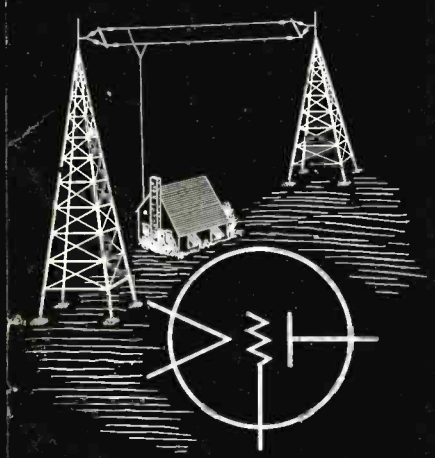
SEPTEMBER, 1933

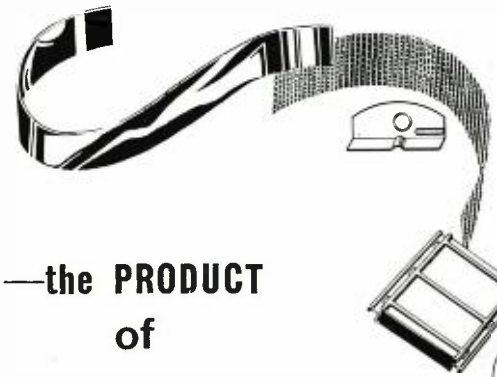
Radio Engineering



IN THIS ISSUE

The Journal of the Radio and Allied Industries

SVEA METAL



—the PRODUCT
of
A CENTURY OF PROGRESS
is at your
COMMAND!

- 32 new customers in 6 months!
- 2,000 lbs. of metal present weekly sales!
- 10,000,000 SVEA METAL tubes on the market!
- $1,500,000 estimated annual saving to the industry!

PROGRESSIVE tube makers are now turning from tube ***design*** research to tube ***materials*** research for PROFITS!

Makes
BETTER TUBES *that* COST LESS

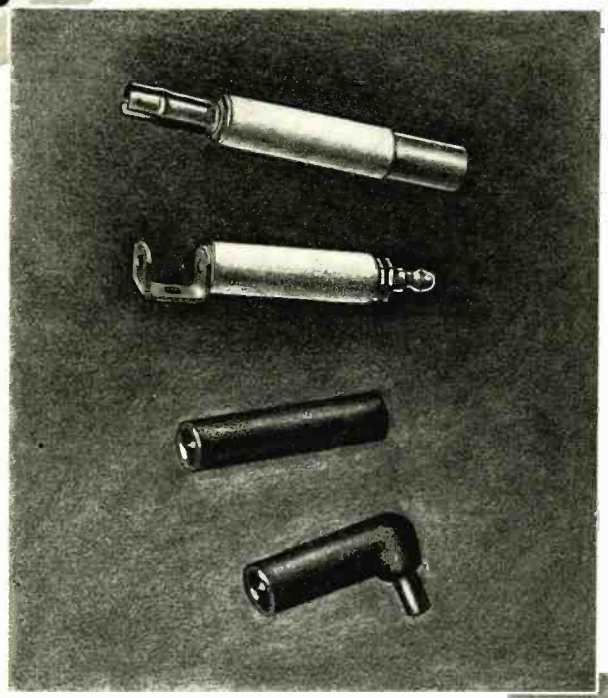
Swedish Iron & Steel Corporation

17 Battery Place — New York City

For more than a quarter of a century suppliers of high grade metals to the foremost electrical equipment manufacturers.

NRA MEMBER U.S. WE DO OUR PART

50000 miles with little change in RESISTANCE VALUE.



Repeated tests in actual use and in the laboratory have proved that ERIE SUPPRESSOR RESISTORS do not change more than 10% in resistance value in 50,000 miles of use—provided one suppressor resistor is used in each high tension lead.

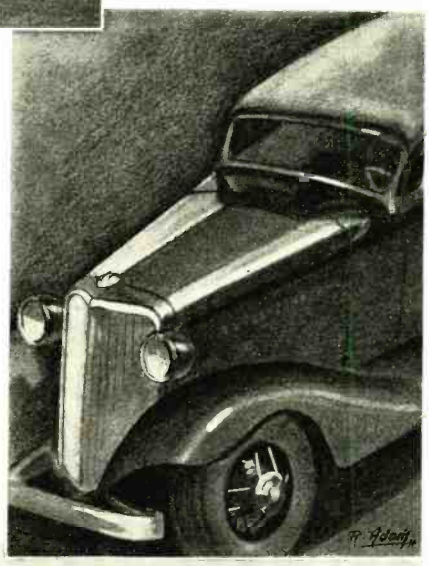
Makers of automobile radio receiving sets have confidence in ERIE SUPPRESSOR RESISTORS because of their high suppression effectiveness and long life resistance value.

Resistance units are enclosed in both porcelain and Bakelite tubes, giving the best possible protection from oil, dirt, moisture and mechanical breakage.

In addition to the plug, screw and distributor types the new L type has been perfected recently. In this suppressor the resistance unit is a special "mix" which stands up in spite of the extremely short length used.

We will gladly give you charts and complete data showing performance of ERIE SUPPRESSOR RESISTORS and furnish you with any details needed on the particular type or types of suppressors needed for your requirements.

THE ERIE RESISTOR CORPORATION, ERIE, PA.
TORONTO, CANADA, AND LONDON, ENGLAND



ERIE SUPPRESSOR RESISTORS

RADIO ENGINEERING

Reg. U. S. Patent Office

MEMBER AUDIT BUREAU OF CIRCULATIONS

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Managing Editor
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Vol. XIII | SEPTEMBBER, 1933 | Number 9

Contents

Departments

THE I. R. E. ROCHESTER MEETING

ON November 13, 14, and 15 the Rochester Fall Meeting of the I. R. E. will be held at the Sagamore Hotel at Rochester, New York. An outstanding technical program has been arranged including the following subjects and speakers:

"Development of Cathode Ray Tubes for Oscillograph Purposes," by H. B. Headrick, R. T. Orth and C. W. Taylor, RCA Radiotron Company.

"Dynamic Detection," by Kenneth W. Jarvis, Zenith Radio Corporation.

"Some Television Problems and Their Solutions," by I. G. Maloff, RCA Victor Company.

"Super-Regeneration as Applied to Ultra High-Frequency Reception," by David Grimes and William S. Barden, RCA License Laboratory.

"Losses in Electrolytic Capacitors," by P. Robinson, Sprague Specialties Company.

"Speaker Problem in High Fidelity Receivers," by Hugh S. Knowles, Jensen Radio Mfg. Company.

"Conditions Necessary for an Increase in Usable Receiver Fidelity," by Dr. Alfred N. Goldsmith, Consulting Engineer.

"Problems in Ignition Interference Suppression," by L. F. Curtis, United American Bosch Corporation.

"New Tube Design Problems," by Roger M. Wise, Hygrade-Sylvania Corporation.

"Vibrating Rectifiers for 'B' Power Supplies," by C. T. Wallis, Delco Appliance Corporation.

There will be technical exhibits as in the past, and several important RMA Committee meetings will be held during the three meeting days.

BRYAN S. DAVIS
President

JAS. A. WALKER
Secretary

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In Assembly Work it will pay YOU to follow the Leaders

JUST glance down the list of radio manufacturers shown here. Certainly those concerns "know something" about radio assembly work. And when all of them agree on the same method of fastening parts to the chassis, IT MEANS SOMETHING. You couldn't ask for stronger evidence of the worth of Parker-Kalon Hardened Self-tapping Sheet Metal Screws.

These unique Screws were thoroughly tested against other fastening devices by each of the manufacturers listed here. Adoption, and consistent use year after year, has come solely because no other device offers such great speed, ease, economy and security of assembly.

In many cases Hardened Self-tapping Sheet Metal Screws have saved 50 per cent and more of assembly time and labor. Savings of 15 per cent to 30 per cent are common on the assemblies of the concerns listed. Your opportunity to cut costs with these famous Screws is just as large, for savings do not depend on volume production.

Make a test. See how these Screws eliminate tapping . . . unhandy riveting . . . fumbling with bolts and nuts. Prove to your own satisfaction that assemblies made this easier, cheaper way actually do hold better than assemblies made with machine screws, bolts and nuts, etc. Use the coupon to get a free "Money-Saver Test Bag" of samples with recommendations of Parker-Kalon Fastening Specialists.

Where and How to use them

Parker-Kalon Hardened Self-tapping Screws

For making fastenings to sheet metal up to 6 ga., aluminum, die castings, Bakelite, etc. Turn Screw into drilled, pierced or molded hole. It forms a thread in the material as it turns in. Can be removed and replaced. Available in a full range of diameters and lengths, and 5 styles of heads as shown below.

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Tell me whether assemblies described on attached sheet can be made cheaper with Self-tapping Screws. I'll make a "Money-Saver Test" if you send samples and recommendations—Free.

Name and Title.....

Company .....

Address .....

Radio Engineering Readers

are cordially invited to investigate
the Research and Development Laboratory facilities of the

RCA Radiotron Company, Incorporated

A radio tube is no better than the laboratory facilities behind it. RCA Radiotron Co., Inc., believes that the excellent reputation of its product is due to its superb technical talent and equipment—its unsurpassed laboratory facilities. We invite you to investigate them through the medium of these pages.

Systematic Development and Application of Radio Tubes

The Research and Development Laboratory of RCA Radiotron Company, Inc., at Harrison, N. J., is necessarily organized on a broad basis. While the primary functions of such a laboratory are to develop new types of tubes for broadcast and amateur use, and to perfect existing types, a conscientious and vigorous application of this program leads into almost limitless paths of research and engineering endeavor. Exploration of these paths, many of them long and difficult, has no attraction for a manufacturer who is concerned solely with immediate sales. Yet it is through research, backed up by a capable and sympathetic development and application engineering organization, that the real advances are made.

The aim of the RCA Radiotron Laboratory staff is to cover the broad field of electronics in so far as this is humanly possible; to concern themselves equally with research on the fundamentals of tube characteristics and designs, the development of new tubes and the application of existing tubes; to look not only at the immediate present but the near and distant future as well.

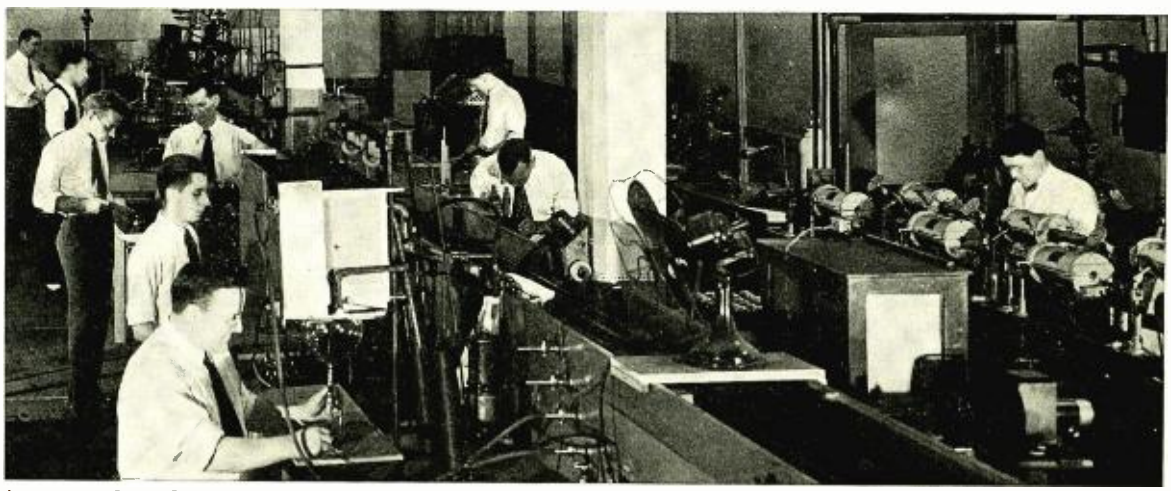
The pursuit of this objective involves a division of laboratory activity into three parts:—research, development and application. While at times, due to the closely related nature of the work, the activities of one section may merge with those of another, the general field of each section remains clearly defined.

The Research Sections

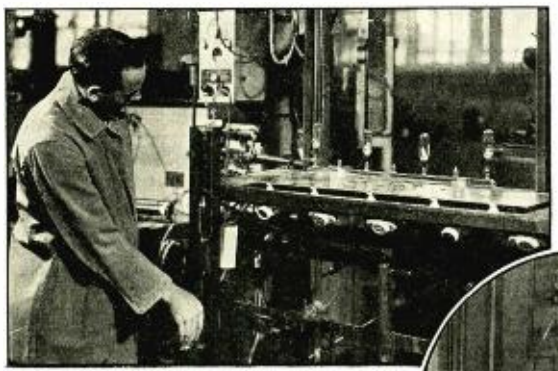
The Research Sections are concerned with new ideas in radio tube characteristics, principles of design, basic materials and processes. Seldom do they occupy themselves with existing tubes, or even the introduction of new tubes of conventional design. Their research activities extend into the field of physical and chemical science. An example of physical research is the recent work on the fundamental principles of tubes for ultra-short waves. The work of the chemical division includes such things as new "getter" substances, ceramics for insulation, alloys for various tube parts, chemical processes and studies of primary and secondary electron emission.

The Development Section

The introduction of RCA Radiotrons and Cunningham Radio Tubes for which there is an immediate practical market, or for

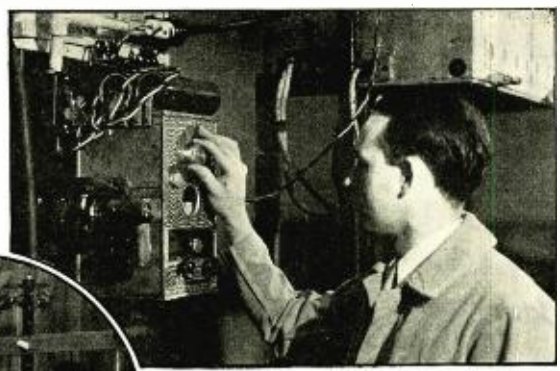


A SECTION OF THE RCA RADIOTRON RESEARCH AND DEVELOPMENT LABORATORY



Exhausting experimental tube types

Extreme care is exercised in all measurements

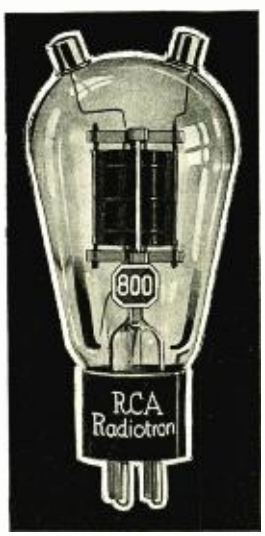


Precision apparatus reduces errors to a minimum

which there will be such a market in the future, and the constant improvement of existing types, fall in the province of the Development Section. It is the designing engineering group of the company and is the largest section of the RCA Radiotron Laboratory. It is continually incorporating into actual tube designs the new ideas obtained from the Research Sections, as well as from its own personnel. In this section a new design is carefully worked out before it goes on to the factory for regular production. Developmental tubes are made in a special factory where the combined experience of engineers and expert factory personnel is applied.

The Application Engineering Section

RCA Radiotron Company, Inc., has long prided itself on its Application Engineering Section. Working closely with "Development," this section acts as a "proving ground" for tubes in process of development. No automobile under development is put through more thorough performance tests on the proving ground than these tubes under actual performance tests in circuits.



RCA-800—an example of RCA Radiotron Engineering development. The new 800 is designed particularly for short wave transmitting.

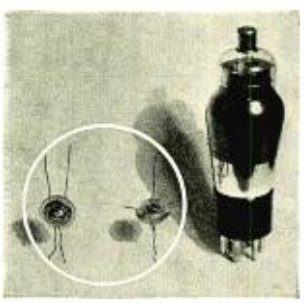
Before any new tube is introduced it should be proven that it offers the equipment-design engineers at least two possibilities as compared with tubes already available. These are, to produce a receiver which will give better performance for the same cost, or equal performance for less cost. The two-fold function of this section is, therefore, to find out (1) what can be done with both old and new tube designs, and (2) the manner of obtaining best results from them. The coordination between tube and set manufacturer is facilitated by the Field Division of the Application Engineering Section, whose members are constantly calling on set manufacturers, discussing their problems, answering their questions and receiving their recommendations.

Commercial Engineering Section

Another highly important work of the RCA Radiotron Laboratory is the collection, correlation and dissemination of technical data in concise and usable form. This work is performed by the Commercial Engineering Section. The staff of this section, through handling much technical correspondence with users of the product, are fully informed as to the type of data which will be helpful to the technical man. As a result, they are always mindful of his needs and viewpoint when preparing information for distribution.

Testing

The activities of the RCA Radiotron Research and Development Laboratory have been outlined in brief. Numerous essential engineering functions that belong to the laboratory as a whole have not been discussed. Probably the most important of these is the thorough and extensive testing program which is carried on to insure a product of uniformly high quality. The development of the test equipment for measuring both the common and more obscure tube characteristics, careful test procedure, rigid test limits and a consistent life testing program are activities which have been developed to a high degree because of the leading role which testing plays in RCA Radiotron engineering, as it does in RCA Radiotron manufacture.



An example of RCA Radiotron research —a miniature laboratory tube used in research on ultra-short waves.

The broad scope of RCA Radiotron research and engineering, plus a manufacturing organization that works hand in hand with it, is responsible for the technical leadership of RCA Radiotrons and Cunningham Radio Tubes.

RCA RADIOTRON CO., INC.

HARRISON · · · · · NEW JERSEY

A Radio Corporation of America Subsidiary

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS MAXIMUM OVERALL LENGTH × DIAMETER	CATHODE TYPE ■	RATING FILAMENT OR HEATER VOLTS	RATING FILAMENT OR HEATER AMPERES	RATING PLATE MAX. VOLTS	RATING SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUPPLY VOLTS	GRID VOLTS■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
RCA-1A6	PENTAGRID CONVERTER ◎	SMALL 8-PIN	FIG. 28	4 1/2" x 1 3/16"	D-C FILAMENT	2.0	0.06	180	67.5	CONVERTER	180	−3.0 min.	67.5	2.4	1.3	500000	Anode-Grid (#2) 135 Max. Volts. 2.3 Ma. Oscillator Grid(#1) Resistor, 50000 Ohms. Conversion Conductance, 300 Micromhos.				C-1A6
RCA-2A3	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	5 3/8" x 2 1/16"	FILAMENT	2.5	2.5	250	—	CLASS A AMPLIFIER	250	−45	—	—	60.0	300	5250	4.2	2500	3.5	C-2A3
										PUSH-PULL AMPLIFIER	300	−62	Self-bias		40.0	Power Output is for 2 tubes at stated load, plate-to-plate		5000	10.0	
											300	−62	Fixed-bias		40.0			3000	15.0	
RCA-2A5	POWER AMPLIFIER PENTODE	MEDIUM 8-PIN	FIG. 15A	4 1/4" x 1 1/16"	HEATER	2.5	1.75	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.5	34.0	100000	2200	220	7000	3.0	C-2A5
RCA-2A6	DUPLEX-DIODE HIGH-MU TRIODE	SMALL 6-PIN	FIG. 13	4 1/32" x 1 1/16"	HEATER	2.5	0.8	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	250 ✕	− 1.35	—	—	0.4	—	—	Gain per stage = 50-60			C-2A6
RCA-2A7	PENTAGRID CONVERTER ◎	SMALL 7-PIN	FIG. 20	4 1/32" x 1 5/16"	HEATER	2.5	0.8	250	100	CONVERTER	250	− 3.0	100	2.2	3.5	360000	Anode Grid (#2) 200 Max. Volts. 4.0 Ma. Oscillator Grid(#1) Resistor, 50000 Ohms. Conversion Conductance, 520 Micromhos.				C-2A7
RCA-2B7	DUPLEX-DIODE PENTODE	SMALL 7-PIN	FIG. 21	4 1/32" x 1 5/16"	HEATER	2.5	0.8	250	125	PENTODE UNIT AS R-F AMPLIFIER	100	− 3.0	100	1.7	5.8	300000	950	285	—	—	C-2B7
											250	− 3.0	125	2.3	9.0	650000	1125	730	—	—	
										PENTODE UNIT AS A-F AMPLIFIER	250‡	− 4.5	50	—	0.65	—	—	—	—	—	
RCA-6A4 also LA	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 8	4 1/32" x 1 1/32"	FILAMENT	6.3	0.3	180	180	CLASS A AMPLIFIER	100	− 6.5	100	1.6	9.0	83250	1300	100	11000	0.31	C-6A4 also LA
											180	−12.0	180	3.9	22.0	45500	2200	100	8000	1.40	
RCA-6A7	PENTAGRID CONVERTER ◎	SMALL 7-PIN	FIG. 20	4 1/32" x 1 5/16"	HEATER	6.3	0.3	250	100	CONVERTER	250	− 3.0	100	2.2	3.5	360000	Anode Grid (#2) 200 Max. Volts. 4.0 Ma. Oscillator Grid(#1) Resistor, 50000 Ohms. Conversion Conductance, 520 Micromhos.				C-6A7
RCA-6B7	DUPLEX-DIODE PENTODE	SMALL 7-PIN	FIG. 21	4 1/32" x 1 5/16"	HEATER	6.3	0.3	250	125	PENTODE UNIT AS R-F AMPLIFIER	100	− 3.0	100	1.7	5.8	300000	950	285	—	—	C-6B7
											250	− 3.0	125	2.3	9.0	650000	1125	730	—	—	
										PENTODE UNIT AS A-F AMPLIFIER	250‡	− 4.5	50	—	0.65	—	—	—	—	—	

◎ Grids #3 and #5 are screen. Grid #4 is signal-input control-grid.

‡ Applied through plate coupling resistor of 200000 ohms.

✕ Applied through plate coupling resistor of 250000 ohms.

RCA-6F7	TRIODE-PENTODE	SMALL 7-PIN	FIG. 27	4 1/32" x 1 5/16"	HEATER	6.3	0.3	100	—	TRIODE UNIT AS AMPLIFIER	100	− 3.0	—	—	3.5	17800	450	8	—	—	C -6F7
								250	100	PENTODE UNIT AS AMPLIFIER	250	− 3.0	100	1.5	6.5	850000	1100	900	—	—	
										PENTODE UNIT AS MIXER	250	−10.0	100	0.6	2.8	Oscillator peak volts = 7.0. Conversion conductance = 300 micromhos.				
UX- 200-A	DETECTOR TRIODE	MEDIUM 4-PIN	FIG. 1	4 1/16" x 1 1/16"	D-C FILAMENT	5.0	0.25	45	—	GRID LEAK DETECTOR	45	Grid Return to (−) Filament			1.5	30000	666	20	—	—	CX-300-A
RCA- 01-A	DETECTOR★ AMPLIFIER	MEDIUM 4-PIN	FIG. 1	4 1/16" x 1 1/16"	D-C FILAMENT	5.0	0.25	135	—	CLASS A AMPLIFIER	90	− 4.5	—	—	2.5	11000	725	8.0	—	—	C - 01-A
											135	− 9.0			3.0	10000	800	8.0			
RCA- 10	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	5 3/8" x 2 1/16"	FILAMENT	7.5	1.25	425	—	CLASS A AMPLIFIER	350	−31.0	—	—	16.0	5150	1550	8.0	11000	0.9	C - 10
											425	−39.0			18.0	5000	1600	8.0	10200	1.6	
WD- 11 WX- 12	DETECTOR★ AMPLIFIER TRIODE	WD 4-PIN MEDIUM 4-PIN	FIG. 12 FIG. 1	4 1/8" x 1 3/16" 4 1/16" x 1 1/16"	D-C FILAMENT	1.1	0.25	135	—	CLASS A AMPLIFIER	90	− 4.5	—	—	2.5	15500	425	6.6	—	—	C - 11 CX- 12
											135	−10.5			3.0	15000	440	6.6			
UX -112-A	DETECTOR★ AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 1/16" x 1 1/16"	D-C FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	90	− 4.5	—	—	5.0	5400	1575	8.5	—	—	CX-112-A
											180	−13.5			7.7	4700	1800	8.5			
RCA- 19	TWIN AMPLIFIER	SMALL 6-PIN	FIG. 25	4 1/16" x 1 1/16"	D-C FILAMENT	2.0	0.26	135	—	CLASS B AMPLIFIER	135	0	—	—	Power output value is for one tube at stated load, plate-to-plate.				10000	2.1	C - 19
											135	− 3.0							10000	1.9	
UX -120	POWER AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/8" x 1 3/16"	D-C FILAMENT	3.3	0.132	135	—	CLASS A AMPLIFIER	90	−16.5	—	—	3.0	8000	415	3.3	9600	0.045	CX-220
											135	−22.5			6.5	6300	525	3.3	6500	0.110	
RCA- 22	R-F AMPLIFIER TETRODE	MEDIUM 4-PIN	FIG. 4	5 1/32" x 1 1/16"	D-C FILAMENT	3.3	0.132	135	67.5	SCREEN GRID R-F AMPLIFIER	135	− 1.5	45	0.6*	1.7	725000	375	270	—	—	C - 22
											135	− 1.5	67.5	1.3*	3.7	325000	500	160			
RCA- 24-A	R-F AMPLIFIER TETRODE	MEDIUM 5-PIN	FIG. 9	5 1/32" x 1 1/16"	HEATER	2.5	1.75	275	90	SCREEN GRID R-F AMPLIFIER	180	− 3.0	90	1.7*	4.0	600000	1000	400	—	—	C - 24-A
											250	− 3.0	90	1.7*	4.0	600000	1050	630			
										BIAS DETECTOR	275●	− 5.0 approx.	20 to 45	—	Plate current to be adjusted to 0.1 milliampere with no signal.						
RCA- 26	AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 1/16" x 1 1/16"	FILAMENT	1.5	1.05	180	—	CLASS A AMPLIFIER	90	− 7.0	—	—	2.9	8900	935	8.3	—	—	C - 26
											180	−14.5			6.2	7300	1150	8.3			
RCA- 27	DETECTOR★ AMPLIFIER TRIODE	MEDIUM 5-PIN	FIG. 8	4 1/16" x 1 1/16"	HEATER	2.5	1.75	275	—	CLASS A AMPLIFIER	135	− 9.0	—	—	4.5	9000	1000	9.0	—	—	C - 27
											250	−21.0			5.2	9250	975	9.0			
										BIAS DETECTOR	250	−30.0	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
RCA- 30	DETECTOR★ AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/8" x 1 3/16"	D-C FILAMENT	2.0	0.06	180	—	CLASS A AMPLIFIER	90	− 4.5	—	—	2.5	11000	850	9.3	—	—	C - 30
											135	− 9.0			3.0	10300	900	9.3			
											180	−13.5			3.1	10300	900	9.3			

★ For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.

● Applied through plate coupling resistor of 250000 ohms or 500-henry choke shunted by 0.25 megohm resistor. *Maximum.

RCA- 31	POWER AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/8" x 1 3/16"	D-C FILAMENT	2.0	0.13	180	—	CLASS A AMPLIFIER	135	−22.5	—	—	8.0	4100	925	3.8	7000	0.185	C - 31
											180	−30.0			12.3	3600	1050	3.8	5700	0.375	
RCA- 32	R-F AMPLIFIER TETRODE	MEDIUM 4-PIN	FIG. 4	5 1/32" x 1 1/16"	D-C FILAMENT	2.0	0.06	180	67.5	SCREEN GRID R-F AMPLIFIER	135	− 3.0	67.5	0.4*	1.7	950000	640	610	—	—	C - 32
											180	− 3.0	67.5	0.4*	1.7	1200000	650	780			
										BIAS DETECTOR	180♥	− 6.0 approx.	67.5	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
RCA- 33	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 8	4 1/32" x 1 1/16"	D-C FILAMENT	2.0	0.26	135	135	CLASS A AMPLIFIER	135	−13.5	135	3.0	14.5	50000	1450	70	7000	0.7	C - 33
RCA- 34	SUPER-CONTROL R-F AMPLIFIER PENTODE	MEDIUM 4-PIN	FIG. 4A	5 1/32" x 1 1/16"	D-C FILAMENT	2.0	0.06	180	67.5	SCREEN GRID R-F AMPLIFIER	135	− 3.0 min.	67.5	1.0	2.8	600000	600	360	—	—	C - 34
											180		67.5	1.0	2.8	1000000	620	620			
RCA- 35	SUPER-CONTROL R-F AMPLIFIER TETRODE	MEDIUM 5-PIN	FIG. 9	5 1/32" x 1 1/16"	HEATER	2.5	1.75	275	90	SCREEN GRID R-F AMPLIFIER	180	− 3.0 min.	90	2.5*	6.3	300000	1020	305	—	—	C - 35
											250		90	2.5*	6.5	400000	1050	420			
RCA- 36	R-F AMPLIFIER TETRODE	SMALL 5-PIN	FIG. 9	4 1/32" x 1 1/16"	HEATER	6.3	0.3	250	90	SCREEN GRID R-F AMPLIFIER	100	− 1.5	55	—	1.8	550000	850	470	—	—	C - 36
											180	− 3.0	90	—	3.1	500000	1050	525			
											250	− 3.0	90	1.7*	3.2	550000	1080	595			
										BIAS DETECTOR	100●	− 5.0	55	—	Plate current to be adjusted to 0.1 milliampere with no signal.						
											250●	− 8.0	90	—							
RCA- 37	DETECTOR★ AMPLIFIER TRIODE	SMALL 5-PIN	FIG. 8	4 1/8" x 1 1/16"	HEATER	6.3	0.3	250	—	CLASS A AMPLIFIER	90	− 6.0	—	—	2.5	11500	800	9.2	—	—	C - 37
											180	−13.5			4.3	10200	900	9.2			
											250	−18.0			7.5	8400	1100	9.2			
										BIAS DETECTOR	90	−10.0	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
											250	−28.0									
RCA- 38	POWER AMPLIFIER PENTODE	SMALL 5-PIN	FIG. 8A	4 1/32" x 1 1/16"	HEATER	6.3	0.3	250	250	CLASS A AMPLIFIER	100	− 9.0	100	1.2	7.0	140000	875	120	15000	0.27	C - 38
											180	−18.0	180	2.4	14.0	110000	1050	120	11500	1.00	
											250	−25.0	250	3.8	22.0	100000	1200	120	10000	2.50	
RCA-39-44	SUPER-CONTROL R-F AMPLIFIER PENTODE	SMALL 5-PIN	FIG. 8A	4 1/32" x 1 1/16"	HEATER	6.3	0.3	250	90	SCREEN GRID R-F AMPLIFIER	90		90	1.6	5.6	375000	960	360	—	—	C -39-44
											180	− 3.0 min.	90	1.4	5.8	750000	1000	750			
											250		90	1.4	5.8	1000000	1050	1050			
UX -240	VOLTAGE AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 1/16" x 1 1/16"	D-C FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	135 ✕	− 1.5	—	—	0.2	150000	200	30	—	—	CX-340
											180 ✕	− 3.0			0.2	150000	200	30			
RCA- 41	POWER AMPLIFIER PENTODE	SMALL 6-PIN	FIG. 15A	4 1/8" x 1 5/16"	HEATER	6.3	0.4	250	250	CLASS A AMPLIFIER	100	− 7.0	100	1.6	9.0	103500	1450	150	12000	0.33	C - 41
											180	−13.5	180	3.0	18.5	81000	1850	150	9000	1.50	
											250	−18.0	250	5.5	32.0	68000	2200	150	7600	3.40	
RCA- 42	POWER AMPLIFIER PENTODE	MEDIUM 8-PIN	FIG. 15A	4 1/16" x 1 1/32"	HEATER	6.3	0.7	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.5	34.0	100000	2200	220	7000	3.00	C - 42

★ For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.

