first clean break with traditional principles, employed in the manufacture of magnetic type reproducers, since the introduction of such devices in early phonographs. Discarded now by this amazing development is the need for delicately spaced "air gaps," which collect lint and dust, and thereby become a prime source of trouble in other type magnetic pickups. Their elimination in the Magneto-Induction cartridge is all the more revolutionary . . . a newly opened door to greater record enjoyment . . . to a peak fidelity of reproduction that LASTS, even under the most consistent service or adverse climatic conditions.

MODEL MI-1, Code ASAKA — Standard Housing
MODEL MI-2, Code: ASALZ — Mumetal Housing*

**Provides increased shielding effect for maximum reduction of hum*

Two Equalizer-Amplifier models available:

Model EA-1, compact unit designed for installation in radio sets and audio amplifiers having insufficient gain for operation of Astatic Magneto-Induction Pickup Cartridges. Provides "bass boost."

Model EA-2, self-powered, provides adjustable "bass boost," adjustable treble "roll-off," and selection of "turnover frequency."

Here are the OUTSTANDING FEATURES . . .

1. No "Air Gaps."
2. Necessity for delicate handling eliminated.
3. No troublesome, costly armature balancing problems.
4. Longer-lived, troublefree performance without distortion or changes in characteristics.
5. Transcription quality reproduction.
6. Velocity response flat to 12,000 cycles.
7. Output is 100 millivolts. This is approximately 20 db. greater than most previously available, light-weight magnetic pickups.
8. Needle pressure, 1 oz.
9. Impedance, 7,500 ohms at 1,000 c.p.s.—110,000 ohms at 10,000 c.p.s.
10. Interchangeability: Physical dimensions of this cartridge are such that it can be employed with a majority of present day standard pickup and transcription arms.

Now Available

Manufactured under Massa Laboratories License

THE Astatic CORPORATION
CONNEAUT, OHIO
IN CANADA: CANADIAN ASTATIC LTD. TORONTO, ONTARIO

TELE-TIPS

The record for speed in processing film for television belongs to DuMont Labs. if the reports we hear are correct — that the company has developed a method for recording a televised program on film after which it is developed, reversed and delivered ready for projection in 20 (yes, twenty) seconds!

—TT—

Not only has Stewart-Warner promised to increase its TV receiver production ten-fold by mid-summer, but the company claims it will reveal a new line of television sets with "unique features and innovations" not currently available anywhere.

—TT—

The replacement package idea is not new — it happened before, notably in the automotive industry and most recently in AM radio. Then why not a replacement package for television receiver maintenance? We predict that a manufacturer will soon come up with a practical replacement package for TV receiver maintenance.

—TT—

One manufacturer we know of is "aging" projection TV tubes in underground storage for 30 days before shipping. During this "cooling off" period, internal strains in the glass reveal themselves, and future breakdowns are minimized.

—TT—

Taxicab television is here — almost! We know of a venturesome engineer who hooked up a table model TV receiver in a taxicab with the antenna out the window. He reported that picture reception was fine. (And then there's Dr. T. T. Goldsmith's famous jalopy with TV in the back seat which has been the vehicle of many hair-raising rides as Dr. Goldsmith simultaneously twirled steering wheel and tuning controls, artfully avoiding both roadside trees and TV ghosts.)

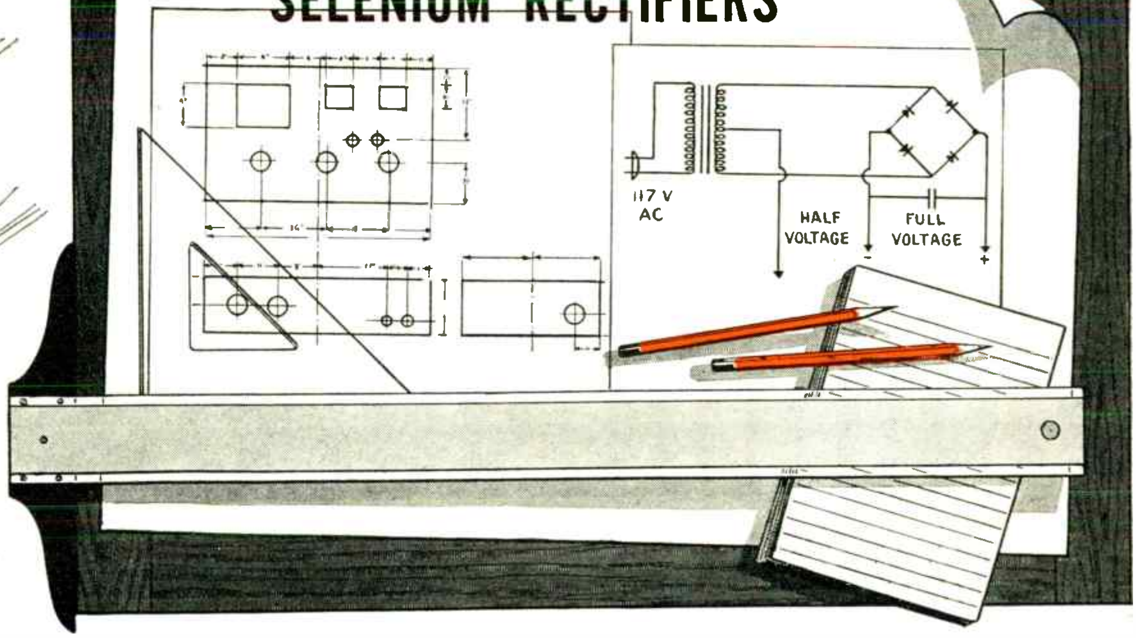
—TT—

That $99 television receiver with 7-in. tube is here again—or is it. Walter Spiegel, Regal Electronics Corp., N. Y., tells us that it will be shown at the Chicago Parts Show opening May 11. In the meantime we can't tell you what we know.

—S.G.

Federal

The FIRST NAME in SELENIUM RECTIFIERS



Gives you BETTER PRODUCT DESIGN

Electrically, Mechanically, and Thermally

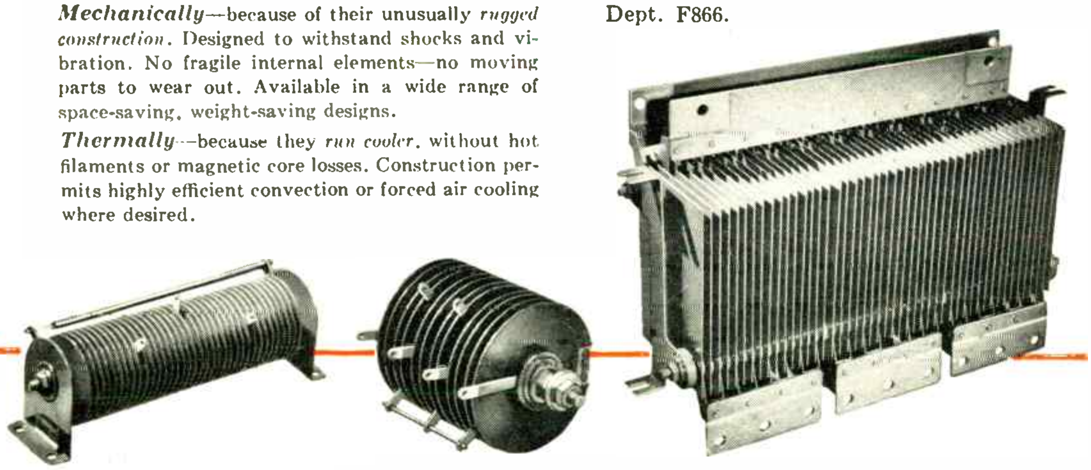
Wherever your product calls for conversion of A-C to D-C, Federal Selenium Rectifiers can simplify your design problems *three ways:*

Electrically—because of their inherent *high efficiency* and lasting characteristics. No power-consuming filaments—less wattage loss—and no time lag. D-C output is delivered instantly on application of A-C potential.

Mechanically—because of their unusually *rugged construction*. Designed to withstand shocks and vibration. No fragile internal elements—no moving parts to wear out. Available in a wide range of space-saving, weight-saving designs.

Thermally—because they *run cooler*, without hot filaments or magnetic core losses. Construction permits highly efficient convection or forced air cooling where desired.

Whatever your power conversion requirements, from milliwatts to kilowatts, there's a Federal Selenium Rectifier that will fit into your plans. And *every* Federal Selenium Rectifier is backed by the research, engineering and production skill of America's oldest and largest manufacturer of selenium rectifiers. Write Federal today for information on *your* rectifier requirements. Dept. F866.



FTR
An IT&T Associate

Federal Telephone and Radio Corporation

SELENIUM and INTELIN DIVISION, 900 Passaic Ave., East Newark, New Jersey

KEEPING FEDERAL YEARS AHEAD... is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

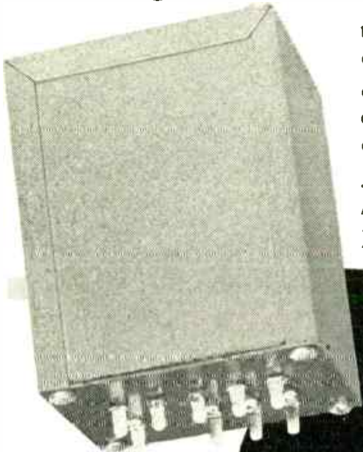
In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors:—International Standard Electric Corp. 67 Broad St., N. Y.

ADC TRANSFORMERS

Fill Super Specifications From Subsonic to Ultrasonic

For Ultrasonic Ranges

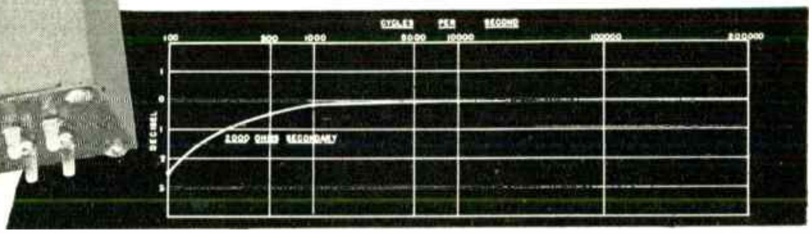
This **ADC** Transformer is custom-built to couple the output of an amplifier (30 watts) to a transducer. Impedance Ratio is 2500 ohms (4-2A3) to 500/700/1000/1500/2000 ohms. Transformers have been designed at **ADC** to operate up to 3 mc with useful band width in excess of 1:1000.



Whenever your equipment requires the unusual in transformers, **ADC** has the ingenuity, skill and capacity to produce them. If your problem requires . . .

- **reliable performance**
- **extreme compactness**
- **unusual frequency ranges**
- **hermetic sealing (for severe service conditions—commercial or Army-Navy)**

. . . it will pay you to submit your specifications to **ADC** for reasonable prices, quality products and prompt delivery.



For Audible Ranges

This transformer has no unusual electrical properties, but it was designed for extreme dependability. It is an output from pp 6V6 to line, for voice range only (1 db—150 to 4000 cps). It was ordered from ADC simply because the equipment manufacturer required *unfailing* performance.

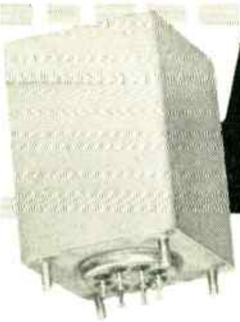
All **ADC** transformers have built-in reliability . . . a feature especially necessary for radio broadcasting, communications, wire recording, telemetering equipment, etc. A slightly higher original cost is more than offset by the dependability and quality of **ADC** design and manufacture.

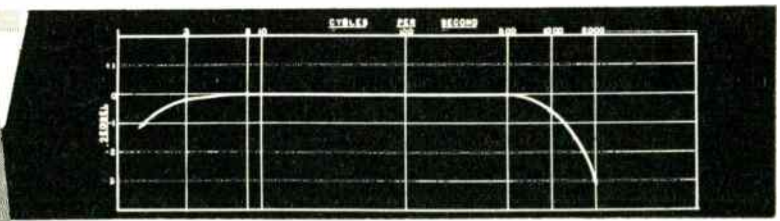
For Subsonic Ranges

(such as geo-physical work)

This transformer operates from pp plates (20,000 ohms) to pp grids (320,000 ohms) down to 2 cps. Secondary inductance is over 60,000 henries. It also has tertiary low impedance winding. Hermetically sealed—10 cubic inches.

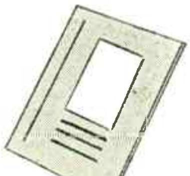
ADC has designed and made many low frequency transformers—some to operate from frequencies as low as 0.1 cps.





HERE are several charts showing characteristics of unusual transformers developed by ADC engineers. Many transformers have a wide range of requirements shown in the ADC Transformer Catalog. If you do not have your copy—*WRITE TODAY FOR CATALOG NUMBER 46-R.*

Send us your special specifications for prompt and able transformer service.



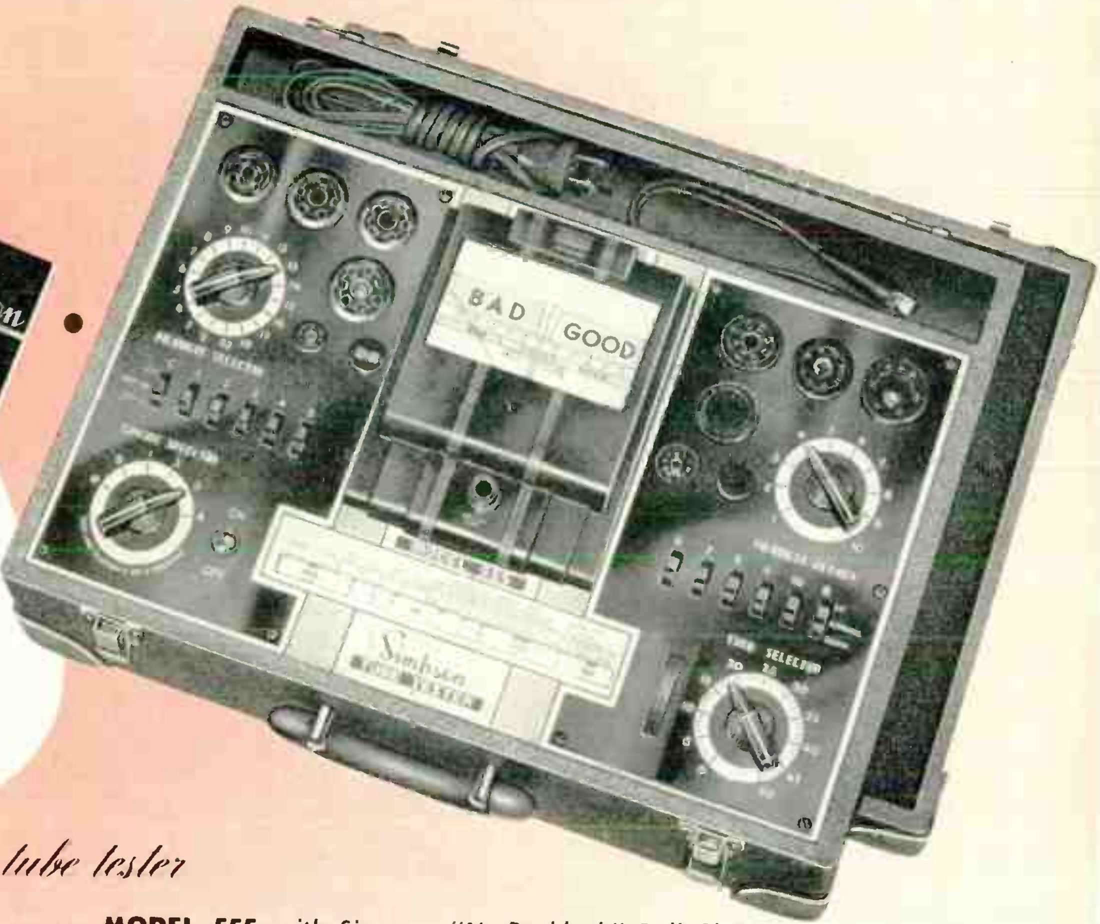
AUDIO DEVELOPMENT

Audio Development Co.

2839-13th Avenue So., Minneapolis, Minn.

Audio Develops the Finest

There's an Operator's Manual for every Simpson tester, of a kind completely unique in the industry. Averaging 32 pages, these manuals contain circuit diagrams and schematics complete data on functioning of parts, operation, and maintenance. Printed on heavy map paper, durably bound for long usage.



A new tube tester

MODEL 555 *with Simpson "No-Backlash" Roll Chart*

This latest addition to the Simpson engineered line of quality test equipment is outstanding in its simplicity of operation and attractive appearance.

Using the basic RMA recommended circuit, it is possible to test any tube regardless of its base connections or the internal connections of its elements through the use of the new exclusive Simpson three-position lever-operated toggle switches. These switches use a molded rotor carrying silver plated contacts which are self-cleaning through their wiping action.

The Model 555 will test all receiving tubes, including the latest nine pin miniature tubes and the subminiatures as used in hearing aids, etc. Extra sockets are provided and the flexible individual element switching arrangement takes care of future tube developments. Tests can also be made on gaseous rectifiers, pilot lamps, and continuity of ballast tubes.

The panel of Model 555 is distinguished by beautiful modern styling in the shining silver and black of highly polished, enduring, anodized aluminum. Ask your jobber, or write, for descriptive circular.

Size: 16¾" wide x 12½" high x 6" deep.

Dealer's Net Price.... $69.85

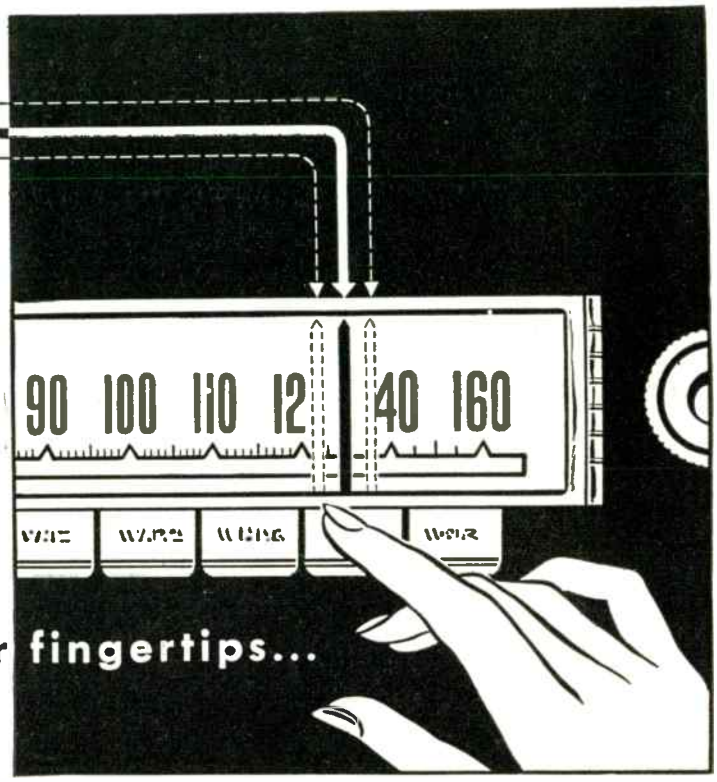
A new Signal Generator

MODEL 340

75 Kilocycles to 120 Megacycles
Fundamentals to 30 MC

The 120 megacycle range on the dial of this new Simpson instrument makes available readings for the high frequencies encountered in servicing FM receivers. A special high output jack is provided. Electron coupled circuit assures extreme stability and output uniformity throughout the band. Standard 30% modulation at 400 cycles. Effective shielding throughout. Beautiful black and silver panel of enduring anodized aluminum.

For 105—130 volts, 50-60 cycle. Size 15" x 10" x 6". Dealer's Net Price.... $69.85



STRAIGHT LINE TRACKING at her fingertips...

A station comes in at the number it's supposed to . . . IF the tuner gives straight line tracking.

To get perfect tracking — straight line tracking — in your inductance tuners, the electrical characteristics of the cores have to be *uniform throughout the entire core-length.*

But a core can be no more uniform than the powder it's made of. That's why it's important to use the uniquely uniform G. A. & F. Carbonyl Iron Powder.

Made with great care — and by G. A. & F.'s exclusive, patented carbonyl process — G. A. & F. Carbonyl Iron Powders are uniform, not only within a batch, but from one batch to another. For example, the permeability of different batches over a period of years has been held *within plus or minus one percent.*

G. A. & F. Carbonyl Iron Powders for high frequency cores offer these advantages to the electronics industry:

1. When used at radio frequency, G. A. & F. Carbonyl Iron Powders are superior in coefficients of eddy current loss and residual loss. These low losses make for higher Q.

2. G. A. & F. Carbonyl Iron Powders stand alone in co-efficients of magnetic and temperature stability.

3. In comparison with air-cored coils, G. A. & F. Carbonyl Iron Powder-cored coils permit savings in volume, weight, and wire-length, along with great increases in inductance and Q.

➡ Ask your core manufacturer for information about G.A.&F. Carbonyl Iron Powders. Or write direct to: Antara Products, 414 Madison Avenue, New York 22, N.Y. Dept. **54.**

These unique properties tell why G. A. & F. Carbonyl Iron Powders are superior:

PROPERTY	ADVANTAGE
Spherical structure	Facilitates insulation and compacting
Concentric shell structure (some types only)	Low eddy current losses
High purity	Exceptional permeability and compressibility
Absence of non-ferrous metals	Absence of corresponding disturbing influences
Relative absence of internal stress; regular crystal structure	Low hysteresis loss
Spheres of small size	Low eddy current losses; usable for high frequencies
Variations of sphere size	Extremely close packing

G. A. & F. CARBONYL IRON POWDERS

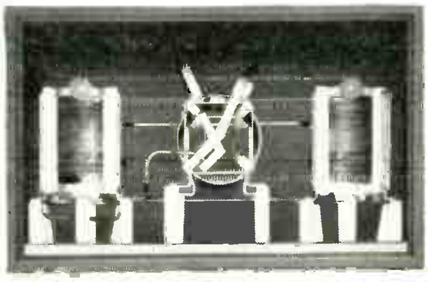
An Antara® Product of General Aniline & Film Corporation

YOU CAN CONTROL MULTI-TOWER ARRAYS THIS SIMPLE WAY

1 Use one Antenna Control Unit
for two towers

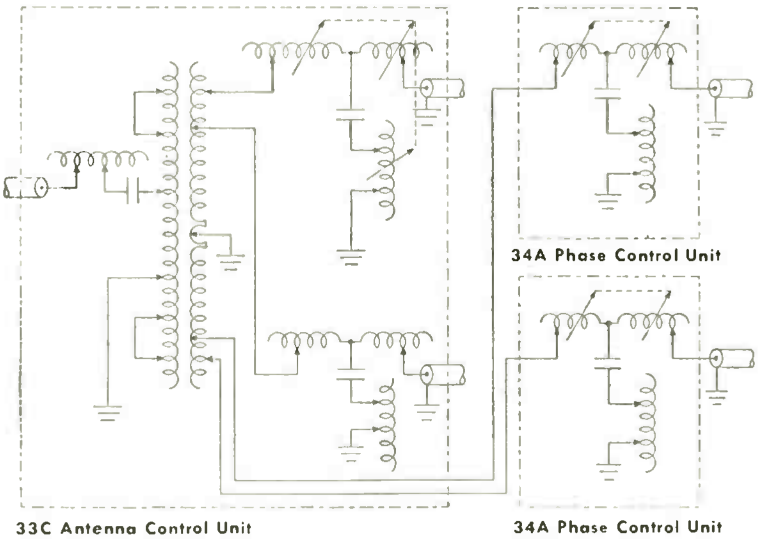
The Western Electric 33C Antenna Control Unit includes a branching circuit and two phase shifters, and permits adjustment of the current ratio and phase relation between the element currents of two towers. This unit handles up to 10 kw.

2 Add a compact Phase Control Unit
for each additional tower



Does your pattern call for an array of 4 or even 6 towers? Then merely order the necessary number of compact 34A Antenna Phase Control Units to be connected to taps on the branching transformer of the 33C. The 34A handles up to 10 kw.

TYPICAL CIRCUIT DIAGRAM SHOWING TWO 34A ANTENNA PHASE CONTROL UNITS CONNECTED TO BRANCHING TRANSFORMER OF 33C ANTENNA CONTROL UNIT FOR CONTROL OF 4-TOWER ARRAY. ADDITIONAL 34A'S MAY BE CONNECTED AS NEEDED FOR AS MANY AS 6 TOWERS.



You can use Western Electric Antenna Control Equipment to good advantage in controlling current ratios and phase relationships. The master 33C Antenna Control Unit is styled to harmonize with cabinet design of Western Electric AM Transmitters. The 34A Phase Control Unit measures only 2′ high, 3′7″ wide, 2′ deep, and requires no front-of-panel line-up space.

–QUALITY COUNTS–

For complete information on Western Electric Antenna Control Equipment, send the coupon below.

Graybar Electric Company, T-37
420 Lexington Avenue, New York 17, N. Y.

Gentlemen: *Please send me Bulletin T-2513, Western Electric Antenna Control Equipment.*

Name

Company

Address

City State

Distributed by GraybaR — OFFICES IN 95 PRINCIPAL CITIES

Western Electric

DISTRIBUTORS: IN THE U. S. A.— Graybar Electric Company. IN CANADA AND NEWFOUNDLAND— Northern Electric Company, Ltd.

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

O. H. CALDWELL, EDITOR ★ M. CLEMENTS, PUBLISHER ★ 480 LEXINGTON AVE., NEW YORK (17) N. Y.

HIGH POWER invariably improves any radio service to the public, whether it be AM, FM, TV, or general communications. A resolution now before Congress to throttle standard broadcast station powers to 50 kw (about the power exerted by a single automobile going up hill!) will limit the future usefulness of our broadcast channels, particularly to farmers and remote communities. Instead of 50-kw stations, we need 500-kw and even 2500-kw transmitters, in the best public interest.

MEMBERS OF CONGRESS are not qualified to pass upon the intricate problems of radio operation,—which they would be required to do by two proposals now before the Capitol lawmakers. Congress has created FCC to perform this radio task, and has equipped the Commission with funds, engineers and facilities to handle this technical job. Regrettable mistakes have indeed been made by FCC. But it would be an even more collossal error (hazarding possible radio chaos, as in 1926), if Congress itself ever attempts to legislate the complex and changing technical details of radio administration.

ENGINEERING DESIGN ECONOMIES result from a lot of small and large items. Comparing present with prewar models, we note high-frequency power supplies with inexpensive transformers and filter capacitors. An ingenious expedient utilizes the inner and outer coatings of the bulb of the cathode-ray tube to provide the necessary filter capacitance. These coatings (in a projection tube) may be at 20 to 30 kv difference of potential.

The use of intercarrier modulation principles has resulted in substantial cost reduction in some of the latest inexpensive 7-inch sets.

Higher figures of merit found with the new miniature tubes have not only simplified circuit design but make the wide-band requirements easier to attain.

One large company has inaugurated a continuous cabinet production line that fabricates TV cabinets from the wood, and applies all of the finishing processes in a matter of four hours. No longer are the multiple handling and storage times needed awaiting finish drying.

LOWER-COST TV SETS—We have received many queries as to what happened in designs to account for the recent downward trend in TV receiver prices. The answer is not the same in every case: (1) Some companies have worked out new distribution policies which they think will be more efficient and economical. (2) Others believe that an arbitrarily-set lower price will put them in the forefront immediately and make easier sailing later. (3) Some prices have been set by companies which have capitalized on the experience and developments of others and so have no great development overhead to write off. (4) Engineering design economies have been achieved. These last are the only real gains that mean anything in the overall picture.

PROJECTION VS. DIRECT-VIEW—Controversy over projection versus direct-view television is crystallizing in the Baltimore area according to reports from that region where it is claimed that a growing demand by the public for direct-view receivers gives evidence that the small-picture set is not the drug on the market that some expected it to be. Low-priced receivers are literally changing the "picture" of the mass television market.

TELE-TECH's TV TIMETABLE for 1948 . . . See Part 2

Our TV Timetable included with this issue as Part 2 is the first and only compilation of its kind showing by months TV stations scheduled to go on the air commercially in 1948. Supplementing this exclusive Timetable are other pertinent facts on television actions which make this special Timetable the most informative reference chart of the year.

HOW MUCH Pay Is

Second in a series of articles on engineer pay. This article analyzes the pay for radio and electronic engineers in research and manufacturing fields and outlines a bonus plan covering engineers with General Radio Company

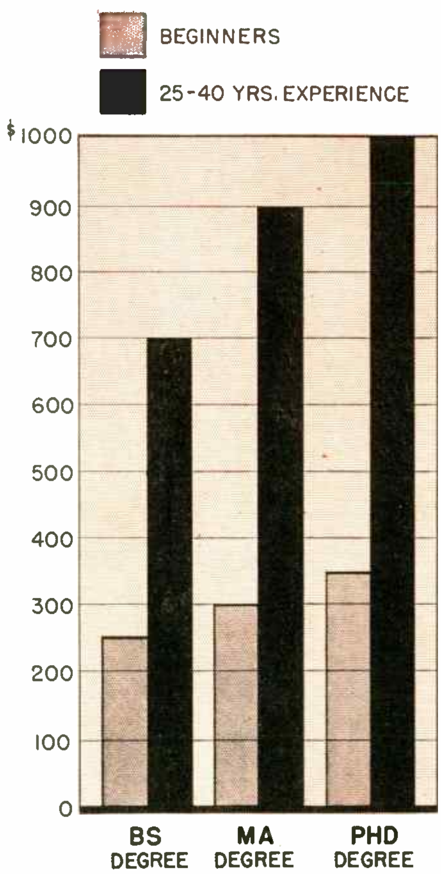
WHEN an engineer enters employment, no subject is of more interest to him than pay. This interest is natural because it is the measure by which others appraise his ability. It is also a measure of the appraisal put on different types of talents.

Competent engineers sometimes complain that technical sales positions and administrative positions pay higher salaries to persons considered by the engineer to be less competent than himself. Such a person may also have had less academic training than the complaining engineer. The law of supply and demand is inexorable in the long run and it, nearly alone, determines pay rates, barring, of course temporary controls. If there is a shortage of chemical engineers and a surplus of electronic engineers, the chemical engineer will be the higher-paid. That situation currently exists.

In general, the young man who has decided on an engineering career is far more influenced in his choice of fields by his like or dislike of a field than by the pay opportunities in that field. There is, of course, some influence exerted where employment and pay conditions in a particular field are unusual. Tangibility is also an important factor. For example, many young men are attracted to electronic courses because they recognize electronic phenomena all around them, and in many cases they have constructed some sort of electronic equipment. On the other hand, metallurgy is a rather intangible subject to a preparatory school student, with the result that students training in this field have been rather few. Pay after graduation has accordingly averaged higher than in the electronic field.