■ Either A. C. or D. C. may be used on filament or heater, except as specifically noted. For use of D. C. on A-C filament types, decrease stated grid volts by ½ (approx.) of filament voltage.

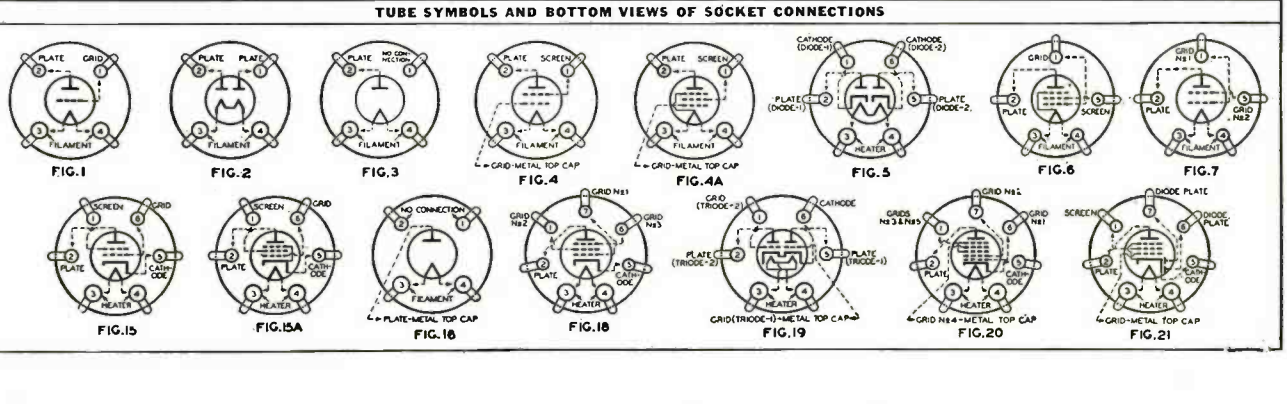
● Applied through plate coupling resistor of 250000 ohms or 500-henry choke shunted by 0.25 megohm resistor.

♥ Applied through plate coupling resistor of 100000 ohms.

✕ Applied through plate coupling resistor of 250000 ohms.

*Maximum.

TUBE SYMBOLS AND BOTTOM VIEWS OF SOCKET CONNECTIONS



TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS MAXIMUM OVERALL LENGTH X DIAMETER	CATHODE TYPE ■	RATING: FILAMENT OR HEATER VOLTS	FILAMENT OR HEATER AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUPPLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
RCA- 43	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 15A	4 1/16" x 1 3/8"	HEATER	25.0	0.3	135	135	CLASS A AMPLIFIER	100 135	−15.0 −20.0	100 135	4.0 7.0	20.0 34.0	45000 35000	2000 2300	90 80	4500 4000	0.90 2.00	C - 43
RCA- 45	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 1/16" x 1 3/8"	FILAMENT	2.5	1.5	275	—	CLASS A AMPLIFIER	180 250 275	−31.5 −50.0 −56.0	180 250 275	—	31.0 34.0 36.0	1650 1610 1700	2125 2175 2050	3.5 3.5 3.5	2700 3900 4600	0.82 1.60 2.00	C - 45
RCA- 46	DUAL-GRID POWER AMPLIFIER	MEDIUM 5-PIN	FIG. 7	5 1/8" x 2 1/16"	FILAMENT	2.5	1.75	250 400	— —	CLASS A AMPLIFIER □ CLASS B AMPLIFIER ♦	250 300 400	−33.0 0 0	— —	— —	22.0 Power output values are for 2 tubes at indicated plate-to-plate load.	2380	2350	5.6	6400 5300 5800	1.25 16.0 20.0	C - 46
RCA- 47	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 6	5 1/8" x 2 1/16"	FILAMENT	2.5	1.75	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.0	31.0	60000	2500	150	7000	2.7	C - 47
RCA- 48	POWER AMPLIFIER TETRODE	MEDIUM 6-PIN	FIG. 15	5 1/8" x 2 1/16"	D-C HEATER	30.0	0.4	125	100	CLASS A AMPLIFIER	95 125	−20.0 −22.5	95 100	9.0 9.0	47.0 50.0	10000 10000	2800 2800	28 28	2000 2000	1.6 2.5	C - 48
RCA- 49	DUAL-GRID POWER AMPLIFIER	MEDIUM 5-PIN	FIG. 7	4 1/16" x 1 3/8"	D-C FILAMENT	2.0	0.120	135 180	— —	CLASS A AMPLIFIER □ CLASS B AMPLIFIER ♦	135 180	−20.0 0	— —	— —	5.7 Power output values are for 2 tubes at indicated plate-to-plate load.	4000	1125	4.5	11000 12000	0.17 3.5	C - 49
UX -250	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	6 1/2" x 2 1/16"	FILAMENT	7.5	1.25	450	—	CLASS A AMPLIFIER	300 400 450	−54.0 −70.0 −84.0	— —	— —	35.0 55.0 55.0	2000 1800 1800	1900 2100 2100	3.8 3.8 3.8	4600 3670 4350	1-6 3.4 4.6	CX-350
RCA- 53	TWIN-TRIODE AMPLIFIER	MEDIUM 7-PIN#	FIG. 24	4 1/16" x 1 3/16"	HEATER	2.5	2.0	300	—	CLASS B AMPLIFIER	250 300	0 0	— —	— —	Power output value is for one tube at stated load, plate-to-plate.				8000 10000	8.0 10.0	C - 53
RCA- 55	DUPLEX-DIODE TRIODE	SMALL 6-PIN	FIG. 13	4 1/32" x 1 1/16"	HEATER	2.5	1.0	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	135 180 250	−10.5 −13.5 −20.0	— —	— —	3.7 6.0 8.0	11000 8500 7500	750 975 1100	8.3 8.3 8.3	25000 20000 20000	0.075 0.160 0.350	C - 55
RCA- 56	SUPER-TRIODE AMPLIFIER DETECTOR★	SMALL 5-PIN	FIG. 8	4 1/4" x 1 3/16"	HEATER	2.5	1.0	250	—	CLASS A AMPLIFIER BIAS DETECTOR	250 250	−13.5 −20.0	— —	— —	5.0 Plate current to be adjusted to 0.2 milliampere with no signal.	9500	1450	13.8	— —	— —	C - 56
RCA- 57	TRIPLE-GRID AMPLIFIER DETECTOR	SMALL 6-PIN	FIG. 11	4 1/16" x 1 3/16"	HEATER	2.5	1.0	250	100	SCREEN GRID R-F AMPLIFIER BIAS DETECTOR	250 250	−3.0 −3.9	100 100	0.5 Cathode current 0.97 ma.	2.0	exceeds 1.5 meg. —	1225 Plate coupling resistor 250000 ohms. Grid coupling resistor 250000 ohms**.	exceeds 1500	— —	— —	C - 57

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.
Requires different socket from small 7-pin.
□ Grid next to plate tied to plate. ♦ Two grids tied together. **For grid of following tube.

RCA- 58	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL 6-PIN	FIG. 11	4 1/16" x 1 3/16"	HEATER	2.5	1.0	250	100	SCREEN GRID R-F AMPLIFIER MIXER IN SUPERHETERODYNE	250 250	(−3.0 min.) −10.0	100 100	2.0 —	8.2 —	800000 Oscillator peak volts = 7.0.	1600	1280	—	—	C - 58
RCA- 59	TRIPLE-GRID POWER AMPLIFIER	MEDIUM 7-PIN#	FIG. 18	5 1/8" x 2 1/16"	HEATER	2.5	2.0	250 250 400	— 250 —	AS TRIODE ¶ CLASS A AMPLIFIER AS PENTODE ** CLASS A AMPLIFIER AS TRIODE ♦ CLASS B AMPLIFIER	250 250 300 400	−28.0 −18.0 0 0	— 250 —	— 9.0 —	26.0 35.0 Power output values are for 2 tubes at indicated plate-to-plate load.	2400 40000	2600 2500	6.0 100	5000 6000 4600 6000	1.25 3.00 15.0 20.0	C - 59
RCA- 71-A	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 1/16" x 1 3/16"	FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	90 180	−19.0 −43.0	— —	— —	10.0 20.0	2170 1750	1400 1700	3.0 3.0	3000 4800	0.125 0.790	C - 71-A
RCA- 75	DUPLEX-DIODE HIGH-MU TRIODE	SMALL 6-PIN	FIG. 13	4 1/32" x 1 1/16"	HEATER	6.3	0.3	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	250×	−1.35	—	—	0.4	—	—	—	Gain per stage = 50-60		C - 75
RCA- 77	TRIPLE-GRID AMPLIFIER DETECTOR	SMALL 6-PIN	FIG. 11	4 1/32" x 1 1/16"	HEATER	6.3	0.3	250	100	SCREEN GRID R-F AMPLIFIER BIAS DETECTOR	100 250 250	−1.5 −3.0 −1.95	60 100 50	0.4 0.6 Cathode current 0.65 ma.	1.7 2.3 —	650000 1500000 —	1100 1250 Plate coupling resistor 250000 ohms. Grid coupling resistor 250000 ohms**.	715 1500	—	—	C - 77
RCA- 78	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL 6-PIN	FIG. 11	4 1/32" x 1 1/16"	HEATER	6.3	0.3	250	125	SCREEN GRID R-F AMPLIFIER	90 180 250 250	(−3.0 min.)	90 75 100 125	1.5 1.0 2.0 3.0	5.4 4.0 7.0 10.5	315000 1000000 800000 600000	1275 1100 1450 1650	400 1100 1160 990	—	—	C - 78
RCA- 79	TWIN-TRIODE AMPLIFIER	SMALL 6-PIN	FIG. 19	4 1/32" x 1 3/16"	HEATER	6.3	0.6	250	—	CLASS B AMPLIFIER	180 250	0 0	— —	— —	Power output value is for one tube at stated load, plate-to-plate.				7000 14000	5.5 8.0	C - 79
RCA- 85	DUPLEX-DIODE TRIODE	SMALL 6-PIN	FIG. 13	4 1/32" x 1 1/16"	HEATER	6.3	0.3	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	135 180 250	−10.5 −13.5 −20.0	— —	— —	3.7 6.0 8.0	11000 8500 7500	750 975 1100	8.3 8.3 8.3	25000 20000 20000	0.075 0.160 0.350	C - 85
RCA- 89	TRIPLE-GRID POWER AMPLIFIER	SMALL 8-PIN	FIG. 14	4 1/32" x 1 1/16"	HEATER	6.3	0.4	250	250	AS TRIODE ¶ CLASS A AMPLIFIER AS PENTODE ** CLASS A AMPLIFIER AS TRIODE ♦ CLASS B AMPLIFIER	160 180 250 100 180 250 180	−20.0 −22.5 −31.0 −10.0 −18.0 −25.0 0	— 100 180 250 —	— 1.6 3.0 5.5 —	17.0 20.0 32.0 9.5 20.0 32.0 Power output values are for 2 tubes at indicated plate-to-plate load.	3300 3000 2600 104000 80000 70000	1425 1550 1800 1200 1550 1800	4.7 4.7 4.7 125 125 125	7000 6500 5500 10700 8000 6750 13600 9400	0.300 0.400 0.900 0.33 1.50 3.40 2.50 3.50	C - 89
UV -199 UX -199	DETECTOR★ AMPLIFIER TRIODE	SMALL 4-NUB SMALL 4-PIN	FIG. 10 FIG. 1	3 1/8" x 1 3/16" 4 1/8" x 1 3/16"	D-C FILAMENT	3.3	0.063	90	—	CLASS A AMPLIFIER	90	−4.5	—	—	2.5	15500	425	6.6	—	—	C -299 CX-299
RCA-864	AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4" x 1 3/16"	D-C FILAMENT	1.1	0.25	135	—	CLASS A AMPLIFIER	90 135	−4.5 −9.0	—	—	2.9 3.5	13500 12700	610 645	8.2 8.2	—	—	C -864

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.
■ Either A. C. or D. C. may be used on filament or heater, except as specifically noted. For use of D. C. on A-C filament types, decrease stated grid volts by 1/4 (approx.) of filament voltage.
Requires different socket from small 7-pin.
** Grid #1 is control grid. Grid #2 is screen. Grid #3 tied to cathode.
¶ Grid #1 is control grid. Grids #2 and #3 tied to plate. × Applied through plate coupling resistor of 250000 ohms.
♦ Grids #1 and #2 connected together. Grid #3 tied to plate. **For grid of following tube.

RECTIFIERS

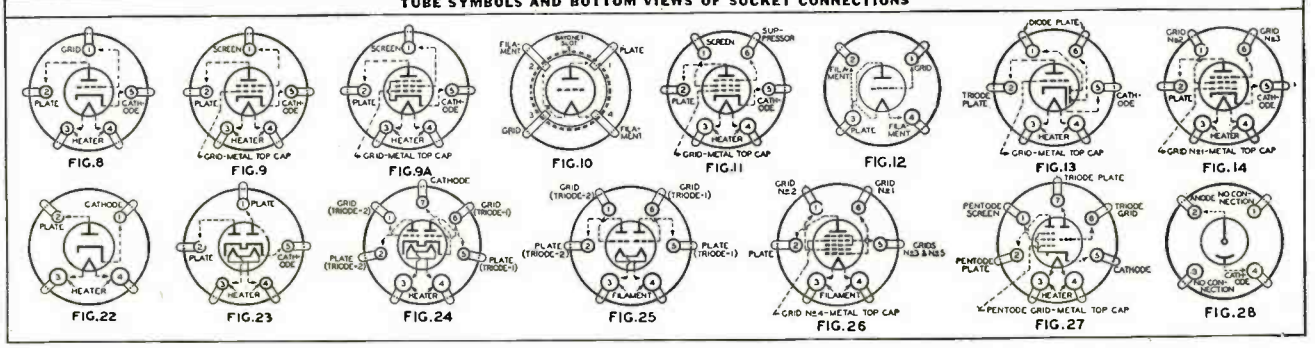
RCA-523	FULL-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 2	5 1/8" x 2 1/16"	FILAMENT	5.0	3.0	—	—	Maximum A-C Voltage per Plate 500 Volts, RMS Maximum D-C Output Current 250 Milliamperes	C -523
RCA-1223	HALF-WAVE RECTIFIER	SMALL 4-PIN	FIG. 22	4 1/4" x 1 1/16"	HEATER	12.6	0.3	—	—	Maximum A-C Voltage per Plate 250 Volts, RMS Maximum D-C Output Current 60 Milliamperes	C-1223
RCA-2525	RECTIFIER-DOUBLER	SMALL 6-PIN	FIG. 8	4 1/4" x 1 3/16"	HEATER	25.0	0.3	—	—	Maximum A-C Voltage per Plate 125 Volts, RMS Maximum D-C Output Current 100 Milliamperes	C-2525
RCA-1-V°	HALF-WAVE RECTIFIER	SMALL 4-PIN	FIG. 22	4 1/4" x 1 1/16"	HEATER	6.3	0.3	—	—	Maximum A-C Voltage per Plate 350 Volts, RMS Maximum D-C Output Current 50 Milliamperes	C-1V°
RCA- 80	FULL-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 2	4 1/16" x 1 3/8"	FILAMENT	5.0	2.0	—	—	A-C Voltage per Plate (Volts RMS) 350 400 550 D-C Output Current (Maximum MA.) 125 110 135 The 550 volt rating applies to filter circuits having an input choke of at least 20 henries.	C - 80
UX -281	HALF-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 3	6 1/2" x 2 1/16"	FILAMENT	7.5	1.25	—	—	Maximum A-C Plate Voltage 700 Volts, RMS Maximum D-C Output Current 85 Milliamperes	CX-381
RCA- 82	FULL-WAVE ▶ RECTIFIER	MEDIUM 4-PIN	FIG. 2	4 1/16" x 1 3/8"	FILAMENT	2.5	3.0	—	—	Maximum A-C Voltage per Plate 500 Volts, RMS Maximum D-C Output Current 125 Milliamperes Maximum Peak Inverse Voltage 1400 Volts Maximum Peak Plate Current 400 Milliamperes	C - 82
RCA- 83	FULL-WAVE ▶ RECTIFIER	MEGIUM 4-PIN	FIG. 2	5 1/8" x 2 1/16"	FILAMENT	5.0	3.0	—	—	Maximum A-C Voltage per Plate 500 Volts, RMS Maximum D-C Output Current 250 Milliamperes Maximum Peak Inverse Voltage 1400 Volts Maximum Peak Plate Current 800 Milliamperes	C - 83
RCA- 84 also #Z4	FULL-WAVE RECTIFIER	SMALL 5-PIN	FIG. 23	4 1/4" x 1 3/16"	HEATER	6.3	0.5	—	—	Maximum A-C Voltage per Plate 225 Volts, RMS Maximum D-C Output Current 50 Milliamperes	C - 84 also #Z4
RCA-866	HALF-WAVE ▶ RECTIFIER	MEDIUM 4-PIN	FIG. 16	6 1/2" x 2 7/16"	FILAMENT	2.5	5.0	—	—	Maximum Peak Inverse Voltage 7500 Volts Maximum Peak Plate Current 0.6 Ampere	C -866 (CX-366)

▶ Mercury Vapor Type. ° Interchangeable with type 1.

PHOTOTUBES

RCA-868	PHOTOTUBE	SMALL 4-PIN	FIG. 28	4 1/8" x 1 3/16"		Max. Anode Supply Voltage, 90 Volts. Max. Anode Current, 20 Microamperes. Static Sensitivity, 55 Microamperes per Lumen. Dynamic Sensitivity, 50 and 48 Microamperes per Lumen at 1000 and 5000 Cycles per second, respectively.	C -868

TUBE SYMBOLS AND BOTTOM VIEWS OF SOCKET CONNECTIONS



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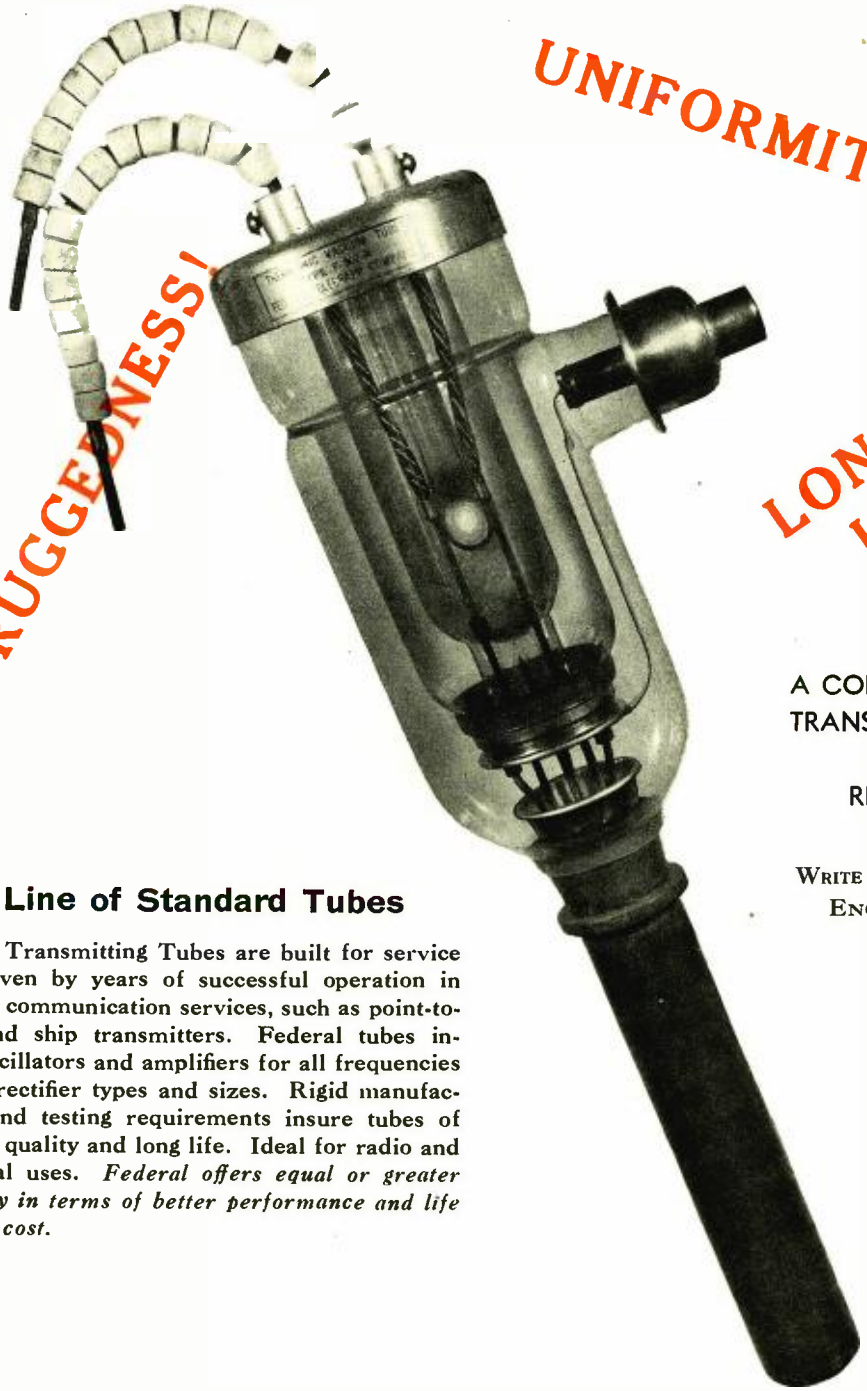

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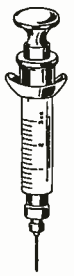

SEAMLESS tubing for the Radio Industry is now our Major Operation. This was not always so. In fact, Summerill's first service to industry was the production in quantity of seamless tubing for manufacturers who wished to escape the trials of machining their own tubes.

Shortly after the Company moved to Bridgeport in 1910 it succeeded in obtaining almost the entire hypodermic needle market, which it has since dominated.

Then came Radio. When pure nickel was found to be the most suitable metal for use in radio tubes the Radio Industry turned to Summerill because of its experience in producing small tubes.

Summerill's radio business grew to such an extent that in 1929 it represented the largest percentage of the Company's total output—its MAJOR OPERATION.

Now, as in 1929, the Radio Industry still consumes the bulk of the Company's business. However, in 1930, '31 and '32 Summerill perfected processes with the result that the price of radio tubing is far below what it was in '29. What is more important, due to the preparation made for increased demand, absolutely dependable schedules can be expected of Summerill.

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SUMMERILL

A chronological history of electrical communication —telegraph, telephone and radio

◆

This history began with the January 1, 1932, issue of RADIO ENGINEERING. The items are numbered chronologically, beginning at 2000 B.C., and will be continued down to modern times. The history records important dates, discoveries, inventions, necrology and statistics, with numerous contemporary chronological tie-in references to events in associated scientific development. The material was compiled by Donald McNicol.

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Part XXI

1890 (*Continued*)
(814) During the year fast-sending telegraph tournaments are held at Hardman Hall, New York, April 10; New Orleans, April 20, and St. Louis, June 10.
1891 (815) Paper insulated cables are introduced in land-line communication and lighting service.
(816) Polyphase motors and alternators are exhibited at the Frankfort, Germany, Exposition.
(817) The Strowger automatic telephone exchange system patented, March 10.
(818) Tesla delivers an important lecture before the A. I. E. E., New York, on polyphase electric transmission.
(819) Eduard Branley, in France, announces the discovery that the effect of electrical oscillations upon a body of metallic filings is to produce an increase in the electrical conductivity of the filings.
(820) W. R. Phelps, in New York, improves existing stock-ticker systems.
(821) Alexander Graham Bell is elected president of the A. I. E. E.
(822) A telephone line is opened for business between London and Paris.
(823) The Automatic Electric Company, Chicago, is organized, to manufacture automatic telephone systems.
(824) Arthur L. Dearlove establishes the duplex method of working on submarine cable lines of the Brazilian Submarine Cable Company at Lisbon, St. Vincent and Pernambuco.
(825) The H. Ward Leonard Electric Company is organized with works at Bronxville, N. Y.
(826) The Burnley dry-cell primary battery patented in January, 1890, is widely used for telephone and bell ringing purposes.
(827) The Bonus system of message handling is given a trial in the New York office of the Postal Telegraph-Cable Company.
(828) Perrett electric motors and dynamos are manufactured by the Elecktron Manufacturing Company, Brooklyn, N. Y.
(829) The Standard Underground Cable Company, Pittsburgh, Penna., manufactures duplex electric light cables, lead covered; also 50-conductor, lead-covered telephone cables.
(830) Queen and Company, instrument makers, Philadelphia, Penna., produce a new line of alternating-current and direct-current ammeters and voltmeters.
(831) Willoughby Smith dies. (Born in England 1828.)
(832) Wilhelm Weber dies. (Born in Germany 1804.)
(833) In the St. Louis, Mo., main office of the Western Union Telegraph Company dynamos are installed to replace primary batteries for line and instrument operation.
(834) George G. Ward is elected vice-president of the Commercial Cable Company.
(835) The International Brotherhood of Electrical Workers organized at St. Louis, Mo., November 28.
(836) H. Ward Leonard invents a multiple-voltage control system.
1892 (837) Professor George Forbes, of Edinburgh, suggests that the Branley filings tube will respond to the action at a distance of Hertz' waves.
(838) Cyrus W. Field dies. (Born United States 1819.)
(839) Frank J. Sprague is elected president of the A.I.E.E.
(840) Samuel Insull becomes president of the Chicago Edison Company, Chicago.
(841) Werner Von Siemens dies. (Born Germany 1816.)
(842) Arthur Vaughn Abbott is appointed chief engineer of the Chicago Telephone Company.
(843) The General Electric Company is established, combining the Edison General Electric Company and the Thomson-Houston interests.
(844) The Electrose Manufacturing Company organized, Louis Steinberger, president.
(845) Toll telephone service is inaugurated between New York and Chicago, October 18.
(846) The Society for the Promotion of Engineering Education founded.
1893 (847) Thomas T. Eckert becomes president of the Western Union Telegraph Company, February 13. (Remained in this position until March 12, 1902.)
(848) A telegraphers' fast-sending tournament is held in Hardman Hall, New York, March.
(849) The attorney general, in behalf of the United States Government, begins suit in Massachusetts asking that Berliner's telephone patent No. 463,569 of 1877, be set aside.
(850) E. J. Houston is elected president of the A.I.E.E.
(851) Gilbert's early electrical writings embodied in his work "De Magnete" are translated into English by P. Fleury Mottelay, of New York.
(852) A three-phase, 2,600 volts, electric power transmission line is built in California, over a distance of eight miles.
(853) The Crocker-Wheeler Company establishes works at Newark, N. J.
(854) The first electric motor-driven roller table is installed at the Homestead, Penna., mills of the Carnegie Steel Company.
(855) Herbert C. Jackson, in England, and Professor Lenard, in France, experimenting with electric discharges in rarefied air and gases, make discoveries which later lead to the discovery by others of X-rays.
(856) On December 26, N. Tesla procures U. S. patents 511,559 and 511,560 covering the invention of a system of electric transmission of power. These patents cover what is known as the "split phase" inventions of Tesla. Patents assigned to the Westinghouse Electric and Manufacturing Company. Patent applications filed December 8, 1888. (In later years these patents were the subject of a considerable amount of litigation in which Tesla's claims were ultimately sustained.)
(857) Thomas E. Morford is granted a U. S. patent (No. 490,034) for an electric heater using enameled wire resistor units. Application filed 1891.
(858) The Fibre Conduit Company, Orangeburg, N. Y., organized.
(859) Moses G. Farmer dies. (Born United States 1820.)
(860) Direct-current arc lighting systems now in operation in America are operated at 5,000 volts, 125 lights per station unit.

(To be continued)

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●

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RADIO ENGINEERING

FOR SEPTEMBER, 1933

— As the Editor Sees It —

THE next few months are crucial ones, not only for the radio and associated industries but for all industry. It is during that time that the complete working out of code operation will take place.

An industry which hopes to get the full benefit of the recovery program must arrange to adjust itself to the trend toward economic planning. If it does not do so, it may find itself at a disadvantage in competing with industries more forward-looking and aggressive, which in the process of looking out for their own futures may inadvertently step on the toes of some related industry. The radio industry, working under the NEMA code, still faces many problems. The solution of many of these problems will be found before the end of the year.

It is extremely important that we keep before us continually the picture of the radio industry as a whole in its competitive position. We are competing as an industry for the leisure time of the general public. There is no doubt that over the past two years the quality of radio reception, as far as the general public is concerned, has been lowered. If there is a falling off in the quality of reproduction from the individual receiver, consciously or sub-consciously, it is recognized by listeners who drift away to other forms of recreation. In a general way we are competing with the theatre, movies, all athletics, night clubs, games, and scores of other forms of entertainment.

In meeting this general industry competition the important factors of product improvement, engineering refinements and research must be matched to a program of intelligent promotion, forceful selling, consumer education and service. It is distinctly encouraging to note that where the engineering personnel of the industry for the past two years has been employed for the purpose of lowering costs, cheapening quality and working down to a price—that to day in many quarters, an increased or reinstated engineering personnel is engaged in the development of improved radio products of all kinds. Within the next few months this change will be observable by all.

The absorption by the public of the products of the radio industry, with its immense productive capacity, can be had only upon the basis of continual "progressive obsolescence." Sustained engineering and research activity is essential to the maintenance of volume sales. During these next few months it behooves the forward-looking manufacturer to move cautiously, but aggressively, with full consideration given to the importance of performance value, technical refinements, material improvements and the resulting increase in the public's time which can and will be given to an improved quality of reception.

Already we are having a foretaste of what is to come although, of course, the advancements have been more in the way of eye value appeal than along the lines of technical improvement, the latter, of course, requiring more time and preparation. Many novelty receivers have recently been released—sets sold in quantities to manufacturers for advertising use, pocket receivers, receivers in bars, beer kegs, remote control speakers, etc.—products which cater to specific or specialized demands.