Except as we may influence young men as to the advantages and disadvantages of the electronics field. our pay problems become quite personal because we are already in the field. Pay data is a very intangible subject because it is so difficult for any individual to make an accurate self-appraisal and thereby place himself correctly on the statistical pay curves. For anyone interested in a splendid analysis of comparative rates of pay for engineers, I recommend a study of a report published last year by the Engineers Joint Council on the 1946 Survey of the Engineering Profession. The report is entitled, "The Engineering Profession in Transition". The price is $1.00, and it may be obtained from the Council, 33 W. 39th Street, New York. (TELE-TECH, April 1948, page 25.)

Comparison of monthly pay by degrees



Comparative Pay Scales

I have recently made some spot checks of current pay rates for young men entering the electronics industry. They are still very confused by the effects of the war. Consideration is usually given to the value of war service, and a preferential rate of from 10 to 20 percent is not unusual for those who have had really useful war experience in the line of work for which they are engaged. Starting pay for the holder of a baccalaureate degree in science or engineering is currently $250 a month for a standard work week. In the case of some training courses, a rate of about $225 may be expected. Useful war experience may add up to about $50 a month, thus bringing the top starting rate up to $300 a month.

The base for a master's degree runs from $25 to $50 a month above the baccalaureate. There seemed to be more hesitancy in quoting finite figures for this degree, largely because of the war experience factor and because of the privileges under the G. I. Bill. A graduate who had useful war service, and then obtained his master's degree at the end of the war, seemed to have his experience credit and his degree

An Engineer Worth?

Dr. H. B. RICHMOND, Chairman of the Board, General Radio Co., Cambridge, Mass.

Dr. Richmond addressing the IRE on the subject of this article

WHAT DO YOU THINK?

Does the pay of engineers in the communications industry keep pace with rise in income in other industries and professions? Do engineers feel adequately paid? Comments from engineers are welcome. Write to TELE-TECH in confidence—names will not be used.

credit merged in a manner hard to appraise separately. A base rate of $275 for an inexperienced holder of a master's degree, particularly if part of the training had been accelerated, can be expected. A more normal rate, including some small allowance for military experience, would be nearer $300.

The holders of the doctorate in the field of science start for about $100 a month more than do the holders of a B. S. degree. The extra time and cost is hardly worth this small starting differential. The employer is very likely to take the attitude that the holder of the B. S. degree is not expected to produce too much at the start, but is amenable to training; whereas the holder of the doctorate, while recognized for his advanced training, is nevertheless often regarded with a bit of suspicion as to his ability to turn this additional training into applied practice until he has actually proved his ability to do so.

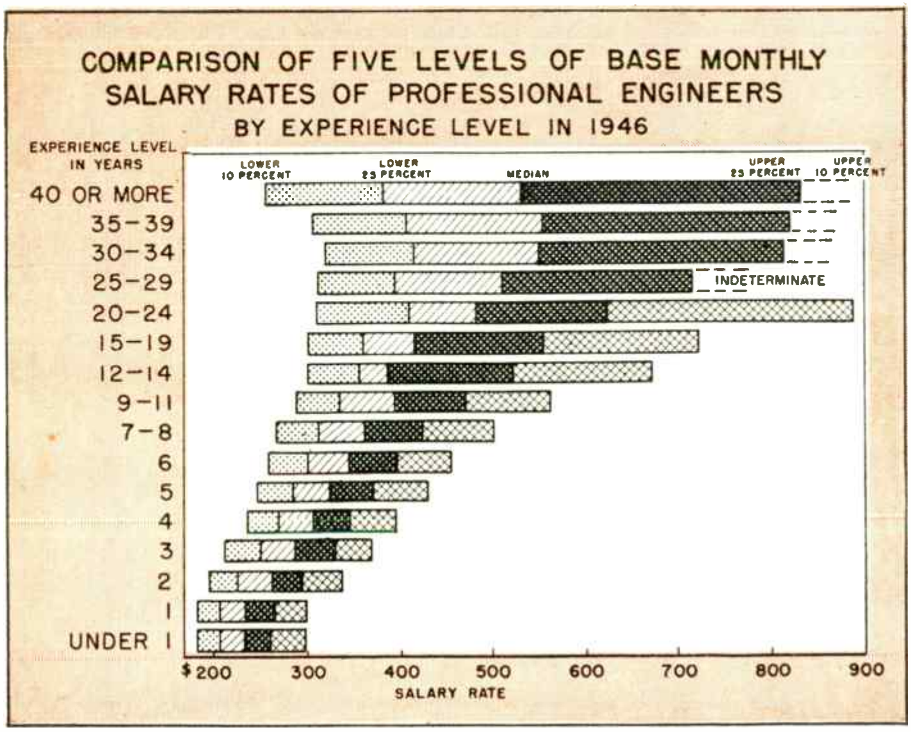
Highest Paid Engineers

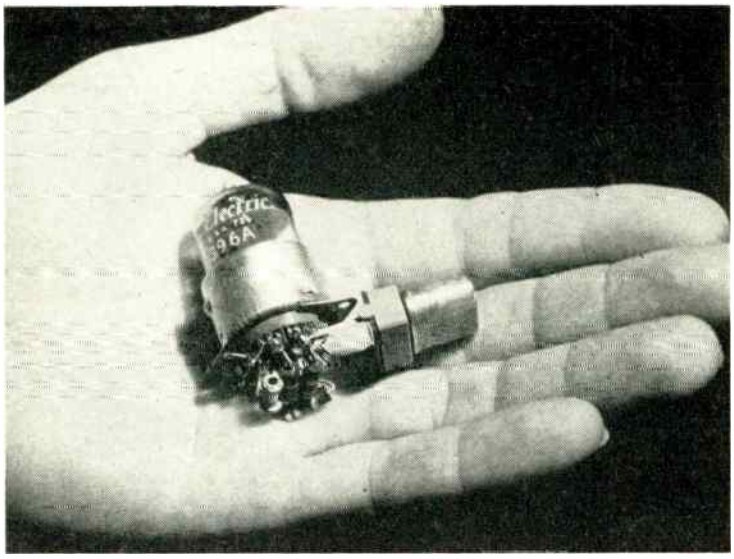
The Engineers Joint Council study shows that the highest paid group of engineers are those holding non-technical management-administrative positions, with those holding technical management-administrative positions coming second. Research workers in the field of basic science come next, followed by research workers in applied science. Teaching, in which many holders of the doctorate are engaged, is twelfth on the list of nineteen classifications.

These starting rates are really interesting to only a small proportion of engineers, principally to those about to seek employment or those who have recently started, and to employers of such young engineers. What is of greater interest is the pay that men with 25 to 40 years of experience in the electronic field receive. This is so complicated by a depreciating currency that a simple answer is very difficult. For example, the starting monthly rate of

(Continued on page 76)

Chart from "Engineering Profession in Transition" by Engineers Joint Council





Simplest series mode crystal oscillator circuit for work at moderate frequencies. Only circuit elements are R and C, inductances are unnecessary

Series Mode CRYSTAL CIRCUITS

Quartz crystal oscillators produce oscillations at 118 mc; by using one twin triode, circuit can be operated at 250 mc. With modifications, the circuit can be used as a converter

By HAROLD GOLDBERG and EDWARD L. CROSBY, Jr.,
Research Engineers, Bendix Radio Division, Baltimore

UTILIZATION of the concept that a piezoelectric quartz crystal may be represented in the neighborhood of a resonance by the equivalent circuit (Fig. 1) has resulted in oscillator circuits having unusual characteristics.

This circuit has two frequencies of resonance, one, termed the series resonance, for which the impedance is a minimum and the other, the parallel resonance, for which the impedance is a maximum. These frequencies are very close to each other in the typical crystal. At low frequencies, the shunt capacitance may be ignored without much error as far as the series mode is concerned, and the series mode resonant frequency may be taken as that of the series arm alone. If one uses the crystal in an oscillator circuit which drives the crystal in its series mode at low frequencies, the crystal may be represented by the series arm alone without significant error.

The oscillator, basically represented in Fig. 2 is essentially an amplifier having a complex gain, the real part of which is G and the phase shift of which is θ, connected back on itself through an impedance Z, the quartz crystal. The condition for steady oscillation is shown by the relation for (C) in Fig. 2B. Both G and A may be computed for the condition of steady oscillation. If the center frequency is sufficiently high the frequency of oscillation can be computed to a good degree of approximation from A, where

$$A = \omega/\omega_0 - \omega_0/\omega = 2\Delta\omega/\omega_0 = 2\Delta f/f_0$$

where Δf is the difference between f and f_0.

From the relations in Figs. 1 and 2, it can be shown that

$$G = R+R_0+R_1/(R_1 \cos\theta - X_1 \sin\theta)$$

$$2\Delta f/f_0 = -[(X_0 + X_1)/\omega_0 L] + (\tan\theta + X_1/R_1)/Q_{eff}(1 - X_1 \tan\theta/R_1)$$

where Q_{eff} is given by

$$Q_{eff} = \omega_0 L/(R+R_0+R_1)$$

Although θ, X_1 and X_0 are treated as though they are independent of

Fig. 1: Equivalent circuit of crystal and holder

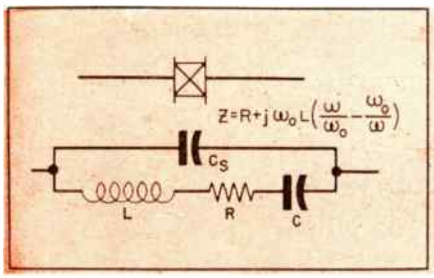
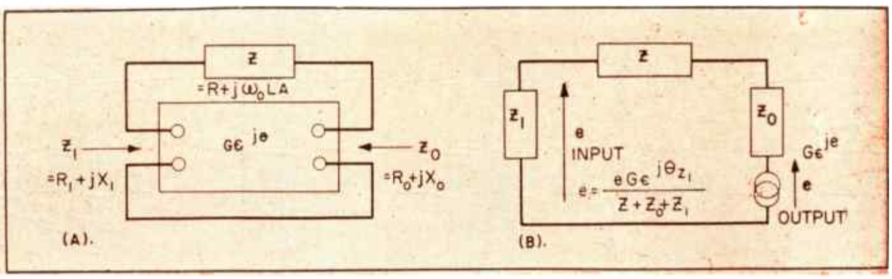


Fig. 2: Fundamental oscillator circuit shown in (A) left; equivalent circuit (B) right



frequency, the more exact analysis becomes complicated and does not necessarily yield more significant results.

Frequency Stability

Since we are primarily interested in frequency stability, let us investigate the last relation. If the circuit is tuned so that tan θ, X_0, and X_1 are zero at the frequency f_0, $\Delta f/f_0$ is also zero, so the oscillator operates at the resonant frequency of Z. If the resonant frequency of Z is independent of ambient conditions, the stability will be determined by the way in which temperature, operating voltages, vibration, aging, etc. affect the parameters on the right of this equation. It is obvious that the effect on the frequency of such changes will be small if $\omega_0 L$ is very large compared to R, R_0, R_1, X_0, and tan θ. Furthermore, stability will be improved if tan θ, X_0, and X_1 change very slowly with frequency. The first requirement is satisfied if we choose a quartz crystal for Z, and keep R_0, R_1, X_0, and X_1 comparable in magnitude with R. This is a consequence of the high Q of quartz crystals.

The second requirement may be satisfied by making the amplifier broad band, and making the input and output impedances broad band. In other words, a sharply tuned band pass amplifier will give poor stability as compared to a broad band amplifier having the proper gain. With good crystals, it is obvious that high orders of stability are possible. However this circuit is not as stable as the Meachem bridge stabilized oscillator, which can achieve higher degrees of stability by minimizing the effects of variations in tan θ, etc., by increasing the gain of the associated amplifier.

This is not the case for the circuit analyzed here but the circuit does possess remarkable stability if properly designed.

The quartz crystal has been treated as a simple series resonant circuit, which is justified when the shunt capacitance across the crystal has a negligible effect at resonance. At high frequencies (>30 mc) this capacitance, even for crystals mounted in low capacitance holders, is no longer a quantity to be ignored. It has been found in this series mode oscillator, that one can take care of the shunt capacitance by anti-resonating it at the operating frequency. An examination of the resulting impedance equation shows roughly the same behavior at resonance as that obtained for the series arm alone when used in the neighborhood of resonance.

Circuit Characteristics

The equation above for G suggests that the class of amplifiers whose input and output are considered to be in phase may be used for this type of oscillator. Since simplicity is generally desired, only two generic circuits will be considered (Figs. 3 and 4).

The amplifier portion of Fig. 3 is a grounded grid amplification stage driving a cathode follower output stage. The amplifier portion of Fig. 4 is a cathode coupled amplifier. Both input and output of the amplifier of Fig. 3 are generally low impedance because the input impedance of a grounded grid amplifier, and the output impedance of a cathode follower, are low. The input

Fig. 4: Diagram shows an alternate circuit for Fig. 3. This circuit operates at higher impedance levels

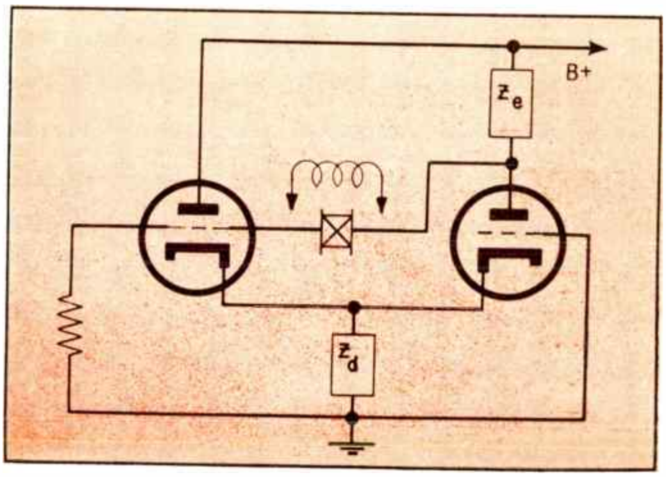
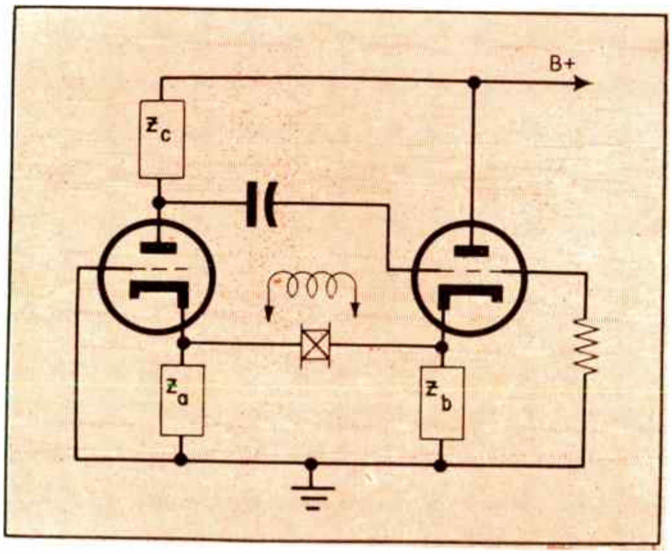
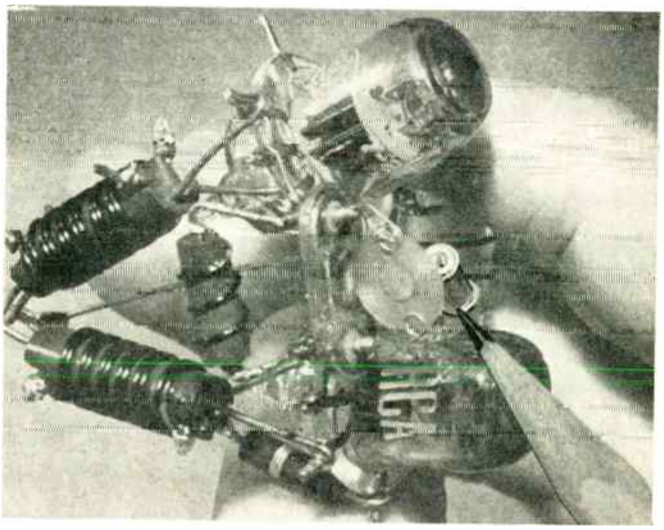


Photo below right: VHF series mode crystal operates directly at 236 mc. Pencil pointer indicates tiny A-T cut quartz crystal ground for approximately 10 mc fundamental frequency

Fig. 3: Circuit utilizing series mode of crystal is a grounded grid triode which feeds a cathode coupled output stage as illustrated





and output of the amplifier of Fig. 4 are generally high impedance although they need not necessarily be. For given tube types, the lowest impedances will generally be achieved with the amplifier of Fig. 3. Although the tubes shown are triodes, the circuit is not restricted to triodes. It may be advantageous to use tetrodes or pentodes in either position.

The networks shown may also be four terminal networks. Amplitude control is accomplished by grid leak bias of the cathode follower although other means of control may be used. For the utmost in stability, some means of control should be used which limits operation to class A. At high frequencies, the crystal holder shunt capacitance is antiresonated as shown. The circuit of Fig. 4 would require a blocking condenser if the holder is antiresonated. If stability is the prime consideration, the circuit of Fig. 3 is to be preferred, all other factors remaining constant. The circuit of Fig. 4 may be used where a so-called "rubber crystal" circuit is desired.

Poor stability may be obtained with the circuit of Fig. 3 by inserting resistance in series with the crystal, or by resorting to stratagems which cause the right side of equation (2) to vary rapidly with frequency. The frequency of the oscillator may be changed by causing these quantities to vary or by inserting a variable reactance in series with the crystal.

It should be realized, for the circuit of Fig. 3, that Z_a and Z_b are not the input and output impedances. The input impedance, denoted by Z_i in the analysis, is a function of Z_a, Z_c, and the parameters of VT_1, even when the effects of interelectrode capacitance and grid current in VT_2 are neglected. If the latter are not neglected, both input and output impedances involve all of the circuit constants including those of the crystal. This interaction may be reduced by the use of grounded grid pentode amplifiers in place of the triodes shown.

Low Frequency Operation

Z_a, Z_b and Z_d are resistors for low frequency applications. The plate circuit impedances Z_c and Z_e may be resistors with or without high frequency peaking circuits or tuned band pass circuits. The low pass circuit has the considerable advantage that it is useful with any crystal of any frequency for which the amplifier gain will sustain oscillation. By using high figure-of-merit tubes, it should be possible to build a circuit which would accept crystals having frequencies up to 10 mc without adjustment changes. Changing frequency would merely mean changing crystals.

One must be careful, however, with this type of circuit, to pick crystals that have their greatest activity at the desired frequency. All crystals have many modes of oscillation of different activity. The circuit will oscillate at the frequency of the most active mode within the pass band of the amplifier, not necessarily the nominal operating mode designated by the manufacturer of the crystal. If the desired mode is not the most active one, it must be selected, or favored, by using tuned band pass circuits for the plate impedance. If the band pass circuit must be made sharp to exclude a nearby unwanted mode, the stability will not be as good as with the broad low pass circuit.

The equations for the frequency of the oscillator indicate greater stability for broad band amplifiers in general, since their phase shift changes more slowly with frequency. Despite the fact that one would expect that the effect of variations of shunt capacitance would be reduced by using low L/C ratios, an analysis shows that the stability is greatest when the Q's of the circuits in the amplifier are a minimum.

The cathode follower portion of the amplifier is cut off during a portion of each cycle if the Class A gain of the amplifier exceeds that necessary for stable operation. Under these conditions, the follower grid draws current and amplitude is

Fig. 5: Circuit of Fig. 3 with output trap to pick selected harmonic

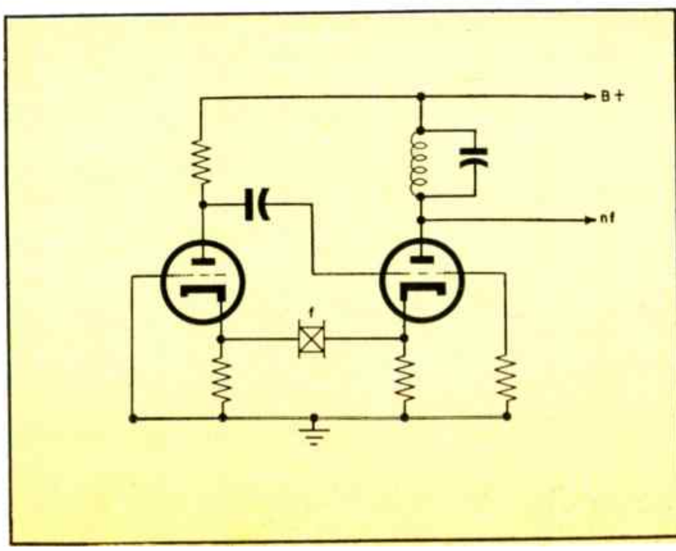
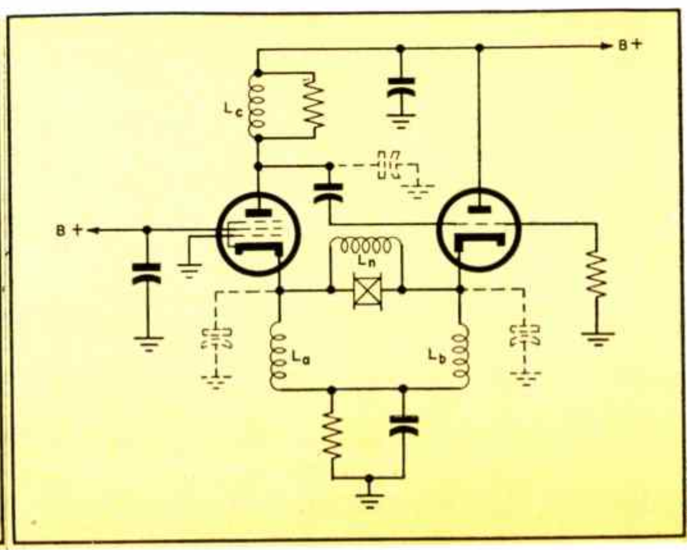
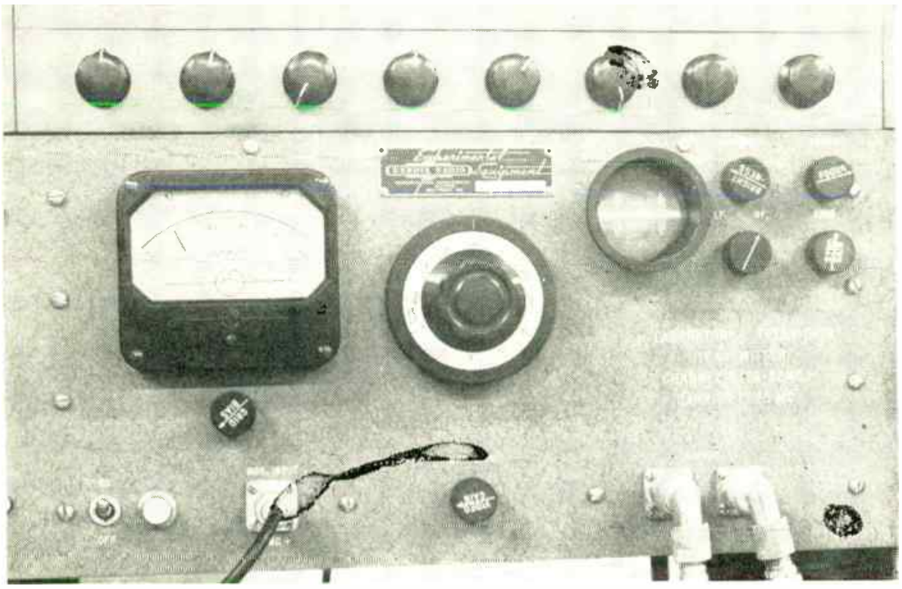


Fig. 6: Pentode oscillator to produce outputs at higher harmonics





Laboratory television transmitter using series mode circuit on 7th overtone at 77.25 mc for the exciter. Design simplicity and power supply economy were achieved by application of circuit developed by G. H. Brower under direction of F. R. Norton, Bendix research engineers

limited by the grid bias developed, but the waveform at the input to the grounded grid stage is good since the crystal acts as a wave filter. Overtones may be obtained from a circuit placed in the plate of the follower section which is tuned to the desired overtone, Fig. 5.

The independence of frequency with respect to tube parameters is illustrated by the following example. Two low-pass circuits were constructed, one using a 7F8 twin triode, the other a pair of 6AC7's connected as triodes. The frequency of oscillation of the two circuits when used with the same 440 kc crystal differed by only 1 PPM.

For high frequency operation, band pass tuned circuits must be used for the plate impedance. This laboratory finds that single tuned circuits for the plate impedance, resonated by the stray shunt capacitances of the circuit are useful. The plate circuit was loaded as much as possible without endangering the condition of oscillation. The shunt capacitance of the crystal holder was anti-resonated at the operating frequency. It was found that with resistances for the cathode impedances, and a 7F8 twin triode, direct operation of a crystal was achieved at a frequency of 118 mc. The particular crystal used for this experiment was a hermetically sealed "quintupler" crystal designed for operation at its 5th mechanical harmonic. Operation at 118 mc was at the 11th mechanical harmonic.

To achieve still higher frequencies complex cathode impedances must be used, since the shunt capacitances reduce the gain to such low levels that oscillation is no longer possible.

There may be an advantage in the use of grounded grid pentodes as in Fig. 6 to obtain the ultimate in high frequency operation. L_a and L_b anti-resonate the shunt capacitances present in the cathodes. L_c tunes the plate. The pentode provides additional decoupling between input impedance and plate impedance. Although not yet tried in this laboratory, it is hoped that this circuit will make possible direct operation at frequencies higher than 118 mc.

If desired, electrical overtones may be derived from the plate of the follower, as already noted. The circuit using the single 7F8 and running at 118 mc produced appreciable third harmonic at 354 mc.

Use as Converter Circuit

In converter service the grounded grid may be used as a signal grid, the follower plate delivering the IF output, Fig. 7. Mixing takes place primarily in the follower. For this type of service, the gain of the amplifier must be optimized for the greatest conversion gain. Operation

(*Continued on page 86*)

Fig. 7: Signal applied to input of "grounded" grid tube of Fig. 5

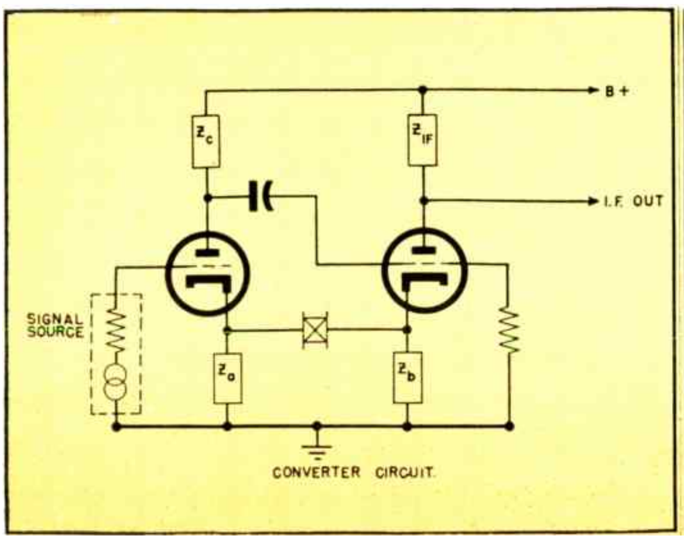
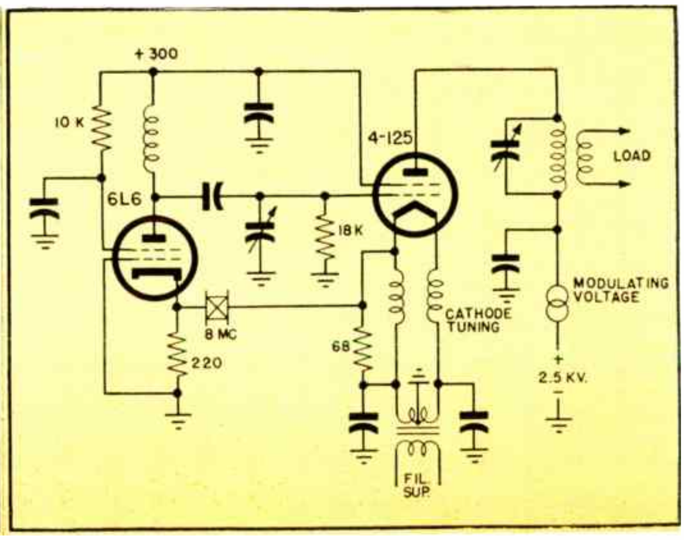


Fig. 8: High power oscillator delivers 400 w at 1st or 3rd harmonic



(l to r): Roland Hale, WCOP, Boston; Homer Courchene, WLS & WENR, Chicago; George Milne, ABC, at IRE Convention in March

IRE CANDIDS

Below: Dr. Benjamin E. Shackelford, 1948 IRE president, (l) Mrs. Shackelford and F. E. Terman, Stamford U., past pres. IRE

Below (l to r): Harry Gawler, Gawler-Knoop; Dr. T. T. Goldsmith, DuMont; John Reed, Crosley (AVCO) at IRE convention

Below (l to r): R. F. Shea of General Electric and L. M. Temple of Winchester Company look serious at IRE's informal party

Engineers Reveal New

New tubes, circuits, radar, computer and amplifier

AN OUTSTANDING technical success, in addition to being a sell-out insofar as attendance and exhibits were concerned, the 36th annual convention and radio engineering show recently held by the Institute of Radio Engineers in New York presented the industry and the world with several interesting reports on new radio engineering and electronic developments. In a majority of the papers, new concepts were disclosed that bear directly on new fields of research: nuclear studies, rapid telemetering of multichannel effects over radio channels, and computer equipment in several forms. In addition there were several new communication circuits disclosed that may well serve in associated fields at a later day. An analysis of a few of the papers follows:

Educated Echoes

The possibility of reflected-power communication was analyzed by Stockman of Watson Labs., Harvard. Here, a continuous source of energy (such as radio signals, infra-red or ultrasonic) can be modulated at a remote point so that the reflected signal returns carrying the desired intelligence.

Synthetic Quartz Substitutes

Several papers were presented by representatives of the Bell Telephone Labs. on the subject of a quartz substitute of a synthetic type—Ethylene Diamine Tartrate. While this is a new, all-organic water-soluble material and is more fragile, still its properties are of interest. The material is finding ready use in many applications as, for example, in band-pass filter circuits in telephone systems.