And let's not overlook the opportunities for increased export sales. The social and economic upheavals in foreign nations seem to be paving the way to a better living standard for the nationals of these various countries. In the immediate offing we have the economic conference with the South American countries, with every prospect of resulting favorable trade agreements. The position of the American dollar in foreign exchange is a self-evident aid to securing a larger proportion of the world's radio purchases. International loans, made upon the strict understanding that the money is to be spent for American products, will, directly or indirectly, help to finance increased purchases of radio from this country. The next two years should see a material increase in our radio shipments to foreign shores.

At this moment the general feeling throughout the radio and associated industries is distinctly one of optimism, which we believe is entirely justified. Cut-throat competition is disappearing, and increased markets are in the offing. The outlook today for the legitimate manufacturer is decidedly favorable.

THE EXTERNAL LOUDSPEAKER and the MINIATURE RECEIVER

By Barnet S. Trott*

WHEN the miniature or so-called cigar-box receiver first made its appearance it was looked upon with scorn by the more conservative radio manufacturers. The first models of this type of receiver were 4-tube t.r.f. sets using a small magnetic speaker and utilizing such tubes as were then available. The sensitivity was poor, the selectivity wretched and the "tone quality," if it could be called such, miserable. Though interesting as examples of ingenuity the less said about their performance, the better.

However, the small size, attractive appearance, portability and novelty of these receivers, together with the a-c.—d-c. feature, appearing just before the Christmas season, seized upon the public imagination. By the middle of January, every wide-awake manufacturer had either a set of this type in production, or in the laboratory. The tube engineers, always on their toes, came forward with better tubes and tubes serving dual purposes, and in some cases triple functions, specially developed for a-c.—d-c. service at low voltages, so that seven or eight tube performance was obtainable with five tubes.

With the advent of high current output rectifiers, it now became possible to utilize dynamic speakers, which though in general insufficiently energized, contributed a considerable improvement in tone.

At a low price and in a space hardly greater than that occupied by the original 4-tube t.r.f. sets, there are now available five or six tube superheterodynes, with excellent gain and selectivity, equipped with avc tone control and wave band switches for listening in on police calls, airports and amateurs, and housed in beautiful cabinets of metal, moulded Bakelite, or contrasting woods; in fact everything that can be desired in a radio set except a high degree of fidelity.

Within the last few months, there has been considerable discussion regarding the use of external plug-in speakers with 8 or 10 inch cones, with fields adequately excited from a separate power source, and mounted on baffles of sufficient area to permit of a high degree of fidelity contributed by increased bass response, and the ability to handle more power. Thus the control mechanism, housed in its small artistic cabinet, may still be placed on a table alongside the favorite arm-chair or on the book shelf, without sacrificing any of its advantages. It still may very readily be carried from room to room or be taken away for the week-end, as a complete self-contained a-c. or d-c. receiver.

The external plug-in speaker may be mounted in an attractive piece of furniture which serves some other usual function as well, such as a secretary desk or end table.

Though permanent magnet dynamic speakers have been used to some extent, they are expensive and their performance is not comparable to that of a good electromagnetic type of dynamic speaker. With the latter type, used in a housing separate from that of the receiver itself, an additional consideration presents itself. Since this speaker is separately excited from a copper oxide or a tube rectifier it becomes desirable to have some means of turning the power for this device on and off without having to cross the room and manipulate another switch. Furthermore, a pilot light with its attendant complications would be necessary to remind the listener to turn the device off when through listening.

Where the speaker plugs into the plate circuit of the output tube, in place of the small self-contained speaker, a means of overcoming this difficulty readily suggests itself. The d-c. component of the plate current of the power tube, usually a 43, which is of the order of 20 milliamperes, is sufficient to operate a simple and relatively rugged relay in series with the transformer primary. This may be placed adjacent to the speaker. The a-c. component may be adequately by-passed by an inexpensive low-voltage dry electrolytic condenser of the order of several microfarads so that no loss of the audio component is sustained here. The d-c. drop through the relay is inconsequential. This arrangement is illustrated in Fig. 1.

Another possibility is to utilize the leakage flux of the output transformer itself to actuate the relay arm, so that no additional coils are required, or any additional parts other than the armature with its contact. This is built in as an integral part of the output transformer assembly as indicated schematically in Fig. 2. While it is true that the plate current fluctuates somewhat with an overload condition existing, this fluctuation is relatively small and with proper design of the armature system, no chattering should result.

With either of these arrangements, the extension

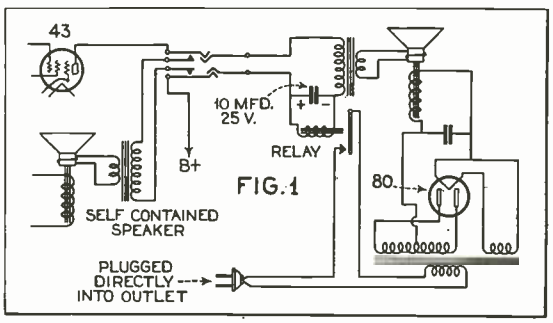

Fig. 1.

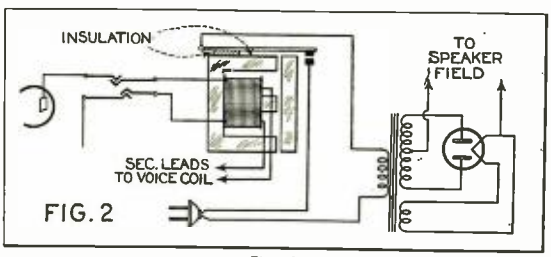

Fig. 2

* *Chief Engineer, Garod Radio Corporation of N. Y.*

cord is a simple two wire cable, with the external speaker plugged directly into a convenient outlet. With a jack provided for plugging into the plate circuit of the output stage (Fig. 1) no additional wiring is required and no extra switches need be used. Inserting the plug and turning the radio set on, switches on power for the speaker field without any further manipulation.

The miniature radio set is now capable of good sensitivity and selectivity as well as good bass response. With the low plate voltage available for the operation

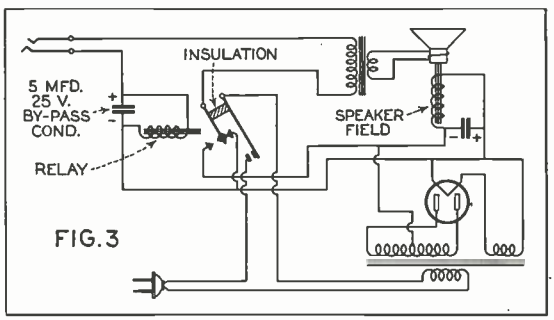

Fig. 3.

of the output tube, the power supplied to the speaker is limited to about one watt when a 43 type tube is used, and even at this level, considerable distortion is noticeable due to the presence of a fairly high harmonic content which is more or less characteristic of all pentode output tubes. In a portable receiver, this is not considered of any great importance where adequate power output is paramount and due to the limitations of the small speaker with its inadequate baffle, any improvement here would go unnoticed. In the home, with the large external speaker, this distortion becomes more apparent. While, it is true, a power output of one watt is generally more than ample for the average room, still, under certain conditions, a greater power output is desirable.

With the common use of diode detection, the output tube generally overloads long before the detector tube. It seems a pity, therefore, that in the search for high quality in home radio reception, we should stop at this point. Since a power supply device consisting of a rectifier and filter of some sort are needed to excite the field for the extension speaker, it becomes a simple matter at only a small increase in cost to include an output stage consisting of one or more pentodes (41's, 42's or 2A5's) operating at full rated plate voltage (250 volts) or better still, one of the new high output triodes (2A3) or preferably a pair of them in push-pull, operating out of the amplifier portion of the dual function detector amplifier tube. With such an output stage and a good loudspeaker, no apologies need be offered for the performance of a well-designed miniature receiver.

Still another possibility, if the increased cost is not warranted, is to utilize the voltage supply for the speaker field (about 100 volts) or a portion of it to boost the plate volage of the output tube. This changeover may be accomplished by adding an additional insulated contact to the relay of Fig. 1, so that when the relay is energized by the plate current of the 43 tube, the speaker field is thrown in series with the "B" supply of the miniature set, the voltage across it, or any portion of it, which may be tapped off, is added to the available plate voltage. (Fig. 3.)

The output of a 43 type tube increases from 0.90 watt at 100 volts to 2.00 watts at 135 volts. Thus a considerable improvement in operation can be obtained at only a slight increase in cost.

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The Relation of Engineering to the Radio Industrial Code

By
Dr. Lewis M. Hull
President, Institute of Radio Engineers

◆

AMERICAN radio manufacturers are now operating under a "Code of Fair Competition for the Electrical Industry" which was approved by President Roosevelt on August 4. In the necessarily broad regulations thereby established for this highly ramified industry there is no formal recognition of that select class of professional laborers to whose creative effort the principal commodities of every radio manufacturer owe their origin. There exists, nevertheless, a vital connection between the corporate welfare of every radio manufacturer and the productivity of his engineering employees. Unless the teachings of industrial history are mockery, the radio industry will be distinguished for years to come by an essential dependence upon inventive thought, both technical and artistic. Periods in which this industry has provided large employment for labor and legitimate return on invested capital have always been preceded by exceptionally productive engineering activity. The recurrence of this sequence has been too consistent to suggest anything but a causal relation.

A choice is now presented squarely to all radio engineers and their employers: whether to revive conditions favorable to *inventive* engineering efforts or to continue with price-lowering as the main objective of engineering thought. Such a revival would provide sufficient centrifugal force to throw the industry out of the vicious competitive circle in which it is now spinning. Competition in ideas, rather than competition in prices, is still a sane and profitable activity. Furthermore, this revival of creative engineering is the most direct means of reconciling the Government's requirement of sustained highly-paid employment with that renewed effectiveness of invested capital which is vital to the industry. Recognition of this principle is an obligation to be shared alike by engineers and by their employers, in striving toward that rehabilitation of the industry which we all confidently anticipate.

A COMPLETE BROADCAST STUDIO

By P. S. Gates *

THE modern broadcast station today is decidedly different from that of yesterday in practically every phase of its operation.

Several years ago the broadcast engineer saw the feasibility of eliminating the use of batteries in the radio frequency and modulator portions of the transmitter and substituting in their place either generators or tube rectifying equipment, which resulted in increased economy and better stability of operation. However, due to the low current drain and low voltage required for the operation of speech amplifiers, condenser microphones and other associated equipment in connection with broadcast studios, broadcasters were slow to change to rectifying equipment in this department of the equipment.

Also, due to the fact that in the majority of cases the output of the studio amplifier is amplified many times before reaching the antenna, it has been until recent months the general concensus that unless a great investment was made in rectifying equipment and new design speech amplifying equipment, that the alternating-current hum could not be reduced to a satisfactory level to bring about high quality transmission. Hence, until only a short time ago the complete a-c. operated studio equipment was found only in the larger stations, and even at this time some of the largest stations in the country use battery supply in certain parts of the complete installation.

Fig. 1 illustrates the complete a-c. operated broadcast studio of Station KUOA, Incorporated, of Fayetteville, Arkansas. The studios of this station had been destroyed by fire and, of course, when designing their new studios they were desirous of having the entire outlay of equipment without any batteries, whatsoever. Consequently, the model 3205D speech input amplifier was chosen. This amplifier uses the conventional high quality three-stage circuit, having the vacuum tube type level indicator self-contained in the amplifier proper. Directly below the amplifier is found the meter test panel for testing the plate current on the amplifier tubes, as well as the carbon microphone current when carbon microphones are used and below the meter test panel will be found the four-channel mixing panel. This mixing panel has four channels which will handle either carbon or condenser type microphones, each channel being fully equipped with transformers, current adjusting and testing equipment for carbon microphones. Constant impedance T pad mixing controls are used and these controls are so wired into the circuit that no change in output level is had when channels are added or taken from the circuit by means of the channel switches directly above the mixing controls.

Below the mixing panel will be found the filament rectifier, which will be discussed somewhat in detail, due to the fact that the copper oxide rectifier has been a subject of discussion both pro and con for many years. The early type of rectifier used a chemically treated copper plate with the elements driven in one direction so that when alternating current was applied to this plate it could travel but in one direction, hence resulting in a fair measure of direct-current output. This was known as the electrolytic principle and the output waveform of direct current was not as straight as could be desired and it had the added disadvantage that as the element aged, the voltage, current output and waveform deteriorated in efficiency and in the case of the waveform, uniformity.

However, in recent years a new type of copper oxide rectifier has been developed by Dr. L. O. Grondahl, which basically is a sheet of copper with a layer of cuprous oxide. Rectification takes place between the oxide and the mother copper, hence it can be seen that the element operates electronically, and not electrolytically. Life tests have shown as much as six years of satisfactory results with little or no deterioration.

The design of the filtering portion of the rectifier, of course, depends entirely upon the voltage output of the rectifier. In the case of the 3205D speech input rack, the output voltage required is 6 volts at 3½ amperes, hence the filtering condensers need not have as high a working voltage as would be required with speech input amplifiers requiring a 12-volt filament supply. A total of 16,000 mfds. of filter are used in connection with two .6 henry choke coils. The choke coils have a d-c. resistance of one twelve hundredth ohm and, of course, are able to carry about 25 per cent more current than the normal operating requirements.

The a-c. supply transformer has a tapped secondary ranging from 10 to 16 volts, so that adjustments can be made for either low or high line voltage. The usual rheostat voltmeter and other desirable accessories are incorporated to complete a rectifier for filament supply purposes that is equivalent in every respect to that of

Chief Engineer Gates Radio & Supply Company.

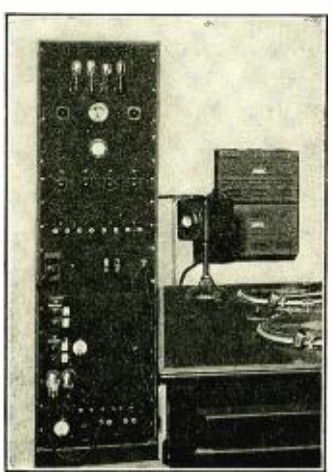

Fig. 1. A-C. operated studio station KUOA.

INSTALLATION FOR A-C. OPERATION

storage battery supply, and has the desirable advantage that it is clean, requires no maintenance, and because of the low voltage output of the transformer used in the filament rectifier, little or no difficulty is encountered with induction hum, even when the rectifier is placed close to the adjacent equipment.

The bottom panel is the plate and bias rectifier, which is conventional in design to any good rectifier to develop a ripple content of .25 per cent or lower. As the design of suitable rectifiers of this type has been discussed in previous issues of RADIO ENGINEERING, and the design of this rectifier is very similar, it will not be discussed in detail other than to say that the rectifier incorporates large capacitors to eliminate any trace of alternating-current hum, and due to the high voltage output of the rectifier, the parts are carefully placed to prevent any induction pickup between it and the other adjacent equipment on the rack. Jacks are provided for testing each plate and bias voltage, and a voltmeter is also incorporated in connection with a cord and plug for testing each voltage.

All of the lines running between the various units on the rack are run in heavy shielded cable and the input circuits are segregated and run through a separate cable to those of the output and alternating-current lines. This is not all absolutely necessary where the cables are shielded, but it is done as a precaution.

The a-c. input connections and output are terminated at the bottom rear of the rack through standard conduit outlet boxes, and dust covers are then mounted on the back as a complete protection, as well as shield, both mechanically and electrically to the equipment. It is preferable to ground the rack, especially where it is in the field of the transmitter.

In Fig. 1, directly to the right of the rack assembly will be found mounted on the wall the two rectifiers for supplying current to the condenser microphones. The top rectifier is the filament supply rectifier, which will supply 1½ amperes or adequate current for six condenser microphones. It is very similar in design, only in smaller proportions, to the filament rectifier on the rack, and is supplied with voltmeter and rheostat so that the voltage may be adjusted to the correct amount as microphones are added, or taken from the circuit.

The plate supply rectifier for the condenser microphones takes advantage of the new type 25Z5 tube, which is a voltage doubler tube and delivers a maximum of approximately 220 volts, which is adjustable by means of a variable bleeder strip across the output of the rectifier, giving a variation from 170 to 220 volts. A second control is also provided for microphones requiring an intermediate voltage for the amplifier tubes. This is variable from 90 to 167½ volts. The rectifier incorporates a total of 56 mfds, of capacitors in connection with the usual filter circuit. Due to the fact that the 25Z5 tube is a voltage doubler tube, grounding of the microphone filament supply, when necessary, must be done through a 1 mfd. condenser or larger, that is, the condenser must be inserted between the ground and the rectifier, proper. The complete design of a plate rectifier for condenser microphones will be discussed in a succeeding issue of RADIO ENGINEERING.

Fig. 2. Transcription equipment.

On the transcription desk will be found the type B Gates condenser microphone and the transcription unit is a standard VB-105 assembly altered to fit into an ordinary desk as shown in Fig. 2.

The complete setup offers operation without the use of batteries in any form. The filament rectifier on the 3205D speech input rack supplies current for the carbon microphones on the mixing panel, while the rectifiers discussed in the above paragraphs supply complete current to the several condenser microphones used in the studio.

All broadcast stations that have installed modern speech input equipment for alternating-current operation throughout have agreed that their service has been improved one hundred per cent as the periodical noises which naturally develop from worn batteries were completely eliminated, the confidence in the stability of operation was increased in the opinions of the control engineers, and the cleanliness of the operating room and the convenience of having no batteries to contend with have been expressed by several as, alone, worth the investment in new a-c. operated apparatus.

From the standpoint of economy a-c. operated equipment is decidedly an advantage. The average broadcast station is required, when using storage batteries, to replace them once every twelve to eighteen months due to the moderately heavy drain and continued charging required. Dry batteries naturally require replacing at certain specified intervals and broadcast stations desiring to supply a high grade of service at all times usually replace these batteries before they reach the point of noisy operation.

The average broadcast manager will readily agree, if he has had occasion to check battery cost and current cost for charging batteries, that his expenditure in this particular has ranged from seventy-five to two hundred dollars a year, even in the average size station. The complete a-c. operated studio setup as described consumes approximately 300 watts, which is far less than the current consumption of the battery charger required in the average radio station, and would effect an expenditure of approximately four dollars a month for power to operate the equipment in a station operating from ten to twelve hours a day. Hence, it can be seen that the station working toward the goal of economy can have economy as well as increased efficiency by changing its studio equipment for complete a-c. operation.

A New and Practical Multi-Vibrator

By Samuel S. Egert and Samuel Bagno*

ALTHOUGH our modern multiple pronged tubes have been conceived principally for their uses in broadcast receiver design, they have as well opened paths leading to a wide variety of uses to which they are applicable in the laboratory. It is the intention of the authors to demonstrate one of these uses and also to incorporate the following in this paper.

(1) Describe the relaxation type of multi-vibrator; interpret the factors upon which their action depends, and demonstrate their weaknesses and limitations.

(2) Describe a practical method of obtaining a multi-vibrator effect by using a multi-pronged tube such as the 78, and to demonstrate the advantages of this method when compared to the relaxation type of vibrator.

Almost everyone who has had experience with the relaxation type of multi-vibrator will admit that the latter is subjected to temperamental tendencies all their own. A careful analysis of a conventional circuit of this type (Fig. 1) will show why this is so.

Here a self-induced oscillatory action is created in tubes 1 and 2 by feeding part of the induced signal from the plate of tube 2 back to the grid of tube 1. The frequency of this action is dependent on the values of the characteristics of the tubes, coupling condensers and resistors. Deriving this condition from the values known in order to analyze the resultant factors we obtain:

$$Ep_1 = \frac{Eg\ \mu_1\ R_2}{Rp_1 + R_2} \qquad I_1 = \frac{C_1\, dEp_1}{dt}$$

$$Ep_2 = \frac{I_1 R_3 \mu_2 R_4}{Rp_2 + R_4} = \frac{C_1 \dfrac{dEp_1}{dt} R_3 \mu_2 R_4}{Rp_2 + R_4}$$

also

$$I_2 = \frac{C_2\, dEp_2}{dt}$$

$$I_2 R_1 = Eg_1 = \frac{C_2 R_3 \mu_2 R_4}{Rp_2 + R_4} \frac{d^2Ep}{d^2t}$$

but

$$Ep_1 = \frac{Eg_1\ \mu_1\ R_2}{Rp_1 + R_2}$$

Therefore:

$$Eg_1 = \frac{C_1 R_3 \mu_2 R_4 \mu_1 R_2 C_2}{(Cp_2 + R_4)\ (Rp_1 + R_2)} \frac{d^2Eg_1}{dt^2}$$

This is a differential equation of the second order whose solution is:

$$Eg_1 = K_1 \sin\left(\sqrt{\frac{C_1 R_3 \mu_2 R_4 \mu_1 R_2 C_2}{(Rp_2 + R_4)\ (Rp_1 + R_2)}}\ t + \Theta\right)$$

where K_1 and Θ are two arbitrary constants, depending on the initial conditions at the start of oscillation.

This derivation assumes that the tubes are linear over their infinite range, and that the capacitive admittance is negligible in comparison to the leakages of the various resistors.

Neither of these assumptions is strictly true and the actual result will probably be far from the calculated value. Nevertheless, the formula demonstrates the factors that determine the frequency, and the tube constants involved are very important parameters.

μ_2, μ_1, Rp_2 and Rp_1 are the factors involved. Herein lies the weak spot of multi-vibrators of this type as tube characteristics are known to change with age and also with battery voltages. While aging the tubes in the circuit, constant resetting of the capacity C_1 and careful inspection of battery voltages are imperative for with a change of the above demonstrated values, vibrators of this type have the very annoying habit of skipping ahead an entire sub-harmonic. When a vacuum tube burns out, and it becomes necessary to go through the entire

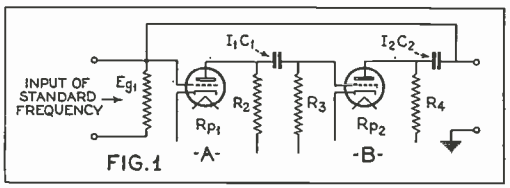

FIG. 1

Fig. 1.

process of aging again, one can appreciate that the foregoing is not only costly but is also a very trying and uncertain method of tying into a standard oscillator in order to obtain a known sub-harmonic of that frequency, especially so when the above described aging process necessitates from two to three months of constant observation.

In similar manner it can be demonstrated that the above derivations also hold true in relaxation circuits employing both neon or thyratron tubes.

With the recent issuance of the type 78 tube the authors have endeavored to ascertain the practical advantages of employing the three grids of this tube in an electronic tie-in circuit. It has been found that an electronic tie-in between a definite pre-determined frequency and any harmonic or sub-harmonic of that frequency is possible over a sufficiently wide band, to make this characteristic extremely useful in order to obtain a

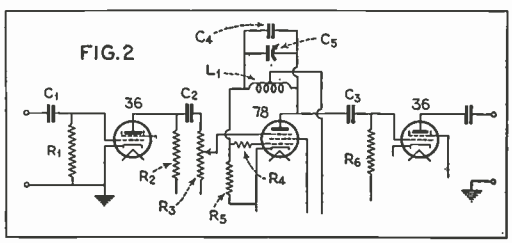

FIG. 2

Fig. 2.

Wireless Egert Engineering, Inc.

multi-vibrator effect. Also it has been found that this effect could be employed in a circuit which would minimize, to a great extent, the disadvantages encountered in the relaxation type of multi-vibrator.

Fig. 2 shows a diagram of the general arrangement of the circuit employed. The standard frequency is fed into the input posts, amplified by the first type 36 tube and impressed across the external connections of the potentiometer R_3. The necessary voltage to accelerate the desired action is tapped off by the moving arm of the potentiometer and impressed on the suppressor grid of the type 77 tube. Incidentally, this voltage is not critical. The remaining elements of the 77 tube are employed in an independent series fed Hartley circuit operating at a pre-determined sub-harmonic of the introduced frequency. By varying the capacity C_5 the frequency of the independent circuit can be adjusted until it ties in with the standard frequency. The resultant signals are then amplified by another 36 tube. Analyzing the tie-in circuit we can see the following:

Fig. 3 shows a curve of the suppressor-grid voltage E_{G3} against mutual conductance. It can be seen that the incoming standard frequency changes the G_m of the 78 tube and makes it sensitive at definite time intervals, depending on the voltage of the incoming standard frequency. Fig. 4 shows a curve of Eg against Ip which demonstrates the action of the independent oscillator circuit. By inserting R_4 in Fig. 2, the grid is biased so that on the positive cycle the tube is insensitive.

By arranging the biases of the two grids, the sensitive portion of both waves can be made to operate on the same part of the cycle. In this manner the tie-in effect of the standard incoming frequency and of the independently generated sub-harmonic can be accentuated to a great degree.

In a practical example of the above it has been demonstrated that employing a 50 kc. oscillator as the standard frequency and using 10 kc. as the independent sub-harmonic generated, the 10 kc. oscillator tied in with the 50 kc. standard within 1000 cycles of zero beat. This tie-in factor of 1000 cycles either side of zero beat allows for ample variance of the 10 kc. oscillator. As it is not very difficult to construct an oscillatory circuit which will stay within 200 cycles (2 per cent) when operating at 10 kc. it can be seen how really practical this unit can be.

Coupled with this accentuated tie-in effect, it can be seen that the independent oscillatory circuit is truly independent in the sense that it does not depend on the incoming frequency to determine its action, unless it is at some sub-harmonic reasonably close to the standard frequency. By placing a dial on the variable

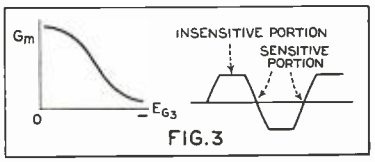

Fig. 3.

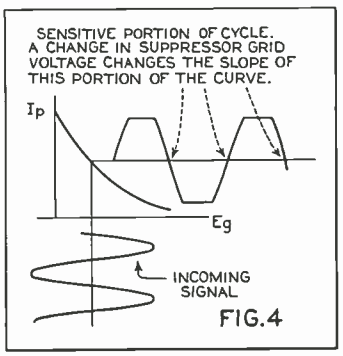

Fig. 4.

condenser C_5 it is possible to calibrate the sub-harmonic desired and to be sure that this point of calibration will truly represent that definite sub-harmonic at all times.

Also, in conclusion, note that it is possible to obtain a wide variety of known sub-harmonics of the introduced frequency by means of changing the capacity of the fixed condenser C_4 coupled with the variable condenser C_5.

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RMA Secures More Freight Rate Reductions

FURTHER and substantial reductions in freight rates on receiving sets have been secured by the RMA. The reduced rates, effective August 31, are estimated to effect annual savings, on freight charges, to receiving set manufacturers of from $250,000 to $400,000 annually. This follows freight rate reductions secured by the Association amounting to about $1,500,000 annually two years ago.

The new freight savings on receiving sets, on which the RMA traffic committee and W. J. M. Lahl, traffic manager, have been working with the carriers' classification committee for several months, are effective in reductions now ordered in minimum carload weights. Effective August 31 minimum weight on console type sets, in carloads, will be reduced from 18,000 lbs. to 16,000 lbs. Very few shippers can load the present minimum rates and are being penalized for excess charges. The same reductions will apply on combined radio and talking machines in carload lots.

On mixed carloads minimum weight will be reduced from 24,000 lbs. to 20,000 lbs. There will be no change in the rating and the present second-class rating will apply on both console sets and combined articles, in carload quantities; also, the present third-class rate will be retained on mixed carloads.

In addition to the above reductions in minimum carload weights, the RMA secured a reduction in the less-than-carload rating on other than console type sets from one and one-quarter times first-class rate to the first-class rate.

The above reductions mean a saving to set manufacturers of $25.05 in the minimum charge per car between Chicago and New York City, for example. On console type sets and on mixed carloads there is a difference of $42.40 per car. On box type sets in less-than-carloads the saving in freight rates is 38 cents per hundred pounds.

ARMSTRONG "FEEDBACK" DECISION RENDERED

THE invention of no other element of modern radio has had such shuttling back and forth in the courts as has that of the feedback or regenerative circuit arrangement. The decision rendered toward the end of August by the United States Circuit Court of Appeals for the Second Circuit, returns the honors to Major E. H. Armstrong, of New York.

Throughout the decade following the year 1914, Major Armstrong was the legally recognized inventor of the regenerative system. Then, in 1924, the courts decided that Dr. Lee de Forest was the original inventor. From the legal viewpoint explanation of reversals of court decisions takes into consideration whether in particular court actions the question to the fore is infringement, priority, or original invention. Evidently court actions may be prosecuted on any of these scores without prejudice to the others.

The latest decision in this historical controversy hinged upon a suit brought against a manufacturer of radio receivers and transmitters, by the de Forest Radio Company, the A. T. & T. Co., and R. C. A. In this case the plaintiffs charged infringement of de Forest's patent covering regeneration.

Notwithstanding that Armstrong sold his invention to R. C. A., he supported the receiver manufacturer, the defendant in the recent suit, in his defense action, recognizing the opportunity to again present the question of priority, with new evidence. Naturally, the plaintiffs cited the Supreme Court decision of ten years ago, but the majority opinion of the judges of the Court of Appeals was that the present action had no relation to the matter of the previous Armstrong-de Forest case.

Majority Opinion

In the majority opinion, Judge Chase, of the U. S. Circuit Court of Appeals, states, in part:

"On the merits the decisive question of fact is the same as it was in Armstrong et al v. de Forest Radio Telephone and Telegraph Co., where the matter was considered carefully in this court and Armstrong found to be the first inventor. Had the district judge been of the opinion, as we are, that the decision of the Supreme Court was based on questions of law not here involved he would not have confined his consideration of the evidence to deciding whether or not any new proof was present which would have led the Supreme Court to reverse instead of affirm. On the contrary he would have entered a decree for the defendant on the authority of Armstrong's discovery of the hitherto unknown existence of radio frequencies in the plate circuit and the regenerative feedback of these frequencies to the grid circuit gave the necessary novelty to the invention; that the work of de Forest in 1912 did not disclose these essential facts to him or to any one else; and that the contrary results which have been reached on the facts have been due to a divergence of opinion as to what really was the invention. If when de Forest discovered audio frequencies in the plate circuit when he was trying to perfect his telephone repeater in 1912 the presence of radio frequencies in that circuit was to be taken as a matter of course; the note book entries of Van Etten may be read in that light and stretched to cover Armstrong's invention. That such a thing could be so obvious in 1912 seems impossible because of the then uncertain state of the art, and because de Forest, a recognized genius in the field, could hardly have made such a discovery without promptly taking steps to protect it. That he did not is highly significant and leaves the claims he advanced after Armstrong's discovery became known faced with the inconsistency of his own inaction."

The patents involved in this suit are Armstrong's No. 1,113,149 granted October 6, 1914, and those granted to de Forest by decision, September 2, 1924; numbers 1,507,016 and 1,507,017, the former the oscillating audion patent and the latter the feedback circuit patent. The latter was the original de Forest-Logwood patent No. 1,170,881 of February 8, 1916.

Commenting on this latest decision Major Armstrong says: ". . . the decision handed down by Judge Chase is a tribute to the memory of the late Judge Julius Mayer, who tried this case and decided it correctly when it was first presented more than ten years ago, and whose decision, affirmed at the time by the Circuit Court of Appeals in an able opinion by Judge Manton, has now been reaffirmed in this case, where every fact found in the previous decisions has been re-proved."

Life of Patent

The patent control over the use of feedback or regenerative systems in radio, gained by de Forest in 1924, would have continued in force until the year 1941. At the present time most short-wave receivers, and many radio transmitters, employ the feedback principle.

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Broadcast Towers, Demand Best Care, Says U. S. Official

RADIO transmitting stations could be improved greatly in general appearance and repair bills would be cut down if all broadcasters were to paint the towers of their stations at frequent intervals, according to Thad H. Brown, acting chairman of the Federal Radio Commission and commissioner in charge of the division of field operations.

Chairman Brown, in discussing ways and means to improve the appearance of radio transmitters, recalled that the aeronautic branch of the Department of Commerce demands that all radio towers in the immediate vicinity of airports be painted. He added:

"While this is a matter outside the jurisdiction of the Commission, radio stations, as part of their good-will campaign, should see to it that their equipment does not produce eyesores in the neighborhoods in which they operate.

"Believing that it is a good investment, the Commission's master monitoring station at Grand Island, Nebraska, is kept scrupulously clean and painted. All the uprights in and near the station are kept freshly painted as well as the walls of the rooms wherein the valuable equipment is located."

Paint experts say that not only will the painting of radio towers add to the distinctive appearance of a station, but it will prolong the life of the towers themselves.

"It is difficult to make an accurate estimate," said Dr. Henry A. Gardner, one of the leading paint research experts of the country, "of the losses resulting from weathering away of metals, but the annual loss of steel alone, due to corrosion, has been estimated to be in the neighborhood of five hundred million dollars." Dr. Gardner says that "a ton of fabricated steel, worth. say $50.00, is effectively preserved by probably less than three dollars worth of paint."

NOTES on CRYSTALS

By E. H. Rietzke*

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ALTHOUGH the piezo-electric effect of certain crystalline substances has been known for almost 50 years, the practical commercial use of this effect is not much more than 10 years old. Briefly, their action is described as follows: When certain crystalline substances are compressed and then allowed to expand, a difference of potential will be generated by the compression and a difference of potential of opposite polarity will be developed by the expansion. Conversely, if an alternating voltage is applied across this same substance the substance will alternately be compressed and expanded by the action of the difference of potential.

The piezo-electric effect can be shown in many substances. It is very pronounced in tourmaline, rochelle salts, and quartz. Tourmaline is a semi-precious stone, is not usually found in large pieces, and is comparatively rare, thus not being commercially suitable. Rochelle salts can be "grown" in a laboratory in any quantities and in almost any dimensions at a comparatively low cost. However, this substance is strongly affected by temperature and humidity, and where exact dimensions are necessary is not suitable. Quartz, on the other hand, has many good qualities to assure its use for a piezo-electric effect—it can be found in abundant quantities; it is hard, it is not easily affected by moisture; it lends itself to accurate machining, and it has an extremely low temperature coefficient.

The period of vibration of a quartz crystal is dependent upon its physical dimensions in much the same manner as a violin string or a bridge's sections. Hence, as the structure of quartz is almost always the same, frequencies have approximate predetermined dimensions.

A crystal has three assumed axes, x, y, and z. Fig. 4 shows the rough form of the quartz crystal in its natural state, always hexagonal and pointed at both ends. The axis drawn from point to point through the length of the crystal is called the optical or z axis. Along this axis the crystal manifests no piezo-electric effect. Figs. 2 and 3 represent sections cut out of the crystal perpendicular to the z axis as shown in Fig. 4. In this hexagonal section of crystal the x axes are from corner to corner and the y axes are perpendicular to the flat sides as shown. The crystal manifests a piezo-electric effect along both the x and y axes; that is, it will oscillate at frequencies corresponding to the dimensions of both the x and y axes. Along its x axis the frequency of vibration corresponds to a wavelength of about 105 meters per millimeter and along the y axis to a wavelength of approximately 110 meters per millimeter.

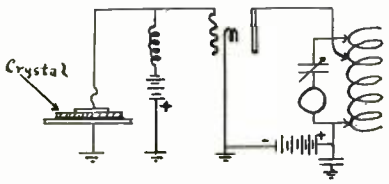

Fig. 1

Fig. 2 shows an x cut crystal. A piece is cut from the hexagonal section as shown, along the y axis, with its thickness along the x axis. The two axes of the crystal are thus separated by 90 degrees and the crystal can be made to oscillate at either frequency. In the case of very low frequency crystals, such as 50 or 100 kilocycles, the y oscillation is normally used. In the broadcast band and at higher frequencies the x dimension usually determines the frequency.

Fig. 3 shows the y cut crystal. In this case the length of the cut is along the x axis, 30 degrees displaced from that of the x cut, and the thickness of the crystal corresponds to the y axis. This is sometimes called a "30° crystal." It will be observed that in this crystal the x and y axes are separated by only 30 degrees. The length of the x and y axes through the crystal are not greatly different and it may be very easy to obtain oscillations at either frequency by means of plate circuit tuning.

The greatest natural change in the dimensions of a quartz crystal (and hence the frequency) takes place when the crystal is subjected to a change of temperature. In the x cut crystal this change will be approximately 25 parts in a million per degree Centigrade change in temperature and the frequency will *decrease* with an increase of temperature. In the case of the y cut crystal the frequency change will be approximately 10 parts in a million per degree Centigrade temperature change and the frequency will *increase* with an an increase of temperature.

At first glance it may seem that 10 to 25 parts in a million represents a comparatively small variation. Let us consider this in terms of cycles. In the middle of the broadcast band, say at 1000 kc., in cycles a frequency of 1,000,000, the x cut crystal will vary in frequency about 25 *cycles per degree of temperature change*. Room temperature will often change 10 degrees or more

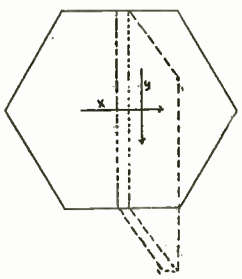

Fig. 2

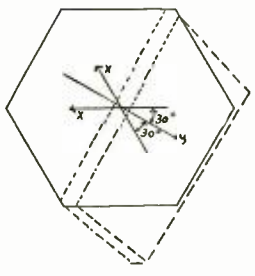

Fig. 3

*President, Capitol Radio Engineering Institute.

over a period of several hours and a crystal subjected to this change would undergo a frequency variation of about 250 cycles. In the broadcast band the Federal Radio Commission allows a maximum variation, + or —, of only 50 cycles. This could be caused by only a 2 degree variation of temperature. At 10,000 kc. this same percentage variation would represent not 250 cycles but 2500 cycles. Another factor entering here is the increase of temperature of the crystal caused by the r-f. current through it.

It therefore becomes necessary to provide means for keeping the temperature of the crystal constant. This is usually done by means of a thermostatically controlled oven, the temperature of which is maintained considerably higher than is likely to be reached by the surrounding air. The usual oven temperature is 50 degrees Centigrade. Since a small temperature change can cause a considerable change in frequency, the thermostatic control should be sensitive to very slight temperature variations. Good crystal ovens can maintain a temperature constant to .01 degree.

The usual crystal controlled oscillator circuit consists of a three element tube, usually a Type 210, a simple tuned LC plate tank circuit and a quartz crystal of the proper dimensions connected between the grid and filament. This is shown in Fig. 1. Since the crystal itself is a non-conductor, a separate d-c. circuit must be used between grid and filament. In the diagram the d-c. circuit consists of a bias battery and an r-f. choke. Very often a grid leak is used in place of the

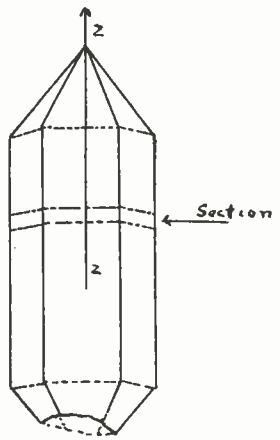

Fig. 4

bias battery. However, with the grid leak, the operating bias is developed by the flow of grid current through the leak and the crystal must supply the necessary power to develop the correct bias. With such a load the crystal vibrations are reduced in amplitude and less power will be supplied by the tube. When a bias battery is used in conjunction with a choke the operating bias is supplied by the battery and no power is taken from the crystal for this purpose. The crystal can then vibrate more strongly for a given amount of feedback and the tube can be made to supply a greater power output. With this circuit the tube can be biased almost to the cutoff point so that when the crystal is not oscillating there is little plate current and when oscillations start the plate current is brought up to normal.

The type 47 tube (power pentode) or a similar tube may be more advantageously used. The characteristics of this tube of primarily high amplification factor and small plate-grid capacity suit themselves admirably for this purpose. The high feedback reactance of the tube tends to keep the r-f. crystal current and the amplitude of the vibrations low and at the same time the high amplification factor of the tube permits adequate power output with the crystal furnishing comparatively low excitation voltage.

With ordinary care a quartz crystal will give long and efficient service. A small chip from the edge of a crystal, dirt or even fingerprints will often cause its failure to oscillate. All dirt or dust should be carefully cleaned and removed with carbon tetrachloride (carbona) before being placed in the holder. The crystal holder should be well designed for clearance around all edges of the crystal and for the correct area and pressure of the upper contact plate. The holder should also be dust-proof.

When purchasing a crystal it is well to remember that the crystal must be very carefully ground to a given frequency. In order to grind it accurately, the manufacturer must have very accurate frequency measuring equipment for checking as the crystal calibration cannot be any more accurate than the calibration equipment by which it is checked. Such equipment is expensive and the purchaser should expect to pay a little more for a crystal manufactured under such conditions if an exact calibration is required.

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Chain Television

CHAIN television, like chain radio broadcasting, is going to be one of the first requirements of commercial television, but the links in that chain need a wholly new method of interconnection, a method which challenges the skill of the engineer and fires the imagination of the man in the street who wants to know the "how" of things.

"Tall buildings, high hills and great towers will be at a premium for television," states Hollis Baird, chief engineer of the Shortwave and Television Laboratory. "Ultra-short waves will be used in order to get the space (or width) in the ether necessary for sending the fine details that will make up the home pictures of the future. As ultra-short waves have more the characteristics of light rather than radio, they can easily penetrate darkness and fog, but solid objects rapidly weaken them. Thus, the visual horizon, from a given point, promises to be the range limit of an ultra-short wave station.

"The television broadcaster will have a range for his main station, depending on how high he can get the transmitting antenna into the air; the higher its location, the broader the horizon and thus the greater distance the signal will travel.

"When radio became good entertainment, it had to expand its field to meet the public demand. So will television. Present chain radio broadcasting is sent over telephone wires, but the voice requirements are only one four-hundredth of television requirements and no present telephone circuits, nor any that appear in the offing, will be able to carry the television signals.

"A relay system is the solution. At the farthest visible point on the horizon from the main transmitter, a receiving station will pick up the television signals and relay them to another similar station. This point to point transmitting is called 'directional' and the action is repeated until the required distance is covered. When the signal reaches the city desired, it will be put out on a non-directional antenna and the program will then cover a circle some 30 miles in radius.

"As an instance, a two hundred mile airline between two cities would require five 1,000 watt relay stations 30 miles apart. Sending ultra-short waves out on a narrow focused beam requires but little power. This same signal to be clearly heard over a radius of 30 miles necessitates a transmitter as powerful as those now used for city radio broadcasting stations. This means that every sizable city in the country will eventually have its own powerful television station interconnected by relay stations to various key television stations from which the programs will emanate. At first thought, the erecting of a sufficient number of powerful stations and small relay stations to provide nation-wide reception appears to be a herculean task but, as in radio, public needs are invariably met when the demands become great enough. Research and invention have a kindly way of meeting such requirements when they arise.

"These stations, dotting the countryside, transmitting Super Eye television from point to point, create an exciting picture of the not too distant future when skilled artists will appear in our homes over chain television systems."

Circuit Data on
AN IMPROVED 200 WATT CLASS B AMPLIFIER

By I. A. Mitchell*

THIS article is not intended to cover the theory of class B amplification, but rather to illustrate a number of developments which tend to simplify and improve a typical class B power amplifier using 203A tubes in the output stage.

The four major requirements for any amplifier are low frequency discrimination, low harmonic content, ample power handling ability, and low hum level.

The first of these qualities is governed almost entirely by the transformers used. Good transformers are available, one commercial grade having a uniform response from 30 to 15,000 cycles.

The second factor, harmonic distortion, is dependent upon proper bias, properly designed transformers and correct matching throughout the circuit. One major difficulty is the use of batteries for biasing. Fig. 1 illustrates a complete 203A amplifier showing a bias rectifier designed to eliminate the variability of battery bias. Through the use of a liberally designed power transformer, mercury hot cathode rectifiers and a saturated input reactor, the d-c. output of this bias system can be kept very constant. The 250 mils thrown away in the 150 ohm bias potentiometer also tends to stabilize the grid bias action. While oscillograph tests have shown that quite a wide variation in the bias voltage is allowable (30 to 42 volts), it is essential that the plate currents be equalized for best operation. This is readily accomplished with the dual arm potentiometer indicated.

Another form of distortion which is often mistaken for higher harmonics is due to an audio oscillation in the output tubes. This oscillation occurs only when an audio-frequency signal is applied to the grids and results in an audible rasp in the output. To remedy this effect, a shunt path for the high frequency oscillation should be introduced from each 203A grid to ground. Tests have indicated that .001 mfd. condensers are highly suitable for this purpose. However, if an equalizing network is used in the output circuit as described below, .0005 mfd. condensers can be used. The resisters in the plate circuits of the 203A tubes also aid in stabilizing the circuit.

Proper coupling is an essential feature for low harmonic content. The 2A3 driver tubes are coupled to the 203A tubes with a transformer having a high step-down ratio. Unfortunately, the grid circuit of the class B tubes varies in impedance continuously as the signal is varied. Naturally, this reflects a varying load to the 2A3 tubes and, inasmuch as these tubes are somewhat critical as to load value, there is a tendency for additional harmonic introduction. To keep this grid impedance at a more constant value, 10,000-ohm ballast resistors are used in the class B tube grid circuits. The input transformer design is irrelevant as few readers will desire to construct their own transformers. However, one feature is important in the design of this transformer. If we examine the distortional components, we find that the maximum is the third harmonic. It is found that the third harmonic introduced into the audio system through the input transformer will be opposite in phase to the distortion in the class B output circuit and the result is a partial nullification of the distorting effects. It is evident that this nullification will not be perfect unless exact phase displacement is effected between the input and output distortions. This is possible if the leakage reactance in the transformer is kept down to a very low value.

Another important point in keeping harmonic content in class B systems to a low level is proper loading of the class B tubes. The load in such a system, very much like a pentode tube is quite critical. When operated into a class C stage, the plate load is *non-inductive* and *constant* in value. This is readily matched to the class B tubes. However, when attempting to use a class B system, such as indicated to operate a loudspeaker system, it is found that the load circuit is highly inductive in nature. In other words, if the impedance of the entire system is 6,000 ohms at 1,000 cycles, it may be four times that value at a higher frequency. Naturally such a great mismatch at the higher frequency will introduce a large degree of harmonics. To neutralize this effect, an equalizing network is necessary. A typical network for use with the amplifier noted, operating into a number of dynamic speaker voice coils, consists of a 6,000-ohm resistor and a .04 mfd. condenser connected in series from each 203A plate to ground.

It is interesting to know, with reference to the class B output transformer, that this transformer differs very appreciably from the average push-pull class A output. As in other transformers, the high frequency response is dependent principally on low leakage reactance and low distributed capacitance in the transformer structure. In a class A transformer, the leakage reactance computations are based on the entire primary and the entire secondary. In class B only one-half the secondary is really working at a time, and it is therefore necessary to consider the leakage reactance as between the primary and one-half the secondary. It is consequently necessary to have a more closely coupled coil structure.

The third amplifier requirement given above, ample power handling ability is governed by the tubes used. The fourth requirement, low hum level is effected by plate supply hum, filament supply hum, electrostatic pickup and electromagnetic pickup.

The filter circuits shown in the fig-

(*Continued on page* 28)

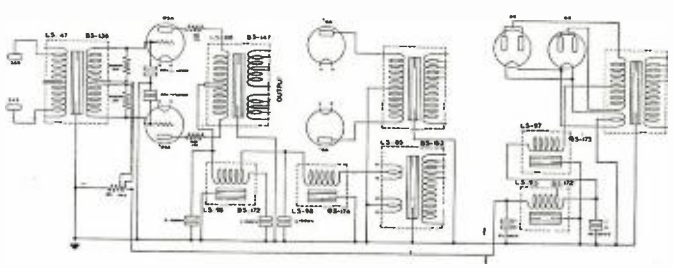

Fig. 1

*President United Transformer Corp.

SVEA METAL— its application and use

By Harold C. Todd*

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NOW that the new material, Svea metal, is being used on a production basis by large radio tube makers, both in this country and abroad, it is easy to look back upon its beginning and the minor production difficulties, both real and imaginary, which have been so simply overcome.

When, several years ago, nickel and other raw materials were being tested out for internal vacuum tube parts a somewhat similar experience was had. Naturally, engineers who were interested in deriving the benefits to be obtained from Svea metal, both in quality and price, were able to profit by their experiences and soon found that the general methods of handling and operation were along the same lines as those previously used for nickel and other metals. The variations were slight and once the proper procedure was determined it was found simple to adapt it to standard routine.

Probably the greatest handicap was the preconceived notion that iron, as such, had been tried in electronic tubes for many years and found to possess characteristics of corrosion, gas, and hard temper, which made it wholly unsuitable for use.

Iron itself is centuries old but Seva metal is as new as radio. It is a distinct departure from iron as it is generally known, and possesses very different characteristics. In the process of the development of Svea metal it was observed that as the remaining impurities were removed from an already pure quality of iron the fundamental characteristics were changed and the extraction of each additional percentage of impurity brought new properties heretofore considered foreign to iron. Resistance to corrosion increased tremendously; the reduction of gas content and the elimination of all slag resulted in the total elimination of blistering at high temperatures. The refinements not only improved the chemical features but modified the physical structure so that the metal might be readily formed, rolled, drawn or processed into any kind of shape and type of strip, wire, woven mesh, pertruded strip, tubing or similar intricately formed part. Under this new method of treatment iron ceased to be a base metal and rightfully took its place in the class of noble metals. To these characteristics and properties were added that of brilliancy of finish, the metal being furnished with a satin silver finish. Many of the chemical and metallurgical advances of the past decade have been brought about not so much by the discovery of entirely new products but rather by the production of well known and largely used materials by new and more direct processes, either synthetically or by improvement in methods of refinement.

In the application of Svea metal to vacuum tubes there have been only two problems of any consequence, namely those of oxidation and carbonization. The problem of oxidation was never a serious one and has long since been solved. Carbonization presented a real initial difficulty but this, too, can no longer be considered as an objection because it has likewise been overcome.

* *Engineer, Swedish Iron and Steel Co.*

Oxidation

There is in Delhi (British India) a column of iron made 1,000 years ago by metallurgists of that remote period. This column has withstood the ravages of a tropical climate for 1,000 years without showing any signs of erosion or other deterioration. When the startled discoverers of the column had some chips taken from it and analyzed, they found to their greatest surprise that it was just iron of an exceptionally high degree of purity. Investigations undertaken in recent years, mostly on electrolytic iron as a medium, have shown conclusively that very pure iron has remarkable rust resisting properties.

It is known that all metals take on a film of oxidation to greater or lesser degree. On some metals the film is invisible while on others it may readily be seen. Svea metal, when *improperly* treated, will show a thin oxide film or temper color due in the first instance to atmospheric conditions or in the second to the application of heat in the presence of oxygen. Strange as it may seem, the slight oxide coloring on Svea metal under *improper* treatment has been considered an advantage which other metals do not possess because it shows immediately the presence of an oxide which should *not* be permitted to enter into the sealed radio tube.

The presence of any oxide film on this metal may be eliminated with a very slight change of method and at no additional expense. The metal itself is furnished in bright rolled form with a thin protective film of light neutral oil which may be promptly removed by a carbon tetrachloride wash. This wash is given to all metals entering into vacuum tubes and therefore is merely a matter of routine, whether the material be Svea metal or any other.

The difference in the treatment of Svea metal as compared with nickel begins after the carbon tetrachloride wash. If Svea metal is permitted to be exposed for any appreciable time after the wash it will take on a slight oxide film. If, on the other hand, it is hydrogen fired within a reasonably prompt period of, say 24 hours (preferably less) after the bath, it will resist oxidation in a very satisfactory manner and plates thus treated have been permitted to lie around in plants for several months without any visible oxidation. Thus, so far as this type of oxidation is concerned, there is no occasion for its further consideration.

The second type of oxidation occurs when the metal

is heated in an atmosphere of air. Every engineer knows that all iron, however pure, will show temper color in the presence of oxygen. It only remains, therefore, to eliminate the presence of oxygen in the treatment and this may be done by a number of methods. If the metal is to be hydrogen annealed, it is preferable to use a furnace with a single continuous annealing chamber running through the hot zone and into the cooling zone. Such a single continuous pipe or square chamber for both the heating and cooling zones will prevent oxygen from entering through a joined middle section between heating and cooling parts of the furnace.

Hydrogen should be introduced, if possible, at two points: one between the heating and cooling zones and the other near the exit end of the cooling zone. If this is not possible it should be introduced at the entrance end and turned on to a point where the flame at the door is about 3 inches high. It is advantageous to have an illuminating gas pilot burning at the rear end of the furnace to ignite the oxygen hydrogen mixture formed upon opening the exit door. This prevents the possibility of an explosion or the presence of free oxygen in the cooling zone.

Plates or other parts should be placed in a heat resisting metal boat and it is important and essential that this boat be covered with a loose fitting cover of the same material. The boat itself may have perforations in the side of it but in practice the covers have not contained perforations. The plates or other parts come into contact with the hydrogen through the perforations in the side of the boat and up under the sides of the loose fitting cover. Best results are obtained at a temperature of about 1,000° C., but this, of course, may be varied somewhat. It is suggested that the boat be kept in the heating zone for about one minute, although very fine results have been obtained with as long as three minutes, the time being varied with the temperature. The boat may be permitted to remain in the cooling chamber for from 5 to 12 minutes, depending upon the other factors.

It will be noted that the practice of handling this metal differs from that of handling nickel mainly in that the parts must not come in direct contact with oxygen while they are hot, and every precaution be taken to prevent the entrance of oxygen into the furnace. The procedure suggested above is practically the same as that now used for nickel and requires little if any modification of present method.

Considerable experience has been had with the tendency of Svea metal to oxidize or show temper coloring on spot welds where the material is brought into direct contact with the heat of the welding apparatus. If a nickel support is to be welded to Svea metal plate, or vice versa, the temperature at the point of welding should be kept as low as possible—that is, below the point at which discoloration takes place. Since Svea metal has a greater heat conductivity than nickel, or conversely, since nickel requires a higher heat for welding purposes, it is suggested that the time of application of heat be reduced to a minimum. The proper combination of the heat and time elements can be quickly determined by experiment.

A much easier and more satisfactory job can be done if both the plate and the support are of Svea metal, since it welds itself very satisfactorily and quickly at a low temperature, and its use offers a very definite way of eliminating any difficulty.

In either of the above cases, it should be known that the difficulties in connection with this type of oxidation have been overcome after a very slight amount of experimentation.

Suggestions for Prevention of Oxidation

No doubt the readers of RADIO ENGINEERING will be interested in a few suggestions for the prevention of oxidation. These suggestions have been adopted by practically all users of Svea metal with excellent results.

(a) Keep Svea metal uncontaminated by finger prints as far as possible, or, if it is so contaminated, put it through the processes and make it into finished tubes without any unnecessary delay.

(b) If hydrogen cleaned parts are kept for more than 24 hours after they are taken from the furnace, they should be stored in a desiccator.

The latter may be one of the customary glass desiccators, or a closet or small room where the doors and windows have been made tight by felt strips or otherwise, and where a tray of calcium chloride or other desiccating material is kept to absorb humidity.

(c) Svea metal will oxidize at a lower temperature than nickel. It is therefore necessary to make sure that a reasonably high vacuum is present in the tube in process of exhaustion when the first induction heating treatment is applied. If this precaution is taken, no trouble whatever with oxidation during exhaust is experienced.

(d) When Svea metal is shipped its surface is protected by a very light coat of a special oil which completely protects it from oxidation during shipment. This oil film is no heavier than the one present on nickel or other parts after it has been passed through stamping or other forming operations. The film can be washed off with carbon tetrachloride, but it will also evaporate completly during hydrogen firing. As an additional precaution, no considerable amount of time should elapse between washing with carbon tetrachloride and hydrogen firing.

It is to be remembered that carbon tetrachloride, particularly after having been used several times, may easily contain some acid decomposition products of the tetrachloride which may lead to tarnishing if too much time elapses between washing and hydrogen firing.

(e) Hydrogen fired parts of Svea metal should either be used up the same day or stored in a desiccator closet as described.

(f) For best results the hydrogen used in cleaning should be dried. The most practical method consists of passing it through two vertical 6 inch pipes, 6 feet high which are filled with caustic potash. This is standard practice in many plants even for nickel.

Carbonization

By the time this article goes to press carbonized Svea metal will be available and ready for distribution. It has been a long and difficult task to overcome this final obstacle. It is not anticipated that the tube makers will have much interest in doing the carbonizing work themselves and for this reason the method used for carbonizing will not be outlined here. Suffice it to say that a considerable quantity of strip has been carbonized and the results pronounced as excellent and fully equal to that now being furnished to the vacuum tube industry. This has been accomplished by what has proven to be a simple method and the finished strip is soft, easily formed, and coated with a firm adherent coating of carbon. Naturally this development has been slow and, like most new processes, it required considerable experimental work along entirely new lines. The main

difficulty was due to the fact that the maximum heat of carbonization, without carburization, was found to be very close to the minimum cracking at which the gas would deposit carbon. Once the base was established an increase in deposit could be obtained by time of exposure at the critical heat. The suppliers of carbonized Svea metal plan to be prepared to furnish it to all users on a production basis within a comparatively short period of time.

It may be asked at this point whether the precautions outlined for the use of Svea metal are warranted or, in blunt language, whether Svea metal is worth the consideration which has been given to it. To these questions the answer is most emphatically in the affirmative. The benefits to be derived from the use of Svea metal are worth many times any slight modification in method of manufacture or precautions required. In this respect the writer wishes to point out and emphasize the advantages of quality and cost. These may be summarized for quick review as follows:

1. *Gas Content*—An important tube engineer has reported that Svea metal contains 55 per cent less gas and consequently less impedance to electronic emission and less ionization.

2. *Higher Heat Resistance*—A higher heat resistance means not merely longer life in the tube but less distortion in the part, greater rigidity after heat treatment, and a better ability to withstand application of higher voltages without tube damage.

3. *More Conductive*—Svea metal is more conductive of heat and electrical current under high frequency treatment which permits the maintenance of higher equilibrium temperature and a quicker operation of the tube.

4. *Lighter Weight*—For a given area of plate size Svea is approximately 12 per cent lighter in weight. The progressive tendency of tube makers is naturally toward lightness provided there is no sacrifice of ruggedness or rigidity. For transmitter tubes it is a distinct advantage.

5. *Retains Springiness*—This is advantageous because it permits a part to be subjected to abuse in handling without permanent distortion and the part tends to resume its initial position after receiving a physical shock.

6. *Joins Better with Glass*—The coefficient of expansion of Svea metal is nearer that of glass and for all parts coming in contact with glass there is an excellent fusion without air bubbles or gas. This should be of interest in connection with the development of the new all metal tube.

7. *Temper*—Svea can be produced to a much softer temper. Material has been made with a Rockwell hardness under standard methods down to 79.5.

These are only a few of the major points of quality.

There has probably never been a time in the history of the manufacture of radio tubes when the matter of cost was of such paramount importance as it is in these days of price competition. Svea metal represents a saving to the vacuum tube industry of approximately one and one-half millions of dollars annually. This, however, is not all. It has for years been the consensus of opinion of the best technical talent available that shrinkage in production and difficulties arising in the use of tubes are decreased in the same measure as materials of greater purity are used in the fabrication of tubes. If this be true it is a forcible conclusion that Svea metal, which is by far the purest tube making material commercially available, must do its share in decreasing both shrinkage and field troubles. In the last analysis, the proof of the pudding is in the eating. Svea metal is being produced in various forms at the rate of approximately two thousand pounds per week for internal parts in electronic tubes. Over thirty manufacturers of various types of radio receiving tubes, neon lights and similar vacuum tubes are using it in production regularly and without difficulty. It has long since passed the experimental stage and has received the final approval of many of the finest tube engineers in the country. It is estimated that over ten million tubes are already on the market. This material represents progress and the spirit of the times.

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BOOK REVIEW

"THE INDUCTANCE AUTHORITY," by Edward M. Shiepe, B.S., M.E.E., published by Herman Bernard, 135 Liberty St., New York. N. Y., 9 x 12 inches, 50 pages, 40 curve sheets, flexible black cover. Price, $2.00.

This book makes it unnecessary to calculate single-layer coils, by presenting on large curve-sheets in logical order the results of precise calculations for the entire radio-frequency spectrum, using the accurate corrected formulas of the Bureau of Standards. All coils of diameters between ¾ and 3 inches, of wire between No. 14 and No. 32 B. & S. gauge, and for all insulations, are included.

The text shows how coils with spaced windings can be determined from the curve sheets, with examples. The effect of resistance on frequency response is reviewed.

This book has not appeared until now because of the considerable amount of work necessary to bring it out. It will undoubtedly become of great value to all radio men.

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CIRCUIT DATA ON AN IMPROVED 200 WATT CLASS B AMPLIFIER

(*Continued from page 25*)

ure use a hum-bucking arrangement which is much more efficient than a brute force filter. In this way, the plate supply ripple can be kept to a small value economically. The filament hum is negligible in the output stages and can be remedied by using DC on the first stages. Push pull tube connections also tend to minimize the filament hum. Magnetic pickup is the most difficult to cure, but by using transformer components in cast iron housings, preferably of a high permeability steel, this effect can be practically eliminated.

Audio and power components should be kept as far as possible from each other to prevent both electrostatic and electromagnetic coupling.

An audio amplifier as described is at present being used for carillon sound projection covering a radius of five miles. The audio-frequency range of the system compares with that of the finest broadcast equipment. A preliminary oscillograph check on the harmonic distortion of this amplifier showed a total content of slightly over 5 per cent at maximum power output.