Wideband Amplifier Systems

Two papers described wideband amplifier systems using distributed

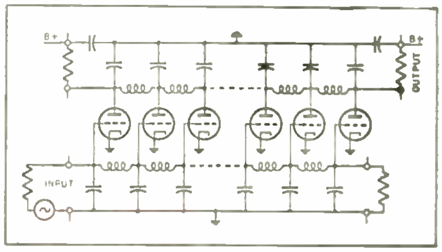


Diagram of basic distribution amplifier (Ginzton, Hewlett, Jasberg and Noe) giving greater bandwidth-times-gain characteristics. Lumped transmission lines in input and output circuit must be properly terminated in order to prevent reflections

transmission line principles. W. R. Hewlett (Hewlett-Packard) showed that, by an appropriate distribution of ordinary vacuum tubes along artificial transmission lines, it is possible to obtain amplification over much greater bandwidths than would be possible with ordinary circuits. A typical amplifier of this type is shown herewith. The method approaches the travelling-wave tube system but uses presently available tubes.

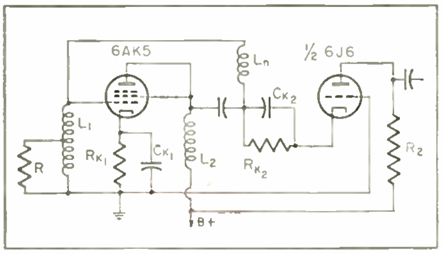
Another delay-line coupled amplifier was described by Rudenberg (Harvard) where a bandwidth (like the preceding, also obtainable with standard tubes) is obtained one order of magnitude larger than that limiting a single-tube stage. The gain of a lossless chain is $ng_m/\omega' C$ per group of n tubes. A bandwidth of $g_m/20\ C$ cycles per tube was found for a chain having 8.6 db gain, equivalent to a bandwidth of 50 mc for each 6AK5 in the chain. An 11-tube chain showed nearly linear phaseshift response, and a gain of 10 db up to 250 mc, with a cutoff frequency of 300 mc.

Low Noise Circuit

A low-noise cascode circuit was described by Wallman giving superior noise performance of a grounded-cathode triode first stage with the stability and amplification

Developments at IRE

system are some disclosures made at March N. Y. meeting



Grounded grid triode follows grounded cathode stage in low noise amplifier (Wallman, Macnee and Gadsden). L_n serves as neutralizing coil. Noise factors averaging .25 db at 6 mc carrier show typical achievement

of an ordinary pentode amplifier. A typical circuit is shown here.

New Tube Designs

Among a number of new tube designs present, several would seem to offer features suitable for new industrial service. The new long-life red line of control tubes was disclosed at the conference.

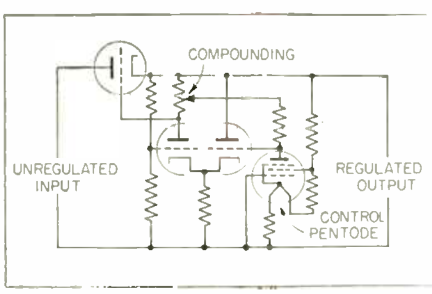
A new trigger tube developed at National Union Radio Corp. will be useful in control service because of its small size and unique features. The NU TR-1032-J is a 9-pin miniature tube with a triode input section producing a primary electron beam. This beam impinges on a secondary-emission surface, and secondary electrons are collected by two different output elements which may be used either separately or as a unit. Suggested uses include the following: relaxation oscillator, multivibrator, pulse inverter, modulator, oscillator, and dynatron.

Another National Union tube opening up new control ideas is a radial beam cathode ray tube where the beam continuously sweeps over 12 (or more) anodes during each revolution around the cathode at the axis. In this electrostatically focused tube, a combination of fields (one of which is from a multiphase source) produces a single radial electron beam which is rotated by the uniform component of the combined fields. A twelve circuit tube is no larger than an ordinary radio receiving tube. The beam current is of the order of 1 ma and the frequency of rotation is limited only by the inductance and capacitance of the elements of the tube. Normal operation may be of the order of 1000 rps but speeds of a million rps might be possible.

Unlike the usual cathode ray tube the deflection fields produce the rotation, but independent control grids in each radial section modulate the beam intensity in accordance with any form of signal. This tube acts as an inertialess distributor with applications to time-division multiplex, telemetering, remote control, and other high-speed switching functions. At the receiving end of the system an analogous tube has been designed to redistribute the time divided signal into the separate channels. Here a single input circuit is diverted into a time-divided 12 circuit output.

Regulated Power Supply

Methods for securing stable regulated power supplies which do not require a battery or regulator tube source of voltage for comparison,



Power supply regulation system without a need for gaseous tube voltage reference source. Stable regulation obtained without fluctuations of usual gaseous regulator tubes

were discussed by R. R. Buss. Several physical effects were analyzed that provide suitable control char-

(Continued on page 46)

(l to r): G. W. Peirce, DuMont South Central rep; Fred. Borneman, Watson Labs; Geo. Mezger, DuMont discuss television at IRE

IRE CANDIDS

Dr. W. R. G. Baker, GE v-p listens to an account of the British radio industry from Dr. W. Jackson, Imperial College, London

Below (l to r): Dr. C. S. Roys, Syracuse U. scores a point in a serious discussion on radio with R. E. Samuelson, Hallicrafters

Below (l to r): Dr. W. L. Everitt, Univ. of Illinois; Stuart Bailey, Washington, Mrs. Bailey; Ray Guy, NBC and Barbara Everitt

New Telecommunications

C. W. Concelman (left), electronic engineer, Industrial Products Co., shows new 95-ohm matched impedance twin connectors to Ed Callum of Airadio, Inc.

New Component parts, test and broadcast equipment, some of which were displayed at the recent IRE Radio Engineering show for the first time, are reviewed on the following pages for Tele-Tech readers

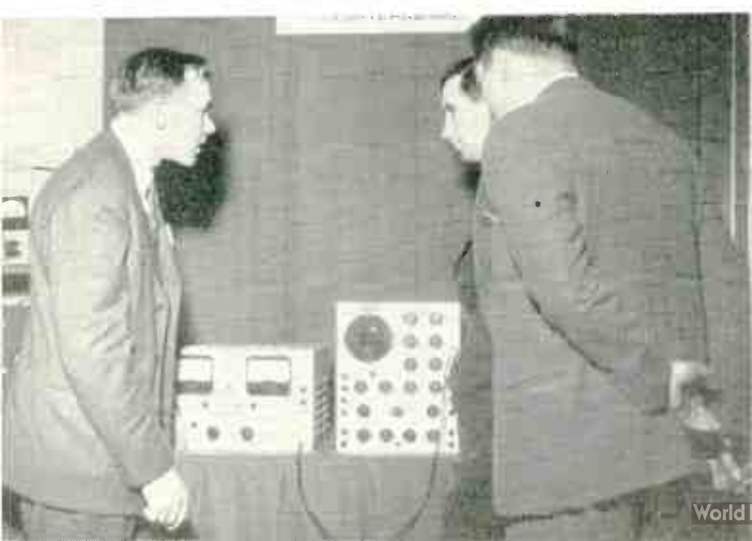
COMPONENT PARTS

D. C. Duncan, chief engineer, Helipot Corp., discusses firm's new potentiometer with C. R. Swan, James G. Biddle Co.

Chris Snyder, v-p (left) and H. Landsberger, engineer, General Ceramics, discuss coaxial conductors with H. F. Harmon, AT&T

TEST EQUIPMENT

Howard Vollum, Tektronix, Inc. (left), describes new oscilloscope with S. Combs, DuMont, and J. M. Carter, Westinghouse



Wm. Hewlett (left) and W. N. Eldred, Hewlett-Packard Co., display standing wave indicator, audio oscillator, voltmeter

Equipment On Parade

Bud Luth (left), Burlington Instrument Co., and Chas. J. Metz, sound recording engineer, Robinson Recording Labs, discuss Burlington's model 731 milliampere meter in standard ranges

John Wolfe (left), Super Electric Products chief engineer and F. Sullivan of the company's Electronic Parts Division are shown talking over firm's new horizontal output transformer which supplies deflection current for standard electromagnetic yoke

William Eitel of Eitel-McCullough, Inc. (left) describes firm's new variable vacuum capacitors to Paul Megan and Bill LaRose, W. T. LaRose Associates. Available in 3 capacities

Morris Salzberger and Lawrence Freed, Freed Transformer Co., talk over the company's new incremental inductance bridge

Howard J. Tyzzer, Ferris Instruments Co. (left) demonstrates new AM-FM-TV signal generator to H. Boyle, N. Amer. Philips

Above: Paul deMars, R. M. Wilmotte, Inc. consulting engineer questions C. R. Runyon, III, about Radio Engineering Lab's new studio-transmitter FM ST link equipment shown at IRE show

Above: Stanley Irwin, Ass't. Dir. of Communications, American Airlines and H. F. Penfield, Collins Radio Co. review features of the new VHF receiver assembly for aviation communications

Above: Ernest A. Barbeau, radio consultant of Schenectady (left) asks questions about General Electric's new type 8A-C ST link receiver. Dr. E. D. Cook, equipment's designer, answers him

Above: Langevin's amplifier model 122 designed to work with crystal phono pickup and radio tuner is described to Chas. Thon, engineer, WEEX, Easton, Pa., by Howard Harkavey (left)

Below: R. R. Taylor, transmitter engineer for WSAN, Allentown, looks over new turntable of Gray Research & Development Corp. Jay H. Quinn (right) explains its 7 major features

Below: Gerald R. Chinski, engineer, KXYZ, Houston, (left) and F. G. Fenberg, Western Electric, discuss company's new 57A FM three-element clover-leaf antenna first shown at the IRE

Amplifier Load Impedance Reduction

GENERAL design equations are derived for output watts, efficiency, and load impedance, and it is shown that a range of at least 10:1 in load resistance can be made available with a change of output watts of only 1.3:1.

The discussion is put in terms of a specific tube and the essential design of an amplifier of 34 db gain, with voltage and current feedback, and an internal impedance equal to the directly-fed 50-ohm load, having an output of 10 watts, is given. An output stage design (600 ohms) with no restriction on supply voltages, demonstrates the use of a low anode voltage (compared to the screen voltage) without a special output tube.

The procedure described provides an alternate solution to the more general graphical methods using tube characteristic curve plots, giving all practical information, supply voltages, currents and some insight into the operation of tubes with low impedance loads. (British Patent No. 2515/44)

By B. M. HADFIELD, Research Engineer, Research Laboratory of Electronics, MIT. Cambridge, Mass.

THE DESIGN of amplifiers to deliver power into low-value load impedances over a wide range of frequencies, without the use of large ratio output transformers, or special tubes, is possible by departing radically from the usual ratio of screen and anode voltages for pentode and tetrode tubes. High-ratio output transformers have bulk and limited frequency response range, even when great care is used in design and construction. Few tubes, used in a conventional manner, can be properly loaded directly with impedances of the order of 600 ohms and less, so specially designed tubes are frequently necessary.

When voltage and current feedback is applied in such amplifiers to stabilize the gain and internal impedance the design of these networks becomes more difficult when the output load impedance is high. The plate-to-ground capacitance of the output stage, which is far larger than that of previous stages, will be of greater influence on the high frequency response if the load impedance is high, while the unwanted feedback from anode-to-grid is larger with larger load impedances since the gain of this stage is higher.

There are many reasons, therefore, why it would be advantageous to feed the low-load impedance directly, provided this does not involve use of a special tube. This can be done with the normal tubes by using an anode voltage substantially smaller than the screen voltage.

The author has shown[1] the general design of circuits operating under incipient waveform distortion conditions. The method used differed from conventional practice in that a symbol (p) was introduced to represent the ratio of the negative anode voltage variation to the steady voltage sustained by the tube. To make the treatment general, the positive output voltage change is defined as 1/Nth of the negative, and the corresponding current variations are given the ratio M:1; the values of M and N being defined in a specific case by the proposed use of the tube circuit.

The steady anode voltage is defined as (E_b) the maximum and minimum voltages as E_b' and E_b'' and the corresponding maximum and minimum currents as (I_a') and (I_a''). The output volt-amperes, efficiency and load are then derived, and are as follows (for the case where I_a' is negligible compared to I_a and under maximum output conditions just prior to overloading by waveform distortion: (k) is a numerical constant of value depending on the waveform, being 0.125 for a sine wave).

$$\text{Volt amperes} = I_a p k E_b (N+1)/N \qquad (1)$$

$$\text{Efficiency} = pk(M+1)(N+1)/N \qquad 2)$$

$$\text{Load Res.} = pE_b(N+1)/NI_a \qquad (3)$$

$$I_a = (K_a/\mu^m)(E_s + \mu E_g)^m \qquad (4)$$

Equation 4 shows for the range of currents normally used, the power law relationship that exists for the tube current in terms of the electrode voltages. Here (E_s) is the screen-to-cathode voltage for a pentode or tetrode (or the anode to cathode voltage for a triode), (E_g) is the grid-to-cathode voltage, (μ) is the grid to screen (or grid-to-plate, for a triode) amplification factor, (K_a) is a constant having a value depending on the design of the tube,[2] and (m) is the index of the assumed power law relationship.

E_g 5 results when (E_g) is defined as sE_s/μ where (s) is a number of positive sign if the maximum grid-to-cathode voltage is positive, and vice-versa. For instance, in the case of operation with "zero" grid current, s is 0; in the case of operation with zero grid bias to an input having equal positive and negative values, s is +1. In this way, the designer will know the value of s

(*Please turn to next page*)

[1] Wireless Engineer, Vol. 21, August 1944, pps. 368 to 376.

[2] K_a can be determined from published tube data by taking the quotient of the zero-grid-voltage plate current and 3/2 power of the screen voltage. Having found this value, the simplest way to find K_a is to use the given value for μ. This will be quoted for triodes, but not for pentodes and tetrodes in terms of its value considering the tube as a triode (i.e. the μ we want is the grid-cathode, screen-cathode control voltage). One quick way of finding this μ for pentodes and tetrodes, is to find the grid bias which will substantially cut off the cathode current and divide it into the screen voltage. Another way, not involving a knowledge of μ, is to find the transconductance G at a given current I, assumming the exponent is 1.5.

by consideration of the desired function of the tube circuit.

So far, the conditions of maximum output have been defined as: (a) a minimum current of negligible value compared to the maximum; (b) a maximum current defined by equation (5) in terms of the tube parameters, the screen voltage, a power law and the ratio (s) of the maximum grid voltage to the grid "cut-off" voltage (E_s/μ).

With pentodes and tetrodes a further condition has to be specified, since the anode (and screen) current-voltage characteristics show a marked change at low anode voltages at the "knee" of the characteristic, and, since the characteristic exhibits substantially constant current for voltages down to this "knee," clearly the greatest output will result when the anode voltage attains the "knee" value simultaneously with the attainment of maximum current on the maximum positive grid voltage. From elementary theory, and as a matter of experience, the "knee" voltage is a fraction of the screen voltage. Letting this fraction be (q) a relation between E_b and E_s is possible in terms of $(p)(1-p)E_b = qE_s$. Hence equation (5) becomes:

$$I_a = (K_a/\mu^m)E_s^m(1+s)^m \qquad (5)$$

$$I_a = (K_a/\mu^m)[(1-p)E_b/q]^m(1+s)^m \qquad (6)$$

Output va. =

$$(K_a/\mu^m)pk[(1-p)/q]^m\left(\frac{N+1}{N}\right)(1+s)^m E_b^{m+1} \qquad (7)$$

Load Res. =

$$\frac{p}{(1-p)^m}\,\frac{N+1}{N}\,\frac{q^m\mu^m}{E_b^{m-1}(1+s)^m K_a} \qquad (8)$$

Equations (7) and (8) are obtained by substituting (6) in (1) and (3) and (2), including all factors which are known, or may be postulated. A variety of optimum conditions for design may be deduced from them by considering each quantity in turn as a variable. In the present case, the ratio (p) is chosen for consideration.

Condition for Optimum Output

For a given tube, μ^m/K_a with given values of V, s, N, k and q, the optimum output is obtained when $p(1-p)^m$ is a maximum. By differentiation, this $p = 1/(1+m)$. Over a normal range of plate current variation (say 10:1), the value of m may be taken as 1.5, so that the optimum value of p, for the above conditions of operation, is 0.4.

By inspection of the plate characteristics of normal pentode and tetrode tubes, a value for q of 0.2 has been found to satisfy nearly all types; some may have a lower "knee" voltage than 0.2 of the screen voltage, but very few have a higher value. From (5) the normal condition of operation in which $E_s = E_b$ corresponds to a p value of 0.8. However, using the optimum value of $p = 0.4$, derived for the above conditions, together with $q = 0.2$, in equations (5), (7), and (8), gives the following results: (a) the output is 2.63 times as great for $p = 0.4$ as when $p = 0.8$: (b) the load resistance is 0.096 of the normal value; (c) E_s is raised to three times E_b.

The above results of taking this condition (where E_b is considered constant but the ratio E_s/E_b is a variable), are very striking and useful in the present case where direct loading of the output stage is required. For it will be shown that there is a wide range of p values on either side of the optimum value of 0.4, over which the load resistance can have a range of at least 10:1, without greatly affecting the output power.

Output Characteristics

To determine the output characteristics of a specific Class A tube operated with a given steady plate voltage, the output waveform will be assumed sinusoidal by having the grid driven by a waveform which causes this to be so, generally by the aid of overall feedback on the previous stages, if the input is sinusoidal. This assumption is not imperative, since the waveform of

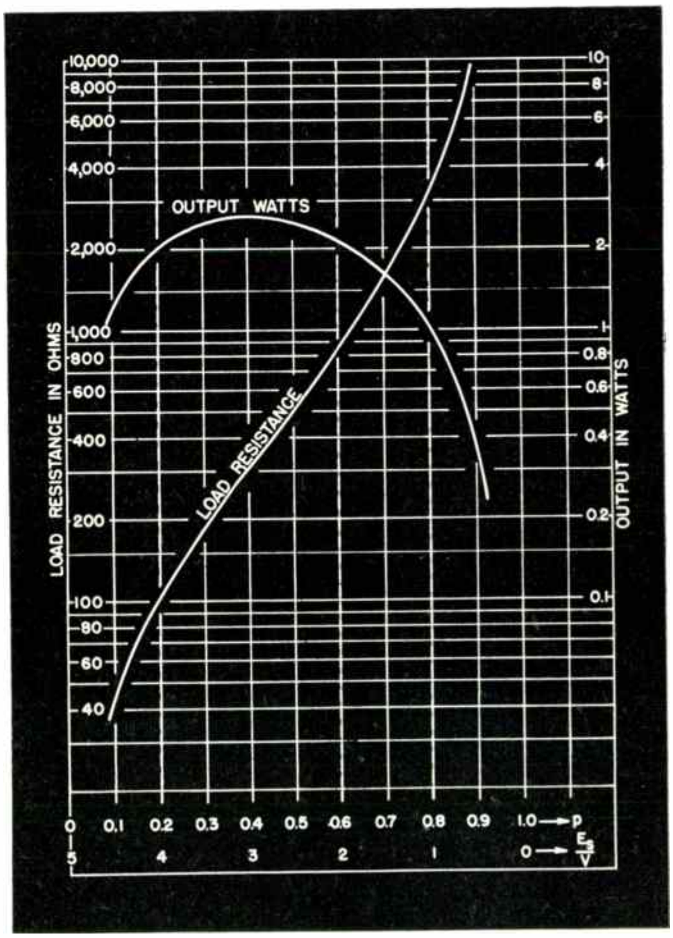


Fig. 1: Showing curves for output watts and load resistance plotted on a logarithmic scale, against values of (p) and O to 1 on a linear scale. Effects of alternate values may be seen by shifting curves bodily up or down by an amount corresponding to the ratio of the alternation

the output is immaterial to the discussion; it merely enables (M) and (N) to be assigned the value unity, and defines (k) as 0.125.

Grid current operation will not be assumed, so that (s) can be given the value zero. Although, again, this assumption does not affect the type of output characteristics. Assume (q) = 0.2, the exponent m = 1.5, and E_b = 100 volts. In the specific case of telephone repeater stations, the latter permits the use of the normal 130-volt supply, with an allowance for the steady voltage drop on the plate choke or transformer, and for automatic grid bias if required.

The tube factor μ^m/K_a will be taken as 20,000, since a wide variety of output pentodes and tetrodes have this value; e.g., British EL 50, 6L6G, 807. With these values, equations (7), (8), and (2) become,

$$\text{watts} = 14p(1-p)^{1.5} \qquad (7a)$$

$$\text{resistance} = 358p/(1-p)^{1.5} \qquad (8a)$$

$$\text{efficiency} = p/2 \qquad (2a)$$

Fig. 1 shows curves for the output watts and load resistance plotted on a logarithmic scale, against values of (p) from 0 to 1 on a linear scale. In this way, the effects of alternate values may be seen by shifting the curves bodily up or down by an amount corresponding to the ratio of the alteration. The ratio E_s/E_b corresponding to the (p) values has also been shown.

Over a range of from 2 to 4 for E_s/E_b, about twice the output watts are obtainable compared with normal operation and over a range of 10:1 in load resistance, while the geometric mean of this resistance range is about one-tenth the normal value.

Also, the order of this range approaches more nearly that required for modern transmission methods. For example, an output of 10 watts may be required for carrier telephone operation of a cable of impedance 50 ohms. This could be met with 4 tubes of this type in parallel, by operating them at a (p) value of 0.32 or (E_s/E_b = 3.4), without the use of a step-down output transformer, since the single tube output and load resistance are 2.5 watts and 200 ohms respectively.

It is possible to raise the output by increasing E_b above the assumed value of 100 volts, but it is not possible to produce a large reduction in the load resistance value, since the output is proportional to the 2.5th power of E_b but the resistance is inversely proportional to its 0.5th power. Moreover, there is a wide choice of tubes whose maximum permissible screen voltage lies between 300 and 400 volts, all of which can be used if anode voltages around 100 are used.

The provision of the feedback patch impedance is also facilitated by this method of operation. In the case of voltage feedback, the same value of potentiometer across the load resistance will dissipate one-tenth the total output of the tube, by comparison with normal operation, since the load resistance is around one-tenth the normal value. Alternatively, if the normal potentiometer gives difficulty owing to its high impedance and the associated circuit residuals, then the impedance can be reduced appreciably without incurring too great a power loss.

As regards the current feedback resistance, difficulty is often experienced when this resistance must be placed in series with the load, since it may give a marked loss in E_b. The value of this resistance is proportional to the load resistance (for a given voltage feedback ratio) and a given ratio of load-to-internal impedance. From equation (6), the steady plate current will be proportional to $(1-p)^m$, (since the steady current is proportional to the maximum), while from equation (8) the load resistance (and hence the current feedback resistance) is proportional to $p/(1-p)^m$. The product of these is proportional to p, so that reduction of p value will reduce the steady voltage drop on the current feedback resistance.

Class A Amplifier Design

An example of basic design of a class A amplifier taking its main plate supply from a given voltage will be considered. The case cited above where an output of 10 watts into 50 ohms is desired, will not be completed as regards the output stage and its associated components.

Assuming that a stabilized gain of 34 db is required, and that the output transformer (if any) will be of 1:1 ratio, then this gain may be split into 14 db on the input transformer of 1:5 ratio, plus 20 db from the amplifier proper. One stage of amplification prior to the output stage will enable sufficient open circuit gain to be obtained to insure high gain stability, and permits the use of simplified formulae for the feedback network calculations.

On this basis, the voltage feedback ratio required will be ½ x 10 or 0.05 (the 2 in this case provides an internal impedance equal to the load), while the current feedback resistance will be 0.05 times the anode load, i.e., 2.5 ohms. The steady plate current of the 4 tubes in parallel will be one-half I_a (since the output is assumed to be sinus-

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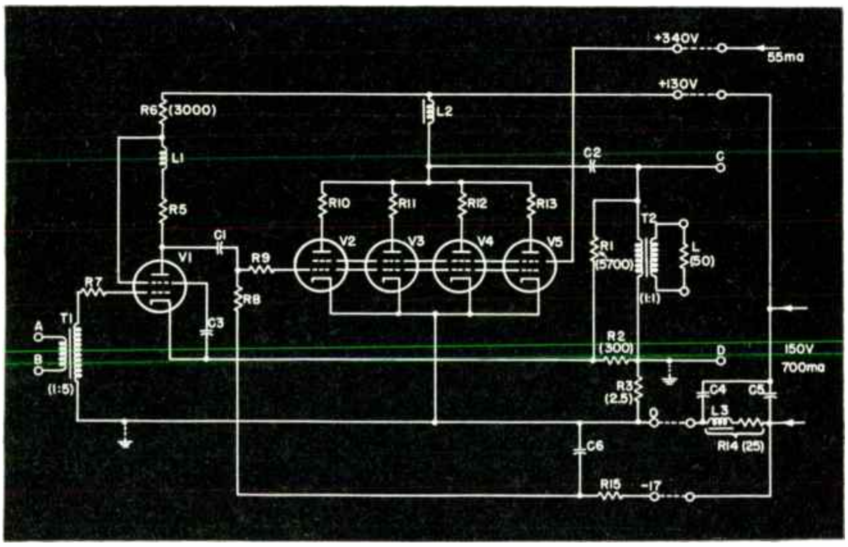
Fig. 2: Typical circuit for amplifier. Detailed explanation appears in text of this article



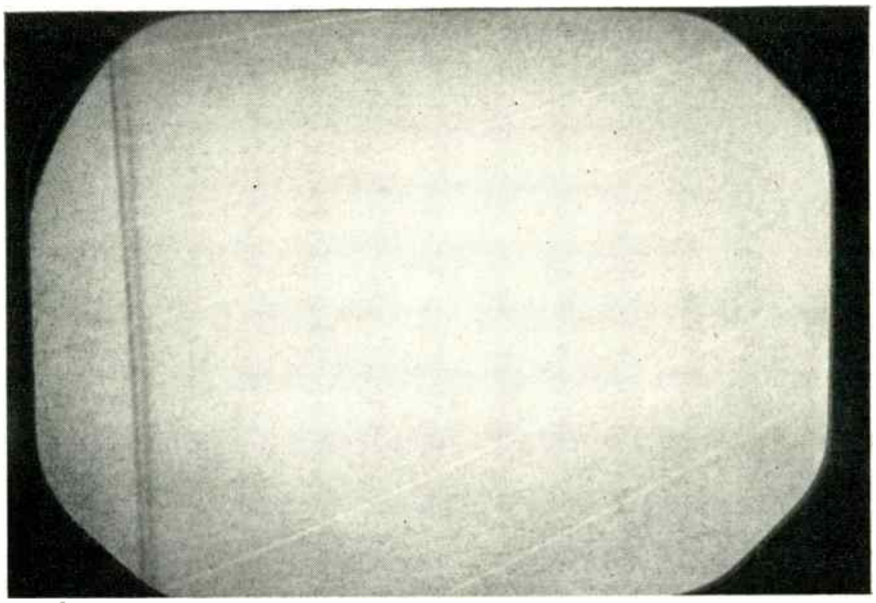


Fig. 1: Interference appears as black bars at left of raster. Typical example occured when receiver was tuned to 208 mc with maximum sensitivity, both sweeps running non-synchronously

Cause & Cure of Spurious TV Receiver Oscillations

RF bursts of hf oscillations cause interference in sets using single pentode horizontal deflection amplifier tubes; magnet or solenoid effects cure

By R. T. CAVANAUGH, Assistant to Director of Research, Allen B. DuMont Labs., Inc., Passaic, N. J.

INVESTIGATION of the conditions causing spurious oscillations in television receivers has revealed some interesting findings and resulted in development of several methods for suppression of this interference. Spurious oscillations were found to occur mainly in receivers employing single pentode horizontal deflection amplifier tubes.

This interference appears as one or more vertical black bars from 1/8 to 1/2 in. in width displaced from 1/4 to 2 in. from the left hand margin of the raster. The line or lines are tunable by the local oscillator and, in the majority of receivers, may be tuned in the range of channels 5 to 13. A typical example is shown in Fig. 1 where the receiver is tuned to approximately 208 mc with maximum sensitivity and both sweeps running non-synchronously.

If a simple tube is considered which contains plate, grid, cathode and heater, the voltages on the tube elements may be set so that very high frequency oscillations are produced. Two types of oscillations may result, one in which the frequency is practically independent of the external circuits and dependent directly on the electron transit time, and the second in which oscillation occurs only when the transit time bears the proper relation to the period or periods of the external circuit. The first is defined as a Barkhausen-Kurz (B-K) oscillation, the second as a Gill-Morrell oscil-

Fig. 4: View of horizontal deflection amplifier and flyback supply of receiver showing magnet for oscillation suppression bolted to cover which, when in position brings magnet against horizontal amplifier tube

lation. The two forms of oscillation may be attributed to the same cause. These oscillations exist when the grid voltage is zero or at a slightly positive potential with respect to the cathode, and the plate voltage is zero or at a slightly negative potential with respect to the cathode. The frequency is dependent upon the tube geometry and the magnitude of the applied voltages as these affect the transit times of the beam electrons.

With modern beam-power pentodes, the internal geometry is somewhat complicated by the presence of beam forming plates, and screen grids. Thus any transit time oscillations cannot exist as simple oscillations, but as a spectrum of oscillations. A necessary condition for the sustainance of oscillation is that the external effective negative resistance of the circuit must be less than the tube resistance representing all loss in the tube.

In a typical horizontal deflection circuit (Fig. 2) voltage and current waveforms appear on the various tube electrodes as are shown roughly in Fig. 3. The waveform of the plate voltage of the 6BG6-G shows that B-K oscillations can exist during the first negative swing of the plate voltage. In practice these oscillations are produced with peak amplitudes so that the equivalent field strength at the antenna terminals is 500 microvolts, and in some cases up to 10,000 microvolts. The oscillations are not continuously sustained, since they exist only for the interval of plate voltage negative swing. They appear as an RF burst synchronous with the horizontal sweep, (Fig. 3j), with the phase relationship expected from the voltage waveforms.

The duration of the negative swing is very long compared to the transit time of the electrons. Assuming that electrons leave the cathode with zero initial velocity, an emitted electron is first accelerated by the field between the cathode and grid. On reaching the grid, there are two possibilities: it may strike the grid or pass through the grid structure into the grid-screen grid field. Here it is again accelerated on its way to the plate. On reaching the screen, there are again two possibilities: it may strike the

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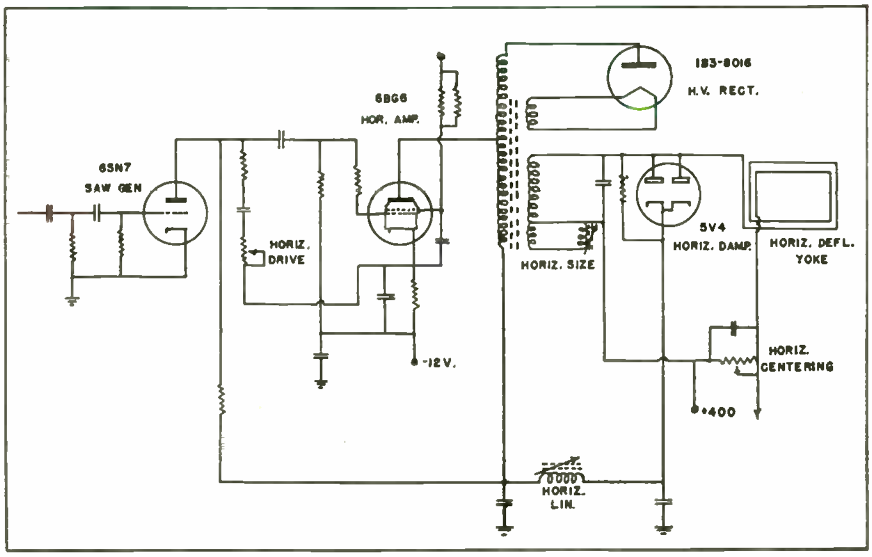
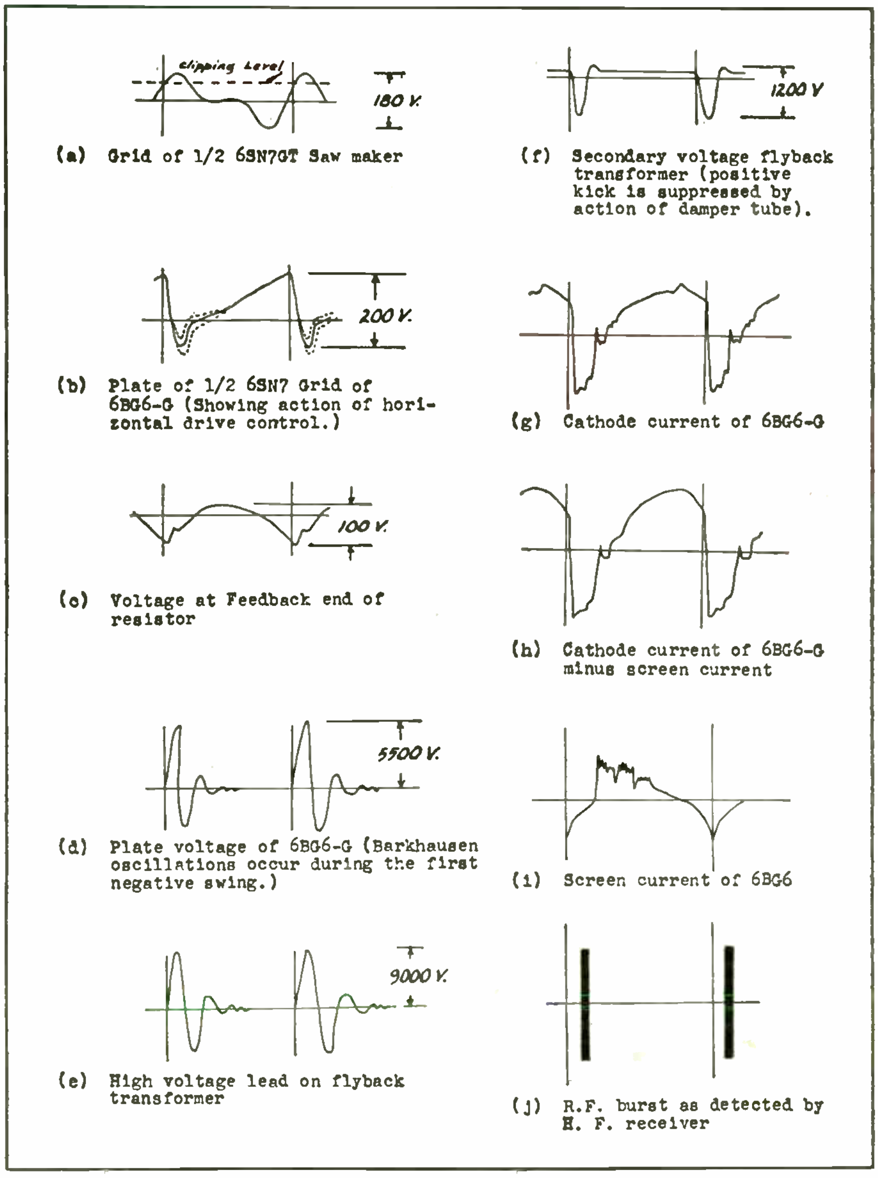
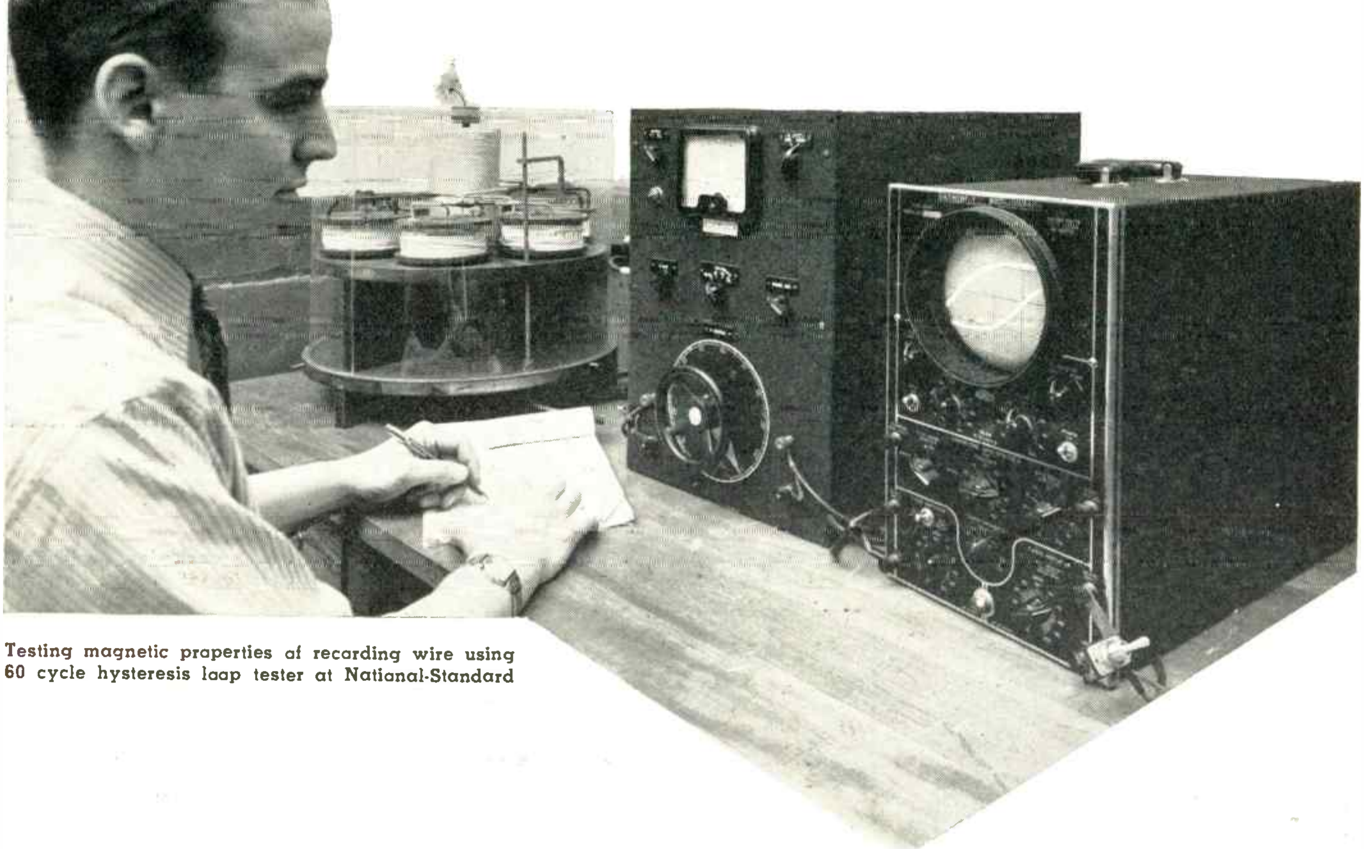


Fig. 2: Typical horizontal deflection circuit causing spurious oscillations

Fig. 3: Voltage and current wave forms appear on various tube electrodes roughly as shown in this graph. See article for description of wave forms identified from (a) to (j)



Test Characteristics of



Testing magnetic properties of recording wire using 60 cycle hysteresis loop tester at National-Standard

Review of wire characteristics, test methods and performance reveals some of the problems that beset engineers in the design and manufacture of magnetic recording wire

A GREAT deal of worthwhile experience has been gained by the National-Standard Company during 7 years of magnetic recording wire production and close association with the industry. This article discusses the problems that face the engineer designing a unit utilizing the art of magnetic wire recording—that is, of impressing on a moving steel wire a varying magnetization that is directly proportional to the instantaneous value of the recording current, which magnetic signal can be later picked up and electronically reproduced to sound.

The listening result is dependent upon all of the components involved: (1) wire (2) recording-playback head (3) mechanism which moves the wire (4) oscillator and audio system and (5) speaker. Of these, the wire, head and mechanism must be closely complemented or the end result will be limited.

Some of the problems of the past that have beset engineers designing and manufacturing units using wire recording technics are—wow, hum, flutter, distortion, variable speeds, eccentricities, tapered winding of the wire on the spools and other "bugs" present in any new art. These problems can be avoided today by proper design and shop practice. Following is a list of some of the errors of the past and "cures" that have been successful in correcting the same:

1. Wire Breakage:

The recording wire develops a tensile strength of approximately 300,000 psi which is well over 3 lb. per strand. A wire mechanism which does not exceed a 3-lb. tensile strength in acceleration, reversal or drag will not break the wire.

2. Erase Failure:

Poor erasure of the record on the wire may result from abnormal loss of high frequency energy fed into the erase system by mismatching impedances between oscillator coil and erase head winding. In other cases the erase head winding may be too far away from the erase gap. The high frequency energy is easily lost in the magnetic core of the erase head if the core material is too light in cross section.

3. Poor Frequency Response:

Frequency response can be impaired very easily by an accumulation of foreign or magnetic material in either the recording or playback gap. The head grooves must be smooth and clean to assure good

Recording Wire

By GAIL S. CARTER, Fidelitone, Chicago, Ill., and
RICHARD KOONTZ, National-Standard Co., Niles, Mich.

mechanical contact of the wire in the head across the recording and playback gap. The bias frequency must be high enough not to beat with the high frequency audio signals, otherwise the high frequency response is lost.

By bias is meant the supersonic energy which is put into the recording head gap along with the audio signal in order to obtain linearity between output and input. The magnetic property of recording wire is such that flux is not uniformly proportional to field strength—particularly at low field values. The bias field gives the uniform results without distortion.

4. Wire Noise or Hum:

The absolute level of wire noise measured on low hum and noise equipment is approximately 10 db above 10 mv with a maximum signal of low distortion of about 55 db. This gives a useful dynamic range of 45 db. If, however, inadequate shielding is used, noisy amplifiers are in the circuit or the heads have become permanently magnetized — noise is produced in the system which is often erroneously blamed on the wire. Poor head lamination material, poor annealing or cold work in heads after annealing, or switching transients in the head circuits can all contribute to permanent magnetization and "wire noise" will result. Shields around heads must have adequate clearance for the head laminations or noise will be introduced.

5. Distortion:

The recorded signal has a definite limit if distortion is to be avoided. An attempt to cut corners on the amplifier equipment and make up by recording on the wire at overload limits will only result in distortion. The bias can not be adjusted to eliminate distortion at low frequencies with overload levels without cutting seriously the high-end response. An attempt at this overload level, together with overnormal bias, will not give uniform results with the low frequencies.

Wire Testing

While the final test by the user is the recorded program he hears on the wire, there are certain tests which the wire-mill engineers must make, and which engineers utilizing the wire recording art should make with instruments, to assist them in locating deficiencies audible when the listening tests are applied.

These wire tests include:

Frequency Response tests can be made with a wire moving mechanism together with recording, playing and erasing heads and a standard frequency response recorder. The proper level of audio signal, together with normal bias, is fed to the recording head, and the playback is fed through an amplifier to the recording pen movement producing the chart. The audio oscillator is motor driven over the frequency range producing an overall frequency response chart of the wire on the heads used during the test. Or, such a chart can be made without a special recorder, by manual manipulation of an audio oscillator selecting enough frequencies to develop the desired curve.

Wire noise measurement can be made accurately only where the measuring device is free of hum and noise. Using a virgin wire and no erase power the playback head is connected to an amplifier and vacuum tube voltmeter. With wire-running and erase not energized,

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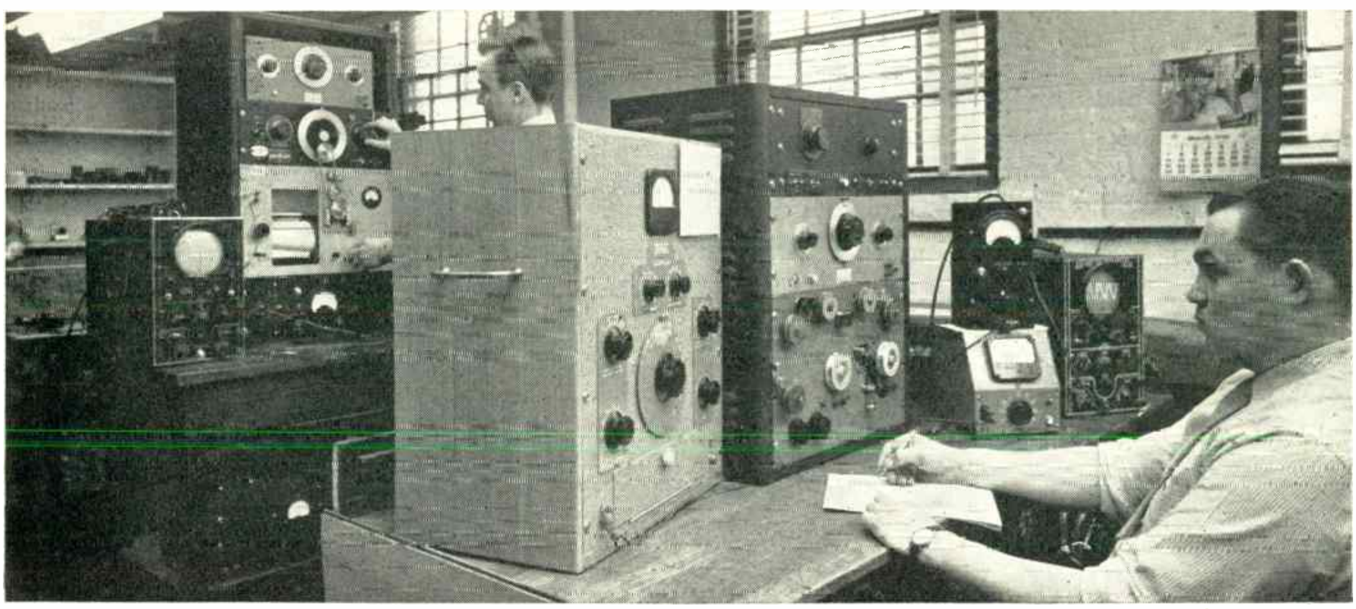
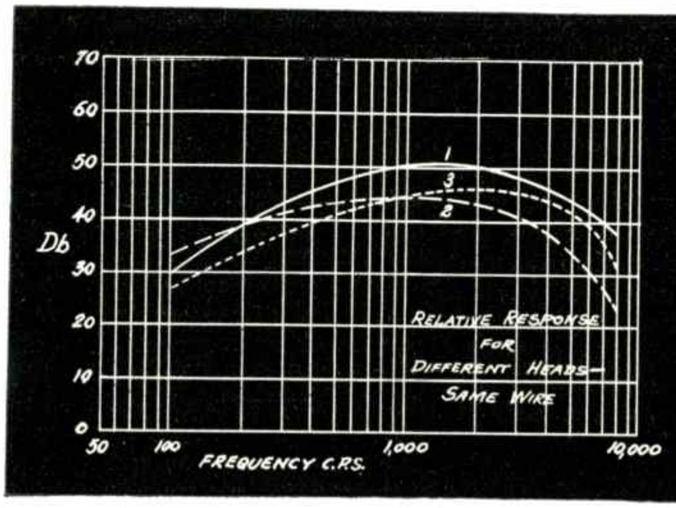
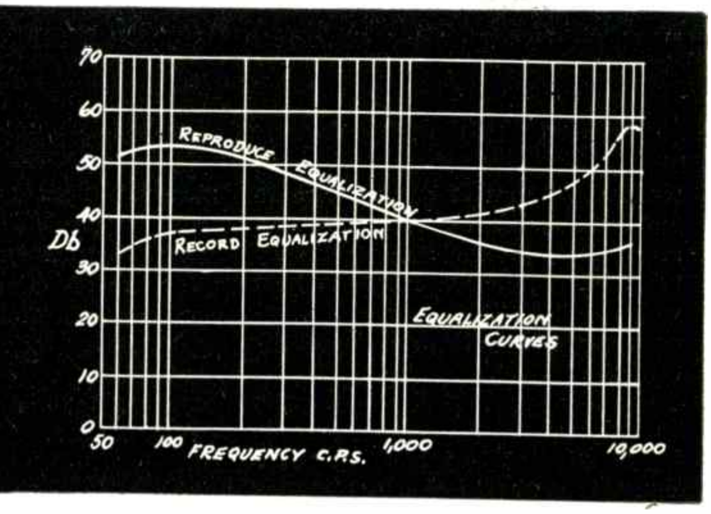
Foreground—testing ac and dc noise, signal strength, erase and distortion. Rear—testing frequency response (National-Standard Labs)





Different responses obtained from identical lengths of magnetic recording wire as used in 3 different recording, playback heads



Curve shows recommended equalization by means of amplifiers for best use of medium by avoiding overload and distortion

the playback head should not indicate a level of over 10 microvolts. Then, when the erase is energized, the playback head will indicate the erased noise level of the wire. Many preliminary tests on the wire have been made during production in addition to these. Some of the equipment used at the Niles, Michigan, plant of the National Standard Co. for testing magnetic recording wire during and after production follows:

1. Specially designed magnetic tester to check Hc and Br.
2. Precision wire moving mechanism to check noise, uniformity and response.
3. Audio oscillators to determine frequency response of the wire.
4. Decade amplifiers Ballentine (or equal) VTVM to measure power output of the wire.
5. Harmonic wave analyzer to measure distortion of recorded signals.
6. Frequency response recorder to plot frequency output characteristics.
7. Esterline Angus chart recorder to chart uniformity of the wire.
8. Bias oscillators to supply power for erase and bias for testing the wire.
9. Continuous loop testers for comparison of various heads. (These are also used in testing wire.)
10. Cathode ray oscillograph to show recorded signal wave shape.
11. High fidelity amplifiers, microphones and loudspeakers for comparative listening tests.
12. All types of recording heads — those in production and under development are used to check performance of the wire with various heads.
13. All types of wire recorders—those in production and under development are used in overall comparison of final use of wire in wire recorders.

Constant check of transfer characteristics of the wire is maintained at the wire mill, to keep at absolute minimum the cross magnetization

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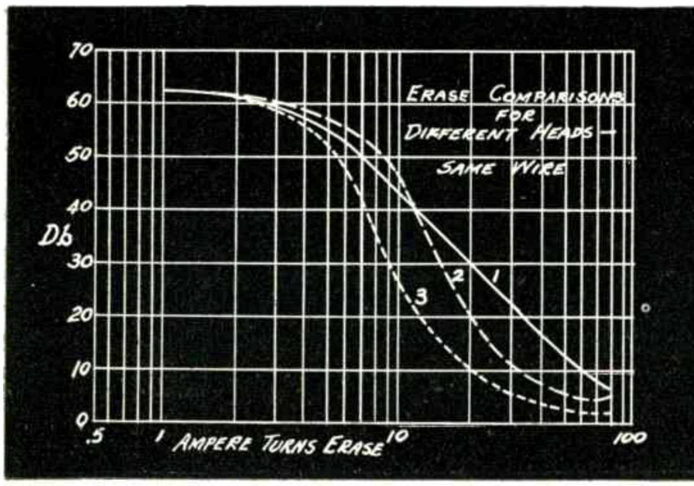
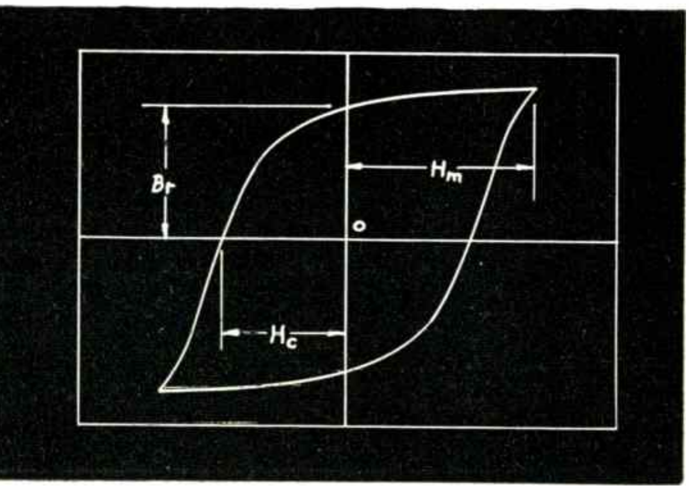
Curve shows different erase results obtained from identical length of magnetic recording wire as used in three different erase heads



Hysteresis loop of a recording wire indicating Hc, Br and Hm graphically illustrating certain terms used in the wire specifications



Impedance Matching Half-Wave Transformer

By H. E. DINGER and H. G. PAINE, Naval Research Labs, Wash., D. C.

Constructed from a few feet of coaxial cable and N connectors half-wave transformer gives reasonably accurate continuous frequency coverage from 100 to 400 mc

A HALF-WAVE transformer constructed of interchangeable coaxial cables provides a simple and effective method of matching an unbalanced coaxial cable to a balanced load. A set of 4 cables will give continuous frequency coverage from 100 to 400 mc with small voltage transformation error.

Most HF signal generators use an unbalanced output, usually in the neighborhood of fifty ohms impedance, although many applications, especially in field intensity measurement work using half-wave antennas, require a balanced input. Several applications of a coaxial half-wave transformer using interchangeable half-wave sections have been in use at the Naval Research Laboratory for several years, see Fig. 1. Its operation is based on a simple principle.

Since voltage at opposite ends of a half-wave line are of equal magnitude but opposite in phase, the voltage between the two ends of the inner conductor will be twice the voltage between one end and the sheath. Power relations demand that the output power be equal to the input power (neglecting losses), giving the relations in Fig. 1(b).

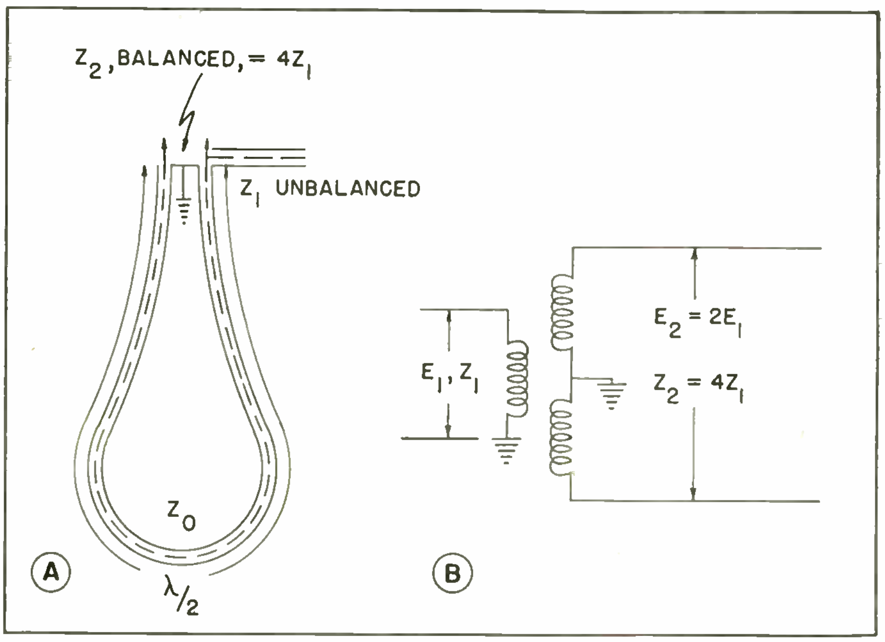
For best results, Z_0 in Fig. 1(a) should be twice the surge impedance of the incoming unbalanced line or $2Z_1$. With this condition and the assumption of non-reactive terminations and connections, the incoming cable will be properly terminated in Z_1 at all frequencies. The voltage E can then be shown to be equal to $2E_1 \sin(\theta/2)$, where θ is the electrical length of the line in degrees, as plotted in Fig. 2. A balanced voltage (one that has equal magnitude and opposite phase angles between each side of the line and ground or sheath) is obtained from the transformer using an unbalanced voltage source, if θ is held at 180° as the frequency varies. A continuously variable line to cover a continuous range of frequencies would involve mechanical difficulties and the cost of such a system would be out of proportion to its value. The transformer described in this article was constructed at a cost of only a few type N connectors and a few feet of coaxial cable. It gives reasonable voltage accuracies and voltage balance conditions over the range of frequencies for which it is designed.

The curves in Fig. 2 indicate that such a cable can be used at 20% off resonance with not more than 5% error, which is acceptable for many applications. It can also be used at its odd harmonics as well as at its fundamental, at the same actual bandwidth or frequency coverage. At such frequencies, minimum bending-radius limits the shortness to which a cable may be cut, although the frequency coverage at a harmonic is less than would be obtained from a cable cut for that frequency.

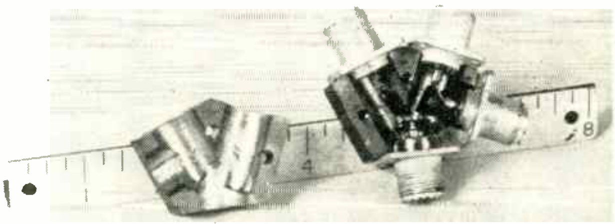
The transformer is terminated in a balanced, resistive impedance equal to $4Z_1$. If the surge impedance Z_0 of the half-wave cable is equal to

(*Please turn to next page*)

Fig. 1: Half-wave transformer (A) in use at Naval Lab and equivalent transformer (B)



Half-wave transformer unit with cables designed for 100-400 mc range



Pentagonal shape of block reduces sharp bend in short cables

$2Z_1$, shown in Fig. 3, the far end of the half-wave cable will be properly terminated to ground and no standing waves will occur on it. The expression for the voltage at the far end is then $E_1e^{-j\theta}$, where E_1 is the incoming reference voltage. For frequencies which cause θ to fall within a few degrees either side of 180°, E_2 is approximately equal to $2E_1$ and the unbalanced component of voltage, $E_u - 2E_1 \sin (180 - \theta)/2$, is not of serious magnitude. The effect of non-constant-impedance connectors is neglected here.

A cable cannot always be chosen where Z_0 is exactly $2Z_1$. In the application for which this transformer was built, Z_1 was 50 ohms. RG/8U cable was used for the half-wave section which made $Z_0 = Z_1$. A first approximation of the voltage relations in this case (Fig. 4) assumes that standing waves occur only in the half-wave section, hence E_1 is constant. The input impedance of the transformer is then equal to Z_1 only at $\theta = N\ 180°$ (N — n odd integer), and is a reactive impedance less than Z_1 at other values of θ. Standing waves also occur on cable Z_1 which introduces an additional error.

A complete mathematical analysis of the output voltage, E_2, of the transformer, in terms of the signal source E_s is quite difficult to obtain in a general form covering all applications. The error introduced by standing waves on the signal generator cable is small for values of θ close to 180°. It may add to or subtract from the error introduced by the half-wave cable when operated off half-wave frequency, depending on the relation of the electrical length of the signal generator cable to the electrical length of the half-wave section. This error might be eliminated by using another half-wave section as the signal generator output cable. However, this would not be feasible as a general case because of the difficulty in determining the equivalent electrical length of the output system of some signal generators. It is more practical to use the material and time in constructing more transformer half-wave sections for operation closer to the $\theta = 180°$ value.

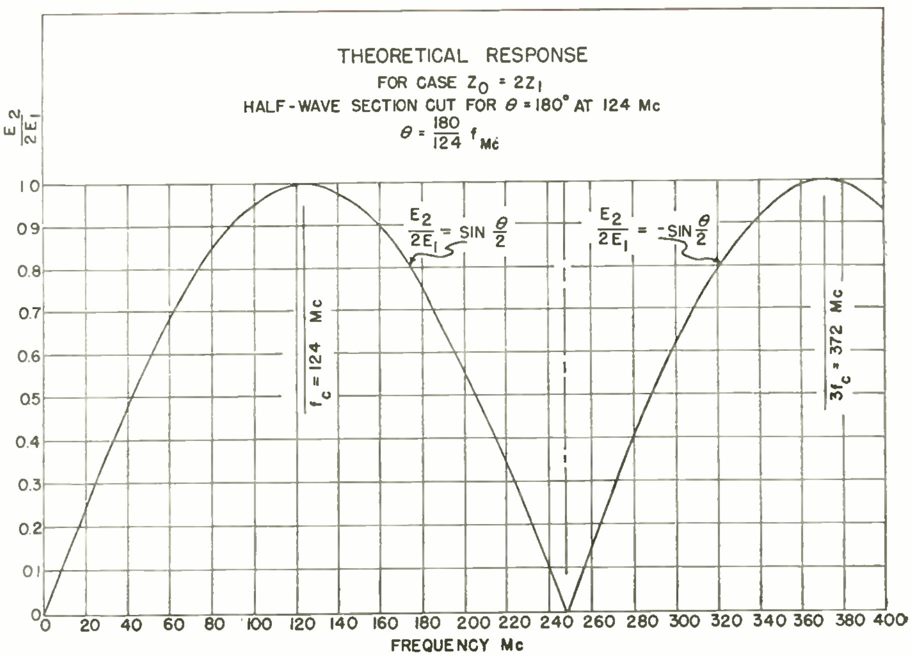
The curve of Fig. 5 shows actual data of the response versus frequency of the transformer using a half-wave section of 50 ohms impedance. The electrical length of the signal generator cable was approximately 1.6 times the electrical length of the half-wave section for this curve. It will be noted that at 148 mc the response was 0.97. By varying only the electrical length of the signal generator cable at this frequency from 0.43 to 1.6 times the electrical length of the half-wave section, the response varied from 0.92 to 1.02. In all cases where computations were made, the measured performance exceeded that predicted by calculations, indicating that some factor or set of circumstances was at variance with the idealized case which resulted in the introduction of compensatory errors.