NEWS OF THE INDUSTRY

TUBE PRODUCTION GROWING

Hygrade Sylvania Corporation, manufacturer of incandescent lamps, radio tubes, broadcasting equipment and other electronic devices, with plants at Salem, Mass., Emporium, Pa., St. Marys, Pa., and Clifton, N. J., increased its employees by over 1,400 between June 17 and August 12.

A majority of these employees were added in anticipation of the provisions and requirements of the NRA.

Payroll increases for this eight-week period are at the rate of $1,000,000 yearly, or over 35 per cent.

All plants of the corporation are working at capacity and officials of the company anticipate an unusually active Fall season, stimulated by actual market demands. Present production of both incandescent lamps and tubes is the result of consumer needs rather than an anticipation of price increases, one of the officials of the company said.

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UNITED TRANSFORMER CORP.

I. A. Mitchell, chief design engineer and vice-president, S. L. Baraf, technical and sales director, and L. Goldstone, production manager, have organized the United Transformer Corporation with plant and offices at 264-266 Canal St., New York City.

The plant of the United Transformer Corporation is equipped with modern precision machinery and accurate tools and testing equipment for the manufacture of quality audio, filter and plate transformers, as well as voltage regulators for broadcast, television, public address, laboratory and industrial applications.

UTC engineers specialize in the design of audio transformers having a linear characteristic from 20 to 20,000 cycles. Special schematic circuits are available on Class A and Class B power amplifiers having power outputs from 5 to 200 watts.

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TUBE SHIELDS

Goat Radio Tube Parts, Inc., 314 Dean St., Brooklyn, N. Y., announce that they are now supplying their new form fitting-tube-shield in five sizes.

These various shields fit the standard receiving tubes using both the short and long dome bulbs and the S-14 pear shaped bulb.

Two models are with the chimney top to provide shielding around the control grid cap.

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SYNTHANE'S CLEVELAND MANAGER MOVES

The Synthane Corporation, of Oaks, Pa., manufacturers of Synthane laminated bakelite, announces a change in address of J. W. Davis, their Cleveland manager. Mr. Davis' new quarters are now located at Room 437, Penton Building, 1213 West Third Street, Cleveland, Ohio.

ZAPON-BREVOLITE CONSOLIDATION

The announcement of The Zapon Company, a subsidiary of Atlas Powder Company, that its western business has been combined as of September first with that of the Brevolite Lacquer Company, of North Chicago, Illinois, should be of interest not only to all users of finishing materials, but to the business world in general. The consolidation will be known as The Zapon-Brevolite Lacquer Company. A new corporation of that name has been formed under the laws of the State of Illinois.

The Zapon Company was founded in 1884 and in addition to being the oldest manufacturer of pyroxylin base finishing materials, is also one of the world's largest producers of leather cloth, suede fabric, auto top and similar materials.

The Brevolite Lacquer Company was founded in 1919 by the late Dr. Brevis, one of the pioneer lacquer chemists of the country. It has enjoyed a steady growth and occupies at the present time a modern fireproof factory, constructed in 1930, at North Chicago, Illinois.

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NEW GATES CATALOGS ISSUED

The Gates Radio & Supply Co., of Quincy, Illinois, manufacturers of a complete line of public-address and broadcast station equipment, have announced the release of three new catalogs.

Catalog G-33 covers public-address, sound distribution and sound amplifier equipment to meet every requirement from microphone to speakers.

Catalog A-10 covers a complete line of accessories for the broadcast engineer and sound engineer for use in replacement and maintenance work.

Catalog B-20, strictly for broadcast stations and broadcast station engineers, describes speech input and remote amplifiers, volume indicators, transcription units, microphones, microphone mixers, and so forth, with valuable technical data.

These catalogs may be obtained by letterhead requests to the Gates Company.

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SHURE TECHNICAL BULLETIN

A monthly publication of special interest to broadcast, public-address and recording engineers, radio amateurs, transmitter operators and others concerned with microphones and related equipments, is issued by the Shure Brothers Company, 215 West Huron St., Chicago. There is no charge for the publication, which is known as "The Shure Technical Bulletin." Address subscription requests to the company on your letterhead. A limited number of back issues are available for those who wish complete files.

The bulletin contains authoritative articles covering various phases of microphone placement, as well as design data on associated speech-input circuits, new applications of microphones for industrial and research purposes, and similar technical information.

CONTINENTAL CARBON, INC., PURCHASES IGRAD

The Igrad Condenser & Manufacturing Company, of Rochester, New York, has been purchased by Continental Carbon, Inc., of 13900 Lorain Ave., Cleveland, Ohio.

The Rochester plant is being moved to Cleveland, and a complete line of paper condensers will be offered by the same sales organization that is now distributing Continental resistors and auto-radio suppressors to manufacturers and jobbers.

The Igrad Company was organized in 1925 by C. C. Eckhardt. Carl Grams, who became secretary and factory superintendent, has had twenty years experience in the manufacture and design of paper condensers with Stromberg-Carlson, and will come to Continental to take charge of the production of Continental-Igrad condensers.

The new Continental-Igrad line will include all paper condenser types now in use. An exclusive new development of the Continental-Igrad engineers is a line of paper condensers to replace electrolytic condensers. These are housed in containers of the same size as the electrolytics they replace and will withstand exceptionally high potentials and temperatures.

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GREECE NOW HAS EIGHT RADIOTELEGRAPH STATIONS

Radiotelegraphy in Greece is entirely in the hands of the State. There are eight sending stations, six belonging to the Navy located at Athens, Piraeus, Salónika, Alexandroupolis (Dedeagatch), Corfu, and Chios. Two others are owned by the Ministry of Communications, located at Vari, near Athens, and Canea (Island of Crete). Private messages are handled through all stations except Athens, which is used exclusively for official business. Private messages for Athens are handled through the Piraeus station. Telegrams transmitted by radio have been increasing, notably in the marine.

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ARGENTINA OPENS NEW POLICE RADIO STATION

The wireless station at the Buenos Aires Central Police Department was formally inaugurated on March 22. The new station is to be known as LPZ, Radio Policial, and will transmit on a wavelength of 140 meters. The station is to be used in transmitting instructions to police stations, detachments, etc.

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NEW STATION FOR CHILE

The Government granted a concession to Sr. Joaquin Lepeley, Director of "El Mercurio," one of the leading newspapers in Valparaiso, to install and operate a radio broadcasting station. The station will have a power of 1,000 watts and will operate on a frequency of 880 kilocycles; call letters, CE88. The concession is granted for a period of 30 years.

UNIVERSAL MICROPHONE ANNOUNCES PRICE REDUCTIONS

Universal Microphone Co., Inglewood, Cal., has announced a list price reduction on microphone cords and cables; desk counts; input stages, and QRXF, which is a QRQ microphone mounted directly on a junior output stage.

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CHARACTERISTICS OF THE TYPE RCA 1-v AND THE TYPE RCA 12Z3; CUNNINGHAM C 1-v AND C 12Z3 TUBES

The type 1-v and type 12Z3 tubes are half-wave vacuum-type rectifiers having heater voltages of 6.3 and 12.6 volts respectively and heater currents of 0.3 ampere each.

Rated characteristics follow:

	1-v	12Z3	
Heater voltage	6.3	12.6	v.
Heater current	0.3	0.3	amp.
Maximum a-c. plate voltage (RMS)	350	250	v.
Maximum d-c. output current	50	60	ma.

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JENKINS BROS. PUBLISHES DATA BOOK ON VALVES

An excellent source of information on valves and valve layout is the new Catalog No. 23 just published by Jenkins Bros., 80 White Street, New York. Not only does this book cover 400 Jenkins valves, in a wide range of types and patterns, but also it gives unusually complete details. All features of design and construction are clearly and fully described. Full information is given about the metals used in making the valves. Services, pressures, temperatures and fluids for which the valves are recommended are stated. The last section of the book contains many pages of engineering data that is constantly needed where valves are used.

NEW YORK OFFICES OF GENERAL ELECTRIC MOVED

The General Electric Company and four of its associated companies have announced the removal of their offices in New York City to the new General Electric Building, 570 Lexington Avenue at 51st Street. Included are the executive offices, New York district office, air conditioning department, electric refrigeration department, Atlantic division of the incandescent lamp department, merchandise department, and plastics department of the General Electric Company, and the General Electric Contracts Corporation, G. E. Employees Securities Corporation, General Electric Realty Corporation, and International General Electric Company, Inc.

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NEW RADIO DISTRIBUTION SYSTEM FOR SING SING

Arrangements for the installation of a modern multiple radio receiving system which will distribute three separate programs simultaneously to every cell in the state penal institution, have been made by Warden Lewis E. Lawes, of Sing Sing.

The equipment is being supplied by the RCA Victor Company, Inc., with funds raised from the proceeds of prison athletic activities. The programs will originate from three control panels having separate radio receivers feeding into a centralized sound distribution system, and sent out to the individual earphone sets located in the cells. An automatic phonograph mechanism is also being provided so that programs of recorded music may be sent over the same system. Two new "velocity" type microphones will be located in the chapel-auditorium and on the athletic field so that religious services, lectures and announcements can be carried through the entire institution by the centralized sound system.

NATIONAL RADIO AND ELECTRICAL EXPOSITION

The National Radio and Electrical Exposition will be held at Madison Square Garden, New York, September 20 to 30. It is expected that many interesting exhibits will be there.

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TRANSCRIPTION PROGRAMS

A new west coast transcription activity has come into being with the establishment of Radioart Guild of America, with headquarters in Los Angeles and a branch in New York City.

The group will act as producers and distributors of transcription programs and will do recording at Recordings, Inc., in Hollywood.

Officers will be W. L. Standard, for 22 years executive of the Standard Oil of California, as president, and Miss Ruth Clark, former KFI-KECA music librarian, as secretary-treasurer.

Weyert Moor, for twelve years orchestra manager for the Cleveland Symphony and at one time its director for summer concerts, will be music director for the Guild.

Miss Zhay Clark, harp soloist with the Chicago Opera Company for two years, will be official arranger. W. Arthur Rush, who was with the Hollywood office of the RCA-Victor Company, will also be associated with the Guild.

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GILBY HANDBOOK

Walter Gilby, for many years identified with all phases of electrical resistance wire manufacturing, announces that the Walter Gilby Alloy Company Handbook of Electrical Resistance Alloys is ready for distribution.

This catalog contains completely revised data and tables concerning Nicraloy "A" and "C"; Constaloy; special alloys; pure nickel; Svea metal; and enameled and covered wires.

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RMA ACTIVITIES

FOLLOWING conclusion of arrangements between the RMA and NEMA for the operation of the electrical code as it affects radio manufacturers, as soon as possible there will be called a general radio industry meeting, according to present plans. Uniformity of operation under the code is expected to result, together with plans regarding submission of reports required by the NRA, particularly as to labor operations. The RMA members and the trade generally will be advised at an early date of the time and place of the proposed general meeting.

Radio Interests Block Proposed Tax in Ohio

The RMA and Ohio radio interests have blocked a proposal before the special session of the Ohio State Legislature to levy a new ten per cent. "luxury" sales tax on receiving sets. With the assistance of Charles T. Naddy, Columbus radio jobber, and other Ohio distributors and dealers, under the direction of Bond Geddes, executive vice-president, general manager of the RMA, a vigorous fight against the proposed ten per cent. sales tax, suggested to apply generally in Ohio, has been waged. The latest reports indicate that the proposed tax will be defeated. Fortunately, a few years ago the RMA brought a test suit against a similar tax law in South Carolina and secured a Federal Circuit Court decision that radio receiving sets are instrumentalities of interstate commerce and therefore cannot be taxed by any state. This United States court decision was transmitted by Mr. Geddes to the Ohio legislative committee and used most effectively.

Leading RMA set manufacturers also were advised by the RMA of the proposed Ohio tax and through their jobbers and dealers brought much influence to bear against the ten per cent. tax plan before the Ohio special taxation committee. Originally the Ohio committee proposed to tax cosmetics and other luxuries in addition to radio, but present information is that the radio tax will probably not be included in the Ohio sales tax program.

Marconi Will Be Guest of Radio Industry

As a feature climax to Radio Progress Week beginning October 2, Senator Guglielmo Marconi will be a guest of the RMA during the radio industry celebration. He probably will be the honor guest at a radio "Family" dinner in New York during Radio Program Week. Through the Italian Embassy in Washington, a formal invitation was recently extended by the RMA to Senator Marconi and Mr. David Sarnoff, president of the Radio Corporation of America, who is now in Europe, has pursuaded Mr. Marconi to visit America. The distinguished radio pioneer will be a guest of the Chicago Exposition and his visit is timed during Radio Progress Week.

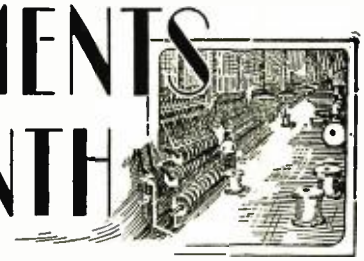
Many New RMA Members

A large number of radio manufacturers recently have affiliated with the RMA to secure the advantages of Association membership especially in connection with the NRA code and its administration. They have also taken advantage of the temporary reduction by one-half of the RMA initiation fee. This privilege expires October 18 and companies which are considering membership are requested to act before the full initiation fee again becomes effective.

New RMA Committee on Police Radio

A special committee to study engineering developments in connection with police radio has been organized by Chairman Virgil M. Graham of the Association's Standards Committee. Special study will be made of problems in connection with police radio. The committee consists of L. F. Jones of Camden, New Jersey; E. L. Nelson of New York; T. J. Scofield of Jackson, Michigan; W. E. Poor of New York; L. F. Curtis of Springfield, Massachusetts, and David Grimes of New York. C. G. Jolliffe, chief engineer of the Federal Radio Commission, has accepted appointment as guest member of the committee.

NEW DEVELOPMENTS OF THE MONTH



COLD-FORGED THUMB SCREWS

The Parker-Kalon Corp., 200 Varick St., New York City, announces the addition of cold-forged thumb screws.

These thumb screws are made by a new and improved process perfected after eighteen months of experimentation. The thumb grips are nicely shaped and are of pleasing proportions; because they are free of burrs and roughness they take an excellent plated finish. The knurling pro-

vides a firm finger grip. The screws are rolled-threaded to close limits. They are made for stock in a complete range of sizes—from 3/16 inch—24 by ½ inch to ⅜ inch—16 by 3 inches inclusive.

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EBY MULTIPOLAR SNAP SWITCH

The H. H. Eby Mfg. Co., Inc., of Philadelphia, Pa., is marketing a new and novel snap action switch which answers a question that has been frequently raised as to the availability of a multipolar snap action switch and which is applicable to power or radio circuits.

This switch can be furnished in any combination of polar arrangements up to 6 poles and either single or double throw.

It is sturdily constructed in addition to being compact and is adaptable to a wide variety of mounting conditions. The endurance of the Eby multipolar switch is beyond question as is also the excellence of design, the quality of materials used and the workmanship.

Due to low contact resistance and low capacitance to ground of the live parts, this series of switches is ideal for two-band receivers, low-powered transmitters, test equipment, laboratory apparatus and electronic equipment generally.

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NEW NICKEL ALLOY FOR TUBES

The Gilby Wire Company, 150 Riverside Ave., Newark, N. J., has developed a new alloy filament known as Cobanic. This material has distinct advantages over pure or silicon nickel inasmuch as it definitely eliminates chipping. We have this filament available for the following type tubes: Types 210, 250, 281, 230, 232, 231, 233, 280, 282, 566, 567, 572, 575 and 5Z3.

NEW RECORDING FEED SCREW DEVICE

Latest releases from the laboratory of the Universal Microphone Co., Inglewood, Calif., is the Universal recording feed screw device which moves any recording cutting head across the face of the recording disc and thereby grooves the record at the time of making the recording.

This method of making the groove at the actual time of the recording has proven far superior to the use of pregrooved records. The device is so constructed that the recording head may be lifted from the record without disturbing the feed screw.

There are no critical adjustments required in the operation of the device, and the instrument will fit any phonograph turntable. Records up to 12 inches in diameter can be accommodated, and the thread is cut at the rate of 80 grooves an inch.

It will be marketed through regular trade channels and will be found practicable for transcription studios, home recording purposes and agencies which make a check of air programs, and broadcasters who make their own recordings and transcriptions.

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STATICHECKER SIMPLIFIES TESTING NEW AND OLD SETS

A very simple device, called the Statichecker, has been built by the Clough-Brengle Company of 1140 W. Austin Ave., Chicago, Ill.

A midget size test plug and cable, small enough to get into any socket, brings every socket contact up to the terminals of a rotary selector switch on the panel of the instrument. On this same panel is a chart that shows the proper switch position for connecting to any element of

every type of tube, old or new. No more is time lost in puzzling out confusing tube diagrams.

The output may be connected to any ohmmeter, or the resistance range of an analyzer, the combination making a modern point-to-point tester that is low in cost and rapid in operation.

The Clough-Brengle Statichecker, complete with test plug and cable for 7, 6, 5 and 4-prong tubes is priced at only $8.82 net.

Clough-Brengle are also introducing a companion instrument, the Unimeter, which measures d-c. voltage and current, resistance, a-f. receiver output, and tube performance.

NEW DUMONT AMPLIFIER

In order to extend the range of the cathode ray oscillograph a special high quality a-c. operated amplifier has been developed by the Allen B. DuMont Laboratories, Upper Montclair, N. J. This amplifier may be used for the measurement or observation of many effects which of themselves are not of sufficient magnitude to operate the cathode ray tube directly but which nevertheless should not be entrusted to an ordinary amplifier for their faithful reproduction. It may also be used for many laboratory problems not connected with the cathode ray oscillograph.

The DuMont Type 136 amplifier is a three stage unit with power supply which has a voltage amplification of 500 and will deliver 50 volts r.m.s. to the cathode ray tube. The input impedance is one megohm and the output impedance is 7,000 ohms resistive. The ratio of output to input voltages does not vary more than 3 per cent from the 1,000 cycle value between 10 and 100,000 cycles, in which range the phase shift is proportional to frequency, there being a lag of 8 degrees at the upper frequency. The ratio of output to input voltages does not vary by more than 5 db. from the 1,000 cycle value between 100 kc. and 900 kc.

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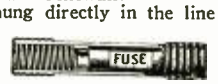
NEW FUSE RETAINER

The Littelfuse Laboratories, 1772 Wilson Ave., Chicago, Ill., announce their new No. 1061 fuse retainer. This fuse retainer was developed to meet the demand of manufacturers of auto and battery operated radio sets for a fuse mounting that would not take up any additional room in the set and still be readily accessible for servicing and renewals.

It is hung directly in the line between



the storage battery and the radio power supply. A tension spring furnishes perfect contact at all times to the fuse which is fully protected by the fibre casing. It takes a 3 AG type automotive fuse or Instrument Littelfuse. About one thousand a day are going into auto radio sets at this time.

FILTERMATIC OCTAVE TONE CONTROL

The Octave tone control, manufactured by The Filtermatic Mfg. Co., Philadelphia, Pa., was especially designed and developed for tone control. It is a patented tapped condenser, which entirely eliminates the resistance strip. It is a complete tone control in very compact form. This unit is very sturdily built, and is constructed of the best material obtainable for the purpose, such as bronze plates, mica dielectric and bakelite case. All exposed parts are plated to prevent rust or corrosion. It is thoroughly impregnated with the best grade

of condenser wax, rendering it practically moisture proof.

The Octave tone control can be supplied either with or without a power switch. The shafts are ¾ inch long to permit their use as original equipment in practically all standard receivers, although we can supply shafts in any desired length. Threaded ⅜-inch diameter mounting bushing permits single hole mounting in ⅜-inch or 7/16-inch hole. The bushing is ⅜ inch long, permitting mounting on panels

up to ¼ inch thick. The Octave tone control requires very little space on the panel. It measures only 11/16 of an inch by 1⅝ inches. It also cuts down installation costs by requiring only two soldered connections.

Tone control may be used either in the grid or plate circuit of the audio amplifier. The most desirable is the grid circuit, since the same capacity can be used in any grid circuit, whereas different capacities are required in different plate circuits. When the tone control is used in the grid circuit it also eliminates the danger of current breakdown. There is also a saving in space and expense, as a smaller capacity condenser can be used in the grid circuit.

The Octave tone control has a variable capacity of from 50 mmfd. to .006 mfd., for the grid circuit. Although the Octave tone control is composed of seven steps of capacity there is no noticeable interruption between capacities when used. It produces a smooth gradual tone taper from treble to bass.

◆

NEW PORTABLE INSTRUMENTS FOR ELECTRICAL MEASUREMENTS

A new line of portable electrical instruments has been announced by the General Electric Company. The instruments, designated as Type AP-9, includes medium-size voltmeters, milliammeters, ammeters, and wattmeters.

The case, of Textolite compound with hinged cover and snap lock, measures 2½ by 6½ by 4¾ inches. The finish is mottled red with stippled leather finish on top and with nickel trimmings. The handle, of pliable leather, is convenient and durable. When the cover is closed, the case has no projecting parts; in the Type P-8 instruments, which have been superseded by the new line, the binding posts were on the side of the case, but in the new ones the terminals are under the cover, out of the way and easily connected. The cover also protects the glass over the scale when the instrument is not in use. Flush with the surface there is an external zero adjustment on top of the case.

Intermediate in size and accuracy between the small, pocket-size instruments and the large, highly accurate portables, the new instruments are of higher accuracy than is usually found in utility instruments; are far less costly than the larger portables, and but slightly higher in price than the small pocket instruments.

The length of the scale in mean arc is 4¼ inches. The accuracy is 0.75 per cent of full-scale value, except in the case of the triple-range voltmeters in which it is 1½ per cent, and can be improved by special calibration on the job. An AP-9 instrument can be read easily to within 0.5 per cent of full-scale value.

◆

POWER SUPPLY FOR CONDENSER MICROPHONES

Designed to entirely eliminate batteries, the Shure model 41A power supply, manufactured by the Shure Brothers Company, 215 West Huron St., Chicago, is now available for condenser microphones. A special rectifier circuit converts a-c. from commercial circuits into a perfectly filtered d-c. for both filament and plate circuits of the head amplifier, with the result that there is no audible hum even with the highest quality speech amplifying equipment. Tests on broadcast circuits have definitely established the suitability of the Shure 41A condenser microphone power supply for this most discriminating service. The equipment weighs only 12 pounds as compared with 24 pounds for the lightest corresponding battery complement, a feature which will be appreciated in portable work.

The power supply operates from 105 to

125 volt, 60-cycle lines and furnishes 6 volts at 0.06 amp. and 200 volts at 5 ma., direct current, for filament and plate circuits respectively, "A" plus and "B" minus being grounded to the case. The plate voltage is adjustable. While designed especially for the Shure model 40A condenser microphone, the model 41A power supply may be used with any condenser microphone whose current requirements correspond with these specifications. The base is double-baked black japan with chromium plated cover. The equipment is furnished complete with plug for attachment to the microphone cable, a-c. cord and plug, and rectifier tube.

NEW IRC VOLT-OHMMETER

An outstanding feature of the new IRC volt-ohmmeter is its automatic vacuum relay which prevents costly burn-outs of meters or circuits resulting from accidental overloads. When an overload occurs, the relay automatically throws the circuit open, then closes it when the overload is removed.

The IRC volt-ohmmeter weighs only 2½ lbs. It is 7 inches long by 3 inches

deep. Voltage ranges are 3, 30, 300 and 600. Resistance ranges are 0 to 1,000; 0 to 100,000 and 0 to 1 megohm. With minor wiring changes and the addition of IRC Precision Wire Wound Resistors, various d-c. current readings can be made. The basic meter used is an 0-1 milliammeter.

This new instrument is expressly designed for accurate servicing through the point-to-point method. The volt-ohmmeter cannot be rendered obsolete by the introduction of new tubes or circuits and makes good servicing possible with a minimum of equipment. All that is necessary is the volt-ohmmeter and a tube checker to enable the point-to-point servicer to handle practically any job, quickly and satisfactorily.

Other IRC volt-ohmmeter features include extra large 3-inch etch scale with double strength glass cover; full Bakelite case in either black or mahogany finish; one set of pin jacks for all readings; rotary switch; convenient compensation for battery variations on ohmmeter and many more.

◆

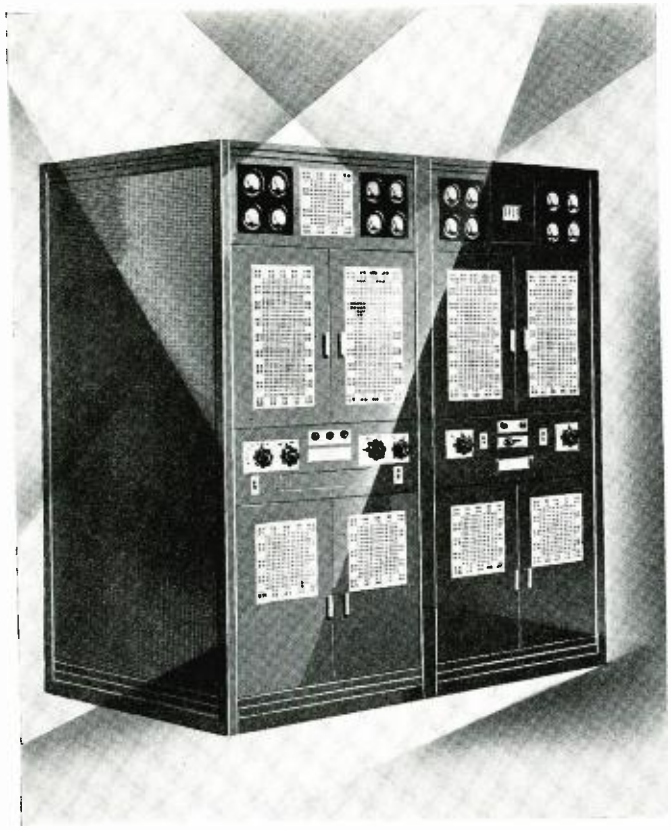
NEW MICROPHONE AND CRYSTAL HOLDER

Eastern Coil Co., manufacturers of quartz crystal holders for the past three years, has expanded its line and is now manufacturing in addition to the above a high grade line of microphone stands.

Instead of concentrating on a single type of floor stand, three floor types have been developed to take care of price requirements.

An innovation in the line is a cable clamp which allows external use of the

"mike" wire, holds it neatly to the side of the stand, prevents injury to the wire and allows instant adjustment. Two of these clamps are meant to be used with each stand. Catalogue sheet describing the complete line may be had by writing to Eastern Coil Co., 56 Christopher Ave., Brooklyn, N. Y.



THE NEW RCA VICTOR TYPE "1-D" ONE-K.W. TRANSMITTER — A MODERN AND ATTRACTIVE DESIGN

THE MODERN RCA VICTOR ONE K. W. TRANSMITTER TYPE "1 D"

Radio Headquarters takes pride in introducing this advanced-design one-k.w. broadcast transmitter, in anticipation of the great improvements being made in broadcast receiving sets, and the general trend towards extended audio frequency range of microphones and remote pickup telephone lines.

NOTE THESE OUTSTANDING FEATURES:

1. Simplified and efficient all A.C. operation, resulting in reliability and the usual RCA Victor high standard of performance.
2. Class B Audio Modulators for plate modulation of the power Amplifier stage.
3. Specially designed for economy in power consumption.
4. Cathode. Ray Modulation Indicator, permitting the actual modulation envelope to be viewed at any time.
5. High fidelity monitoring loudspeaker with range extending to 10,000 cycles.
6. Provision for connection direct to antenna or for feeding into a two-wire transmission line.
7. Constructed in two main units for convenience in transportation, installation and operation.
8. Radiotron complement designed for efficiency, economy and convenience of maintenance, as follows:

EXCITER UNIT	AMPLIFIER UNIT
1 — RCA 843	4 — UV 204-A
1 — RCA 865	2 — UV 849
5 — UV 203-A	4 — UV 872
2 — UV 845	1 — Cathode Ray Tube
2 — UV 872	

RCA — HIS MASTER'S VOICE

NRA

RCA VICTOR COMPANY, INC.

CAMDEN, N. J., U. S. A.

"RADIO HEADQUARTERS"

New York: 153 E. 24th St.
Chicago: 111 N. Canal St.
Atlanta: 150 Walton St., N.W.
San Francisco: 235 Montgomery St.
Dallas: Santa Fe Bldg.

BRANCH OFFICES in: Rio de Janeiro - Yokohama - Shanghai - Buenos Aires - Santiago (Chile)

NEW HAMMARLUND PRODUCTS

The Hammarlund Mfg. Co., 424 W. 33d St., New York City, announces the following new products:

Short-Wave Coil Forms.—The low losses and stability of these forms provide for efficient high frequency reception under all conditions, being made of extruded Isolantite, a material closely approximating the ideal qualities of fused quartz.

Equipped with convenient black enameled wooden handle with a flat top in which is inserted a removable paper disc for writing in frequencies. A celluloid disc protects the paper, a spring ring holding the disc in place. Surface is "non-skid," eliminating troubles encountered in winding on slippery surfaces. The enormous holes provided in the form make drilling unnecessary. The form is 1½" in diameter and 2½" long exclusive of knob and prongs. Made in 4, 5, and 6 prong types to fit the standard sockets.

Ultra Short-Wave Coil Forms.—These

Short-wave coil form

Ultra short-wave coil form

Shielded r-f. choke

forms are designed for maximum efficiency at ultra high frequencies, or within the 28 to 56 megacycle band. Being made of Isolantite, and having correct form factor, high frequency resistance is at a minimum and absolute stability is achieved. The number and location of holes facilitates securing the exact inductance desired and permits of almost any conceivable type of experimental winding.

Form is 1⅛" in diameter and 2" long exclusive of prongs:

Made only in five-prong type to fit standard sockets.

Shielded R-F. Chokes. A new and improved shielded choke for general use in high gain circuits. The coil unit is completely shielded in an aluminum shell resulting in minimum external field and permitting compact receiver design without stray coupling to cause instability or feedback. Universal wound pies are thoroughly impregnated to prevent moisture effects. The multiplicity of pies provides both high inductance and low distributed capacity resulting in extremely high impedances to all frequencies within the short wave and broadcast bands.

The mounting legs provided are on 1 11/16" centers.

EBY UNIVERSAL ADAPTOR

The H. H. Eby Manufacturing Company, Inc., 21st and Hunting Park Ave., Philadelphia, Pa., has brought out a new type of universal analyzer adaptor which, with the use of a good multi-range meter, performs all the functions of the modern analyzer or tube checker and is not restricted to any circuit or tube limitations.

This new instrument consists of a long-handled plug with grid connector, cable and small plug, a test panel having two seven-prong sockets and twenty-one jacks

with insulated jumpers, and a set of eight special adaptors. These parts are fitted into a neat imitation leather-covered carrying case.