Four cables constructed of RG/8U cable with type N connectors cover the 100 to 400 mc range. They are:

Line No.	*FC (mc)*	*Length (In.)*	*Range (mc)*
1	120.7	29.79	100-141
2	170.7	20.34	141-200
3	241.4	13.61	200-283
4	341.4	8.91	283-400

Lines 5 to 11 cover the 15 to 150

Fig. 2: Curve shows cable can be used at 20% off resonance with not more than 5% error



mc range. These lines are shown below:

Line No.	*FC (mc)*	*Length (In.)*	*Range (mc)*
5	17.92	215.0	15 - 20.85
6	24.9	154.1	20.85- 28.95
7	34.6	110.3	28.95- 40.2
8	48.0	78.8	40.2 - 55.8
9	66.7	55.9	55.8 - 77.6
10	92.3	39.74	77.6 -107.0
11	128.5	27.84	107.0 -150

The length of cable as given does not include the necessary extension of the inner conductor for attachment to connectors. The propagation constant for RG/8U cable is approximately 0.66. The equivalent length of the 2 pairs of type N connectors necessary to complete the half-wave circuit was determined by measurement to be approximately 3.8 in. and was taken into account in computing the lengths as given above. Fig. 6 illustrates the manner in which the 4 cables indicated in lines 1 to 4 above would cover the 100 to 400 mc range if constructed of 100 ohm cable. The actual response when constructed of 50 ohm cable is subject to the additional errors just discussed. When extreme accuracy is desired cables should be cut for the exact spot frequencies.

Two units were constructed which were designed to work from an unbalanced signal generator with an output impedance of 50 ohms into a balanced load of 100 ohms and 72 ohms, respectively. In each case this required a network of resistors at the output terminals of the transformer. These networks were designed so that impedances were matched in both directions. The complete units then have multiplying factors (K_1) and (K_2) of 0.586 and 0.4 respectively. They may also be calibrated in decibels if desired.

If resistor networks are not used, the impedance ratio is constant at 1:4 and the voltage ratio will be 1:2, except that reactive loads may cause resonant voltage changes, (usually negligible when resistor networks are used at the output).

To determine the correct output-resistor values for any impedance combination, consider the equivalent network shown in Fig. 7. The impedance looking into terminals 1

(*Continued on page 77*)

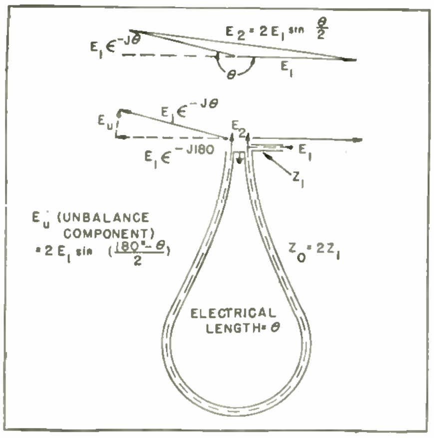


Fig. 3: Shows voltage and phase relationship

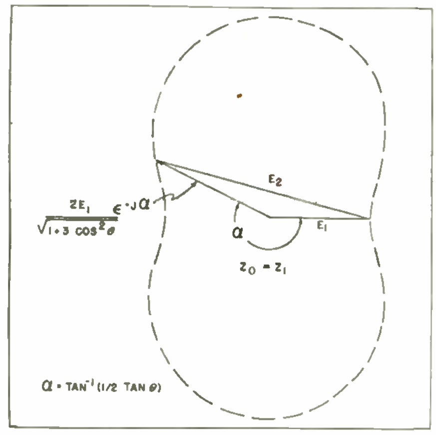


Fig. 4: 1st approximation of voltage relations

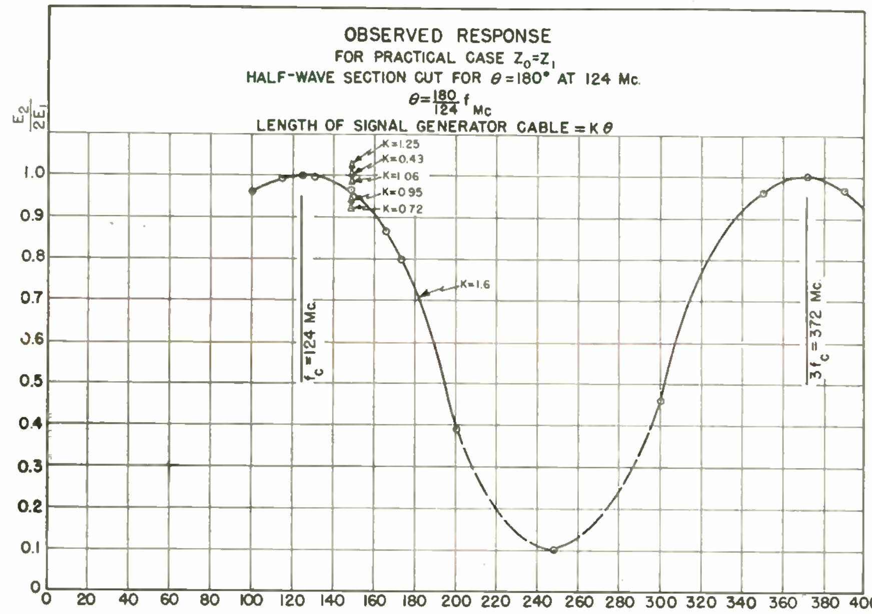
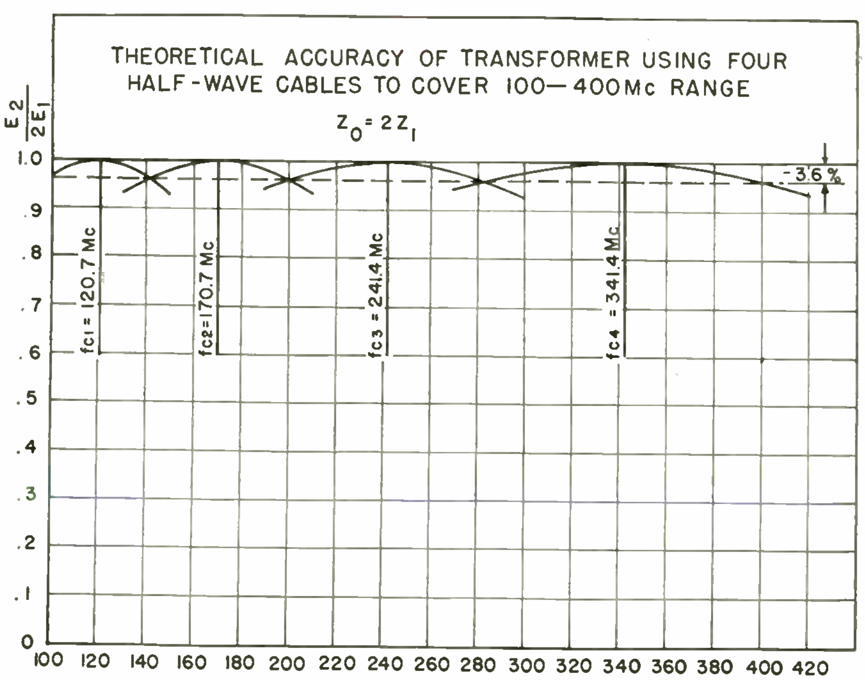


Fig. 5: Data of response vs. frequency of transformer using section of 50 ohms impedance

Fig. 6: Shows manner in which 4 cables would cover 100-400 mc if constructed of 100 ohm



Pneumatic

By HAROLD A. ZAHL and M. J. E. GOLAY,
Signal Corps Engineering Laboratories, Bradley Beach, N. J.

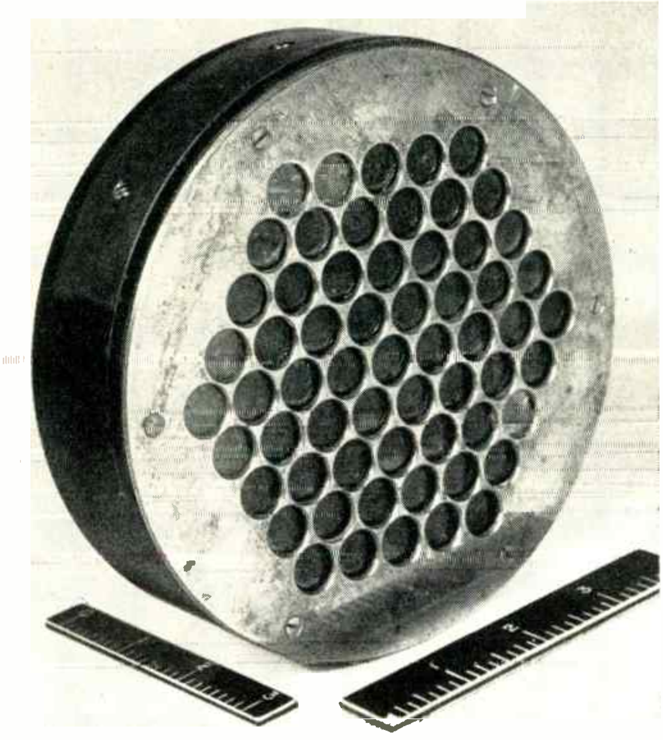


Fig. 2a: Front view of 61-cell pneumatic heat detector with cells arranged in hexagonal pattern and individually connected to detecting films

SINCE World War I there has been a continual interest in heat detection devices for military application. Many experiments were and are being made embodying bolometric, thermopile and other principles with a view towards utilizing the 8 to 14 mu spectral band.

In general, it was found that a sensitivity adequate for military purposes could be obtained for the detection of objects which varied only in range or azimuth, although serious limitations were imposed by the absorption of the atmosphere (rain, fog and snow). For the detection of aerial targets which varied in range, azimuth and elevation, devices based on the thermopile or bolometer principle did not yield sufficient information to permit the continuous tracking of a target moving several hundred miles per hour and presenting a high angular velocity at short ranges.

For a new approach to the problem a study was made of the Hayes Cell.[1] While this cell did not form the basis of a convenient multiplicity because of the amplification needed, it led to the design of an optical system for the detection of the pneumatic energy generated by the heat receptor of the Hayes type.

In the first unit approximately 150 one-eighth inch honeycomb cells, formed by partially boring a brass block, were loosely filled with carbonized vegetable fluff (milkweed) and sealed from the outside and from each other by an infra-red window. Each cell was connected by means of a small duct to the other side of the brass block which was machined and polished flat. A very thin circular collodion film was spaced within 0.001 in. from this flat surface. On the other side of the collodion film, and nearly parallel to it was the inner surface of an optical wedge which served also to seal the apparatus from the outside. The interference pattern produced between the collodion film and the inner surface of the glass wedge,

[1] Review Scientific Instruments, 1936, page 202.

Fig. 1: Single unit cell developed for laboratory experiments

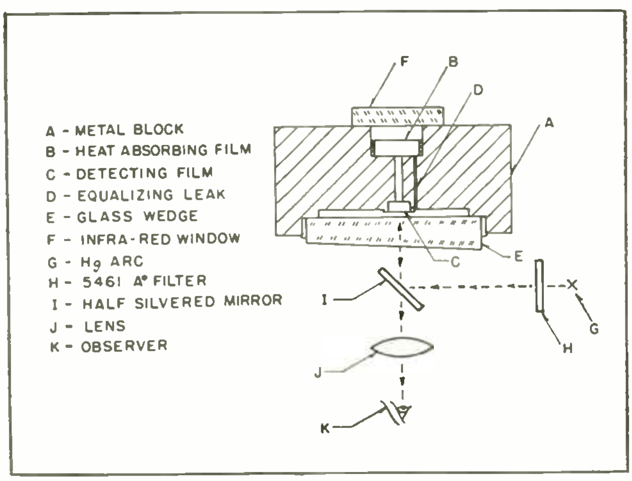
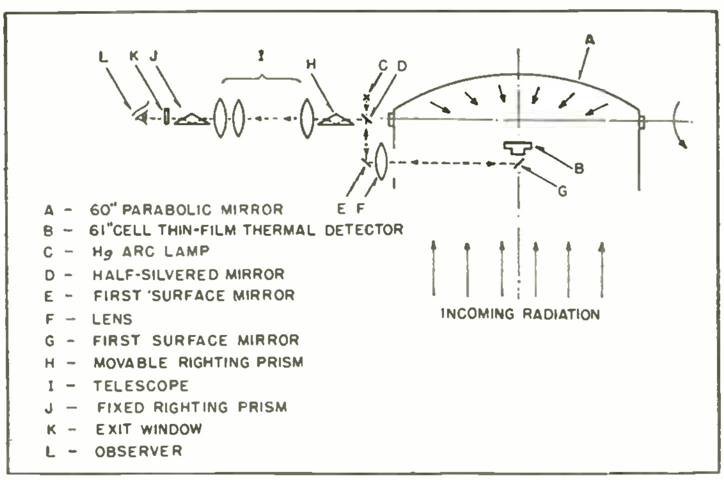


Fig. 3: Exploded drawing of heat detector cell unit illustrated in photos



Heat Detector

Signal Corps engineers improved pneumatic heat detector for use in radar; new cell has scientific applications in industry as electronic instrument

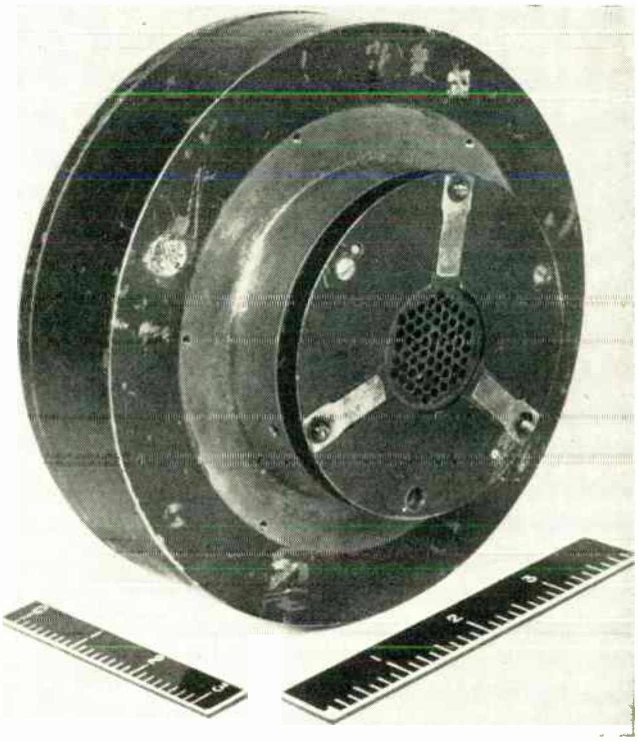


Fig. 2b: Rear view of 61-cell pneumatic heat detector. Identical cell pattern that appears on face of detector is shown in the smaller area

when monochromatic illumination was used, was observed to detect the slight disturbances produced on a small portion of the film when a flow of air in or out of the cells was caused by their momentary exposure to the heat image of an object having a temperature differential with its background.

Placed in the focus of a 60-in. searchlight mirror, the image of a strong source of thermal radiation such as a Navy blimp at a mile range, produced a group of Newton's rings which moved continually across the observer's field as the target moved across the optical field of the system. Although tracking aerial targets was very easy when the signal was strong, good sensitivity was not obtainable unless the separation between the collodion film and the polished brass block was very small. In this circumstance the air intake in the cells which followed the cessation of a strong signal caused the collodion film to be sucked against and adhere to the block. This limitation led to the more practical, though less elegant, system described below.

A single unit cell for laboratory experiments (Fig. 1), was built into a massive metal block (A). Incoming radiation is absorbed in black film B which in turn raises the temperature of the surrounding gas, the expansion of which serves to distend thin film C observed by an interferometric arrangement.

Black films were substituted for the carbonized vegetable fluff originally used after a series of experiments indicated that the essential action of the fluff was to absorb heat radiation and raise the temperature of the surrounding gas. Collodion film with a suitable black deposit proved to be equally or more efficient as radiation absorbers, and presented straightforward fabrication and lower specific heat than the fluff.

The collodion mixture utilized was made up as follows: Collodion (non-flexible), 30 parts; castor oil, 1 part; clear glyptol cement, 10 parts; amyl acetate, 100 parts.

The films are produced by dropping a few drops of the mixture from a height of a few cms onto a freshly swept surface of clean water at a temperature not exceeding 20°

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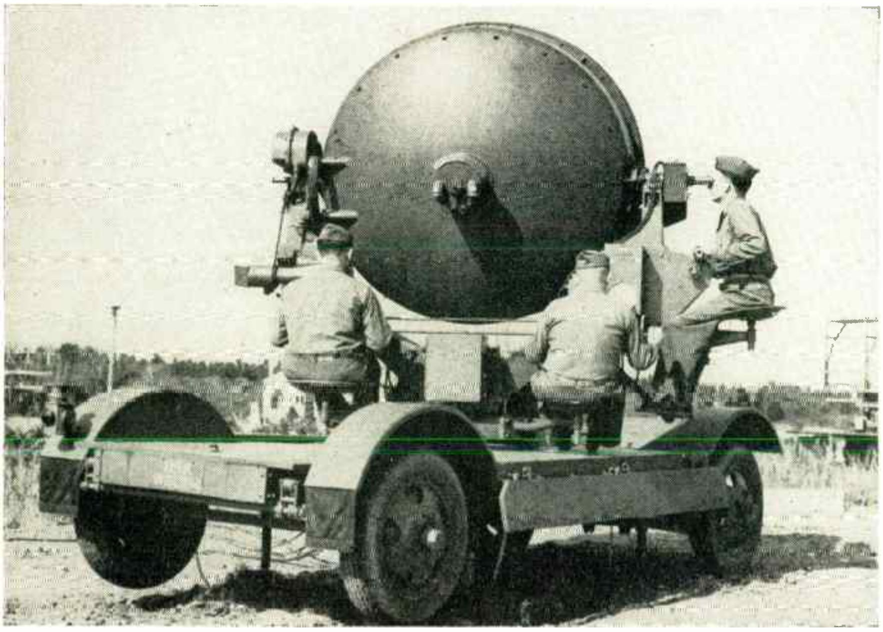
Fig. 4: Personnel in operating position with radar set equipped with pneumatic heat detector



(l to r): M. H. Muhlman, J. Walter Thompson; L. S. Thees, sales mgr. and G. R. Shaw, chief engr., RCA Tube Division

IRE CANDIDS

(l to r): R. A. Wilson, Muzak Corp., J. W. Koch, KFEQ, St. Joseph, Mo., Chas. Quentin, engineer, KRNT, Des Moines; Tom Rowe, WLS, Chicago, at annual meeting

Below (l to r): Arthur Van Dyck, RCA; Paul Larsen, Univ. of Calif.; Bob Aiken enjoying an informal evening during IRE meet

Below (l to r): Frank Hinners, Servo Corp. of America; Geo. Clark, RCA; Lloyd Espenshied, consultant for Bell Telephone Labs

ENGINEERS REVEAL NEW

(Continued from page 29)

acteristics. For example a filamentary-cathode pentode can be arranged to give the desired control action. Increasing input to the controller tends to increase plate current because of an increase in screengrid voltage and a change in space charge through filament temperature changes.

Gated-Beam Tube

A new tube (unconventional in structure) operating as limiter without assistance from external circuit elements may be used as clipper or square wave generator or as a limiter in an FM receiver. The tube was described by Adler (Zenith). In its structure, based on electron-optical ideas, a rectangular cathode, surrounded on three sides by a grounded focusing electrode, faces an accelerator plate on its only open side and emits a compact sheet-like beam. This beam is then projected against a flat grid.

The anode current reaches its full level with the grid still negative; even with the grid positive, grid current is only about one-tenth of the anode current. To operate such

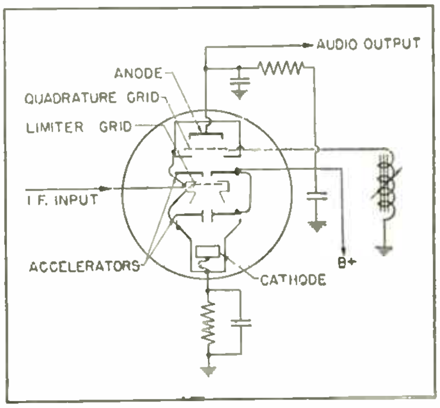


Diagram of gated-beam tube operating as a limiter without assistance from external circuit elements described in text

a tube as a limiter, the grid is so biased that the plate current is at half its maximum level. If a second grid is inserted into its electron stream, following the second accelerator slot, and is tuned to signal frequency and driven by space charge coupling, audio output is produced on the final anode. The audio output in this FM-limiter detector is about equivalent to the output from a Seeley-Foster discriminator.

Network Analyzer

A network analyzer for the study of electromagnetic field problems giving solutions of the wave equation in two-dimensional cylindrical coordinates for cases of rotational symmetry was described by Spangenberg (Stanford University). The network consists of a lattice of inductances with capacitances from every junction to a ground plane, simulating two interconnected sets of transmission lines, one transmitting waves in the axial direction and the other in the radial direction to represent any TEM, TM or TE mode having axial symmetry. It is designed to operate at a mid-frequency of 100 kc.

The network construction is an open one with plugged in inductances making it possible to open the network to represent boundaries of arbitrary shape. It will give immediate answers to the following problems: the resonant frequency of cavities possessing rotational symmetry but of arbitrary cross sectional contour, tuning curves of such cavities as one dimension is varied, guides, shunt resistance of cavities.

Electronic Computers

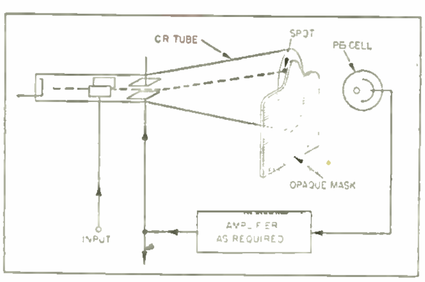
Large scale computing devices are a relatively recent development which have accompanied the ever increasing complexity of industry and science. Two groups of papers on computers received a great deal of attention, giving surveys and progress on some projects now being developed.

In this country there are at least seven differential analyzers. Most recent projects are of digital types. Of the large scale computing devices of the digital type now in operation, the automatic sequence control cal-

DEVELOPMENTS AT IRE

culator given by IBM to Harvard University, the Mark II calculator, and the large relay type machines, are all primarily electromechanical, and the ENIAC and the IBM Selective Sequence Calculator are electronic. The projects which are now under way include Whirlwind, a parallel binary digital computer being designed by M.I.T., Mark III at Harvard, a second parallel binary machine at the Institute for Advanced Study in Princeton, the Univac, a binary coded decimal system at Eckert-Mauchley Computer Corporation, and the large scale general purpose analog computer built by Westinghouse and substantially duplicated for California Institute of Technology, and the EDVAC under construction at the University of Pennsylvania.

An unusual demonstration was given by Sunstein (Philco) employing feedback principles with a cathode-ray tube, photocell, and a shaped mask. The law of output versus input of the system is controlled by selecting the geometric shape of the mask. The device has application in computers, modulators, tone generators, demodulators, signal generators, and any circuit where a predescribed relationship shall exist between an input signal and output signal.



Photoformer system—a nonlinear source having transfer characteristics that can be altered at will by replacing shape of the mask. Presented by Sunstein (Philco)

In this system, called the Photoformer, the photocell is covered up so that it provides no output when the beam of the cathode ray tube is centered vertically to such a position that the spot is near the top of the tube. The output of the photocell is used to vertically deflect the cathode ray tube beam, and is so phased that increasing light on the photocell causes the spot to be deflected downward. The mask placed between the tube and the photocell causes an abrupt change in light striking the photocell as the spot moves across the edge of the mask. Equilibrium will be maintained at a position such that the spot is partially hidden by the mask providing the Nyquist feedback stability criterion is satisfied. If output be taken as shown from the vertical deflecting plates (assuming a linear deflection system) it will be proportional to the height of the mask, and so the output voltage is linearily related to the height of the mask.

If the upper edge of the mask be such that its height varies as a function of horizontal displacement, and if an input signal be applied to deflect the beam horizontally, then the output signal obtained at the vertical deflecting plates will obviously bear a relationship to the input signal which is given by the function describing the shape of the mask.

If the input signal varies linearily with time in the manner of a saw-tooth wave, then the output signal will be substantially identical to the wave shape drawn as the edge of the mask. Thus, merely by drawing a mask of the desired wave shape, that wave shape is produced.

High-Voltage Rectifier Tube

A new 2-terminal high-voltage rectifier tube (Chatham Electronics) was described for use in the voltage-multiplying stages of a radio-frequency power supply. This new tube employs a heater circuit that is energized by the radio frequency dielectric losses in the cathode coating around a straight "filament" core. This coating is some 10 times thicker than the usual coating and is of a form that is readily energized by losses introduced by the RF electrostatic field. It has the low-voltage drop and high inverse-peak-voltage rating of hot-cathode tubes. Tubes delivering 10 kv at about ½ milliampere load were shown.

(l to r): M. G. Nickolson, Colonial Radio; J. D. Reed, Crosley; Burgess Dempster, Electric Engineering Co. at the IRE informal

IRE CANDIDS

Below: R. E. Shelby, National Broadcasting Co. (left) and R. R. Thompson, Standard Oil Development Co. discuss convention events

Below (l to r): C. W. Horn, Radio IM Mexico; S. B. Spracklen, E. C. Evans, Carbide & Chemical Co. talk of Radio Mexico

Below (l to r): P. F. Siling of RCA Frequency Bureau and Mrs. Siling relax at IRE's annual party at convention opening

WASHINGTON

★ ★ ★ **Latest Electronic News Developments Summarized by Tele-Tech's Washington Bureau** ★ ★ ★

RADIO INDUSTRY HAS BIG ROLE IN NATIONAL DEFENSE SPEED-UP—To strengthen the national defense machinery with the aim of preserving the peace, Congress is sanctioning substantial appropriations, considerably above normal peacetime allotments to the Army-Air Force-Navy. Out of the more than $14 billion (about one-eighth of the wartime peak) funds, the Army Signal Corps and Air Forces communications materiel command and Navy's electronics procurement division will receive an estimated allotment of approximately $250 million for procurement of new radio-electronic apparatus and equipment and new research and development projects. Practically all of the major "prime contractor" radio-electronic manufacturing companies have already been alerted to their role in the stepped-up defense program, while the Munitions Board of the National Military Establishment has undertaken a canvass of around 500 plants of smaller suppliers and components' producers.

The National Security Resources Board, top government agency in mobilization planning, with Leighton H. Peebles, former WPB Communications Division director as communications chief, is engaged in blueprinting minimum civilian requirements in the face of mounting military needs and undoubtedly will give television the stamp of approval as a major broadcasting service for civilian entertainment and morale.

COMMISSIONER WEBSTER HEADS U. S. RADIO "TEAM" TO LONDON SAFETY-AT-SEA CONFERENCE—Main spokesman of U. S. delegation on radio proposals in the maritime service at third London Safety-At-Sea conference (first since end of the war), which commenced April 23, is FCC Commissioner E. M. Webster, leading government authority in this radio field, who is being aided by assistant chief engineer William N. Krebs and engineer in charge of public marine mobile services William Minners and Edward Phillips, acting director of telecommunications of the National Federation of American Shipping. The American delegation is seeking to have all ocean-going passenger and cargo vessels equipped with modern radiocommunications transmitters and receivers, lifeboats with radio, radar and direction finders on larger passenger and cargo vessels.

AVIATION ELECTRONICS PLAN TO BE EXPEDITED—Military preparedness will without doubt speed up the huge $1.113 million project of the Radio Technical Commission for Aeronautics for the establishment of the integrated all-weather electronic air-traffic control system to a span of only a few years instead of the contemplated 15-year goal as reported in Tele-Tech's April issue. This was the view of authoritative Air Force sources to TELE-TECH's Washington bureau. The RTCA program, which includes installation of GCA, Instrument Landing Systems, DME and VHF automatic DF equipment, comprised the expenditure of $989 million for the modernization of military airways and airports, and this major portion of the program is slated to be hastened along by the national emergency.

Already, the Civil Aeronautics Administration has ordered $2.8 million worth of GCA installations. Building up of the U. S. Air Force's strength to 70 groups of airplanes of all military types means installation of hundreds of millions dollars worth of airborne radio-radar-DF-ILS equipment.

REBUFF TO CONGRESSIONAL ASPIRANTS TO DICTATE ALLOCATIONS—The heavily-manned barrage of opposition to Lemke resolution which would constitute a Congressional mandate to FCC to turn the 44-50 megacycle band back to FM broadcasting was believed to have definitely shelved the measure. FCC Commissioner Sterling cracked hard at proposal and brought out danger of pressure opposition to FCC allocations plans.

From the mobile radio industry came many strong protests, spearheaded by Dr. Daniel E. Noble, Motorola vice-president and head of RTPB panel on mobile radio. RCA Laboratories executive vice-president Jolliffe censured proposal to return FM to "lower band" from present spectrum place as confusing and delaying advancement of FM and television. TBA president Poppele and Philco vice-president Bingley believed Lemke proposal might cause reshuffling of spectrum to force television to give up additional space to mobile radio services.

MISCELLANY—FCC is scrutinizing use of 60 channels by railroads to ascertain if unused frequencies cannot be transferred to growing mobile radio services. . . . Civilian Defense Planning of National Military Establishment places mobile radio and broadcasting as backbone of civilian defense activities in event of war and atomic bombing.

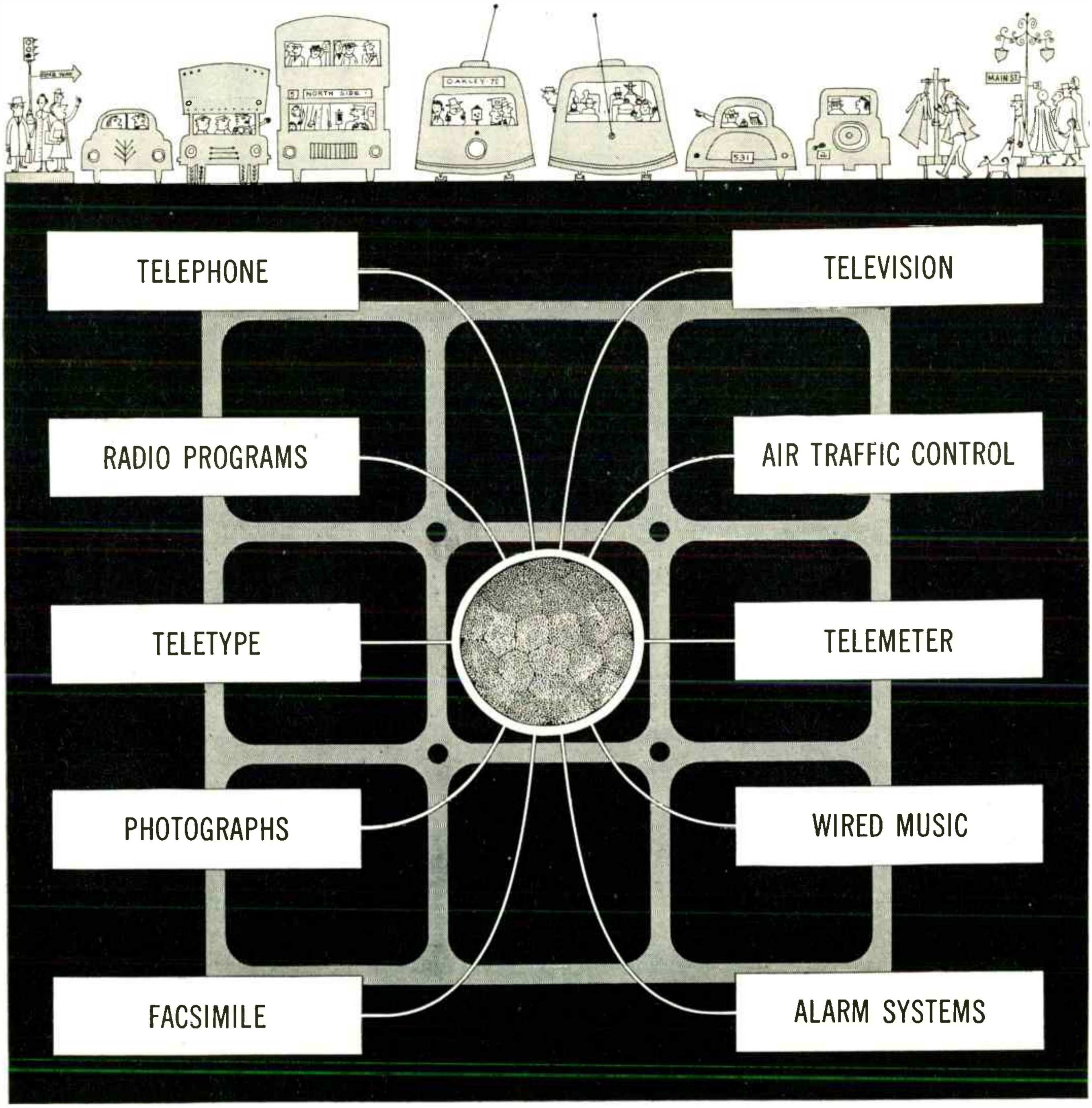
ROLAND C. DAVIES
Washington Editor

Traffic is heavy under the street, too

Surely the busiest thoroughfare in the world is a telephone cable. But it is more than "telephone"; for these thousand or more wires, carrying sound and pictures at lightning speed, are highways for many different services.

Each one of these presents its own problems to Bell Laboratories scientists and engineers: for the telephone differs from television, and television differs from a radio program. And yet they have an essential unity: they involve transmission of alternating currents, with frequencies from zero up to several million cycles. Each calls for new thinking, new ideas, new goals of accomplishment.

The diversity of the cable's many services speaks for the unity of Bell Laboratories' purpose. That is, to know the theory of communication so thoroughly, to practice the art so skilfully, that any transmission of sight or sound can reach its destination clearly, quickly, economically.



BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for continued improvements and economies in telephone service

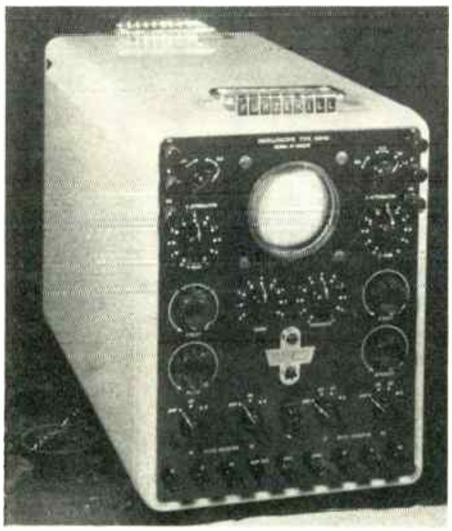
New Lab and Test Equipment

Sweep Calibrator

Model GL-22 is a pulse timing marker oscillator designed for use with oscilloscopes and synchroscopes in the measurement of time intervals and triggered or recurrent sweeps. A marker selector switch makes available 0.1, 0.5, 1.0, 10, and 100 microsecond pulses. A positive or negative variable width gate pulse output is provided for test purposes.—**Browning Laboratories, Inc., Winchester, Mass.**

Instrument Amplifier

Model 102 Phantom Repeater is an instrument amplifier with a high impedance input designed to facilitate electrical measurements on high impedance circuits without disturbing their operation. Consisting essentially of a stabilized amplifier with gains of 1, 10 and 100, the unit has an input impedance of greater than 200 megohms shunted by 5.5 mmfd. from 3 cps. to 80,000 cps. and shunted by approximately 10 mmfd. at 150,000 cps. Frequency response with constant phase shift and amplitude is from 5 cps. to higher than 150,000 cps. within 2% of the midband gain. Dynamic output impedance is less than 200 ohms in series with 20 mfd. Maximum input and output signals are 10 V rms., superimposed on 600 V dc bias; the range can be extended by a special voltage divider to 200 V rms. A vacuum tube voltmeter and cathode ray oscilloscope, or other instruments may be simultaneously connected to the amplifier with negligible loading. The instrument operates on 103-125 V (less than 2% regulation), 50-60 cps.—**Keithley Instruments, 1508 Crawford Rd., Cleveland 6, Ohio.**



DC Oscilloscope

This portable oscilloscope, type 1684D, embodies direct coupled high gain amplifiers for both axes; they consist of 3 long-tailed pairs of tubes in cascade, giving an overall gain of 1500 times. A seperate sync amplifier controls an internal time base circuit and power is drawn from 2 electronically stabilised power supplies. Other features are the instantaneous shifting and controlled expansion of the time-base sweep, independence of frequency, and negligible phase shift over the entire range from zero to 3 mc. No electrolytic condensers are used and all components are conservatively rated, ensuring long service life. First models have recently arrived in this country from the Furzehill Laboratories. —**American British Technology Inc., 57 Park Avenue, New York 16, N. Y.**

Signal Generator

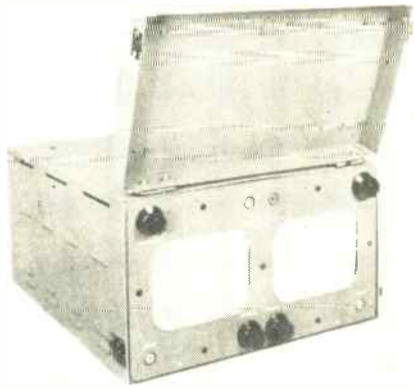
Model 3433 FM-AM signal generator covers from 100 kc to 120 mc in 10 fundamental bands, plus an additional 50 mc from a fixed oscillator to extend the range to 170 mc on fundamentals. Constant deviation has been achieved by using a fixed frequency reactance-modulated oscillator. A meter is provided for measuring relative rf output. RF leakage is minimized by double copper-plated shielding. Other features include: ladder attenuator, coaxial cable output, air trimmer capacitor and permeability adjusted oscillator coils, heterodyne detector, and voltage regulated power supply. The instrument operates on 115 V, 50-60 cycle ac.—**The Triplett Electrical Instrument Co., Bluffton, Ohio.**

Grating Generator

A pattern of horizontal and vertical bars on a kinescope screen which is produced by grating generator WA-3A aids television set manufacturers and broadcasters in determining the correct linearity alignment of deflection circuits for picture and camera pick-up tubes. The horizontal bars are used to check vertical alignment; the vertical bars to check horizontal alignment. Separate controls facilitate independent operation of the horizontal, vertical, and blanking signal circuits. Blanking signal polarity can be changed to permit use of the grating generator in any video system.—**RCA Victor Div., Radio Corp. of America, Camden, N. J.**

Sweep Generator

Covering a range from 10 to 225 mc in 2 bands, model B-115 sweep generator has a sweep width variable from 1 to 10 mc over its entire range. The large dial which is calibrated in mc and television channel numbers has 2 band scales; one printed with a red background, the other with green background. Red or green panel light indicates which band is being covered. Model B-115 has an output of approximately ½ volt, enough to line up television input circuits without additional amplification.—**Essex Electronics Co., Berkeley Heights, N. J.**



Dual TV Monitor

Designed to monitor 2 independent television picture signals, model 102MPD is portable, has a maximum resolution greater than 500 lines, and uses two 7-in. electromagnetic deflection type kinescopes for picture reproduction. Two carrying cabinets house the control unit and dual monitor unit. Requires 115 volts ac, 50/60 cps input and a composite video signal of 1 volt peak-to-peak. Each cabinet is 9 x 16 x 20 in.—**Polarad Electronics Co., 9 Ferry St., New York 7, N. Y.**

Vacuum Pump

A guaranteed vacuum production of 0.1 microns is claimed for this Duo-Seal vacuum pump. The unit has a free air capacity of 300 liters per minute and a speed of 152 liters per minute at 1 micron pressure. Operation is extremely quiet and a built-in trap prevents the oil from backing up into system. An oil level indicator window shows level of oil at all times and an oil drain permits oil change without dismantling system. The unit is 26 in. long, 18½ in. high and 14½ in. wide. **Dept. A, W. M. Welch Mfg. Co., 1515 Sedgwick St., Chicago 10, Ill.**

TV Synchronizing Generator

"Miniaturized" components make this a completely self-contained television synchronizing generator providing a complete RMA signal. The master oscillator of model 5030-A can be locked to the 60-cycle line or run completely free. Half-line driving pulses are provided for the utilization of differential delay techniques, essential for long camera cable hookups. Stability of countdown and pulse width of composite signal are independent of tube changes. Regulated power supplies and autotransformer primary inputs make the unit independent of line voltage variations. Dimensions are 9¼ x 17⅛ x 19½.—**Allen B. DuMont Laboratories, Inc., 42 Harding Avenue, Clifton, New Jersey.**

At the operator's finger tips . . . every vital indicator and control...for maximum operational convenience...

DU MONT Type TA-129-A
Transmitter Control
CONSOLE

FEATURES . . .

12-inch Picture Monitor and Power Supply.

Line and Frame Waveform Monitors, and High- and Low-Voltage Power Supplies.

Station Monitor Receiver.

Visual Frequency Monitor.

Aural Frequency and Modulation Monitor. Aural Frequency Monitor Power Supply.

Visual Meters: PA Plate Ammeter, PA Plate Voltage, Transmission Line Voltage, Carrier Frequency Deviation, Input Level, and Test Meter.

Aural Meters: PA Plate Current, PA Plate Voltage, Transmission Line Voltage, Center Frequency Deviation, Modulation Percentage (KC Swing), Input Level (Vu Meter), and Line Voltage (Single- and Three-Phase).

Pilot lamp flashes when modulation level exceeds any preset positive or negative modulation percentage.

Visual and aural input line switching and previewing selectors.

Visual and aural monitoring keys enable the operator to monitor sight and sound from almost any circuit.

Space available for additional facilities such as room-lighting switches and other desired accessories.

Adaptable for use with any make or model transmitter.

START AS SMALL AS YOU WISH, WITH THE DU MONT *Acorn Package*

Convenience of the streamlined order marks the advanced design of this Du Mont Transmitter Control Console. Transmitter meters and controls are duplicated immediately in front of the seated operator. The smartly styled metal desk holds all monitoring equipment at optimum viewing angle; provides storage space for drawings, memos, logs, typewriter, telephones, etc.; and is complete with all visual and aural monitoring facilities. Space is provided for additional amplifying equipment if required.

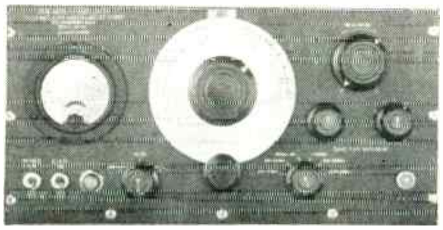
The Du Mont Transmitter Control Console is just another link in the chain of Du Mont equipment from camera to transmitting antenna insuring the "First with the Finest in Television."

LITERATURE ON REQUEST. LET US WORK WITH YOU ON YOUR TELECASTING PLANS AND PROBLEMS.

DU MONT *First with the Finest in Television*

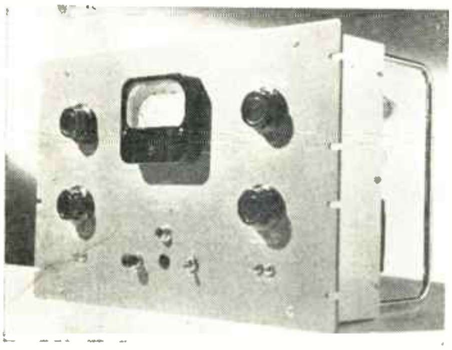
ALLEN B. DU MONT LABORATORIES, INC. • TELEVISION EQUIPMENT DIVISION, 42 HARDING AVE., CLIFTON, N. J. • DU MONT NETWORK AND STATION WABD, 515 MADISON AVE., NEW YORK 22, N. Y. • DU MONT'S JOHN WANAMAKER TELEVISION STUDIOS, WANAMAKER PLACE, NEW YORK 3, N. Y. • STATION WTTG, WASHINGTON, D. C. • HOME OFFICES AND PLANTS, PASSAIC, N. J.

New Design and Sound Components



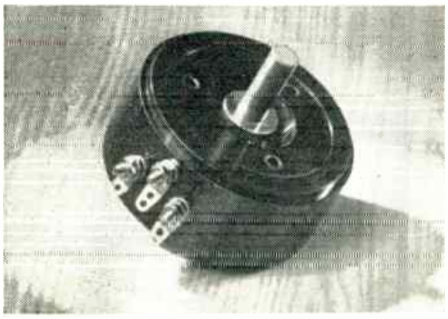
RF Oscillator

Model 410-A is an RF oscillator which may be used as a general purpose laboratory instrument and as a signal source for radio frequency bridges. An output voltmeter, a continuously adjustable output level control and an output level switch make it possible to obtain minimum distortion at normal levels, higher output voltage when a small amount of distortion is tolerable, and a modulated output for signal identification purposes.—**Technology Instrument Corp., 1058 Main St., Waltham 54, Mass.**



Dynamic Noise Suppressor

The improved Dynamic Noise Suppressor, type 910-C has an extended frequency range, a continuous suppression control, and flexible remote control facilities. Functioning on the dynamic-band-pass principle, this device enables broadcast stations to transmit recorded music with a wide frequency range and greatly reduced background noise.—**Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.**

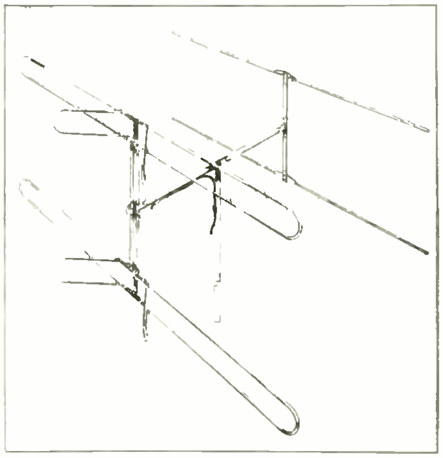


Potentiometer

Reduced in overall depth to 1 5/16 in., type RV3-5 potentiometer is smaller than previous precision variable resistors in the Technology Instrument line. The RV3-5 is available in 9 standard resistance values ranging between 100 and 50,000 ohms. Standard models have an accuracy of ±5% of total resistance; models with a resistance accuracy of 1% are also available. **Technology Instrument Corp., Waltham, Mass.**

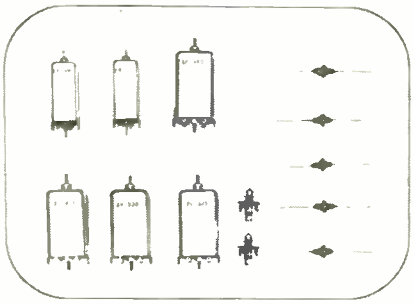
Television Capacitors

Double case construction (capacitor element enclosed in 2 concentric wax-sealed cardboard tubes) is used in type DSTH oil-impregnated capacitors. Capacity range of the new line is from 0.0005 mfd. to 0.05 mfd. and voltages are from 3,000 to 6,000 volts dc. Standard units are without mounting straps but straps or brackets are available if desired.—**Cornell-Dubilier Electric Corp., South Plainfield, New Jersey.**



FM and TV Antennas

Rapid conversion to larger arrays is featured in the JFD line of antennas. They are all pre-assembled; every screw, nut and bolt is in place, facilitating quick assembly. Twenty-two different types cover the 44 to 216 mc range, channels 1 to 13, and FM bands. The JFD line ranges from the single dipole to the double stacked folded dipole with auxiliary high frequency arms. **J. F. D. Mfg. Co., 4109 Ft. Hamilton Parkway, Brooklyn 19, New York.**



Television IF System

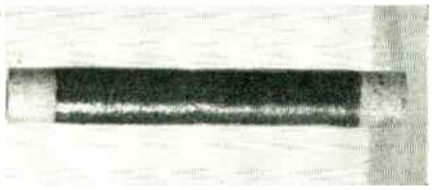
The "ZV" series of 6 IF transformers and 2 peaking coils for television IF amplifier circuits are stable and produce no regenerative effects. Together they provide a completely engineered, easily aligned IF system for video and sound.—**Hillburn Electronic Products Co., 1 Worth St., New York 13, N. Y.**

Polarized DC Relay

Assembled in a standard metal radio tube container, the "Millisec" dc relay is designed for ultra-high speed use and has an operating time of 1 millisecond or less. Its maximum rating is ½ amp., 110 volts dc, on the contacts into a resistive load. Life expectancy increases from 22 million operations at ½ amp. on the contacts to 100 million operations at ¼ amp. The "Millisec" relay is designed for operation with a resistive load, and when so connected does not require an external spark suppression circuit.—**Stevens-Arnold Inc., 22 Elkins St., South Boston 27,**

Beacon Antenna

The addition of a half-wave dipole provides a Power gain of 3½ in this W. Beacon antenna for the 152-162 mc range. Essentially, the antenna is 3 half-wave dipoles stacked 0.7 wavelength apart and driven in phase. The elements, with the exception of the "whip," are completely enclosed in a molded fiberglass housing.—**Workshop Associates, Inc., 66 Needham St., Newton Highlands 61, Mass.**

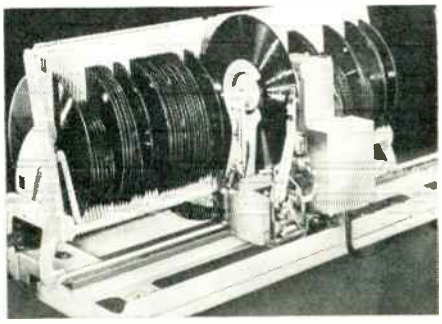


Ferrule Resistor

A new ferrule-type resistor is being offered in the same lower price range as standard tab types. The usual multi-piece assembly is replaced with a design in which the ends of the resistor core are coated with copper and serve as ferrules.—**Milwaukee Resistor Co., 700 West Virginia St., Milwaukee, Wis.**

Portable Electric Megaphone

An amplification of 2500 times is achieved with this portable electric megaphone. Two units make up this public address system: a megaphone with a phenolic pistol-grip handle incorporating a squeeze-to-talk switch, and an amplifier case. The megaphone utilizes Alnico V dynamic driver and microphone units, and a horn specially designed to eliminate phase cancelation effects. The 20 watt amplifier is powered by a self contained plastic, spill-proof and vapor sealed storage battery which can be charged by attachment to any 110-volt, 60-cycle outlet. The amplifier case is 7 x 8 x 12 in. and weighs 23 lb. **Audio Equipment Co., 80-20 15th Ave., Elmhurst, N. Y.**



Record Selector

Both sides of 100 records can be played continuously or selectively in sequence by the Seeburg Select-O-Matic "200" Library, without anyone touching the mechanism or handling a record. A travelling selector moves automatically on a track, removes the selected record from the library, plays it (vertically), returns it to its place, and then moves to the next selected record. The records are preselected by the setting of a sequence of levers in the front of the cabinet. There is a 4-position lever for each record which determines whether the "A" or "B" side or both sides of any desired record should be played, or whether the record should be by-passed.—**J. P. Seeburg Corp., 1500 N. Dayton St., Chicago 22, Ill.**

Conservation Officer gives detailed fire-fighting instructions to mobile unit summoned by radio.

Motorola Units with Sylvania Lock-in Tubes Guard Michigan Forests Against Fire

Conservation Officer radios his call for needed fire-fighting equipment without loss of a moment's time.

Quick action in the early stages of forest fires is a vital factor in their effective control by the Michigan State Department of Conservation. A comprehensive network of two-way radio *assures* quick action!

Each of the 248 Conservation Officers' cars is equipped with Motorola FM, as are 19 land stations. Supplementing this equipment are 130 AM units in lookout towers, 20 in pick-up trucks, 14 in fixed stations—plus two radio-equipped airplanes. Through this equipment, fire-fighting apparatus is speedily marshaled, effectively directed!

Motorola, naturally, counts on Sylvania Lock-In tubes to help maintain uninterrupted, efficient performance of its mobile units. These tubes stay firmly in place in spite of jolting and jarring. They have few welded joints, no soldered ones. No warping or weaving of elements. Low loss, low leakage. See Sylvania Distributors, or write Radio Tube Division, Emporium, Pa.

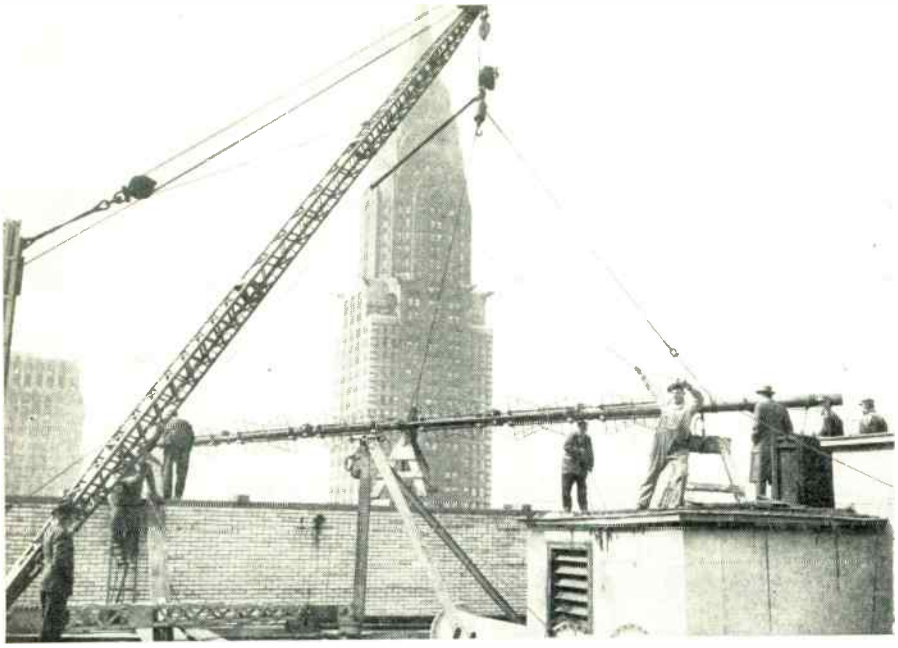
Chief Radio Engineer R. O. Klemetti indicates how fixed land stations are in constant touch with Conservation Officers throughout the state.

Superior mechanical and electrical features of Sylvania Electric's famous Lock-In tube make it the ideal choice for equipment on the road, in the air, on the rails, marine radar, FM and television.

SYLVANIA ELECTRIC

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

NEWS OF THE INDUSTRY



Installation of this RCA 6-bay super turnstile antenna atop New York City's 36-story News Building is scheduled to be completed this month. WPIX, The News television station, will go on the air June 15 with the first "batwing" antenna delivered in New York City

NAB Engineering Conference

The complete program for the National Association of Broadcasters Engineering Conference, May 20-21, a feature of the 26th Annual NAB Convention scheduled for Los Angeles, May 17-21, will include technical papers in all fields of broadcast engineering. The engineering conference will feature 25 specialized papers dealing with the practical side of broadcast problems, it was explained by Royal V. Howard, NAB engineering department director. Some of the subjects to be covered are Design, Construction and Operation of Television and FM Transmitting Plants, TV Studio Systems, Developments in Sound and Relay Broadcast Equipment, A System for Measuring Co-Channel Interference, etc.

HF Bands for TV Assigned

Three high-frequency bands for television pickups, studio-transmitter links and intercity video relay have been temporarily assigned by the FCC. Effective April 2, 1190, 2110, 6875-7125 and 12,700-13,000 mc will be allocated primarily for television pickup and STL purposes and secondarily for television inter-city relaying purposes on the basis of non-interference to the primary service.

NY FMers Up Power

Station WGFH has returned to the air with 20,000 watts effective radiation power and WNYC-FM is now programing with a Western Electric 10 kw FM transmitter.

FCC Approves Citizens Radio

A radio transceiver designed by the Citizens Radio Corp., Cleveland, Ohio, has been approved by the Federal Communications Commission. Weighing approximately 2½ lb. with batteries and operating at 465 mc, the new unit is comparable in size to a folding camera.

FCC's issuance of the type-approval certificate comes after several years of experimentation and design by industry and presages the advent of a new service which will be available to individual citizens for personal use in the 460-470 mc band.

FM Relay Chicago—Wisconsin

Central and southern Wisconsin is hearing FM radio station WEFM, operated in Chicago by Zenith Radio Corp., via two newly installed FM relays at Delafield (WHAD) and Madison (WHA-FM).

CONVENTIONS AND MEETINGS AHEAD

May 3-5 American Section, International Scientific Radio Union, IRE, Washington, D. C.

May 10-13—Radio Parts and Electronic Equipment Shows Inc., Show, Hotel Stevens, Chicago.

May 17 National Association of Broadcasters, 26th Annual Convention and Engineering Conference, Los Angeles.

May 22 New England Radio Engineering Meeting, IRE, North Atlantic Section, Cambridge, Mass.

Sept. 30-Oct. 2—4th Annual Pacific Electronics Exhibit, West Coast Electronic Mfgs. Assoc., Biltmore Hotel, Los Angeles.

IRE Broadcast Engineering Group

More details regarding the formation of a broadcast engineering group will be forthcoming after a special committee meeting at the NAB conference in Los Angeles May 17-21. The broadcasting engineering group, if established, will be under the aegis of the IRE as a result of the resolutions passed by the IRE Professional Committee and passed on to the IRE Board of Directors. Eventual establishment of various semi-autonomous interested groups within the main IRE structure is envisioned by the Professional Committee.

Tooling Up for TV

Several companies have announced plans for television receiver production. Television production at the Magnavox Co. is scheduled to start in May, according to Frank Freimann, executive v-p. The company also announces the addition of Anthony Wright to its engineering staff. He was formerly with RCA for 17 years.

Sonora Radio & Television Corp., Chicago, started receiver production in March and soon expects to up its output to 1,000 TV receivers monthly.

Electronic Lab Private Brands

With procurement of an FRC loan of $285,000, Electronic Laboratories, Inc., Indianapolis announces that the company will operate in the future as a private brand manufacturer of radio in addition to extension of its invertor and convertor program.

FM Heard On Buses

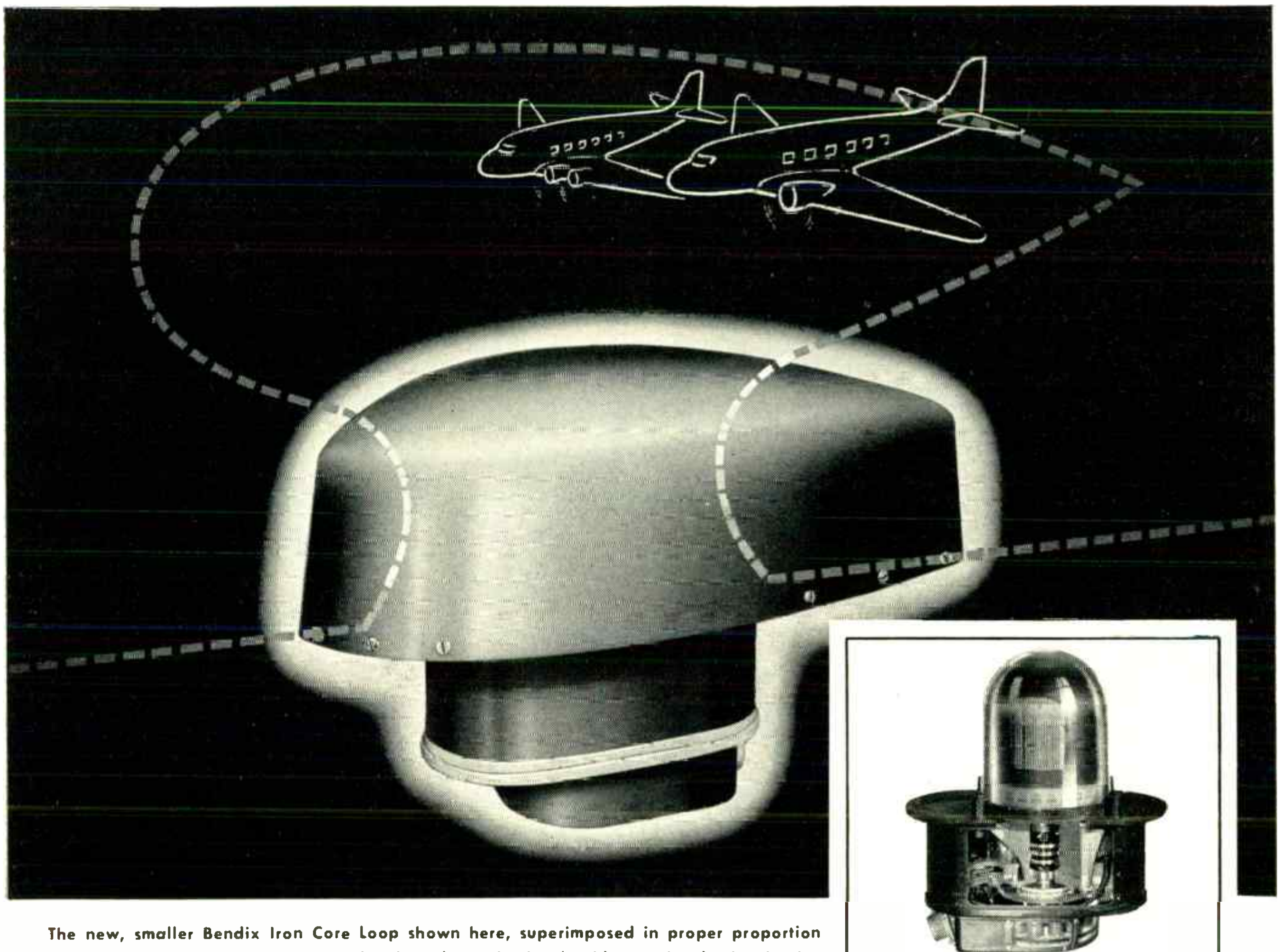
Hulbert Taft, Jr., manager of WKRC and WCTS-FM, Cincinnati has negotiated a contract with the local transportation company to install FM rereceivers in public buses. Mr. Taft plans to sell 20-second spot announcements to advertisers at a frequency of one every 5 minutes.