In use, the tube for the receiver stage being tested is replaced by the long handled plug, the tube being placed in one of the test panel sockets and the small plug end of the cable is plugged into the remaining socket of the test panel. Now, to test any series circuit conditions for any element of the tube in question, the jumper is removed for any particular element according to the pin number indicated by the chart which comes with the adaptor, and a suitable meter inserted into the circuit through the use of pin jacks and leads. For testing a condition between elements, they are chosen according to number and a test made between jacks connected to the respective elements.

For other than seven-prong tubes, the adaptors are used in pairs in conjunction with the long-handled plug and the socket of the test panel into which the tube is to be placed.

The new Eby universal analyzer adaptor is known as Model No. 733.

◆

TAUSSIG MASTERDIAL ELIMINATES CHARTS AND TABLES IN READING METERS

The Masterdial is a new invention which eliminates meter calibration troubles.

Through the use of the Masterdial, an ordinary single-range milliammeter is immediately converted into an instrument having hundreds of different applications. Using the meter in various suitable circuits, the Masterdial is calibrated to read numerous voltage ranges, both a-c. and d-c. It is also calibrated to read resistances, capacities, etc.

The Masterdial consists of a calibrated roll of fine wove linen, fastened above the meter in such a way that it does not interfere with the reading of the meter scale. A knurled metal knob at one end permits the roll to be wound up, while a similar knurled knob at the other end permits it to be unwound. A metal slider with a mica window may be moved laterally across the face of the roll. Above the roll, there is a scale printed on celluloid, which is identical with the scale on the meter face. Thus, suppose that the device is to be used on a voltmeter calibrated from 0 to 1, in 100 equal divisions. The Masterdial would then be furnished with a similarly calibrated celluloid scale. By changing the multipliers the same meter may be used for any desired range. A slight turn of the knurled knob on the Masterdial then brings the corresponding calibrated scale into view.

Sixteen different calibrations are provided on the Masterdial roll and in addition four spaces are available for the engineer to fill in his own calibrations. Circuit diagrams are furnished with the instrument showing how to connect up a single meter for a-c. or d-c. measurements using a Taurex rectifier, how to use this meter as an ohmmeter, as a capacity meter, etc. When the meter is connected according to these diagrams, the sixteen calibrated scales on the Masterdial can then be used to read off the values required.

For example, if the meter is connected to read capacities of from .1 to 4 mfds., the roll is unwound until this particular scale shows in the window. If the meter needle reads .58 on a 0 to 1 ma. meter, the mica slider is moved laterally to this point on the upper permanent celluloid scale. The correct capacity reading is clearly readable directly below, in this case having a value of 1 mfd.

The Masterdial is the invention of Leo Taussig, 3245 37th Street, Long Island City, N. Y.

◆

CROSLEY—COCA-COLA RADIO

Novelty radios are coming thick and fast, but few of them combine utility with display value as well as this new Crosley-Coca-Cola set. It is being sold by Crosley direct to dealers as well as through the Coca-Cola Company, as a display piece on soda fountains, and in drug and confectionery stores. The giant bottle replica

stands two feet high, is molded in two pieces of General Plastics' Durez, brilliant scarlet in color, and is equipped with Crosley's standard 165 chassis, using five tubes. The lettering of the words "Coca-Cola" forms the grille over the dynamic speaker, and the translucent green dial is lighted from behind. Tone value and volume are reported good.

SYNTHANE CORPORATION

RIVER ROAD, OAKS, PENNA.

PHILADELPHIA
NEW YORK
CHICAGO
CLEVELAND
BOSTON
DETROIT
ST. LOUIS

SYNTHANE
Laminated Bakelite

MINNEAPOLIS
ATLANTA
NEW ORLEANS
DALLAS
SAN FRANCISCO
DAYTON
PITTSBURGH
KANSAS CITY

SYNTHANE Laminated Bakelite Will Definitely Better Your Product

SYNTHANE laminated bakelite is made of fabric or paper base (according to the grade) impregnated with phenolic resins and laminated under pressure and heat into a solid, homogeneous material. It is made in sheets, rods and tubes. We also supply fabricated parts and gear blanks to your specifications. Any standard grade listed below can be varied to suit your individual requirements.

SYNTHANE is a high quality, dependable material with uniform electrical and physical properties. It has high mechanical and dielectric strength, low moisture absorption and surface leakage, high impact strength, minimum amount of cold flow, and minimum warpage. It is resistant to water, oil and most chemicals.

SYNTHANE can be turned, sawed, drilled, milled, threaded, tapped, punched, bored and machined in any manner desired. It is made with high glossy and dull finishes and can be easily buffed. SYNTHANE is supplied to close thickness tolerances to meet your specifications.

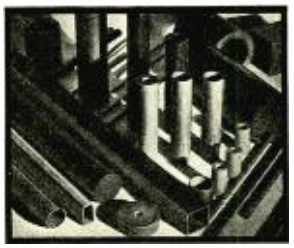
Our engineering department will gladly cooperate with you in developing SYNTHANE to your requirements. Samples for testing sent to your specifications with no obligation.

Standards of Quality For SYNTHANE LAMINATED BAKELITE

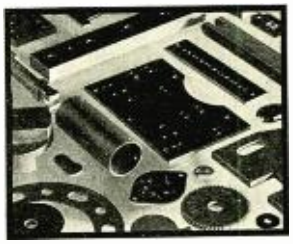
GRADES	X	XX	XXX	XP	C	CE	L	LE
CHARACTERISTICS	For ordinary use where low moisture absorption and good machining and electrical properties are required. Punches and machines easily. Paper base.	For extremely low moisture absorption and high dielectric strength. Machines readily. Paper base.	For unusual applications requiring extreme density and hardness. Has very high resin content. Paper base.	For punching operations. Punches and shears cold upwards to 3/32"; to thicker sizes, depending on temperature of material and type of die. High dielectrical properties. Paper base.	Resilient. High impact strength. Punches easily. Exceptional structural qualities make it usable where high tensile and transverse strength is required. Canvas base.	Same as "C" except better electrical properties (see below). Canvas base.	Resilient, high impact strength. Fine weave fabric base gives easy machining qualities. Punches easily. Fine weave fabric base.	Same as "L" except better electrical properties. Fine weave fabric base.
	Approximate Average	Approximate Average	Approximate Average	Approximate Average	Approximate Average	Approximate Average	Approximate Average	Approximate Average
Tensile Strength, Lbs./Sq.In.	12,500	8,000	7,000	8,000	10,000	9,500	10,000	9.000
Flexural (Transverse) Strength, Lbs./Sq.In.	21,000	16,000	15,000	15,000	20,000	19,000	20,000	19,000
Compressive Strength, Lbs./Sq.In.	.....	.....	.....	.....	38,000	36,000	35,000	37,000
Dielectric Strength, Volts per Mil.-(.001") Short Time	700	700	650	600	150	425	150	500
Step by Step	500	500	450	400	100	275	100	300
Power Factor, $\frac{-6}{}$ at 10 cycles	....	.045	.035	.042	.10	.055	.10	.045
Dielectric $\frac{-6}{}$ Constant at 10 cycles	....	5.5	5.0	5.0	7.0	5.5	7.0	5.0
Dielectric $\frac{-6}{}$ Loss Factor at 10 cycles	....	.25	.18	20	.70	.30	.70	.22
Moisture Absorption—%	4.0	1.3	1.0	4.0	1.7	1.5	2.0	1.2
Color	Natural; chocolate brown surface, natural core; black surface, natural core.	Natural, Black	Natural, Black	Natural; chocolate brown surface, natural core; black surface, natural core; Black.	Natural, Black	Natural, Black	Natural, Black	Natural, Black
SHEETS Size Thickness	36" x 36" .010" upwards.	36" x 36" .010" upwards.	36" x 36" .010" upwards.	36" x 36" .010" upwards.	36" x 36" .015" upwards.	36" x 36" .015" upwards.	36" x 36" .012" upwards.	36" x 36" .012" upwards.
TUBES, RODS Lengths	Wrapped Molded 36".	Molded 36"	Molded 36"	Use Grade X	Molded 36"	Molded 36"	Molded 36"	Molded 36"

SYNTHANE is always equal to and generally better than these standards.

Sheets



Tubes and Rods



Fabricated Parts

Stabilized Gears

Purchasing Guide

The following pages contain information which it is believed will be of value to executives, engineers and purchasing agents. The companies listed are recognized sources of supply whose products thru past and present acceptance and use by the radio, communication, broadcasting and allied industries, have achieved a reputation for merit and satisfactory performance.

In presenting this information, Radio Engineering assumes no responsibility for omissions. We have tried to give comprehensive and accurate information. We have tried to make the information usable and as complete as possible. If we have unintentionally overlooked or omitted information, we'll be only too glad to have it brought to our attention and will make any needed additions in a following issue of the publication.

For the purpose of brevity and convenience, the listings are grouped in rather broad classifications which include groups of related materials or components. See Index below.

INDEX

OUR READERS ARE CORDIALLY INVITED TO COMMUNICATE WITH US AT ANY TIME CONCERNING PRODUCTS WHICH THEY ARE INTERESTED IN PURCHASING. WE WILL BE GLAD TO GIVE PROMPT, UNBIASED INFORMATION REGARDING SOURCES OF SUPPLY.

Broadcasting and Public Address Equipment Amplifiers, Attenuators, Crystals, Decade Boxes, Microphones, Mixers, and Miscellaneous Equipment

AMERICAN TRANSFORMER COMPANY

178 Emmet Street, Newark, N. J.
Date of Organization: 1900

PRODUCTS

Audio, Plate, Filament, Power, Modulation and Testing Transformers, Reactors. and associated equipment for industrial, radio and laboratory application. Also Spot Welding Machines.

EXECUTIVES

C. H. Loutrel.....President
Thomas M. Hunter.....Vice President and Sales Manager
J. L. Schermerhorn.....Vice President and Chief Engineer
Walter Garlick.....Engineer in Amplifier Design
A. A. Emlen.....Engineer. Dry-Type Transformer Design
J. R. Gaston.....Engineer, Oil-Immersed Transformer Design
F. H. Canfield.....Advertising Manager
W. R. Smith.....Purchasing Agent

BRANCH OFFICES OR REPRESENTATIVES

James H. Southard, 420 Market Street, San Francisco, Cal.
Kelburn Engineering Co., 600 W. Jackson Blvd., Chicago, Ill.
Electrical Apparatus Safes Co., 10 High St., Boston, Mass.
Western Radio Engineering, 5th and St. Peters Streets, St. Paul, Minn.
J. W. Jones, 660 So. 18th Street, St. Louis, Mo.
Arthur C. Stallman, 218 Waile Avenue, Ithaca, N. Y.
K. J. Banfer, 1311 Terminal Tower, Cleveland, Ohio.
L. D. Joralemon, 112 So. 16th Street, Philadelphia, Pa.
Arthur L. Pollard, 307 New Sprankle Bldg., Knoxville, Tenn.
Electrical and Mechanical Engineering Co., 612 Title and Trust Building, Phoenix, Ariz.

EXPORT

Ad. Auriema, Inc., 116 Broad Street, New York City.

BEACON MICROPHONE CO.

590 Sumner St., Akron, Ohio.
Microphones.

BLILEY PIEZO-ELECTRIC COMPANY

227 Union Station Bldg., Erie, Pa.

PRODUCTS

Piezo-Electric quartz crystals and holders for use between 20 Kcs and 15,000 Kcs, used in transmitters, receivers, monitors, and laboratory standards.

EXECUTIVES

General Manager.F. Dawson Bliley
Sales Sales Manager.Joseph Haller
Chief Engineer.....C. C. Collman
Production Mgr...Thomas Hellmann
Advertising Mgr.....R. W. Hall

BRANCH OFFICES OR REPRESENTATIVES

Pacific Coast Office: Mr. Don C. Wallace, 4212 Country Club Drive, Long Beach, Calif. . . . Sold through the best radio transmitting parts distributors throughout the United States and many foreign countries.

BRUNO LABORATORIES

20 W. 22nd St., N. Y. C.
Microphones.

BRUSH LABORATORIES

3715 Euclid Ave., Cleveland, Ohio.
Crystal Speakers, Crystals.

THE ALLEN D. CARDWELL MANUFACTURING CORP.

Factory and Sales Offices—81 Prospect Street, Brooklyn, N. Y.
Established 1920

PRODUCTS

Variable and Fixed (air and oil dielectric) Condensers for receivers, transmitters, high frequency furnaces.

Maintains a Contract-Manufacturing Service specializing in designing, or manufacturing to specifications, of Inductances, Transformers, Relays, Automatic Telegraph equipment, electro-mechanical devices and instruments and stamped and welded aluminum and duralumin products.

EXECUTIVES

President and Chief Engineer.....Allen D. Cardwell

EXPORT

Ad. Auriema, Inc., 116 Broad Street, New York, N. Y.

CARRIER MICROPHONE CO.

525 S. Commercial St., Inglewood, Calif.
Microphones.

DAVEN RADIO CO. (See page 44)

158 Summit St., Newark, N. J.
Attenuators and Decade Boxes

DELTA MFG. CO.

37 Osborne St., Cambridge, Mass.
Low Voltage Rectifiers—Rectifier Parts.

DOOLITTLE & FALKNOR

1306 W. 74th St., Chicago, Ill.
Frequency Monitors, B. C. Equipment.

EASTERN COIL CO.

56 Christopher Ave., Bklyn., N. Y.
Microphones and Stands

ELECTRIC SPECIALTY CO.

211 South St., Stamford, Conn.
Converters.

ELECTRICAL RESEARCH LABS.

2500 Cottage Grove Ave., Chicago, Ill.
Amplifiers.

FEDERAL TELEGRAPH CO. (See page 50)

200 Mt. Pleasant Avenue, Newark, N. J.

GATES RADIO & SUPPLY COMPANY

Main Offices and Factory—Quincy, Illinois.
Established 1922.

PRODUCTS

Cable address—GATESRADIO, QUINCY, ILLINOIS

Broadcast station apparatus, public address equipment, centralized sound apparatus, talking picture equipment and other apparatus in the sound communication field.

EXECUTIVES

General Manager.....H. C. Gates
Chief Engineer.....P. S. Gates
Assistant Chief Engineer..P. L. Tourney

GENERAL ELECTRIC CO.

Schenectady, New York.
Transmitting Equipment.

GENERAL RADIO COMPANY

30 State Street, Cambridge, Mass.
(Established 1915)

PRODUCTS

Radio and electrical laboratory apparatus: Frequency-measuring equipment for broadcasting stations, laboratory and governmental monitoring installations; mixer controls, power-level indicators, standard-signal generators, audio- and radio-frequency oscillators, cathode-ray oscillographs, harmonic analyzers, impedance bridges, electrolytic condenser bridges, output power meters; and a complete line of dials, knobs, rheostats, condensers and other laboratory accessories. Also manufacturers of the Edgerton stroboscope.

EXECUTIVES

President.....Melville Eastham
Vice President.....E. H. Locke
Treasurer (General Manager) H. B. Richmond
Engineering Manager..C. T. Burke
Production Manager..E. H. Locke
Purchasing Agent.W. H. Sherwood
Advertising Mgr..John D. Crawford

BRANCH OFFICES OR REPRESENTATIVES

General Radio Company, 274 Brannan Street, San Francisco, Calif.
Leeds Radio Company, 45 Vesey Street, New York City, N. Y. (For laboratory parts and amateur gear.)

EXPORT

Claude Lyons, Ltd., 40 Buckingham Gate, London, S.W. 1, England.
A. A. Posthumus, Vondellaan 15 and 17, Baarn, Holland.
Ing. S. Belotti & C., Piazza Trento 8, Milan, Italy.
Hayward C. Parish, 4th Floor, State Shopping Block, Market Street, Sydney, Australia.
Ad. Auriema, Inc., 116 Broad Street, New York, N. Y.

HAMMARLUND MANUFACTURING COMANY, INC.

424 West 33rd Street, New York City.
Established for over a quarter of a century.

PRODUCTS

Midget condensers in the Midline and Straight Line capacity types; dual Midget condensers; double spaced dual Midget condensers; double spaced Midget condensers; band spread Midget condensers; transmitting condensers single and dual; standard Midline condensers; flexible couplings; Isolantite short wave coil forms and ultra short wave coil forms; Isolantite sockets; screen grid tube shields and triple grid tube shields; "air-tuned" intermediate transformers and oscillator units; standard intermediate frequency transformers; heavy duty transmitting chokes and Isolantite R.F. chokes; high impedance R.F. chokes and shielded R.F. chokes; adjustable padding condensers in single and dual style; Midget trimming condensers and equalizers, "Comet" and Comet "Pro" Superheterodyne receivers for high frequency and all frequency coverage. The condensers and other components are, of course, made in every conceivable size. Among the other special units which are produced by Hammarlund are Western Union call-boxes; variable condensers for air and marine work, and other precision devices.

EXECUTIVES

Oscar Hammarlund .....President
Joseph Lush.....Treasurer
Lloyd A. Hammarlund...Sales Mgr.
H. B. Macartney..Production Mgr.
D. K. Oram.....Chief Engineer
Lewis Winner..Publicity Director

BRANCH OFFICES or REPRESENTATIVES

1438 North 13th Street, Philadelphia, Pennsylvania.
55 Kilby Street, Boston, Massachusetts.
9 South Clinton Street, Chicago, Illinois.
159 East Elizabeth Street, Detroit, Michigan.
1400 West 25th Street, Cleveland, Ohio.
945 East Pico Street, Los Angeles, California.
1264 Folsom Street, San Francisco, California.
917 South West Oak Street, Portland, Oregon.
Box 4101, Station "A," Dallas, Texas.

EXPORT

Rocke International Co., 15 Laight Street, N. Y. C.
White Radio Co., Canadian Representative, 41 West Ave., North, Hamilton, Ontario, Canada.

HYGRADE SYLVANIA CORPORATION

Electronics Department, Clifton, New Jersey

PRODUCTS

Radio Transmitting Tubes, Phototubes, Industrial Power Tubes, Radio Transmitters, Special Radio Receivers, Sound Amplifiers. Broadcast Speech Equipment, Custom-Built Electronic Devices.

EXECUTIVES

W. J. Barkley...General Manager
D. E. Replogle.....Chief Engineer
H. H. Reynolds..Purchasing Agent
C. A. Rice.....Sales Manager

CROWE....

Radio Products for 1933-34

Illustration one-half actual size

NEW tuning units for larger sets now in process, embodying advanced ideas in styles, finishes and mechanical features.

• • •

Remote Controls for automobile radios.
(See illustration at left.)

• • •

A varied line of tuning devices for small compact radios. New applications in small dials, tuning scales and volume controls, either etched or embossed.

• • •

New escutcheons in modernistic finishes, shapes and designs.

• • •

Illustration one-half actual size

A line of escutcheons and tuning units with multi-band scales—for combined short wave, broadcast range and long wave use—for export sale.

• • •

Metal trim in the modernistic trend for wooden cabinets. Designed and made to order only.

• • •

Metal cabinets in the latest finishes for small sets.

• • •

Metal grilles in aluminum and chromium finishes—see illustration—with escutcheons or tuning dials to harmonize.

• • •

Correspondence invited.

CROWE NAMEPLATE AND MANUFACTURING CO.

1749 GRACE STREET **CHICAGO, ILLINOIS**

Broadcasting and Public Address Equipment (Continued)

INT'L BROADCASTING EQUIPMENT CO.
3112 W. 51st St., Chicago, Ill.
Frequency Monitors—Amplifiers.

JENKINS & ADAIR, INC.
3333 Belmont Ave., Chicago, Ill.
Monitors—Microphones, etc.

KELLOGG SWITCHBOARD & SUPPLY CO.
1066 W. Adams St., Chicago, Ill.
Microphones.

OPERADIO MFG. CO.
13th & Indiana Sts., St. Charles, Ill.
Amplifiers—Sound Equipment.

PHILCO RADIO & TELEVISION CORP.
Philadelphia, Pa.
Amplifiers, Sound Equipment.

RCA VICTOR COMPANY, INC.
Camden, N. J.

PRODUCTS
Broadcast Receivers for the Home. Broadcast Transmitters. Electric Phonographs and Records. Sound Reenforcing and Centralized Sound Systems. Radio Communication Equipment for Naval, Merchant Marine, Commercial, Aviation and Police Service. Photophone Sound Motion Picture Equipment for Recording and Reproducing, Portable and Stationary. Industrial and Laboratory Equipment.

EXECUTIVES
Chairman.....David Sarnoff
President.....E. T. Cunningham
Executive Vice President G. K. Throckmorton
Vice President in Charge of Sales.....G. K. Throckmorton
Vice President in Charge of Manufacturing and Engineering.....W. R. G. Baker

THE RADIART CORP.
13229 Shaw Ave., Cleveland, Ohio.
Amplifiers.

THE RAULAND CORPORATION
3341 Belmont Avenue, Chicago, Ill.
Amplifiers.

REMLER COMPANY, LTD.
2101 Bryant Street, San Francisco, Calif.
Transmitting Equipment—Microphones.

SAMSON ELECTRIC INCORPORATED
Subsidiary of S. H. Couch Co., Inc.
89 Broad Street, Boston, Massachusetts

PRODUCTS
Amplifiers, Centralized Radio, Public Address, Recording Equipment, Transformers (power and audio), Chokes (R.F. and filter), Talking Picture Amplifiers, Microphones—carbon, condenser, crystal, dynamic, Microphone Stands, Microphone Cables, etc.

EXECUTIVES
J. E. Atkinson.....President
R. W. Cotton.....Vice-President
Gilbert Smiley.....Chief Engineer
A. T. Morrison....Purchasing Agent

EXPORT
M. Simons & Sons Co., 25 Warren Street, New York City.

SCIENTIFIC RADIO SERVICE
124 Jackson Avenue, University Park, Hyattsville, Md.

PRODUCTS
Crystals for Control of Amateur Transmitters, Broadcast Transmitters, Commercial Short Wave Stations, and for Aircaft Transmitters. Crystals supplied to Radio Receiver Manufacturers for use in their test equipment—to the U. S. Coast Guard, Marine Corps, Dept. of Commerce, Airways Division, and U. S. Naval Reserve.

Scientific Radio Service supplied its first crystal commercially on December 3, 1925 (probably the first organization to supply these crystals for experimental and commercial use). From this date to October 16, 1931 its laboratory was located at Mount Rainier, Md. During this period, demands were so great that it was necessary to build and move into larger quarters. On October 17, 1929, Scientific Radio Service moved into its especially designed laboratory, the structure being a two-story brick building, for the sole production of Piezo Electric Crystals.

Manager and Owner, Harry D. Eisenhauer was one of the pioneers in developing Piezo Electric Quartz Crystals for the control of radio frequencies. From the early part of 1925 to September 1929, Mr. Eisenhauer had charge of the production of crystals at the Naval Research Laboratory, Bellevue, Anacostia, D. C., at which time he resigned to give his full time to his ever expanding business.

SHALLCROSS MFG. CO.
700 Parker Avenue, Collingdale, Pa.
Testing Equipment—Attenuators, Decades, etc.

SHURE BROTHERS COMPANY
215 West Huron Street, Chicago, Illinois

PRODUCTS
Carbon Microphones, Condenser Microphones, Condenser Microphone Power Supplies, Radio Modulator, Microphone Stands, Microphone Cordage, Plugs, Receptacles and Fittings, Microphone Transformers. Mixing and Amplifier Input Transformers, Call-Letter Shields for Microphone Stands. All types of Microphones and related equipment. Expert Microphone repairs.

EXPORT
The M. Simon & Son Co., Inc., 25 Warren Street, New York City.

SOUND ENGINEERING CORP.
412 N. Leavitt Street, Chicago, Ill.
Amplifiers.

STROMBERG-CARLSON TEL. MFG. CO.
Rochester, New York
Sound Equipment—Amplifiers

UNIVERSAL MICROPHONE COMPA.NY, LTD.
424 Warren Lane, Inglewood, Calif.

PRODUCTS
Microphones—all types for broadcasting, amateur and sound uses.

THE WEBSTER COMPANY
850 Blackhawk Street, Chicago, Ill.
Amplifiers.

WEBSTER ELECTRIC COMPANY
Racine, Wisconsin
Established 1909

PRODUCTS
Power Amplifiers, Sound-on-Film Amplifiers, Electric Phonograph Pick-Ups, Radio Transformers and Chokes.

EXECUTIVES
S. A. Loeb.....President
A. C. Kleckner.....Chief Engineer and Vice-President
P. G. Crewe.....Credit Manager
P. A. Karll.....Purchasing Agent
R. Ferda.....Sales Manager

WESTERN ELECTRIC COMPANY, INC.
195 Broadway, New York City.

Founded in 1869. Since 1882 it has been the manufacturer of communication apparatus for the Bell Telephone System. Its research and engineering are conducted by the renowned Bell Telephone Laboratories. The Company has three principal manufacturing plants located at Chicago, Baltimore and Kearny, New Jersey.

PRODUCTS
Radio broadcasting transmitting equipment. Police radio-telephone transmitting equipment. Marine radio-telephone equipment. Aviation communication equipment. Point-to-point radio-telephone equipment. Speech input equipment. Microphones (carbon button, condenser, dynamic types). Vacuum tubes and photo-electric cells. Public address equipment. Music reproducing systems. Program distribution systems. Radio frequency distribution systems. Radio frequency monitoring equipment. Telephone systems, apparatus and cable. Vacuum thermo-couples, cathode ray oscillographs. Audiometers, hearing aids, electrical stethoscope. Talking picture equipment.

BRANCH OFFICES OR REPRESENTATIVES IN THE UNITED STATES
For Aviation Communication Equipment, Marine Radio-telephone Equipment, Point-to-point Radio-telephone Equipment: H. E. Young, General Commercial Engineer, Western Electric Company, Inc., 195 Broadway, New York City.

For talking picture equipment: C. W. Bunn. General Sales Manager, Electrical Research Products, Inc., 250 West 57th Street, New York City.

For all other Western Electric equipment, the distributor is the Graybar Electric Company through their branches.

CANADA

Northern Electric Company, Ltd., 1620 Notre Dame Street, West, Montreal, Quebec.

OTHER COUNTRIES

For Talking Picture Equipment, Audiometers, Hearing Aids, Electrical Stethoscopes: Electrical Research Products, Inc., 250 West 57th Street, New York, N. Y.

For all other equipment: International Standard Electric Corporation, 67 Broad Street, New York City, U.S.A.

Coils and Coil Forms Radio Frequency

(For Chokes, Speaker Coils, etc., see listings under Transformers)

COILS, INC.

GENERAL MANUFACTURING CO.
8066 S. Chicago Avenue, Chicago, Ill.

HAMMARLUND MFG. CO. (See page 37)
424 W. 33rd Street. New York City

MEISSNER MFG. CO.
522 S. Clinton Street, Chicago, Ill.

SICKLES COMPANY
300 Main Street, Springfield, Mass.

Condensers, Fixed. Dry Electrolytic, Wet Electrolytic, Mica and Paper

ACME WIRE COMPANY
New Haven, Connecticut
Paper Condensers and Condenser Parts.

AEROVOX CORPORATION
70 Washington Street. Brooklyn, N. Y.
All types.

CONDENSER CORP. OF AMERICA
259 Cornelison Avenue. Jersey City, N. J.
All types.

CORNELL-DUBILIER CORP.
4377 Bronx Boulevard, New York City
All types.

DONGAN ELEC. MFG. CO. (See page 48)
2995 Franklin Street. Detroit, Mich.
Paper Condensers.

MAGNAVOX CO., LTD.
2131 Bueter Road, Fort Wayne, Ind.
All types.

Condensers, Fixed (Continued)

P. R. MALLORY & CO.
3029 E. Washington Street, Indianapolis, Ind.
All types.

MICAMOLD RADIO CORP.
1087 Flushing Avenue, Brooklyn, N. Y.
All types.

THE MUTER COMPANY
1255 So. Michigan Avenue, Chicago, Illinois

PRODUCTS
Candohm Resistors, Radio and Electrical Products.

EXECUTIVES

President.....Leslie F. Muter	Chief Engineer.....C. M. Kraemer
Vice-President.....A. A. Dailey	Production Mgr..Joseph C. Nasturski
General Manager..Leslie F. Muter	Purchasing Agent.....A. A. Dailey
Sales Manager.....J. R. Scanlon	Advertising Mgr....Leslie F. Muter

BRANCH OFFICES OR REPRESENTATIVES
Edward J. Beckley, 157 Chambers Street, New York, N. Y.
Lombard Smith Co., 425 E. Pico Street, Los Angeles, Calif.

EXPORT
Sylvan Ginsbury—86, Due Du Pelican, Antwerp, Belgium.

RCA VICTOR CO., INC. (See page 40)
Camden, New Jersey
All types.

SOLAR MFG. CORP.
599 Broadway, New York City
All types.

SPRAGUE SPECIALTIES CO.
No. Adams, Massachusetts
All types.

SANGAMO ELEC. CO.
Springfield, Illinois
Mica Condensers.

TOBE DEUTSCHMANN CORP.
Canton, Massachusetts
Paper Condensers, Filters, etc.

Condensers, Variable

ALLEN D. CARDWELL MFG. CO. (See page 37)
81 Prospect Street, Brooklyn, N. Y.

DEJUR-AMSCO CORP.
95 Morton Street, New York City

THE H. H. EBY MFG. CO., INC.
21st & Hunting Park Avenue, Philadelphia, Pa.

GENERAL INSTRUMENT CO.
225 Varick Street, New York City

GENERAL RADIO CO. (See page 37)
30 State Street, Cambridge A, Mass.

HAMMARLUND MFG. CO. (See page 37)
424 W. 33rd Street, New York City

OAK MFG. CO.
308 W. Washington Street, Chicago. Ill.

PRECISE MFG. CO.
254 Mill Street, Rochester, N. Y.

RADIO CONDENSER CO.
Davis Street & Copewood Avenue, Camden, N. J.

SCOVILL MFG. CO.
Waterbury, Conn.

UNITED SCIENTIFIC LABS.
510 Sixth Avenue, New York City

Insulation, Molded and Laminated (Molding Powders)

BAKELITE CORPORATION
River Road, Bound Brook, N. J.

This business was established twenty-four years ago and was founded by Dr. L. H. Baekeland. From a small beginning, it has grown to a point where it now has large modern manufacturing plants and representatives in all the major industrial centers of the country, as well as affiliations in the leading industrial countries in the world.

PRODUCTS
Plastic materials, including transparent resins, molding materials, laminating materials, baking type varnishes, lacquers, cements, and enamels, synthetic resins for air-drying finishes, resinoids for bonding abrasive products and for waterproofing fabrics.

BRANCH OFFICES OR REPRESENTATIVES
Main Office—247 Park Avenue, New York.
Research and Office—230 Grove Street, Bloomfield, N. J.
Plant and Office—River Road, Bound Brook, N. J.
Office—7016 Euclid Avenue, Cleveland, Ohio.
Office—43 East Ohio Street. Chicago, Illinois.
Office—410 Asylum Street, Hartford, Connecticut.