National Electronics Meeting

The annual meeting of the National Electronics Conference will be held in Chicago at the Edgewater Beach Hotel on November 4, 5, and 6. A program of 50 technical papers covering all phases of electronics is planned. Large space is being allocated for manufacturers' exhibits. W. C. White of General Electric has been named chairman of the board of directors for the current year.

W. R. David Joins WPTR

Patroon Broadcasting Co., CP holder of AM station WPTR, under construction at Albany, N. Y., for 10 kw operation on 1540 kc, has appointed W. R. David vice-president in charge of engineering and a member of its board of directors. Mr. David was with General Electric since 1919 in radio engineering, research, development, design and sales work.



The new, smaller Bendix Iron Core Loop shown here, superimposed in proper proportion on the outline of the air core type that it replaces, is visual evidence of reduction in size accomplished by the use of Stackpole Iron Cores. Air drag is reduced 72% because of this more efficient loop.

"Cut-away" view of new Bendix Automatic Loop Antenna. Note iron core in upper cutaway portion of hermetically sealed unit.

STACKPOLE IRON CORES *REDUCE AIR DRAG 72%*

Unusual as it may seem, careful research and modern electronic design has shown that the use of Stackpole Powdered Iron Cores increases the pay load of regular commercial aircraft.

The new Bendix Automatic Loop Antenna as used in Bendix Radio Division's Navigational System is smaller in size and more efficient than the air loop it replaces. Stackpole Iron Cores permit this reduction in size and also increase the efficiency of the loop. Air drag, an all important consideration in aircraft design, is one of the determining factors in establishing the allowable "Pay Load." Air drag at 250 mph, *has been reduced by more than 72%* by use of this new Bendix loop!

Stackpole Powdered Iron Cores are performing miracles like this for many other manufacturers, too. Improved performance, reduced costs, smaller physical sizes—these are some of the advantages that usually result when Stackpole Iron Cores are designed into inductive circuits. *Write on your company letterhead today for full information.* Ask for STACKPOLE Bulletin No. RC7B.

STACKPOLE CARBON COMPANY, ST. MARYS, PA.

STACKPOLE

IRON CORE HEADQUARTERS

Chicago Show Features New Equipment

The 1948 Radio Parts and Electronic Equipment Conference and Show scheduled at the Hotel Stevens, Chicago, May 11-14 will be featured by more than 166 exhibitors of new radio and electronic equipment and an anticipated record attendance. Arrangements have been made with American Television, Inc., to televise the show. Receiver and component parts manufacturers have indicated that many new items will be revealed to the industry for the first time. Exhibitors who will display their 1948-49 line are as follows (numbers in parenthesis are booth numbers):

Advance Electric & Relay Co., 1360 West 2nd St., Los Angeles (19); Aerovox Corp., 740 Belleville Ave., New Bedford, Mass. (86); Alliance Manufacturing Co., Alliance, Ohio (8); Alpha Metals, Inc., 363 Hudson Ave., Brooklyn, N. Y. (77); Alpha Wire Corp., 50 Howard St., New York (100); American Condenser Co., 4410 N. Ravenswood Ave., Chicago (57); American Microphone Co., 370 So. Fair Oaks Ave., Pasadena, Calif. (62); American Phenolic Corp., 1830 So. Fifty-Fourth Ave., Cicero, Ill. (65); American Radio Hardware Co., 152 MacQuesten Parkway So., Mt. Vernon, N. Y. (73); American Television & Radio, 300 East Fourth St., St. Paul, Minn. (19); Amperite Company, Inc., 561 Broadway, New York (3); Astatic Corp., Conneaut, Ohio (125); Atlas Sound Corp., 1443 - 39th St., Brooklyn, N. Y. (134); Audak Company, 500 - 5th Ave., New York (135); Audio Devices, Inc., 444 Madison Ave., New York (83); Barker & Williamson, Inc., 237 Fairfield Ave., Upper Darby, Pa. (123); Belden Manufacturing Co., 4647 West Van Buren St., Chicago (44); Bell Sound Systems, 1183 Essex Ave., Columbus, Ohio (97); Bliley Electric Co., Union Station Bldg., Erie, Pa. (150); David Bogen Co., Inc., 663 Broadway, New York (39); William Brand & Co., 276 - 4th Ave., New York (101); British Industries Corp., 315 Broadway, New York (131); Brush Development Co., 3405 Perkins Ave., Cleveland (130); Bud Radio, Inc., 2118 East 55th St., Cleveland (9); Burgess Battery Co., Freeport, Ill. (113); Burlington Instrument Co., Burlington, Iowa (22); Bussmann Mfg. Co., University & Jefferson, St. Louis, Mo. (155); Camburn, Inc., 32-40 57th St., Woodside, N. Y. (20); Carbonneau Industries, Inc., 21 Ionia Ave., N.W., Grand Rapids, Mich. (81); Carron Manufacturing Co., 415 S. Aberdeen St., Chicago (4); Centralab, 900 East Keefe Ave., Milwaukee (108); Chicago Transformer Corp., 3501 Addison St., Chicago (40); Cinaudagraph Speakers Div., 1401 Fairfax Trafficway, Kansas City, Kans. (27); Cinch Manufacturing Co., 2335 W. Van Buren St., Chicago (105); Clarostat Mfg. Co., 130 Clinton St., Brooklyn, N. Y. (142); Coastwise Electronics, 130 N. Beaudry Ave., Los Angeles (28); Condenser Products Co., 1375 North Branch St., Chicago (74); Continental Carbon, Inc., 13900 Lorain Ave., Cleveland (148); Continental Electric Co., 715 Hamilton St., Geneva, Ill. (33); Cornish Wire Co., Inc., 15 Park Row, New York (48); Crescent Industries, Inc., 4140 W. Belmont Ave., Chicago (106); Craname, Inc., 3701 Ravenswood Ave., Chicago (84); J. W. Davis & Co., 3015 Knox St., Dallas (23); Drake Electric Works, 3656 Lincoln Ave., Chicago (98); Duotone Co., 799 Broadway, New York (144); Eagle Electronics, Inc., Irvington-on-Hudson, N. Y. (156); Eckstein Radio Products, 914 La Salle Ave., Minneapolis, Minn. (41); Eitel-McCullough, Inc., San Bruno, Calif. (95); Electric Soldering Iron Co., Deep River, Conn. (47); Electronic Instrument Co., 926 Clarkson Ave., Brooklyn, N. Y. (133); Electronic Laboratories, Inc., 24 West 24th St., Indianapolis (147); Electro Products Labs., Inc., 549 W. Randolph St., Chicago (153); Electro-Voice, Inc., Buchanan, Mich. (94); Electrovox Co., Inc., 224 S. Michigan Ave., Chicago (30); Espey Manufacturing Co., 528 East 72nd St., New York (85); Federal Telephone & Radio Co., 100 Kingsland Road, Clifton, N. J. (66); Freed Transformer Co., Inc., 72-78 Spring St., New York (143); Ohio ((7(): Tung-Sold Lamp Works, Inc., 95 - 8th Chicago (37); General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill. (79); General Electric Co., 1 River Road, Schenectady (90); General Industries Co., Elyria, Ohio (127); General Transformer Corp., 4321 N. Knox Ave., Chicago (63); Halldorson Co., 4500 Ravenswood Ave., Chicago (128); Hallicrafters Co., 4401 West Fifth Ave., Chicago (87); Hardwick, Hindle, Inc., 40 Hermon St., Newark, N. J. (54); Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland (157); Hytron Radio & Electronics Corp., 76 Lafayette St., Salem, Mass. (69); Indiana Steel Products Co., 6 North Michigan Ave., Chicago (38); Industrial Condenser Corp., 3243 N. California Ave., Chicago (138); Insuline Corp. of America, 36-02 - 35th Ave., Long Island City, N. Y. (107); International Resistance Co., 401 No. Broad St., Philadelphia (110); Jackson Electrical Instrument Co., 18 S. Patterson Blvd., Dayton, Ohio (13); J-B-T Instruments, Inc., 441 Chapel St., New Haven, Conn. (132); Jensen Industries, Inc., 329 S. Wood St., Chicago (116); Jensen Manufacturing Co., 6601 S. Laramie Ave., Chicago (61); J. F. D. Manufacturing Co., 4117 Ft. Hamilton Parkway, Brooklyn, N. Y. (117); E. F. Johnson Co., Waseca, Minn. (149); Kenyon Transformer Co., Inc., 840 Barry St., New York (96); Kings Electronics Co., Inc., 372 Classon Ave., Brooklyn, N. Y. (93); Lectrohm, Inc., 4910 West 25th Pl., Cicero, Ill. (54); Lenz Electric Mfg. Co., 1751 N. Western Ave., Chicago (60); Maguire Industries, 3571 West 62nd St., Cleveland, Ohio (82); P. R. Mallory & Co., Indianapolis (120); Merit Coil & Transformer Corp., 4427 N. Clark St., Chicago (52); Micamold Radio Corp., 1087 Flushing Ave., Brooklyn, N. Y. (152); James Millen Mfg. Co., Inc., 150 Exchange St., Malden, Mass. (139); National Company, Inc., Malden, Mass. (16); National Union Radio Corp., 350 Scotland Road, Orange, N. J. (10); Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood, Calif. (114); Ohmite Manufacturing Co., 4835 W. Flournoy, Chicago (43); Operadio Manufacturing Co., St. Charles, Ill. (50); Park Metalware Co., Inc., Orchard Park, N. Y. (126); Par-Metal Products Corp., 32-62 - 49th St., Long Island City, N. Y. (136); Permoflux Corp., 4900 West Grand Ave., Chicago (42); Permo, Inc., 6415 Ravenswood Ave., Chicago (88A); Philmore Mfg. Company, Inc., 113 University Pl., New York (119); Potter & Brumfield Sales Co., 549 W. Washington Blvd., Chicago (53); Precision Apparatus Co., 92-97 Horace Harding Blvd., Elmhurst, L. I., N. Y. (80); Premax Products Div., Niagara Falls, N. Y. (18); Presto Recording Corp., 242 West 55th St., New York (109); Pyramid Electric Co., 155 Oxford St., Paterson, N. J. (92); Quam-Nichols Co., 33rd Place & Cottage Grove Ave., Chicago (151); Recon Electric Co., 52 East 19th St., New York (122); Rad-El-Co Mfg. Co., 6300 Euclid Ave., Cleveland (87A); Radio City Products Co., 152 West 25th St., New York (35); Radio Corporation of America, Camden, N. J. (135A); Radio Craftsmen, Inc., 1341 S. Michigan Ave., Chicago (32); Rauland Corp., 4245 North Knox, Chicago (71); Raytheon Manufacturing Co., 445 Lake Shore Drive, Chicago (99); Recordisc Corp., 395 Broadway, New York (26); Recotan Corp., 251 Fourth Ave., New York (102); Rek-O-Kut Co., 38-01 Queens Blvd., Long Island City, N. Y. (55); John F. Rider, Publisher, Inc., 404 Fourth Ave., New York (141); Howard W. Sams & Co., Inc., 2924 East Washington, Indianapolis (72); Sangamo Electric Co., Springfield, Ill. (124); Walter L. Schott & Co., 9306 Santa Monica Blvd., Beverly Hills, Calif. (58); Shur-Antenna-Mount, Inc., 266 Sea Cliff Ave., Sea Cliff, N. Y. (129); Shure Brothers, 225 W. Huron St., Chicago (70) McMurdo Silver Co., Inc., 1240 Main St., Hartford, Conn. (115); Simpson Electric Co., 5208 W. Kinzie St., Chicago (118); Mark Simpson Mfg. Co., 32-28 - 49th St., Long Island City, N. Y. (46); SNC Manufacturing Co., Inc., P. O. Box 156, Glenview, Ill. (5); Snyder Manufacturing Co., 22nd & Ontario Sts., Philadelphia, Pa. (11); Sola Electric Co., 4633 W. 16th St., Chicago (68); Solar Manufacturing Corp., 1445 Hudson Blvd., North Bergen, N. J. (67); Spirling Products Co., 64 Grand St., New York (29); Sprague Products Co., North Adams, Mass. (89); Standard Transformer Corp., 3580 N. Elston Ave., Chicago (88); Stark Sound Engineers, Inc., 616 High St., Ft. Wayne, Ind. (34); Stephens Mfg. Co., 10416 National Blvd., Los Angeles (145); Stromberg-Carlson Co., 100 Carlson Road, Rochester, N. Y. (56); Supreme Instruments Corp., Glenwood, Miss. (159); Sylvania Electric Prods., Inc., 500 - 5th Ave., New York (49); Talk-A-Phone Co., 1512 S. Pulaski Road, Chicago (17); Tartak Speakers, Inc., 3120 East Pico Blvd., Los Angeles (21); Technical Appliance Corp., Sherburne, N. Y. (111); Telex, Inc., 12 N. Washington Ave., Minneapolis (154); Tricraft Products Co., 1535 N. Ashland Ave., Chicago (64); Trimm, Inc., 400 West Lake St., Libertyville, Ill. (121); Triplett Electrical Instrument Co., 286 Harmon Road Bluffton, Ohio (7); Tung-Sol Lamp Works, Inc., 95 - 8th Ave., Newark, N. J. (158); Turner Co., 909 - 17th St., N.E., Cedar Rapids, Iowa (146); Ungar Electric Tools, 615 Ducommun, Los Angeles (25); United Transformer Corp., 150 Varick St., New York (59); Universal Microphone Co., 424 Warren Lane, Inglewood, Calif. (15); University Loudspeakers, Inc., 80 So. Kensico Ave., White Plains, N. Y. (140); Utah Radio Products Div., Huntington, Ind. (1); Vaco Products Co., 317 East Ontario St., Chicago, Ill. (45); V-M Corporation, Benton Harbor, Mich. (24); Waldom Electronics, Inc., 911 N. Larrabee St., Chicago (112); Ward Leonard Electric Co., 53 West Jackson Blvd., Chicago (12); Ward Products Corp., 1523 E. 45th St., Cleveland, Ohio (103); Webster-Chicago Corp., 5610 Bloomingdale Ave., Chicago (91); Webster Electric Co., Clark & DeKoven Sts., Racine, Wis. (31); Westinghouse Electric Co., Bloomfield, N. J. (6); Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark, N. J. (78); Wilcox-Gay Corp., 604 W. Seminary, Charlotte, Mich. (76); Wirt Co., 5221 Greene St., Philadelphia, Pa. (104); Workshop Associates, Inc., 66 Needham St., Newton Highlands, Mass. (41A).

A duplicate of the miniature radio transmitter presented to President Truman last Christmas by the National Bureau of Standards is being demonstrated by Dr. Cledo Brunetti, chief of the Bureau's Ordnance Engineering Section. On the table are other transmitters and microphones, including one for the wrist and one in a lipstick holder

NEW NAMES AND ADDRESSES

The firm name of the George S. Mepham Corp. was changed on March 1, 1948, to C. K. Williams and Co. The address remains the same: 2001 Lynch Ave., East St. Louis, Ill.

* *

Rowe Radio Research Laboratory Co., Chicago, announced the formation of Rowe Engineering Corp., 2422 N. Pulaski Rd., Chicago 39. Officers of the newly formed company are Harry Rowe, president and director of engineering; Robert P. Faust, vice-president in charge of sales; S. Charles Kohl, secretary and treasurer; Dwight V. Sinninger, chief engineer.

* *

Spellman Television Inc., manufacturers of 30 kv power supplies and other projection television components, have moved into larger quarters at 130 West 24 St., New York 58, N. Y.

* *

Gray Research and Development Co., formerly of Elmsford, N. Y., has moved to Hartford, Conn.

* *

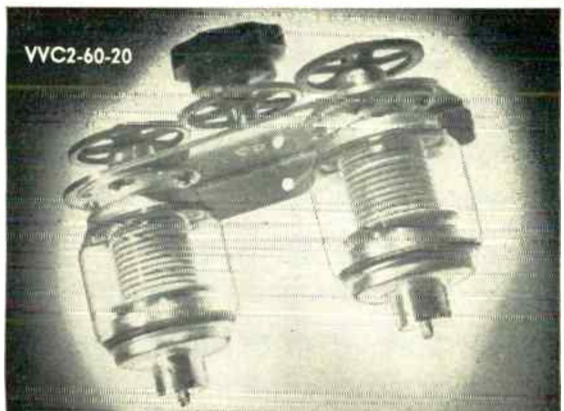
Formation of the Arnold B. Bailey Corp., Scotch Plains, N. J., has been announced by Arnold B. Bailey, the firm's president. The new concern will specialize in the development of electronic communication equipment in broadcasting, television, frequency modulation, and point-to-point microwave systems.

* *

Garstang-May Co., 1422 Circle Tower Bldg., Indianapolis, Ind., has been formed by W. W. Garstang and H. C. May to represent electrical and radio manufacturers in Indiana and the territory immediately surrounding Dayton and Cincinnati.

NOW . . . VARIABLE VACUUM CAPACITORS . . . by EIMAC

Here at last is a dependable variable vacuum capacitor that is physically designed for practical application. Every detail of construction makes the Eimac VVC series the standout variable vacuum capacitor component for your equipment. Here is supreme performance and dependability as only Eimac research and engineering can provide.



CHECK THESE FEATURES

PRACTICAL MOUNTING . . . designed for wide application, the base plate on the single units mounts on panel for direct control, or vertically on chasis for control from a flexible shaft or angular control. Multiple units are conveniently bracketed for chassis and panel installation

COMPACT SIZE . . . the single unit VVC-60 is but 3 inches in diameter and 5 inches in length. Multiple units are proportionally larger.

COPPER COMPONENTS . . . for increased R-F conductivity and minimum internal losses. All contact surfaces are silver plated.

MECHANICALLY RUGGED . . . bellows, bearings and adjusting mechanism designed to withstand excessive use and provide long life.

SIMPLE CONTROL . . . single and multiple units vary capacitance by rotation of a single knob. Return to previously indexed settings is positive.

For further information see your Eimac dealer or write direct.

GENERAL CHARACTERISTICS

	Capacity	R-F Peak Voltage	Maximum RMS Current
VVC 60-20	10-60 mmf.	20-KV	40 amp.
VVC2-60-20 Parallel	20-120 mmf.	20-KV	80 amp.
Split-stator	5-30 mmf.	40-KV	40 amp.
VVC4-60-20 Parallel	40-240 mmf.	20-KV	160 amp.
Split-stator	10-60 mmf.	40-KV	80 amp.

EITEL-McCULLOUGH, INC.
194 San Mateo Avenue, San Bruno, California

EXPORT AGENTS: Frazar & Hansen—301 Clay St.—San Francisco, Calif.

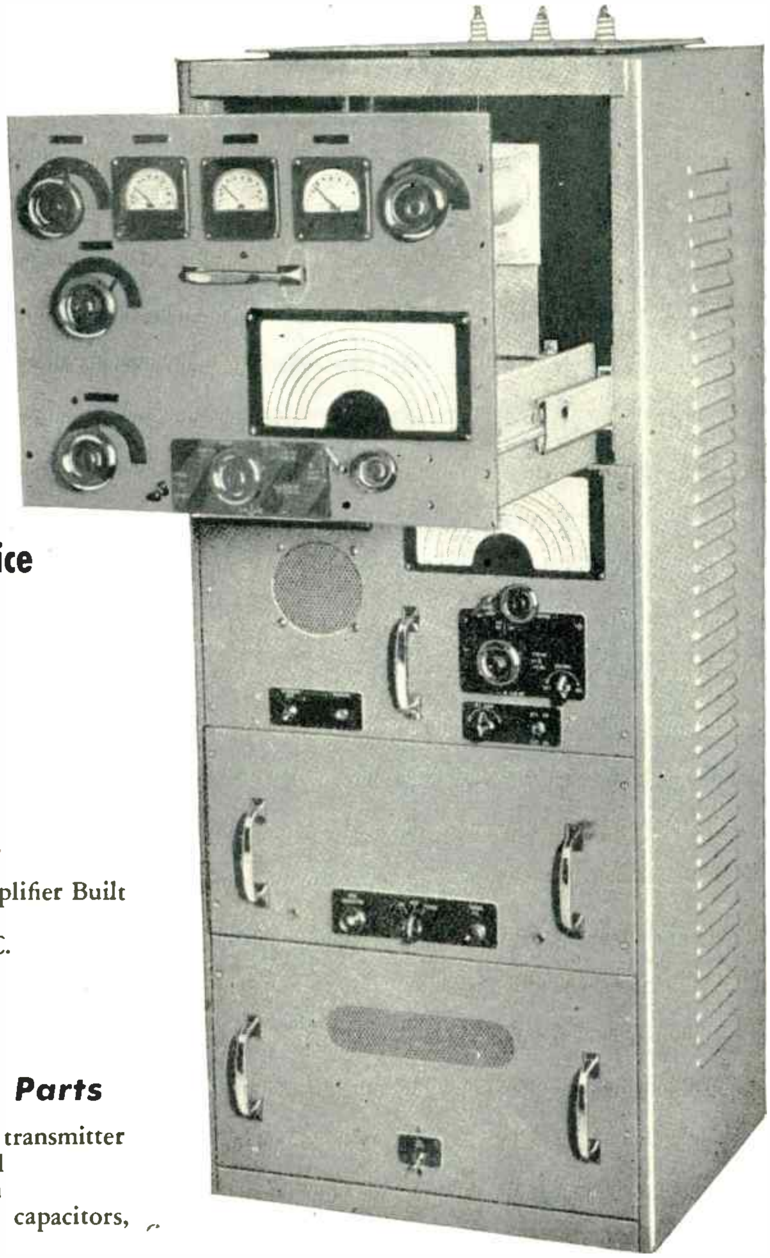
Follow the Leaders to
Eimac TUBES
The Power for R-F

A Complete Station!

Model AN/FRC-1

300 Watt Transmitter

9 TUBE SUPERHETERODYNE RECEIVER



- **Amateurs** • **Airports**
- **Ship-Shore** • **Police** • **Gov't Service**

Phone, CW and MCW
Band-Spread Receiver with Built-in Speaker
Complete Station — Nothing Else to Buy
Push-to-talk Relay System
CW Break-in Operation
E.C.O. With Frequency Meter Accuracy
Receiver Range 1.48 mc. to 12.5 mc. (4 Bands)
Transmitter Range 1.49 mc. to 12.5 mc. (5 Bands)
All Important Circuits Metered
Final: 1-813 Modulator: 2-811's Class B
Power Supply, Modulator, Receiver and Power Amplifier Built in Separate Roll-Out Decks
Operates on 90 to 120 V.A.C. or 200 to 230 V.A.C.
No Modification Necessary — Ready to Operate
Universal Antenna Matching Network
Cabinet Size: 52⅛" X 21½" X 17¾"

Remote Control Unit and Spare Parts

Remote Phone or CW Operation up to 70 feet from transmitter
Unit Contains 5" PM Speaker and Volume Control
Remote Unit Has Primary Power ON-OFF Switch
Spares include 30 tubes (complete replacement) capacitors, resistors, relays, fuses, etc.

Model AN/FRC-1 Transmitter-Receiver, Complete with Speedex Key and push-to-talk microphone, ready to operate—only $495.00.

Remote Control Unit and Spare Parts and Tubes—only $39.00.

Shipped in original crates (3). All units brand new and guaranteed. Weight 800 lbs. Prices are F.O.B., Chicago. $100 with order required on C.O.D. shipments.

Write for Special Listing AN/FRC-1 for Complete Details

Standard Make Type 826—60 Watt UHF Transmitting Tubes at 49c each! The growing popularity of the higher frequency bands makes this general purpose tube an outstanding value. These 826's are brand new, inspected, and in their original cartons. Shipped only in boxes of 8 tubes at $3.92. (Add 50c for mailing anywhere in U.S.) Ceramic Tube Sockets for 826, 829B—50c each.

WELLS SALES, INC.

JOBBERS: See Us During The Parts Show!

320 N. LA SALLE ST., DEPT. T-5, CHICAGO 10, ILL.

An outstanding choice of bakelite-molded receiving and transmitting capacitors for widest range of requirements.

•

Bakelite-cased potted transmitting capacitors for greater load-carrying capacity. Aerovox current ratings insure the most satisfactory selection.

•

Stack-mounting heavy-duty capacitors for transmitting and other high-voltage applications.

•

Ultra-high-frequency molded-in-bakelite capacitors featuring high-voltage minimum-inductance characteristics.

•

Water-cooled oil-filled mica capacitors for higher KVA ratings and greatly reduced capacitor size for given power ratings.

● Be it tiny "postage-stamp" mica capacitor or large stack-mounting unit—regardless, it's a *precision* product when it bears the Aerovox name.

Only the finest ruby mica is used. Each piece is *individually gauged and inspected.* Uniform thickness means meeting still closer capacitance tolerances. Also, sections are of exceptionally uniform capacitance, vitally essential for those high-voltage series-stack capacitors. Meanwhile, the selection of perfect mica sheets accounts for that extra-generous safety factor so characteristic of ALL Aerovox capacitors.

Send us your capacitance problems . . .

Aerovox application engineering service is yours for the asking. Let us quote on your mica, paper, oil, electrolytic, ultra-high-frequency, power-factor and other capacitor needs.

AEROVOX capacitors

FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

AEROVOX CORPORATION, NEW BEDFORD, MASS., U.S.A.

SALES OFFICES IN ALL PRINCIPAL CITIES • Export: 13 E. 40th ST., NEW YORK 16, N. Y.

Cable: 'ARLAB' • In Canada: AEROVOX CANADA LTD., HAMILTON, ONT.

REAL *Mike Flexibility*

for the SOUND EFFECTS MAN

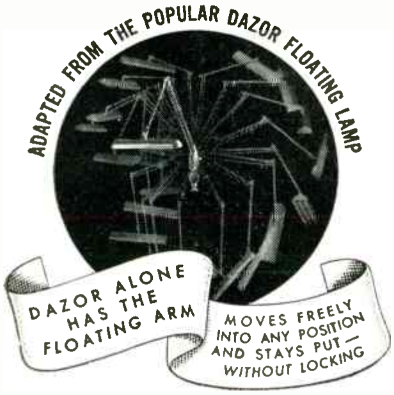
Your microphone, when attached to a Dazor *Floating* Arm, can be switched instantly from one sound-making device to another.

With the tips of your fingers—just a gentle push or pull—you can *float* the mike into hundreds of practical positions. You can tilt or turn it, raise or lower it, swing it from side to side and regulate its reach. This unique *floating* action results from a Dazor-patented mechanism which holds the arm firmly (*without locking*) wherever it is positioned.

As the accompanying photographs suggest, a Dazor-floated microphone picks up sound effects more easily and accurately. It facilitates directional pickup during group broadcasts . . . frees the emcee from manual mike adjustments . . . simplifies control-room operations. Its *flexibility* and stay-putness are conveniences which appeal greatly to plane, train and police dispatchers.

The Dazor *Floating* Arm is adaptable to any mike and can be individualized to meet space limitations. Choice of two bases—the Pedestal type pictured here and a Universal model which fastens to any flat, sloping or vertical surface.

Phone Your Dazor Distributor for full details. If you wish the name of this helpful supplier, write Dazor Manufacturing Corp., 4481-87 Duncan Ave., St. Louis 10, Mo. *In Canada* address inquiries to Amalgamated Electric Corporation Limited, Toronto 6, Ontario.

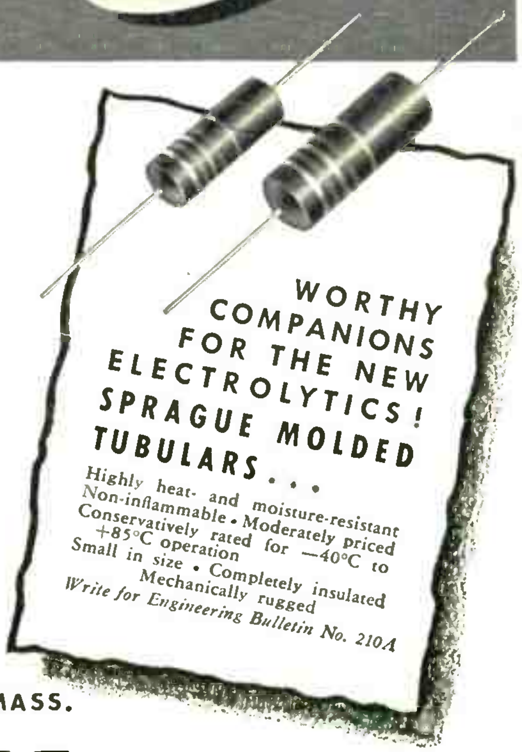


DAZOR FLOATING ARM
FOR MICROPHONES

For operation up to 450 volts at 85° C.

With some 7 times as many components in a television receiver as in the average radio, the possibility of service calls is greatly increased. The new SPRAGUE ELECTROLYTIC line offers the first practical solution to this problem.

Designed for dependable operation up to 450 volts at 85° C. these new units are ideally suited for television's severest electrolytic assignments. Every care has been taken to make these new capacitors the finest electrolytics available today. Stable operation is assured even after extended shelf life, because of a new processing technique developed by Sprague research and development engineers, and involving new and substantially increased manufacturing facilities. More than ever before your judgment is confirmed when you *SPECIFY SPRAGUE ELECTROLYTICS FOR TELEVISION AND ALL OTHER EXACTING ELECTROLYTIC* APPLICATIONS!* Sprague Electric Company invites your inquiry concerning these new units.



SPRAGUE ELECTRIC COMPANY • NORTH ADAMS, MASS.

SPRAGUE

PIONEERS OF ELECTRIC AND ELECTRONIC PROGRESS

Capacitors
* Koolohm Resistors

*Trademarks reg. U. S. Pat. Office

PERSONNEL

Dr. John A. Hutcheson has assumed the directorship of Westinghouse Research Laboratories, succeeding **Dr. L. Warrington Chubb.** During the four years he served as associate director, Dr. Hutcheson directed Westinghouse's wartime radar research program and the formulation of plans for atomic energy development.

R. E. Mathes has become associated with Gray Research and Development Co., as chief engineer. Before the war, he was with the RCA Laboratories and during the war he was in Radar Counter Measures with BuShips.

Anthony Wright, formerly chief RCA Victor television engineer, has been named chief television engineer of the Magnavox Co.

Marcus A. Acheson has been appointed chief engineer for the radio tube division of Sylvania Electric Products, Inc., New York, N.Y.

J. B. Hatfield has returned to station KIRO (CBS 50 kw outlet, Seattle) as chief engineer after two and a half years as full-time consulting engineer for stations in the Pacific Northwest. He replaces Homer J. Ray, resigned.

Otis S. Freeman has joined the engineering staff of WPIX, the New York *Daily News* television station, as assistant for operations. He was formerly chief operating engineer for WABD.

Captain David R. Hull, USN (Retired), has been appointed assistant technical director of the International Telephone and Telegraph Corp.

Ray S. Groenier has been appointed RCA sales engineer in charge of communications sales for RCA's southwest region.

William O. Spink has been named field engineer for Sylvania Electric and will make his headquarters in Cleveland. He was formerly associated

(Continued on page 64)

NEW

the SEEBURG MODEL "R"

A QUALITY CHANGER FOR USE WITH YOUR FINEST INSTRUMENTS

FEATURES:

- *Synchronized two-post construction permits easy setting for automatic play of either 10 or 12-inch records.*
- *Lightweight tone arm and minimum needle pressure for longer record life.*
- *Automatic shut-off after last record is played.*
- *Dual trip—closed circle and eccentric.*
- *Recessed turntable.*
- *Compact — overall size only 13¼ x 13¼ inches.*
- *Changer motor assures constant turntable speed.*
- *Automatically plays twelve 10-inch or ten 12-inch records—may also be set for manual play.*
- *Top section of spindle rotates independently—eliminates objectionable noise—minimizes spindle hole wear.*

Build added appeal into your radio-phonograph combinations with the Model "R" – Seeburg's new record changer.

Combining compactness with quality . . . style with performance—the Model "R" offers every convenience essential to the modern console instrument. Beyond dependable, quiet operation, this new mechanism possesses such important convenience features as the automatic shut-off . . . lightweight tone arm . . . four-position control for automatic play, manual play, record rejection.

Plan now to give your modern instruments every possible sales advantage by equipping them with the new Seeburg Model "R." Seeburg's broad experience in the development and manufacture of changing mechanisms of all kinds is your assurance of satisfaction.

Seeburg

RECORD CHANGERS ★ MUSIC SYSTEMS

J. P. SEEBURG CORPORATION
1500 N. Dayton St., Chicago 22

(Continued from page 62)

with radio station WLAP and the Thordarson Mfg. Co., Chicago.

Bill Wright has taken over the newly created post of production manager for the Hoffman Radio Corp., Los Angeles. He was previously works manager for Detrola Radio Corp., Detroit.

Ben Stanley has been appointed general sales manager in charge of sales for Arco Electronics, Inc., New York.

Robert W. Ferguson has been elected a director in the General Ceramics & Steatite Corp., Keasbey, N. J.

Eric R. Berglund, communications engineer, has been named vice-president in charge of management and engineering of Intercontinent Engineering Corp.

Murray Krause has become production manager for Air King Products, Inc., Brooklyn, N. Y. He has been with Air King for 10 years.

Sidney L. Chertok has been appointed sales promotion manager of Solar Mfg. Corp., North Bergen, N. J., and its distributing subsidiary, Solar Capacitor Sales Corp.

John W. Craig has been named general works manager of Crosley Div., Avco Mfg. Corp.

Lewis Gordon has been appointed director of the International Sales Div. of Sylvania Electric Products, Inc. He replaces **Walter A. Coogan** who has resigned and has joined the John C. Dolph Co. as executive vice president and director.

Bernard Bonder has been named advertising manager of the JFD Mfg. Co., Brooklyn, N. Y. He was previously production manager and copywriter for Radio Wire Television, Inc.

Boris B. Zelman has joined Federal Telephone and Radio Corp., Clifton, N. J. as sales manager for mobile radiotelephone equipment, covering the states of Indiana, Michigan, Kentucky, and Ohio.

George F. Platts has become executive vice president of Clippard Instrument Laboratory, Inc. He will handle sales, promotion and advertising of electronic test equipment, components, TV coils, etc.

NEW BULLETINS

Compounds

New 22-page booklet offered by Mitchell Rand Insulation Co., Inc. classifies compounds into 11 basic application categories. Ring and bell softening point, melting point drip method, cold flow temperature, pouring temperatures, penetrations, viscosity and other pertinent data for each compound are discussed. Convenient thermometer scale is included. (Mention T-T)

Instruments

Simpson Electric Company, 5216 W. Kinzie St., Chicago 44, Ill., has issued a new catalog illustrating and describing its line of instruments, including high-sensitivity set testers for radio and television, mutual-conductance and plate-conductance tube-testers, giant set-testers, vacuum-tube voltmeters, signal generators, micro-tester portables, AC-DC volt-wattmeters, volt-ohm milliameters, ammeters, volt meters, ohmmeters, microammeters, and complete electrical laboratory, combining functions of 60 instruments in one unit. (Mention T-T)

Multiple Arm Relays

A new line of sensitive multiple arm relays are featured in bulletin 50-66 of the Signal Engineering Co., 154 W. 14th St., New York 11, N. Y. Three styles of assembly are illustrated: octal socket and removable dust cover, octal socket and hermetically sealed cover, and header type container, hermetically sealed. (Mention T-T)

Die-Less Duplicating

The origin of Di-Acro system of die-less duplicating is related in the forword to catalog 48-13 of the O'Neil-Irwin Mfg. Co., Lake City, Minnesota. Duplication, shearing, notching, bending, and forming are some of the operations described. (Mention T-T)

French Catalog

A general catalog entitled, "Specification Index for Bristol Instruments," has been published in French by the Bristol Co., Waterbury 91, Conn. Catalog W1815 contains 24 pages of information on automatic controlling, recording, and indicating instruments for use in industry. (Mention T-T)

Tensile Strength Tester

Ranging in capacity from 1 to 1100 lb., the electro-hydraulic tensile strength tester is described in a bulletin by Thwing-Albert Instrument Co., Philadelphia 44, Pa. Various attachments which extend the application of the instrument to all materials failing under tension, compression, or shear, at loads of 1100 lb. or less are also covered. (Mention T-T)

Spectrographic Equipment

Jaco catalog i-5 features spectroscopic research, spectrochemical analysis in metallurgy, mineralogy, agronomy, and chemistry. The catalog is published by Jarrell-Ash Co., 165 Newbury St., Boston 16, Mass., manufacturers, importers and distributors of scientific laboratory instruments. (Mention T-T)

Operations Recorders

Selecting the right Operation Recorder and using it is the theme of bulletin 247, published by Esterline-Angus Co., Box 596, Indianapolis 6, Ind. The operation recorder measures and records automatically the time of occurrence, sequence, and duration of a multiplicity of events. (Mention T-T)

Electrical Connections

The Howard B. Jones Div. of Cinch Mfg. Corp., 2460 W. George St., Chicago 18, Ill., has released catalog 16, a complete listing of the division's line of terminal strips, plugs and sockets. Each model is illustrated; dimensional drawings are included. (Mention T-T)

Magnetic Recording

"Elements of Magnetic Recording—and 999 Applications", a booklet by A. C. Shaney, Chief Engineer, Amplifier Corp. of America, 398-26 Broadway, New York 13, contains useful information about recording and playback technics as well as possible applications to science and industry. The booklet is available for twenty-five cents. (Mention T-T)

Recording Wire Characteristics

(*Continued from page 40*)

that can occur in mass production of the wire. Wire saturated with signal is laid adjacent to or wound around virgin wire, after which the virgin wire thus exposed is passed through a playback head to determine the amount of signal transferred. In conjunction with these tests a set of specifications has been carefully worked out to insure uniformity of results when Fidelitone wire is used in recorders. A resume of these specifications will answer those questions most frequently posed by those working in this field.

This specification shall constitute the requirements for a round (0.004 in. dia.) magnetic stainless steel wire manufactured by the National Standard Co., for sound recording.

Physical requirements are:

Size: .004 in. dia. round.

Gauge tolerance: ±.0002 in.

Out-of-round tolerance: .0001 in. max.

Finish: Smooth and bright.

Tensile strength: 3 lb. or 245,000 psi single strand—minimum.

The minimum inherent curl of the wire as it lays free shall not be less than 1½ in. in diameter. As the wire is processed in the mill it has a characteristic inherent curl. This is measured by cutting off a small length of wire and setting it free on a desk or table top. The wire will thus assume its characteristic curvature, and this should not be less than 1½ in. diameter for best results in use on the wire recorder.

The wire must have a smooth, bright and abrasive-free surface. It should be produced in accordance with the best commercial practices, and should be free from abnormal segregation, laps, seams, pits or welds.

The wire should withstand the bending involved in joining the ends of two wires by the tying of a knot. It should be free of "kinks" or bends severe enough to be felt while the wire is passing through the fingers at low speed.

Coercivity — the maximum coercive force (Hc), when tested in a magnetizing field (Hm) of 1,000 oersteds in an approved manner, should lie between 225 and 325 oersteds. Coercivity is the magnitude of demagnetizing field in oersteds required to reduce ferric induction to zero after the maximum magnetizing field (Hm) has once been applied. Hm is the symbol for "magnetizing field" which is the maximum field in oersteds applied to the specimen in test. Retentivity—the maximum residual induction (Br) is the induction in gauss which remains in the recording medium after the magnetizing field has been reduced to zero.

Range—the saturated signal output at the frequency of maximum response, shall be at least 46 db above the alternating current noise level on a completely erased wire. This test shall be made at a wire speed of ft/sec. Range is a measure of the difference between the loudest signal available from the wire, as compared to the background noise. This range should, naturally, be as great as possible. A saturated signal at frequency of maximum response (1000 to 1500 cycles), is indicative of the loudest signal. The erased noise is the background noise. The difference between these two is the dynamic range. Erase is the use of high frequency (supersonic above 15,000 cycles) energy in the erase gap to put the recording medium in a neutral condition. Erase is a demagnetization procedure.

The modulation noise level should be at least 30 db below the saturated signal output at the frequency of maximum response. The modulation noise should be measured by sufficient direct current in the recording head to attain maximum noise level. This is made at a wire speed of 2 ft/sec. Modulation noise is a noise which rides along with recorded signal, and can be measured by passing direct current through a recording head to obtain maximum noise level. The lower this modulation noise is the better, and a range at least 30 db between this noise and the saturated signal is desirable.

The output voltage measured in an approved manner on standard equipment at a speed of 5 ft/sec., and an input frequency of 2,500 cycles, should not vary more than 1.5 to 1.0 in a 7,500-ft. length, or more than 1.3 to 1.0 in a 60-ft. length. Uniformity of wire is determined by recording a steady signal and testing the strength of this signal as played back from the wire.

HOW MUCH PAY IS AN ENGINEER WORTH?

(*Continued from page 23*)

$250 for today's B. S. degree men corresponds to a figure of $50 to $60 for men starting in the years immediately preceding World War I. Those men, using median reference figures, should now be receiving about $700 per month.

There has been approximately a 3-to-1 increase in the commodity price index since just before World War I. If there were no change in the currency, the $250-a-month beginner of today who is right on the median point should expect a monthly rate of $1,000 in 25 to 35 years from now.

There has been a steady increase in general profit-sharing, incentive bonus, wage dividend and other general methods of reward to the engineer and executive for their contribution to profitable operations of a company. The majority of methods do not single out any individual to try to measure his particular contribution. In large organizations there does not seem to be any effective measure that can be applied where different supervisors are rating different groups, often in widely separated cities.

The small company, however, is in quite a different situation. For about a quarter of a century, the General Radio Company has had a semiannual bonus system in which each person in the entire organization is individually rated and these ratings are coordinated by a single committee known as the Personnel Committee. In addition to the rating points, there are multiplying factors which take into account rate of pay and responsibility. After ratings have been completed, the amount allocated to the bonus is divided by the total points, and then each person receives his individual share of the total bonus, depending on his point value. There is also a profit-sharing trust where all earnings over 6 percent are divided equally between the stockholders and the trust.

The greatest incentive to engineers and executives, however, is what is called the K system, which has been in effect with the General Radio Company for over 15 years. Under this system, each salaried employee has a base rate of pay which is competitive with that of other companies for similar positions. Regardless of whether overtime is asked of him or whether he is on short time, the base rate remains unchanged. At the start of each month, however, he is notified what K for the coming month will be. His base rate will be multiplied by this factor. For the calendar year 1947, K averaged 1.27: thus a $500-a-month man would have received an average monthly pay of $635 in addition to any profit-sharing or other general bonus payments.

K can be less than one as well as more than one. There is published a K table which is made up of three factors: new orders received, shipments, and factory production at estimated billed prices. These factors have equal weights. A K of unity is placed at substantially the break-even point. The figures for the previous month determine the value of K for the following month. The K value is announced on the second or third working day of the month to which it applies.

[While the above article reviews generally the pay problem as it affects engineers in the radio-electronics industry, it would be desirable to hear directly from the engineers themselves. Their testimony alone can confirm the sentiments of engineers with respect to the adequacy of pay scales. The editors invite your comments which will be used *without names* if you wish to remain anonymous.—Ed.]

Half Wave Transformer

(Continued from page 43)

and 2 with R_L connected to terminals 3 and 4 must equal $4R_G$, the transformed generator impedance. Also, with the transformer connected to terminals 1 and 2, and E_1 equal to zero, the impedance across

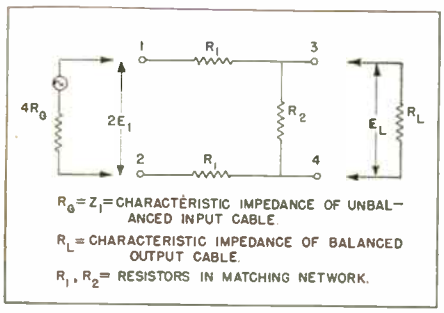


Fig. 7: Illustrates the equivalent network

terminals 3 and 4 must equal R_L, the load impedance. From these relations it can be shown that

$$R_2 = R_L\sqrt{4R_G/(4R_G - R_L)}$$

$$R_1 = \sqrt{R_G(4R_G - R_L)}$$

Since the voltage at the input terminals of the resistor network is $2E_1$, E_L is developed across R_2 and R_L in parallel. Then

$$E_L/E_1 = R_L/(2R_G + \sqrt{R_G(4R_G - R_L)}) = K$$

An alternative arrangement can be obtained by placing a suitably designed resistor network at the input instead of the output of the transformer. The optimum relation, $Z_1 = Z_0$, is then maintained using 50-ohm half-wave sections. This method also appears to offer possibilities for some applications.

TV Receiver Oscillations

(Continued from page 37)

screen or pass through the screen-grid structure into the region of screen grid-plate field. It will be decelerated as it approaches the plate and come to rest past the zero potential plane, then accelerate toward the screen grid. If it passes through the screen-grid structure again, it will be decelerated by the

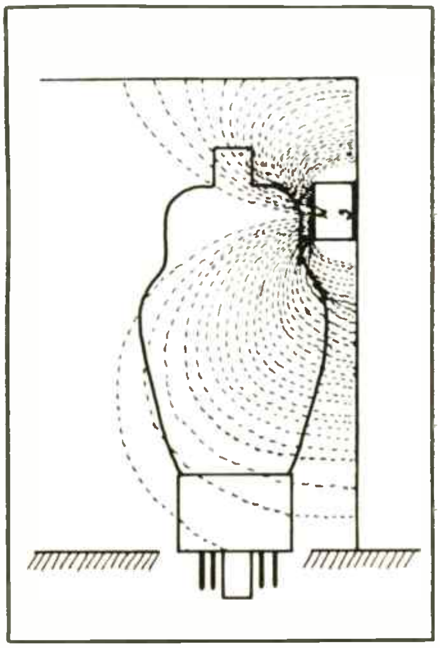


Fig. 5: Magnetic field existing around beam power pentode when high voltage cover is on

grid-screen grid field but still may have sufficient velocity to pass through the grid structure. If it passes through the grid structure it will be decelerated further by the grid cathode field and will come to rest at the cathode essentially at the starting point, if it does not enter the cathode surface.

This is a much simplified description of the electron action within the tube, omitting the effects of the beam forming plates and secondary emissions at several points. It does indicate that oscillations of a frequency dependent upon the transit time will occur during the interval when the plate remains negative with respect to the cathode.

The frequency components of this RF "burst" have been identified for one set of conditions in one receiver as components at 210, 213, 215, 233, 260, 272, 308, 318, 450, 500, 518, 570, 625, 718, 728 and 750 mc. The actual frequencies are unimportant since the spectrum varies from tube to tube and from receiver to receiver.

These "bursts" of RF energy are produced within the pentode tube envelope. There are two ways in which they can be detected by beating with the local oscillator, either by circuit coupling through to the mixer stage or by the radiated RF energy inducing RF in the input RF stage or the mixer stage. At these frequencies it is evident that it must be the radiated RF energy from the tube which is being picked up and detected. If it is considered that the tube elements are the constants of an oscillatory circuit, then it must be assumed that the source of the greater part of the propagation is the leads from the tube elements to the basing connections. These bursts of RF energy synchronous with the horizontal sweep are detected by a conventional beating with the local oscillator in the mixer stage, amplified in the IF amplifiers and detected by the second detector to be indicated on the cathode-ray screen as a black line; the degree of black being dependent upon the peak amplitude of the RF burst.

The burst of RF energy produced is of sufficient magnitude to be considered as a serious interference in television receiver service areas with signal strengths of 15,000 microvolts or less. The interference must be minimized with respect to received signals, and other receivers within the interference circle specified by the amplitude of the RF energy produced. The RF energy is propagated through the metal shield placed around the tube and thus must be efficiently suppressed and not merely reduced in amplitude.

In searching for an efficient suppression it was felt that a change in the tube transit time conditions was the most logical approach, since the external circuit parameters in this case are of such a magnitude compared to the period of any transit time oscillations that only B-K oscillations exist. A magnetic field changes the paths of electrons according to the classical laws, the curvature of the path being dependent upon the electron velocity. If a magnetic field is applied between the tube elements, the electrons can no longer move back and forth from cathode to plate along much the same path, thus no repetitive period may exist. At this value complete suppression takes place.

One form of magnetic parasitic suppressor in use at the present time consists of a permanent magnet bolted to the inside of the high voltage supply cover (Fig. 4). The circuit is essentially that shown in Fig. 2. The magnetomotive force of the magnet is sufficient to cause a few lines of magnetic flux to be present in the interelectrode spaces in the beam power pentode (Fig. 5). This magnet completely suppresses the burst of hf oscillations.

As an alternative, a solenoid may be placed coaxially around the tube. It has been found experimentally that approximately 200 ampere-turns are required to completely suppress the oscillations. Here again there is no efficient suppression until a certain field strength is reached, at this value complete suppression occurs. The orientation of the magnetic field is not critical. In the circuit the solenoid may be utilized as a power supply dropping resistor or bleeder.

Load Impedance Reduction

(Continued from page 35)

oidal), and can be calculated from equation (6), using $p = 0.32$, $E_b =$ 100 volts, $q = 0.2$, s — 0, μ^m/K_a — 20,000 (for one tube), and $m = 1.5$. A value of 625 ma is obtained.

The steady screen voltage will be 340, from the relation for q whilst the grid bias will be approximately one-half the negative grid base of the tubes, i. e., $E_c/2\mu$ and, if μ be assumed 10 for these tubes, the grid bias will be 17 volts. In practice this value should be experimentally adjusted until incipient overloading on both positive and negative peaks of the output waveform is produced at maximum excitation, because the bias should be such as to produce a steady current equal to one half the maximum; otherwise the postulated output of 10 watts will not be obtained.

Fig. 2 shows a typical circuit for this amplifier, with the above specific values in parenthesis. The tube V1 is a pentode or tetrode having the usual inductive plate impedance L1, R5 to give maximum high frequency response in conjunction with the plate-to-ground capacitance. R10 to R13 are 10-ohm oscillation-stopper resistances and the plate choke L2 is designed to carry 625 ma dc and the small ac component due to its inductance. The load of 50 ohms has been shown coupled to the plate via a 1:1 transformer T2, since it is probable that a balanced output will be needed if the load is comprised by a symmetrical transmission line. Alternatively, if the load is asymmetric, T2 may be deleted and the load connected between C and D; in this case the ground may be transferred from the zero potential lead to D.

The voltage feedback is given by R1 and R2, while R3 provides the current feedback. As the sum of the voltages on R2 and R3 must be fed into the cathode circuit of V1 for negative feedback, R2 is made of convenient value to provide the necessary steady grid bias for V1, say 300 ohms, when R1 becomes 5,700 ohms to give the 0.05 ratio. The loss on the shunt feedback path is therefore less than one-hundredth of the wanted output, say 0.1 watt, and is negligible, despite the low and convenient order of resistance used. In order to prevent local feedback on V1, the screen is decoupled to the cathode by condenser C3 and a series plate resistance R6, which must be some 3,000 ohms in order not to reduce unduly the value of R2 and R3. The usual repeater station plate supply voltage of 130 volts has been shown, and this allows 30 volts steady drop on L2, i.e., a dc resistance of 48 ohms.

The grid bias of —17 volts can normally be taken from the usual —21 volt supply via decoupling circuit R15 and C6, but an alternative has also been shown where 60 cycle rectifying units provide the power supplies. The smoothing choke for the 130 volt plate supply, plus additional resistance if necessary to make up R14, is placed in the negative lead and provides the grid bias for the output stage. In this case the rectifying unit will have to deliver some 150 volts at around 700 ma.

The above reference to the use of 60 cycle rectifier units to supply this amplifier may appear somewhat contradictory, in view of the assumption that only a given 100-volt supply was available, but nevertheless a low plate voltage with respect to the screen voltage is essential to the design for directly feeding a low impedance. To demonstrate this point, a case where E_b is not fixed, but direct feed is still required, will now be described.

In wideband oscillators, it is almost impossible to design an output transformer which will not degrade the frequency characteristics of the output. A typical case occurred in the design of an oscillator covering a frequency range of 60 cycles to 1.4 megacycles, with an output of 6 watts into 600 ohms over the whole frequency range. This was desired from a single tube and, in particular, the same tube as was used in the previous example. In this case, since a rectified ac power supply could be used, there was no restriction on the values of the plate and screen voltages in the initial stages of the design.

From the efficiency equation (2a), for M and N equal to 1, and k = 0.125, i.e., sinusoidal operation, and since efficiency=Output Watts 1 Dissipation, it will be be seen that the dissipation is 2W/p, where W denotes the output watts. Inspection

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(Continued from preceding page)
of Fig. 1 shows that the dissipation will decrease with increase of p, i.e., with increase of load resistance. Hence it becomes possible to get more than the previous output from the tube, by raising E_b particularly since the load resistance is much higher (per tube) than the previous example.

Since the output is proportional to the 2.5th power of E_b whereas the load resistance is proportional to the 0.5th power, a relatively small increase will give the desired output, provided the maximum dissipation is not exceeded. To save space, the curves of Fig. 1 can be used to give a close estimate of the required operating conditions, since the increase of E_b will be small, without re-casting the equations to a form not dependent on this voltage.

For a load resistance of 600 ohms, (p) would be 0.54 and the dissipation 8.9 watts, if E_b were 100 volts. Thus raising the dissipation three times, by increasing E_b to 100 x $(3)^{0.4}$, or 150 volts, should meet the maximum dissipation requirement and provide the additional output desired. Checking back, gives a (p) value of 0.58, for E = 154, and output of 6.6 watts, a dissipation of 23 watts, and a screen voltage of 325 volts, all of which are just about right for the given job.

Within the limits of electrode voltage and dissipation, some combination of conventional tubes and applied voltages can always be found to feed a given power into a given load resistance. Other than these limits, the only remaining tube factor is μ^{m}/K_n and this is easily derived for any tube by taking the zero-grid-volts plate current and dividing it into the 1.5th power of the screen voltage.

While Class A operation has been assumed in the examples, the method is independent of waveform, and Class B or C can be handled merely by giving M, N, and k the appropriate values. For instance, with Class B operation (half wave with zero steady current, per tube), (M) and (N) will be infinity, and (k) will be 0.25. Inspection of (7) and (8) will show that such a change in operating method does not alter the general conclusions drawn previously as regards the ratio of plate and screen voltages for feeding power directly into low-load resistances.

Pneumatic Heat Detector

(*Continued from page 45*)

C. The films can be picked up from underneath on mica or bakelite sheets having holes cut in them larger than that part of the film required for each cell. After the film is free of visible moisture, it is placed on a metallic ring which is subsequently inserted into the cell. No special precautions are required in placing the films on the metallic rings for they adhere readily to these and assume a permanently stretched state. The thickness is not critical, and reliably strong films of approximately 0.05 microns thickness were generally used. After the film has been placed on the ring, it is blackened by evaporation of a metal such as antimony in a partial vacuum, at an atmosphere of 3 mm of air or hydrogen. The uncoated detecting film C is also made as described above, except that it is kept to a thickness of approximately 0.03 microns, suitable for a 12-wave plate for the green band. The amount of light reflected by the film is of the order of 4%; i.e., the same as for the surface of a glass having a refraction index of 1.5. This serves to yield, in connection with the inner surface of the glass wedge E, interference fringes of maximum sharpness when the 0.5461 micron line of mercury is utilized for illumination.

Inasmuch as the device is designed to detect thermal changes, it is desired to cancel variations in ambient temperature. Equalizing leak D is introduced to restore the viewed film C to its flat, undisturbed state a short time (approximately 1 sec.) after the thermal background has become quiescent.

The elementary optical system for a single cell consists of Hg arc G, filters H, half-silvered mirror I, lens J, with the observer at point K, as well as adjusting screws which served to bring film C in parallelism to the inner surface of the glass wedge. When a small change occurs in the thermal background of black film B, the interference lines (if present) across film C will shift more or less in accordance with the magnitude of the change. If lines are not present under equilibrium

(*Please turn to next page*)

(Continued from preceding page)

conditions, the first indication is a change in intensity of the illumination of the indicating film, followed by the formation of curved interference lines. With increasing thermal changes, a series of Newton's rings appear momentarily, then disappear as thermal quiescence is restored and the pressure on both sides of the film becomes equalized through D. This leakage path was initially obtained by inserting wires of slightly varying size in the drilled hole D until the desired value was reached.

In a multicell unit, Figs. 2a and 2b, 61 cells were arranged in a hexagonal pattern and individually connected with as many detecting films. The infra-red transmitting windows are made of sphalerite. The detecting films are formed by placing one single large collodion film on an optically flat disc of heat-treated Ketos steel in which 61 holes (also arranged in a hexagonal pattern) had been drilled prior to heat treatment and optical grinding. This plate is held against a similarly perforated brass plate. Individual copper tubes soldered at both terminals provide the pneumatic connections between the cells exposed to radiant energy and the brass plate on which the Ketos plate and indicating films are mounted. The equalization leaks are formed by small holes connecting each cell with the inner chamber of the apparatus and in which very slightly tapered pins are driven by small increments until the desired amount of leakage is obtained for each cell.

The Ketos steel plate is so adjusted with respect to the interfering glass wedge that near parallelism is accomplished, to obtain fewest fringes on the individual indicating films under monochromatic light. With the optimum adjustment, most cells under static conditions showed one distorted broad and fuzzy fringe, while others showed two, or in a few cases more. The event of a small amount of thermal change in the background "seen" by one of the cells is indicated by the shifting of the fringe pattern present under static conditions on the film associated with the particular unit cell on which the radiation is incident.

Large thermal changes cause the

appearance of Newton's rings in the detecting films thus affected. Airplanes at close range, for example, produced as many as 20 or more rings. At maximum range the first indication is always the least discernible fringe shift followed up by Newton's rings which increase in number as the target approaches. The view shown in Fig. 2b does not show the Ketos steel plate with the indicating films, but shows rather a masking brass plate drilled similarly to butt with holes slightly smaller than those carrying the indicating films, which served to cut off undesirable interference lines produced by "edge effects".

When using the device as a tracking instrument for aerial target the 61-cell unit was placed at the focus of a 60-in. metallic parabolic mirror. In Fig. 3 the function of the internally reflecting prism H is to cause the optical system to appear stationary when the elevation of the mirror was changed. This was accomplished by mounting the prism in a bearing and so gearing it to the elevation mechanism that it rotated at half the elevation speed of the mirror and in the opposite direction. Since the observer rode on the azimuth carriage, the image appeared stationary regardless of the motion of the collecting mirror in either azimuth or elevation.

The equipment shown in Figs. 2a and 2b and schematically described in Fig. 3 above was an integral part of the first U. S. Army Radar System (SCR 268 T-1) submitted for Service Tests. Radar azimuth, elevation and range were fed by selsyn motors to the thermal unit which served as the nerve center for the entire radar-thermal searchlight director. (Accuracy of this first U. S. Army radar equipment was approximately 4° in azimuth and 2½° in elevation). The thermal operator searched the skies in the region given by the radar as the target area. Since the thermal unit covered a field of approximately 6° when following the radar aid, pick-ups were easily obtained under conditions of favorable weather.

International Detrola Corp. is under production with a new type of ceramic pickup which the company claims is the first successful one developed.

Series Mode Crystal Circuits

(Continued from page 27)

is not Class A. One precaution that must be observed is that the signal frequency source must not have too high an impedance.

Whenever the plate impedance of the grounded grid tube has sufficiently wide frequency response to handle both signal and oscillator frequencies, (as will generally be the case for fundamental mixing), there is no problem in getting the signal frequency to the follower, where mixing takes place. Where signal and oscillator frequency are widely different, (as with subharmonic mixing), the plate impedance must be altered so as to have resonances at both oscillator and signal frequency if efficient conversion is to take place. It is true that the holder capacitance will couple the cathodes together if the signal frequency is many times higher than the oscillation frequency but such coupling does not provide any gain between signal grid and follower. Subharmonic mixing has been successful for signal frequencies of the order of 250 mc. A single 7F8 tube, with a crystal of the order of 10 mc and mixing at the 3rd subharmonic, has been used as a crystal controlled converter with signal frequencies of the order of 270 mc.

For moderate power transmitter applications, a circuit using a 6L6 tube, a 4-125 transmitting tube and a crystal provides 400 watts output. The output stage may be plate-modulated up to 100%. The crystal current is less than 75 ma. This circuit (Fig. 8) has been operated at 8 mc, the fundamental mode of the crystal, and at 24 mc, the third mechanical harmonic of the same crystal. The 6L6 is used as a grounded grid tetrode amplifier. The screen, grid and cathode of the 4-125 are used as a follower to complete the oscillator circuit. The cathode impedance is kept as low as is consistent with circuit requirements. Power output is taken from the plate of the 4-125. The frequency is not completely independent of the plate voltage on the 4-125 and as a result a small degree of frequency modulation (10 PPM) takes place during the modulation cycle for 100% modulation.

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