CONTINENTAL DIAMOND CO.
Newark, Delaware

FORMICA INSULATION CO.
4614 Spring Grove Avenue, Cincinnati, Ohio

GENERAL ELECTRIC CO.
Schenectady, New York
(Textolite)

GENERAL PLASTICS INC.
North Tonawanda, N. Y.

PRODUCTS
Durez Moulding Compounds, Durez Insulating Varnishes.

BRANCH OFFICES OR REPRESENTATIVES
H. J. Williams, General Plastics, Inc., 9 S. Clinton Street, Chicago, Ill.
C. F. Landsheft, 28 Burnett Terrace, West Orange, N. J.
R. E. Dodd, General Plastics, Inc., 250 Park Avenue, New York City.
A. W. Hanmer, Jr., P. O. Box 153, Wethersfield, Conn.
C. D. LaMoree, Inc., 1325 San Julian Street, Los Angeles, Calif.
Fred Kennerley, C. D. LaMoree, Inc., 1889 Mission Street, San Francisco, Calif.

EXPORT
Gaston E. Marbaix, Ltd., Vincent House, Vincent Sq., London, S.W. 1, England.
Otomune & Co., Ltd., Junkei-Machi, Sanchome, Osaka, Japan.
McKenzie & Hollard Pty Ltd., Newport, Melbourne W. 15, Australia.

MICA INSULATOR CO.
200 Varick Street, New York City

NAT'L VULCANIZED FIBRE CO.
Wilmington, Delaware

RESINOX CORPORATION
Sales Offices—Terre Haute. Indiana.
Executive Offices—230 Park Avenue, New York City.

PRODUCTS
Molding Resins—Molding Compounds—Laminating Varnishes.

SYNTHANE CORPORATION
Oaks, Pa. (near Philadelphia)
Organized in 1928
New plant constructed and production started during March 1929.

PRODUCTS
Synthane laminated bakelite, Sheets, Rods, Tubes, Fabricated Parts, Stabilized Gear Material.

Synthane Corporation has devoted itself exclusively to the production of laminated bakelite. The plant itself was laid out and built to the requirements of laminated bakelite manufacture. This also guided the selection of equipment and, in several instances, machines were specially designed and constructed that would definitely contribute to a better and more uniform product.

EXECUTIVES
R. R. Titus.....President and Treasurer
Jacob B. Rittenhouse.....Vice President and Secretary

BRANCH OFFICES OR REPRESENTATIVES
Synthane Corporation is represented in all the principal cities in the country. Immediate and personal service on a national scale is a feature of this organization. Export shipments largely to Europe and Asia are handled through the New York and San Francisco offices.

TAYLOR & CO., INC.
Norristown, Pa.

WESTINGHOUSE ELEC. & MFG. CO.
E. Pittsburgh, Pa.
(Micarta)

Resistors, Controls and Rheostats Fixed and Variable Resistances, Carbon and Wire-Wound-Volume and Tone Controls, Voltage Regulators, Suppressors, Etc.

AEROVOX CORP.
70 Washington Street, Brooklyn, N. Y.

ALLEN-BRADLEY COMANY
126 W. Greenfield Avenue, Milwaukee, Wisc.

PRODUCTS
Bradleyometers, Bradleyunits, Bradleystats, Radio Leak, Spark Plug Resistors and Suppressors, Fixed and Variable Resistances, Rheostats, Volume and Tone Controls.

EXECUTIVES

President.....Lynde Bradley	Radio Sales Engineer..D. S. W. Kelly
Sales Manager.....F. F. Loock	Purchasing Agent.....Theron Child
Chief Engineer.....G. O. Wilms	Credit Manager.....E. M. Kroening
	Research Engineer....Lynn Mathias

BRANCH OFFICES

Boston, Mass.	Indianapolis, Ind.	New York, N. Y.
Buffalo, N. Y.	Cleveland, Ohio.	Philadelphia, Pa.
Chicago, Ill.	Detroit, Mich.	Pittsburgh, Pa.
Cincinnati, O.	Milwaukee, Wis.	St. Louis. Mo.

EXPORT
Rocke International Electric Corp.
15 Laight Street, New York, N. Y.

AMPERITE CORP.
561 Broadway, New York City

CARTER RADIO CO.
812 Orleans Street, Chicago, Ill.

CENTRAL RADIO LABORATORIES
900 East Keefe Avenue, Milwaukee, Wisconsin.

PRODUCTS
Variable Resistors and Fixed Resistors manufactured primarily for radio service.

EXECUTIVES
E. R. Stoekle.....President H. E. Osmun.....Vice President
T. B. Inglis.....Secretary

(See page 44)

Resistors, Controls, Rheostats, Etc. (Continued)

BRANCH OFFICES OR REPRESENTATIVES

T. B. Hunter, 160 E. Illinois Street, Chicago, Ill.
Mr. W. J. Kelley, c/o Electrical Apparatus Sales Co., 10 High Street, Boston, Mass.
Samuel K. Macdonald, 220 Riggs Bank Bldg., Washington, D. C.
W. Scharp, c/o Stoner & Heath, 545 Fifth Avenue, New York City, N. Y.
Leslie M. De Voe, 5779 No. Delaware St., Indianapolis, Ind.
Wm. E. Hopper, 411 Georgia Savings Bk. Bldg., Atlanta, Georgia.
L. H. Jackman, 2043 E. 77th St., Cleveland, Ohio.
Jas. J. Backer Co., 109-11 Bell Street, Seattle, Wash.
W. T. McGary, 5651 Cabanne Ave., St. Louis, Mo.
Roland Moeller, 2105 No. Third Street, Milwaukee, Wis.
Merrill K. Franklin, 490 Sexton Bldg., Minneapolis, Minn.
Brickman-Saizow Co., 328 West 11th Street, Kansas City, Mo.
R. C. Merchant, 572 Macabees Bldg., Detroit, Mich.
J. O. Russell, P. O. Box 1255 Little Rock, Ark.
Carl A. Stone Co., Ltd., 209 West 17th Street, Los Angeles, California.

CLAROSTAT MANUFACTURING COMPANY

285 N. Sixth Street, Brooklyn, N. Y.
Established in 1928, succeeding the American Mechanical Labs.

PRODUCTS

Wire Wound Volume Controls, Potentiometers, Fixed Resistors, Ballast Resistors, Tone Controls, Hum Controls, Flexible Resistors, Noise Suppressors—Composition Element Volume Controls, Potentiometers, Tone Controls—Compression Type Rheostats—Fractional Horse Power Motor Speed Controls.

EXECUTIVES

President.....John J. Mucher Chief Engineer.....George Mucher
Controller.....Victor Mucher

BRANCH OFFICES OR REPRESENTATIVES

L. G. Cushing Co., 9 S. Clinton Street, Chicago, Ill.
A. M. Baehr, 1400 W. 25th Street, Cleveland, Ohio.
B. L. Moore, 191 Starin Avenue, Buffalo, N. Y.
Trade Contract Corp., 25 Huntington Avenue, Boston, Mass.
J. J. Perlmuth, 1360 S. Hill Street, Los Angeles, Calif.

EXPORT

M. Simons & Son, 25 Warren Street, New York City.

CONTINENTAL CARBON, INC.

13900 Lorain Avenue, Cleveland, Ohio

PRODUCTS

Continental Carbon Resistors, Continental-Igrad Paper Condensers, Continental Suppressors for automobile radio, Carbon Discs and Carbon Granules for telephone transmitters.

EXECUTIVES

President.....S. H. Fleming Treasurer.....G. F. Benkelman
Factory Manager.....P. T. Isley

BRANCH OFFICES OR REPRESENTATIVES

Marshank Sales Co., 1224 Wall Street, Los Angeles, Cal.
R. C. James Co., 2321 Second Avenue, Seattle, Wash.
W. W. Boyd Sales Co., 9 S. Clinton, Chicago, Ill.
Rossiter & Co., Inc., 25 Warren Stret. New York, N. Y.

CHICAGO TELEPHONE SUPPLY COMPANY

(H. H. Frost, Inc.—Sales Division)
1142-1228 W. Beardsley Avenue, Elkhart, Ind.

PRODUCTS

Volume Controls, Tone Controls, Switches, Fixed Resistances, Head Phones.

EXECUTIVES

President.....F. C. Best Sales Manager.....W. A. Nicely
Chief Engineer.....N. C. Schellenger Purchasing Agent.....E. A. Bedk

THE DAVEN COMPANY

158-160 Summit Street, Newark, New Jersey

PRODUCTS

Power Level Indicators, Meter Multipliers, Mixer Panels, Speech Input Control Apparatus, Attenuators, Potentiometers, Faders, Volume Indicators, Output Meters, Line Equalizers, Attenuation Boxes, Decade Resistances, Resistances, Glastor, Super Davohm wire wound Resistor.

EXECUTIVES

President.....Lewis Newman Chief Engineer....Magnus Bjorndal
Production Manager.....Edward Coxey

BRANCH OFFICES or REPRESENTATIVES

K. J. Banfer Sales Co., 1311 Terminal Tower, Cleveland, Ohio.
Ralph P. Glover, 337 W. Madison Street, Chicago, Illinois.
Merton A. Dobbin, Portland, Oregon.
James H. Southard, 420 Market Street, San Francisco, California.
Frazier Amplification Co., 217 S. Broad Street, Philadelphia, Pennsylvania.

DEJUR-AMSCO CORP.

95 Morton Street, New York City

THE H. H. EBY MFG. CO., INC.

21st & Hunting Park Avenue, Philadelphia, Pa.

ELECTRAD, INC.

175 Varick Street, New York City

ERIE RESISTOR CORPORATION

644 West 12th, Erie, Pa.

PRODUCTS

Fixed and Variable Carbon Resistors—Automobile Suppressors.

EXECUTIVES

President.....G. P. Fryling Production Manager..E. H. Mulcahy
Vice President.....W. H. Fryling Purchasing Agent.....C. M. Emery
General Manager.....H. C. Sherk

BRANCH OFFICES OR REPRESENTATIVES

Wesley S. Block, Jr., 15 E. 26th Street, New York, N. Y.
Elmer E. Mills Co., 205 W. Wacker Drive, Chicago, Ill.

EXPORT

Erie Resistor of Canada, Ltd., 49 Bathurst Street, Toronto, Canada.
Erie Resistor, Ltd., Waterloo Road, Cricklewood, London, N.W. 2, England.

FILTERMATIC MFG. CO.

6913 Dittman Street, Philadelphia, Pa.

PRODUCTS

Octave Tone Control, Fentenna Automobile Antenna, Supertone Table Model Tone Control, Short Wave Noise Suppressor, Filtermatic Antenna Adjusting Coil, Super-Filtermatic Outside Antenna Eliminator.

EXECUTIVES

President.....C. H. Draving

BRANCH OFFICES OR REPRESENTATIVES

Adolph Friedman, 205 East 42nd Street, New York City.
Fred Garner, 43 East Ohio Street, Chicago, Ill.
Derneir Sales Co., 326 D. 3rd Street, Los Angeles, Calif.
L. W. Nutt Sales Co., 618 Dayton Industries Building, Dayton, Ohio.
Coopers Radio Service Co., Bowling Green, Missouri.

EXPORT

Smith Kirkpatric & Co., Inc., 115 Broad Street, New York City, N. Y.

GENERAL RADIO CO. (See page 37)

30 State Street, Cambridge A, Mass.
Controls.

GLOBAR CORP.

Niagara Falls, New York

HARDWICK, HINDLE, INC.

40 Harmon Street, Newark, N. J.
Wire-wound

INTERNATIONAL RESISTANCE CO.

21st and Arch Streets, Philadelphia, Pa.

PRODUCTS

I.R.C. Resistors, Automobile Condensers, I.R.C. Volume Controls, I.R.C. Suppressors, I.R.C. Precision Wire Wound Resistors, I.R.C. Power Wire Wound Resistors.

EXECUTIVES

President.....Ernest Searing Chief Engineer.....Jesse Marsten
Vice-President....Dr. Harold Pender Production Mgr...M. W. Weiscopf
Sales Manager..Daniel J. Fairbanks

BRANCH OFFICES OR REPRESENTATIVES

Geo. E. Anderson, Santa Fe Building, Dallas, Texas.
S. B. Darmstader, 520 N. Michigan Avenue, Chicago, Ill.
Hodges & Glomb, 1264 Folsom Street, San Francisco, Calif.
Albert M. Baehr, 1400 W. 25th St., Cleveland, Ohio.
B. J. Fitzner, 159 E. Elizabeth Street, Detroit, Mich.
Henger-Seltzer Co., P. O. Box 877, Arcade Annex, Los Angeles, Calif.
J. Costello, 1160 Delaware Avenue, Buffalo, N. Y.
Harry W. Gebhard, 55 Kilby St., Boston, Mass., and Liberty Tr. Building, Philadelphia, Pa.
Killam, Inc., 53 4th Street, Portland Ore.
Galen Croxton, 606 Fullerton Bldg., St. Louis, Mo.
Jack L. Hursch Co., 436 Continental Oil Bldg., Denver, Colo.
The Lew Bonn Company, 2504 University Avenue, St. Paul, Minn.
J. E. Muniot, Jr., 918 Union Street, New Orleans, La.
Messrs. Murphy & Cota, 70 Spring Street, N. W., Atlanta, Georgia.
W. S. Reid, 308 E. 17th Street, Kansas City, Mo.
Perry Saftler, 25 Warren Street, New York City.
George O. Tanner, 345 4th Avenue, Pittsburgh, Pa.
A. E. Ackland, Ltd., 189 Clarence Street, Sydney, N. S. Wales, Australia.
T. H. Duncan, Box 242, Wellington, New Zealand.
W. Nissen (Pty.), Ltd., P. O. Box 1655, Cape Town, S. Africa; P. O. Box 1326, Johannesburg, S. Africa; P. O. Box 2420, Durban, S. Africa.
Jose M. Zayas, Compostela 57, Havana, Cuba.

EXPORT

International Resistance Co., Ltd., 74 Wellington St., West, Toronto, Canada.
Dubilier Condenser Co., Ltd., Ducon Works, Victoria Road, North Acton, London, W3, England.
Vitrohm Elektroteknisk Fabrik, Holbergsgade 15, Copenhagen.
Arthur Ludke, G.m.b.H. Unter den Linden 60, Berlin, Germany.
Societe Des Condensateurs De Trevoux, 52 Rue De Dunkerque, Paris, France.

LYNCH MANUFACTURING CO., INC.

51 Vesey Street, New York City

P. R. MALLORY & CO. (Yaxley Div.)

3029 E. Washingotn Street, Indianapolis, Ind.

MICAMOLD RADIO CORP.

1087 Flushing Avenue, Brooklyn, N. Y.

THE MUTER CO. (See page 42)

1255 S. Michigan Avenue, Chicago, Ill.

OHIO CARBON COMPANY

Cleveland, Ohio

OHMITE MFG. CO.

636 N. Albany Street, Chicago, Ill.

PRECISION RESISTOR CO.

334 Badger Avenue, Newark, N. J.
(Wire-wound)

SHALLCROSS MFG. CO.

700 Parker Avenue, Collingdale, Pa.
(Wire-wound)

SPEER RESISTOR CORP.

St. Marys, Pennsylvania

STACKPOLE CARBON CO.

St. Marys, Pennsylvania

SOLAR MFG. CORP.

599 Broadway, New York City

WARD LEONARD ELECTRIC CO

Mt. Vernon, New York

S. S. WHITE DENTAL MFG. CO.

152 W. 42nd Street, New York City
Resistors and Suppressors

Resistors, Controls, Rheostats (Continued)

WIRT COMPANY
5221 Greene Street, Philadelphia, Pa.

Sockets, Dials, Switches, Jacks, Plugs, Escutcheons, Nameplates, Binding Posts, Knobs, etc.

THE D. L. AULD COMPANY
5th Avenue and 5th Street, Columbus, Ohio

PRODUCTS

Radio Escutcheons, Name Plates, Embossed Metal Dials or Plates, Balsa Wood, Metal-clad.

EXECUTIVES

President.....F. H. Auld Vice-Pres.....S. G. Brooks

ALDEN MANUFACTURING CO.
Campello Station, Brockton, Mass.

BASTIAN BROS. CO.
1600 N. Clinton Avenue, Rochester, N. Y.

BEST MANUFACTURING CO.
1200 Grove Street, Irvington, N. J.

CARTER RADIO CO.
812 Orleans Street, Chicago, Ill.

CENTRAL RADIO CORPORATION
Beloit, Wisconsin

PRODUCTS

Tube Sockets, Socket Clips, Transformers, Chokes.

EXECUTIVES

W. T. Bracken.....Vice President and General Manager
W. W. Robinson.....Chief Engineer
C. W. Ramquist.....Auditor

SALES OFFICES

C. Hubert Anderson, Box 307, Fort Madison, Iowa.
Edward F. Aymond. 3750 Urban Avenue, Dallas, Texas.
Lew Bonn Company, 2484 University Avenue, St. Paul, Minnesota.
George R. Clarke, 5551 Vancouver Avenue, Detroit, Michigan.
Dernier Sales Company, 408 F. P. Fay Building, Los Angeles, California.
Gerber Sales Company, 94 Portland Street, Boston, Massachusetts.
L. H. Jackman, 2043 East 77th Street, Cleveland, Ohio.
R. C. James Company, 2319 Second Avenue, Seattle, Washington.
Kay Sales Company, P. O. Box 2116, Tulsa, Oklahoma.
Murphy and Cota. 90 Spring Street. N. W., Atlanta, Georgia.

EXPORT

Smith, Kirkpatrick & Co., 115 Broad Street. New York.

CINCH MANUFACTURING CORPORATION
2335 W. Van Buren Street, Chicago, Ill.

PRODUCTS

Tube Sockets, Radio Plugs, Laminated Plugs, Binding Posts, Tip Jacks, Soldering Lugs, Mounting Strips, Metal Stampings.

CROWE NAME PLATE & MFG. CO.
1749 Grace Street, Chicago, Illinois

PRODUCTS

Tuning Units. Escutcheons (Embossed and Etched). Remote Controls (Auto Radio), Grills and Metal Trim for Cabinets. Dials and Scales, Nameplates (metal), Radio Cabinets (metal).

EXECUTIVES

E. C. Coolidge.....President G. C. Hass.. .Purchasing Agent
Winslow C. Goodwin....Radio Sales Manager

BRANCH OFFICES or REPRESENTATIVES

I. Robinson Smith, 142 Liberty Street, New York City.

EXPORT

Rocke Int'l Electric Corp., 15 Laight Street, New York City.
W. Burt Knight, Inc., 1646 West Adams Street, Los Angeles, California.
C. C. Meredith, Streetsville. Ontario, Canada.

DEJUR-AMSCO CORP.
95 Morton Street, New York City

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EDDIE MFG. CO.
9 W. Illinois Street, Chicago, Ill.

FAHNESTOCK ELECTRIC CO.
46-50 Eleventh Street, Long Island City, N. Y.

GENERAL RADIO CO. (See page 37)
30 State Street, Cambridge, A, Mass.

HOWARD B. JONES
2300 Wabansia Avenue, Chicago, Ill.

THE MUTER CO. (See page 42)
1255 S. Michigan Avenue, Chicago, Ill.

OAK MANUFACTURING CO.
308 W. Washington Street, Chicago, Ill.

SORENG-MANEGOLD CO.
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Speakers and Headphones (Dynamics, Magnetic, Crystal Types)

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Established 1930.

PRODUCTS

Public Address and Sound Equipment including Power Amplifiers for all purposes. Condenser Microphones—Power Supplies. Tuners—Mixers—Recording Apparatus—Speakers—Transformers—Condensers—Phono Pick-ups.

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Chief Engineer..Clifford E. Denton Purchasing Agent.....Oscar Roye
Advertising Manager....Nathaniel Feiner

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M. Roye, 631 Spring Street, N.W., Atlanta, Ga.
Walter Fischer, 343 Blvd. of the Allies, Pittsburgh, Pa.
N. Love, 273 Central Avenue, Newark, N. J.
William Carduner, 25 Park Place, New York City.

EXPORT

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BEST MANUFACTURING CO.
1200 Grove Street, Irvington, N. J.

BRUSH LABORATORIES
3715 Euclid Avenue, Cleveland, Ohio

C. F. CANNON CO.
Springwater, New York

CHICAGO TEL. SUPPLY CO. (H. H. Frost, Inc.) (See page 44)
Elkhart, Indiana
Headphones

ELECTROPHONE CORP.
Philadelphia, Pennsylvania

JENSEN RADIO MFG. CO.
6601 S. Laramie Avenue, Chicago, Ill.

MAGNAVOX CO., LTD.
Fort Wayne, Indiana

OPERADIO MFG. CO.
13th & Indiana Street, St. Charles, Ill.

PHILCO RADIO & TEL. CORP.
Philadelphia, Pennsylvania

RCA VICTOR CO. (See page 40)
Camden, New Jersey

RACON ELEC. CO., INC.
52 E. 19th Street, New York City

A. I. Abrahams.....President
C. J. Brown.....Sales Engineer
A. I. Abrahams .....Chief Engineer

PRODUCTS

Air Column Horns, Electro-dynamic Speakers, High-frequency Speakers, Public Address Equipment.

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THE RUDOLPH WURLITZER MFG. CO.
North Tonawanda, New York

STEWART-WARNER CORP.
Chicago, Illinois

STROMBERG-CARLSON TEL. MFG. CO.
Rochester, New York

TRIMM RADIO MFG. CO.
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Headphones only.

UTAH RADIO PRODUCTS CO.
820 Orleans Street, Chicago, Ill.

VICTORY SPEAKERS, INC.
7131 East 14th Street, Oakland, Calif.

WESTERN ELECTRIC CO.
50 Church Street, New York City

WRIGHT-DE COSTER, INC.
St. Paul, Minnesota

Transformers and Chokes (Speaker Coils)

THE ACME ELEC. & MFG. CO.
1440 Hamilton Avenue, Cleveland, Ohio.

PRODUCTS

Radio Transformers—Neon Transformers.

EXECUTIVES

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Vice-President.....J. A. Comstock Production Manager...Wm. Radon
Sales Manager.....C. H. Bunch Purchasing Agent..J. A. Comstock
Advertising Manager.C. H. Bunch

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(Neon) A. D. Strathy, 125 Church Street, New York City.
C. H. Fryburg, 215 S. 5th Street, Philadelphia, Pa.

Transformers and Chokes (Continued)

W. E. Judge, 606 Atlantic Avenue, Boston.
A. M. Baehr, 1400 W. 25th Street, Cleveland, O.
F. C. Somers, 2004 Grand Avenue, Kansas City, Mo.
R. M. Campion, Box 4101, Sta. A, Dallas, Texas.
Jas. J. Backer Co., 109 Bell Street, Seattle, Wash.
Lombard Smith Co., 425 E. Pico St., Los Angeles, Calif.
O. A. Huber, 341 10th Street, San Francisco, Calif

AMERICAN TRANSFORMER CO. (See page 37)
178 Emmet Street, Newark, N. J.

CENTRAL RADIO CORP. (See page 46)
Beloit, Wisconsin

CHICAGO TRANSFORMER CORP.
2626 W. Washington Boulevard, Chicago, Ill.

DONGAN ELECTRIC MFG. COMPANY
2987-3001 Franklin Street, Detroit, Michigan
Established 1809

PRODUCTS
Transformers, Radio Power, Audio, Special, Neon, Oil Burner, Chokes, Condensers.

EXECUTIVES
President.....L. J. Hicks Vice President..Hugh H. Littlebury

BRANCH OFFICES or REPRESENTATIVES
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H. A. Ledig, 1712 67th Avenue, Philadelphia, Pennsylvania.
R. C. James Co., 2319 Second Avenue, Seattle, Washington.
J. H. Healey Co., 120 Pearl Street, Boston, Massachusetts.
Lyman C. Reed, 709 Girard Street, New Orleans, Louisiana.
A. G. Werner, 5522 South 37th Street, St. Louis, Missouri.
S. H. Stover. 704 Century Building. Pittsburgh, Pennsylvania.
G. A. Fischer, Room 608, 47 S. Pennsylvania Street, Indianapolis, Indiana.
O. E. Rosche, 1913 57th Street, Milwaukee. Wisconsin.
Sierra Equip. Corp., 445 South San Pedro Street. Los Angeles, California.
Sierra Equip. Corp., 361 Ninth Street, San Francisco, California.

THE FRANKLIN RADIO CORP.
Dayton, Ohio

GENERAL RADIO CORP. (See page 37)
30 State Street, Cambridge A, Mass.

GENERAL TRANSFORMER CORP.
1900 N. Kilbourn Avenue, Chicago, Ill.

THE HALLDORSON COMPANY
4500 Ravenswood Avenue, Chicago, Ill.

JEFFERSON ELECTRIC CO.
Bellwood, Illinois.

KENYON TRANSFORMER CO., INC.
122 Cypress Avenue, New York, N. Y.

PRODUCTS
Amplifiers, Transformers and Reactors.

EXECUTIVES
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A. H. Beach.....Controller R. J. Philipps.....Chief Engineer

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Jules W. Beneke, 377 Arcade Building. St. Louis, Missouri.
Jas. J. Backer & Co., 109-11 Bell Street, Seattle, Washington.
Joseph Gardberg, 915 Atlantan Hotel, Atlanta, Georgia.
Harry Gerber, Gerber Sales Co.. 94 Portland Street. Boston.
R. O. Holland, 520 North Spring Street, Greensboro, North Carolina.
Frank H. Kaiser, 510 Prudential Building. Buffalo, New York.
Howard P. Hardesty, 356 East Grand Boulevard. Detroit, Michigan.
Kay Sales Co., P. O. Box 2116. Tulsa. Oklahoma.
Ray Kirby, Route No. 3, Box 581-E, Ferguson Road, Dallas, Texas.
Byron L. Moore, 191 Starin Avenue, Buffalo, New York.
J. O. Olsen, 5314 Beelermont Place, Pittsburgh, Pennsylvania.
Arnold Sinai, 626 Powell Street. San Francisco. California.
Conrad R. Strassner, 7840 Fareholm Drive, Los Angeles, California.
Wilmer S. Trinkle, 1438 North 13th Street, Philadelphia, Pennsylvania.
Samul Bialek, 205 East 42nd Street, New York City.

EXPORT
M. Simons & Sons, 25 Warren Street, New York City.

KINGSTON PRODUCTS CORP.
Kokomo, Indiana

RCA VICTOR CO., INC. (See page 40)
Camden, New Jersey

THE RADIART CORPORATION
13229 Shaw Avenue, Cleveland, Ohio

STANDARD TRANSFORMER CORP.
850 Blackhawk Street, Chicago, Ill.

THORDARSON ELEC. MFG. CO.
500 W. Huron Street. Chicago, Ill.
Power Filament, Audio Transformers, Reactors, Microphone and Line Coupling Transformers

UNITED TRANSFORMER CORP.
264 Canal Street, New York City

Testing Instruments (For Manufacturing, Broadcasting, Service and Laboratory)

APPARATUS DESIGN CO.
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Tube Testers.

ALLEN DUMONT LABS.
Upper Montclair, New Jersey
Cathode Ray Equipment—Oscillographs—Telautographs.

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Fairview Avenue, Boonton, N. J.
Micro-Volters.

GENERAL ELECTRIC CO.
Schenectady, New York
Meters.

GENERAL RADIO CO. (See page 37)
30 State Street, Cambridge A, Mass.

HICKOK ELEC. INST. CO.
10514 DuPont Avenue, Cleveland, Ohio
Tube Testers.

INTERNATIONAL RESISTANCE CO. (See page 44)
Philadelphia. Pennsylvania
Volt-Ohmmeters

G. F. LAMPKIN
146 W. McMillan Street, Cincinnati, Ohio
Monitors.

PREMIER CRYSTAL LABS., INC.
55 Park Row, New York City
Impedance Measuring Devices.

RCA VICTOR CO., INC. (See page 40)
Camden, New Jersey

RADIO PRODUCTS CO.
5th & Norwood. Dayton, Ohio
Tube Testers.

RADIO RESEARCH CO., INC.
9th & Kearny Streets, N. E., Washington, D. C.
Special Instruments to Order.

RAWSON ELEC. INST. CO.
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Voltmeters, Electrical Measuring Instruments, Thermocouples, etc.

READRITE METER WORKS
136 E. College Avenue, Bluffton, Ohio
Meters.

SHALLCROSS MFG. CO.
700 Parker Avenue, Collingdale, Pa.
Wheatstone Bridge—Decades, etc.

SUPREME INSTRUMENTS CORP.
Greenwood, Mississippi
Tube Testers.

WESTERN ELECTRIC CO. (See page 40)
50 Church Street, New York City

WESTINGHOUSE ELEC. AND MFG. CO.
East Pittsburgh, Pa.
Meters.

WESTON ELECTRICAL INSTRUMENT CORP.
Newark, N. J.
(Established in 1888)

PRODUCTS
Electrical measuring instruments of all types and for all classes of service, Standard Cells, Elec'l Tachometer and Speed Indicating Equip., Sensitive Control Relays, Photoelectric Cells and Associated Apparatus and Radio Service Equipment, Tube Testers.

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Vice-President.....Caxton Brown W. N. Goodwin, Jr.
Sales Manager Production Manager....R. R. Lambe
H. Leigh Gerstenberger Purchasing Agent.....A. R. Briggs
Advertising Manager..Sidney Cassey

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Albany—Schiefer Electric Co., Inc., 100 State Street.
Atlanta—E. A. Thornwell, Candler Building.
Boston—James O. Murray, 126 Newbury Street.
Buffalo—Schiefer Electric Co., Inc., 891 Ellicott Square.
Charlotte—E. H. Gilliam Co., 1009 W. Morehead Street.
Chicago—Weston Electrical Instrument Corp., 1640 Walnut Street
Cincinnati—Beedle Equipment Co., 906-7 Peoples Bank Building
Cleveland—The Walter P. Ambos Co., 983 The Arcade.
Dallas—T. C. Ruhling Co., 603 Burt Bldg.
Denver—J. W. Van De Grift, 623 Charles Building.
Detroit—T. F. Mueller, 713-14 Stephenson Building.
Knoxville—Bowditch & Co., P. O. Box 3145.
Jacksonville—Ward Engineering Co., 1052 E. Bay Stret.
Kansas City, Mo.—C. B. Fall Co., Commonwealth Hotel.
Knoxville—Arthur L. Pollard, 515 21st Street.
Los Angeles—Electrical Eng. Sales Co., 575 Subway Terminal Building.
Meriden, Conn.—John S. Isdale, 16 Prospect Avenue.
Minneapolis—Howard & Geeseka, Inc.. 1008 Marquette Avenue.
Minneapolis—John T. Jones (Iowa-Nebr.), 106 First Ave. No.
Newark, N. J.—J. R. Hemion, 614 Frelinghuysen Avenue.

(See page 50)

The latest and most modern book featuring exclusively Public Address and Sound Equipment is ready—yours for the asking! It contains much valuable information on the choosing of proper public address equipment written by Clifford E. Denton. It is a valuable reference book of the newest sound amplification devices and a definite selling aid. It contains list prices for direct client solicitation and a separate listing of confidential prices to the trade.

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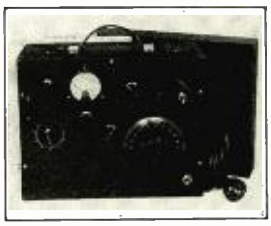
MODEL 310
SERVICE MAN'S SIGNAL GENERATOR

Here is a brand new idea to fill the complete needs of the small radio set manufacturer, service laboratory and service man. This unit can perform every standard factory test made on a receiver today.



1. **Leakage below one microvolt.**
2. **Variable measured percentage of modulation.**
3. **Calibrated attenuation in microvolts.**
4. **Frequency calibration from 100 to 1500 kilocycles.**

and many other features—send for a descriptive pamphlet describing the No. 310 Signal Generator completely.....**Price $95.00**

STATION CATHODE RAY PERCENTAGE MODULATION AND DISTORTION ANALYZER

An inexpensive, small, yet effective method of measuring percentage modulation and analyzing distortion. Particularly useful for general broadcast station measurement work. Designed for rack mounting and extremely simple to control.

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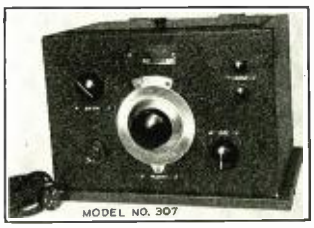

1. **Semi logarithmatic curve.**
2. **Accuracy guarantee 3%.**
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6. **Output 3,000 ohm on level O D.B.**
7. **Good stability.**

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Price: $82.50

Best Frequency Oscillators designed to order to cover any ranges between 0 to 250,000 cycles.

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Pittsburgh—Superior Engineering Co., 810 Penn Avenue.
Rochester—Schiefer Electric Co., Inc., 89 East Avenue.
San Francisco—C. F. Henderson, 420 Market Street.
Seattle—Eicher & Bratt, 263 Coleman Building.
St. Louis—C. B. Fall Co., 705 Star Building.
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179 Varick Street, New York City
Cathode Ray Equipment—Beat Frequency Oscillators.

Tubes—Receiving and Transmitting Photo Cells — Cathode Ray Tubes

ARCTURUS RADIO TUBE COMPANY
Newark, New Jersey

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C. E. Stahl.....Vice-President and General Manager
George Lewis.....Vice-President
M. E. Dorn.....Secretary and Treasurer
John Glauber.....Chief Engineer
J. Geartner.....Sales Promotion Manager

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Duppy, Minneapolis, Minnesota.
T. L. Hursch, Denver, Colorado.
Tri-State Sales Co., Dallas, Texas.
Houran Sales Company, Seattle, Washington.
T. B. Pritchard, Los Angeles, California.
P. F. Madden, McKeesport, Pennsylvania.

EXPORT
Export sales handled direct by T. P. Feeney, Export Manager.

CHAMPION RADIO WORKS, INC.
90 Holten Street, Danvers, Mass.

HERMAN A. DEVRY, INC.
57 E. Wacker Drive, Chicago, Ill.

ALLEN B. DU MONT LABORATORIES
9 Bradford Way, Upper Montclair, N. J.

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H. C. Gawler, 15 E. 26th Street, New York, N. Y.
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O. P. Smith Co., 844 Rush Street, Chicago, Ill.
H. B. Parke Co., 302 Starr Bldg., Pittsburgh, Pa.
Handel-Davies Co., Chester 12th Bld., Cleveland, Ohio.
Charles S. Peters, 1600 Clark Avenue, St. Louis, Mo.
C. H. Annis Co., 2004 Grand Avenue, Kansas City.
Milton A. Ausman, 1716 90th Avenue, Oakland, Calif.
J. J. Backer & Co., 109-11 Bell St., Seattle, Wash.
J. T. Hill Sales Co., 1724 S. Flower Street, Los Angeles, Cal.

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FEDERAL TELEGRAPH COMANY, INC.
200 Mt. Pleasant Avenue, Newark, N. J.

PRODUCTS
Radio Transmitting Tubes and Rectifiers, Radio Transmitters and Receivers, Radio Compasses, Associated Equipment.

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Photo-cells

GENERAL ELECTRIC CO.
Schenectady, New York.

GENERAL SCIENTIFIC CO.
4828 S. Kedzie Avenue, Chicago, Ill.
Photo-cells

GOLD SEAL MANUFACTURING CO., INC.
127 S. 15th Street, Newark, N. J.

GRIGSBY-GRUNOW CO.
5801 Dickens Avenue, Chicago, Ill.

HYGRADE SYLVANIA CORPORATION
500 Fifth Avenue, New York City.

PRODUCTS
Receiving and Transmitting Tubes of all Types. Photo Cells, Broadcasting Equipment, Police Radio Equipment, Incandescent Lamps.

EXECUTIVES
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E. J. Poor.....Chairman of the Board
W. E. Poor.....Vice-President in Charge of Manufacturing
S. N. Abbott.....Sales Manager (Jobber-Dealer Sales) Receiving Tubes and Incandescent Lamps
C. G. Pyle.....Sales Supervisor
P. S. Ellison.....Advertising Manager (Tubes)
R. A. Poor.....Advertising Manager (Lamps)
W. A. Coogan.....Export Manager
C. W. Shaw.....Asst. Manager Equipment Sales
R. M. Wise.....Chief Tube Engineer

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Plants located at Emporium, Pennsylvania, Salem, Massachusetts, St. Marys, Pennsylvania, Clifton, New Jersey.
Offices located at Emporium, Pennsylvania; 500 Fifth Avenue, New York City; 10 Post Office Square, Boston, Massachusetts; 445 Lake Shore Drive, Chicago, Illinois, and 3440 South Hill Street, Los Angeles, California.

HYTRON CORP.
Salem, Mass.

JOHNSONBURG TUBE CO.
Johnsonburg, Pa.

THE KEN-RAD CORPORATION
Owensboro, Kentucky
Organized 1922

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Radio tubes for all receiving sets.

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H. S. Dunning....Works Manager
C. C. Mathews.....Sales Manager
Carl R. Zimmer.....Treasurer
G. W. Bain.....Chief Engineer

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J. H. Kartack Company, 1547 University Avenue, St. Paul Minnesota.
W. Bert Knight, Inc., 1646 West Adams Blvd., Los Angeles, California.
Ernest Kauer & Company, 227 Broad Street, Providence, R. I.
Leo Freed and Associates, 1457 Broadway, New York, N. Y.
H. J. Lenicheck Company, 830 Eighteenth Street, Denver, Colorado.
L. R. O'Brien, 1700 Greenleaf Avenue, Chicago, Illinois.
Frank G. Risher, 3360 North Meridian Street, Apartment C-4, Indianapolis, Indiana.
H. A. Schanaker, 2129 Pine Street, St. Louis, Missouri.
Kay Sales Company, P. O. Box 2116, Tulsa, Oklahoma.
L. P. Naylor, 3222 Sequoia Avenue, Baltimore, Maryland.
C. H. Shuptrine, 2625 Meadowbrook Drive, Cedar Rapids, Iowa.
Jas. J. Backer Company, 109 Bell Street, Seattle Washington.
Albert F. Lotz, 191 Sterling Avenue, Buffalo, N. Y.
Southwestern Radio Sales Co., 212 Thomas Building, Dallas, Texas.

EXPORT
Leonard L. Minthorne Company, 116 Broad Street, New York City.

NATIONAL UNION RADIO CORP.
400 Madison Avenue, N. Y. C.

RCA RADIOTRON COMPANY, INC.
Factories and Laboratories—415 S. Fifth Street, Harrison, N. J.
Sales Headquarters—Front and Cooper Streets, Camden, N. J.

PRODUCTS
Broadcast Receiving Tubes and Receiving and Transmitting Tubes for Amateur and Experimental Use.

RCA Radiotron Company, Inc., was incorporated as a subsidiary of Radio Corporation of America January 1, 1930, to take over the manufacturing activities of General Electric Company and Westinghouse Electric and Manufacturing Company, and the commercial activities of Radio Corporation of America, relating to vacuum tubes and other apparatus in the field of radio purposes.

In November, 1932, a unification of the sales direction of RCA Radiotron Company, Inc., and E. T. Cunningham, Inc., was effected, and the same progressive program has since been applied to both brands of radio tubes.

EXECUTIVES
President.....E. T. Cunningham
Vice President Manufacturing.....J. M. Smith
Executive Vice President.....G. K. Throckmorton
Secretary and Treasurer.....F. H. Corregan
Vice President, Engineering.....J. C. Warner
Asst. Treas. and Asst. Secy.....F. H. Troup
Sales Manager.....C. R. King
Sales Promotion & Adv. Mgr.....T. F. Joyce
Mgr., Equipment Mfrs. Sales & Service.....Meade Brunet

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District 2—H. C. Brown, District Manager, 2009 Holland St., Utica, N. Y.
District 4—F. B. Wanselow, Manager, Front & Cooper St., Camden, N. J.
District 6—P. M. Jeffreys, District Manager, 498 Spring St., Atlanta, Ga.

WESTERN DIVISION
F. H. Larrabee, Division Mgr., 520 N. Michigan Blvd., Chicago
District 5—H. A. Edwards, Manager, 925 Euclid Ave., Cleveland, Ohio.
District 7—R. A. Graver, District Manager, 520 N. Michigan Blvd., Chicago, Ill.
District 8—F. E. Harding, Manager, 4415 Aldrich Ave.. S., Minneapolis, Minn.
District 10—J. W. Cooke, Manager, 2200 Griffith St., Dallas, Texas.
District 11—E. L. Sutton, Manager, 325 Ninth St., San Francisco, Calif.
District 12—E. L. Sutton, Manager, 325 Ninth St., San Francisco, Calif.

EXPORT
RCA Radiotron Company, Inc., exports tubes throughout the world and through its Export Division actively cooperates with its distributors in all locations.

Tubes, Etc. (Continued)

RCA VICTOR CO., INC. (See page 40)
Camden, New Jersey.

RAYTHEON PRODUCTION CORP.
30 E. 42nd Street, N. Y. C.

TELEPHOTO & TELEVISION CORP.
133 W. 19th Street, N. Y. C.

TRIAD MANUFACTURING CO.
Pawtucket, Rhode Island.

TUNG-SOL RADIO TUBES, INC.
95 Eighth Avenue, Newark, N. J.

WESTON ELEC. INST. CORP. (See page 48)
Newark, New Jersey.

WESTINGHOUSE ELEC. & MFG. CO.
E. Pittsburgh, Pa.

WESTERN ELECTRIC CO. (See page 40)
50 Church Street, N. Y. C.

Tube Machinery

CENTRAL SCIENTIFIC CO.
460 E. Ohio Street, Chicago, Ill.

EISLER ELECTRIC CO., INC.
750 S. 13th Street, Newark, N. J.

INT'L MACHINE WORKS, INC.
927 Van Wagenen Place, N. Bergen, N. J.

KAHLE ENGINEERING CO.
320 Manhattan Avenue, Union City, N. J.

LEPEL HIGH FREQUENCY LABS.
39 W. 60th Street, N. Y. C.
Bombarders, etc.

Tube Parts and Materials (including Wire)

ALLOY METAL WIRE CO., INC.
Moore, Penna.

ALO LABORATORIES
Glenwood Avenue, Bloomfield, N. J.
Parts.

AMERICAN ELECTRO METAL CORP.
Lewiston, Maine.

PRODUCTS
Molybdenum and Molybdenum Tungsten Alloys in all forms—Grid Wire, Support Wire, Furnace Wire.

EXECUTIVES
President.....Dr. Paul Schwarzkopf Vice President.....Rudolf Lowit

EXPORT
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Deutsche Gluehfadenfabrik, Berlin, Germany.
Metallwerk Plansee Ges.m.b.H., Reutte, Austria.
Technisches Bureau Willi Schwarzkopf, Vienna, Austria.

AMERICAN LAVA CORPORATION
Chattanooga, Tennessee.
Established 1903.

PRODUCTS
Insulating parts for receiving tubes and broadcasting tubes. For these parts, specially treated Lava, Magnesia and Alumina form the raw materials. Also a new ceramic insulating body to which through derivation from its constituent materials, is given the name of "Alsimag." "Alsimag" combines high dielectric strength with a low loss factor and unusual mechanical strength, while porosity tests show only 0.02 per cent absorption by weight. The co-efficient of expansion at 900° C. has tested as low as 2.93 x 10—⁶. In practice "Alsimag" is being used advantageously, not only in highly specialized applications, but in all ordinary appliance work where it insures against current leakage.

EXECUTIVES
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Sales Manager..Gus E. Richter, Jr. Treasurer.....Warren A. Jeffords
Asst. Sales Mgr....Carl R. Hower Engineer in Charge'Frank J. Stevens

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Boston—No. 80 Federal Street, Room 223.
Chicago—1112 Merchandise Mart.
Cleveland—Newman Stearns Building.
Newark—Globe Indemnity Bldg.
St. Louis—1623 Locust Street.
San Francisco—163 Second Street
Washington—Room 441, Evening Star Building.

ART WIRE & STAMPING CO.
16 Boyden Place, Newark, N. J.

CALLITE PRODUCTS CO.
540 39th Street, Union City, N. J.

PRODUCTS
Tungsten and Molybdenum Products in shape of rods, sheet and wire filament; Tugsten and Refractory Contacts; Radio Products, Refractory Carbide Tools and Dies; Lead-in wire, Kulgrid wire, etc.

EXECUTIVES
President.....C. A. Laise Chief Engineer... {M. Rogers and G. Wheeler
Vice-President.....C. Kraft
General Manager.....C. A. Laise Production Managers.....C. Kraft
Sales Manager.....J. Kurtz Purchasing Agent.....Geo. Dewy
Advertising Manager.....J. Storrs

BRANCH OFFICES OR REPRESENTATIVES
Eisler Electric Corp., Newark, N. J.
International Wire Co., North Bergen, N. J.

EXPORT
R. G. McLoid, London, England.
International Save Co., Paris, France.
Braun & Braun, Vienna, Austria.
Gladitz, Berlin, Germany.

CLEVELAND WIRE CLOTH & MFG. CO.
3573 E. 78th Street, Cleveland, Ohio.

HENRY L. CROWLEY & COMPANY, INC.
1 Central Avenue, West Orange, N. J.

PRODUCTS
Ceramic Products (Crolite) Tubing, Insulator
Radio Tube Parts Heat-proof Materials
Spacers for Radio Tubes Coil Forms, Crolite
Cathode Insulators Resistor Tubing
Insulating Materials Heaters, Tubes for Radio Tube

EXECUTIVES
Henry L. Crowley.....President George Crowley.....Sales Manager
Robert Crowley....Production Manager

DRIVER-HARRIS COMPANY
Harrison, New Jersey.
Alloy wires

FANSTEEL PRODUCTS CO., INC.
N. Chicago, Illinois
Tantalum—Molybdenum

WALTER GILBY ALLOY COMPANY
850 Mt. Prospect Avenue, Newark, N. J.
Svea, Nickel, Alloy Wires.

GILBY WIRE COMPANY
150 Riverside Avenue. Newark, N. J.

PRODUCTS
Bare and Carbonized Nickel Ribbon—Nickel Support Wire—Grid Wire—Filament Wire—Nickel Chromium and Copper Nickel Resistance Wire in rounds or flats. Round wire can be furnished with enamel, silk or cotton insulation.

EXECUTIVES
President.....Wilbur B. Driver Chief Engineer.....Herber H. Hah
Vice-Pres.....Robert O. Driver Production Mgr...William F. Dester
Sales Manager....Sidney A. Wood Purchasing Agent....Daniel J. Kelly
Advertising Manager....Sidney A. Wood

BRANCH OFFICES OR REPRESENTATIVES
217 N. Desplaines Street, Chicago, Illinois.

EXPORT
European Works—Puteaux, France.

GOAT RADIO TUBE PARTS, INC.
314 Dean Street. Brooklyn, N. Y.

PRODUCTS
Radio Tube Parts (Stamped and Formed Metal Elements, Plates, Shields, Cups, Caps, Collars, Discs, Clips, etc.), Tube Shields (Form-Fitting Tube-Shields). Metal Stampings, Light Manufacturing and Contract Manufacturing, Special Machinery.

EXECUTIVES
President.....Walter Goat
Vice-President.....Jens N. Mortensen
Secretary.....Edward F. Stauer—In charge of Sales, Purchasing, Production, etc.

BRANCH OFFICES OR REPRESENTATIVES
Fred Garner, 43 E. Ohio Street, Chicago, Ill.

EXPORT
J. Alois Karst, 90 West Street, New York, N. Y.

KING LABORATORIES, INC.
237 W. Division Street, Syracuse, N. Y.

PRODUCTS
Barex Imbedded Getter for radio tube manufacture.

EXECUTIVES
President.....A. J. King Sec. Treas.....Geo. L. King
Vice-President...Frank Michaelian General Manager.....Geo. L. King
Purchasing Agent..Wm. MacLeod

BRANCH OFFICES OR REPRESENTATIVES
Mr. Frank Michaelian, 295 5th Avenue, New York, N. Y.

EXPORT
J. A. Karst, 90 West Street, New York, N. Y.

NEWARK WIRE CLOTH COMPANY
351 Verona Avenue, Newark, N. J.

PEQUOT WIRE CLOTH CO., INC.
S. Norwalk. Connecticut.

GEORGE W. PRENTISS & COMPANY
439 Dwight Street, Holyoke, Massachusetts

PRODUCTS
Wire for Radio Tubes, namely Filament Ribbon, Strip for Plates. Seamless Tubing, Support Wire, Mesh Wire, etc. Also Alloy Wires of various kinds.

EXECUTIVES
William A. Prentiss.....President W. F. Bachelder.....Sales Mgr.
George W. Prentiss..General Mgr. Frank A. Harris..Production Mgr.

Tube Parts and Materials, Etc. (Continued)

SCOVILL MANUFACTURING CO.
Waterbury, Connecticut.
Parts.

STUPAKOFF LABS., INC.
6617 Hamilton Avenue, Pittsburgh, Pa.
Insulating Parts.

SUMMERILL TUBING COMPANY
Bridgeport (near Philadelphia), Pa.
Established 1899

PRODUCTS

The Summerill Tubing Company was organized to produce precision steel tubing, but in a very short time it added other metals such as brass, copper, aluminum, nickel silver, etc.

In 1910 the Company moved to its present location and spread out into larger sizes and heavier wall tubing. In 1914 the Company succeeded in obtaining practically the entire hypodermic needle tubing market in this country, and ever since it has dominated that field.

Because of their experience in producing very small tubes, the Radio Industry turned to Summerill when Pure Nickel was found to be the most suitable metal in connection with the production of radio tubes. The Company was prepared to produce large quantities, and in 1928 set about taking care of this additional demand upon its facilities. This business grew to such an extent that in 1929, even though its other lines were being produced by the Company at a higher rate than ever before, the radio tube manufacturers, as an industry, took the largest percentage of the Company's total output for that year.

In 1930, 31 and 32, the Company refined its processes, so the price of radio tubing today is one-sixth of that which prevailed in 1929.

Now, as in 1929, the Radio Industry takes a larger percentage of this Company's output than any other line of business the Company serves. The small tube department is operating three shifts on a 24 hour basis, at the present time.

SWEDISH IRON & STEEL CORPORATION
17 Battery Place, New York City

PRODUCTS

SVEA METAL Ribbon and SVEA METAL. Wire for internal vacuum tube parts such as plates, getter cups, screens, grids, mica strapping, welds, lead-ins, etc.

EXECUTIVES

President.....Victor H. Todd
Vice-President.....Harold C. Todd
Sales Manager...John W. Upp, Jr.
Chief Engineer.Dr. Paul G. Weiller

BRANCH OFFICES OR REPRESENTATIVES

29 S. La Salle Street, Chicago, Ill.
66 Rutledge Street, Brooklyn, N. Y.
H. F. Darby, Jr., 2019 Rittenhouse Street, Philadelphia, Pa.

EXPORT

R. G. McLeod, Ltd., 17 Southampton Street, London, W.C. 1.

Wire—Antenna, Hook Up, Magnet, etc.

ANACONDA WIRE & CABLE CO.
20 N. Wacker Drive, Chicago, Ill.

Wire (Continued)

ALPHA WIRE COMPANY
50 Howard Street, N. Y. C.

AMERICAN ENAMELED MAGNET WIRE CO.
Port Huron, Michigan.

BENTLEY, HARRIS MANUFACTURING CO.
Hector & Lime Streets, Conshohocken, Pa.

BELDEN MANUFACTURING COMPANY
4647 W. Van Buren Street, Chicago, Ill.

CORNISH WIRE COMPANY, INC.
30 Church Street, N. Y. C.

ESSEX WIRE CORPORATION
37 Manchester Avenue, Detroit, Mich.

GENERAL CABLE CORPORATION
420 Lexington Avenue, New York City.

HOLYOKE COMPANY
720 Main Street, Holyoke, Mass.

HUDSON WIRE COMPANY
Ossining, New York.

PHELPS DODGE COPPER PRODUCTS CORP.
(Inca Manufacturing Division)
Fort Wayne, Indiana.

JOHN A. ROEBLING SONS CO.
Trenton, New Jersey.

SPARGO WIRE COMPANY
Rome, New York.

Wire—Resistance

DRIVER-HARRIS CO.
Harrison, New Jersey.

WALTER GILBY ALLOY CO.
850 Mt. Prospect Avenue, Newark, N. J.

GILBY WIRE COMPANY (See page 52)
150 Riverside Avenue, Newark, N. J.

HOSKINS MANUFACTURING CO.
Detroit, Michigan.

GEORGE W. PRENTISS AND CO.
Holyoke, Mass.

Wire Strippers

THE WIRE STRIPPER COMPANY
1725 Eastham Avenue, E. Cleveland, Ohio.

PRODUCTS

Wire Strippers, Brush Type Strippers, Knife Type Strippers.

MISCELLANEOUS EQUIPMENT (See Index, Page 36)

Cabinet Ornaments

CROWE NAMEPLATE & MFG. CO. (See page 46)
1749 Grace Street, Chicago, Ill.

SYRACUSE ORNAMENTAL COMPANY
Syracuse, N. Y.

PRODUCTS

Radio Control Knobs. Dial Escutcheons, Carved Loud Speaker Grilles. Carvings and Mouldings for Cabinets.

BRANCH OFFICES or REPRESENTATIVES

Syracuse Ornamental Co., Suite 401, 358 Fifth Avenue, New York City.

EXPORT

Syracuse Ornamental Co., 100 Rue de Montreuil, Paris, France.

Ceramics

AMERICAN LAVA CORP. (See page 52)
1411 William Street, Chattanooga, Tenn.

HENRY L. CROWLEY & CO., INC. (See page 52)
1 Central Avenue, W. Orange, N. J.

ISOLANTITE CO. OF AMERICA, INC.
75 Varick Street, New York City.

Diaphragms for Speakers

HAWLEY PRODUCTS COMPANY
St. Charles. Illinois.

MASLAND MANUFACTURING CORP.
Amber & Willard Streets, Philadelphia, Pa.

UNITED PRESSED PRODUCTS CO.
407 S. Aberdeen Street, Chicago, Ill.

PRODUCTS

Pressed and Moulded Forms and Foundations in Paper—Cloth—Composition—Speaker Diaphragms.

EXECUTIVES

President.....Frank Raffles

Felt

AMERICAN FELT COMPANY
315 4th Avenue, New York City.

T. R. BRAWLEY FELT CO., INC.
279 20th Street, Brooklyn, N. Y.

FELTERS COMPANY
210 South Street, Boston, Mass.

WESTERN FELT WORKS
4115 Ogden Avenue, Chicago, Ill.

Flexible Shafting

CHARLES FISHER SPRING CO.
240 Kent Avenue, Brooklyn, N. Y.

THE S. S. WHITE DENTAL MFG. CO.
152 W. 42nd Street, N. Y. C.

Foil

THE JOHNSTON TINFOIL & METAL CO.
6106 S. Broadway, St. Louis, Mo.

PRODUCTS
Tinfoil, Aluminum Foil.

BRANCH OFFICES OR REPRESENTATIVES
F. W. Flad, 1224 Halsey Street, Brooklyn, N. Y.
O. D. Bramman, 400 W. Madison St., Chicago, Ill.

REYNOLDS METAL CO., INC.
541 W. 25th Street, N. Y. C.

Fuses

LITTELFUSE LABORATORIES
1772 Wilson Avenue, Chicago, Illinois

PRODUCTS
Instrument Fuses, Aeroplane Fuses, Radio Fuses, High Voltage Fuses, Fuse Clips, Fuse Mountings and Retainers.

EXECUTIVES
E. V. Sundt.....Manager and Engineering
B. Kollath.....Production and Design

BRANCH OFFICES or REPRESENTATIVES
David F. Tobias, 30 Church Street, New York City.
Electrical Apparatus Sales Co., 10 High Street, Boston, Massachusetts.

FOREIGN DISTRIBUTORS
South America—Ad. Auriema, Inc., 116 Broad Street, New York City.
Far East—Frazar & Co., 7 Front Street, San Francisco, California.
Sweden—Aktiebolaget ander & Ingestrom. Fredsgatan 4, Stockholm.
Central Europe—D. Bercovitz & Sohn, Belziger Str. 61, Berlin-Schoneberg.
Venezuela—Compania Bauer, Apartado de Correos No. 476, Caracas.
Hawaii—The Hawaiian Elec. Co., Ltd., Honolulu.
Holland—A. F. Hulsewe. Ingenieursbureau. Keizersgracht 188,Amsterdam C.
Italy—Ing. S. Belotti & C., S. A., Piazza Trento N. 8, Milan.
New Zealand—Johns Limited, Chancery Street, Auckland.
Cuba—Roberto Karman, P. O. Box 647. Havana.
Norway—Maskin Aktieselskapet Zeta. Drammensveien 26. Oslo.
Spain—Sanchez Ramos y Simonetta Apartado 1033. Madrid.
Australia—Warburton Franki Ltd., 307 Kent Street, Sydney, N. S. W.; Warburton Franki Ltd., 380 Bourke Street, Melbourne, Cl.

Graphite

ACHESON OILDAG COMPANY
Factory—Port Huron, Michigan
New York Office—654 Madison Avenue

PRODUCTS
Colloidal-Graphited Oil. Colloidal-Graphited Water. Colloidal-Graphited Castor Oil. Graphited Water. Colloidal-Graphited Glycerin.

EXECUTIVES
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President.....H. A. Acheson
Executive Vice-President J. P. Deringer
Vice-President.....G. R. Siegrist
Purchasing Agent.....L. H. Miller
Secretary.....F. L. Stark
Technical Editor...R. Szymanowitz

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Boston—Industrial Products Company, 146 Summer Street.
Chicago—Mr. T. P. Hunt, 2420 N. Sawyer Avenue.
Cleveland—Mr. George F. Willson, 1372 S. 86th Street.
Denver—Schroth Sales Company, 1622 Broadway.
Davenport, Iowa—Hinkelman & Tyler Company, 320 East 4th Street.
Milwaukee—Mr. B. T. Reilly. 2020 N. 56th Street.
San Diego—E. G. Garrettson. 607 First National Building.
Detroit—W. A. Trebein, 143 Griswold Street.

EXPORT
E. G. Acheson, Ltd., 40 Wood Street, London. S.W. 1, England.

Laminations and Stampings

THOMAS & SKINNER STEEL PRODUCTS CO.
1100-1120 E. Twenty-Third Street, Indianapolis, Ind.

PRODUCTS
Permanent Magnets—Dies—Tools—Metal Stampings

F. R. ZIERICK MFG. WORKS
68 E. 131st Street. New York City.

Lacquers and Varnishes

BAKELITE CORPORATION (See page 42)
River Road, Bound Brook, N. J.

E. I. DUPONT COMPANY
Parlin, N. J.

GENERAL PLASTICS INC. (See page 42)
N. Tonawanda, New York.

MAAS & WALDSTEIN CO.
438 Riverside Avenue, Newark, N. J.

PRODUCTS
Speaker Cements for all purposes, such as Paper, Cardboard, Leather, Felt, Metal, Bakelite and Voice Coils. Metal Lacquer, Wood Lacquer, Water Dip Lacquer, Lacquer Enamel, Prasmlac, Thinner.

THE ZAPON COMPANY
Stamford, Connecticut.

ZOPHAR MILLS, INC.
587 Court Street, Brooklyn, N. Y.
Founded 1846

PRODUCTS
Waxes and compounds for condensers, transformers, coils, resistances, lightning arrestors, battery seals, impregnators for cloth and wire, some types of varnishes, etc. The Company also manufactures compounds meeting specifications of buyers.

EXECUTIVES
President and Treasurer.....H. J. Blank
Vice-President and Secretary.....C. W. Gramm
Credit and Accounting.....T. C. Pearlstone
Purchasing Dept.....E. C. Zolkoski

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New York City.....L. M. Mayer
San Francisco, Cal.....H. A. B. Sneve
Seattle, Wash.....J. B. Merifield
Toledo, Ohio.....Ralph B. Clark
Chicago, Ill.....H. Haze
Technical Laboratory.....A. Saunders

Lock Washers

SHAKEPROOF LOCK WASHER COMPANY
2501 North Keeler Avenue, Chicago, Ill.

PRODUCTS
Lock Washers, Screws, Nuts, Locking Terminals.

EXECUTIVES
Sales Manager.....Jack M. Gribbie Chief Engineer.....Carl G. Olson

BRANCH OFFICES or REPRESENTATIVES
Shakeproof Lock Washer Co., 2832 E. Grand Boulevard, Detroit, Michigan. Mr. E. McClelland.
Andrew Carrigan Co., Rialto Building, San Francisco, California.
E. C. Crowther, 1502 W. Venango Street, Philadelphia, Pennsylvania.
F. T. Donnelly, Century Building, Pittsburgh, Pennsylvania.
Clyde D. Eno. 1340 Palmetto Avenue, Toledo. Ohio.
C. O. Hard, 322 4th Street, Scotia, Schenectady, New York.
F. C. Mortensen, 1027 West McKinley Street, Milwaukee, Wisconsin.
Canada Ill Tools, 121 St. Patrick Street. Toronto, Ontario, Canada.
H. M. Howison, 401 Swetland Building, Cor. 9th and Euclid, Cleveland, Ohio.
C. E. Nagel, 41 Park Row, New York City, New York.
Chase. Parker & Co., 288 Congress Street, Boston. Massachusetts.
Carroll Company, 1323 Wall Street, Dallas. Texas.
McVoy & Hausman, Birmingham, Alabama.
Duane Ketcham, Box 110, Hamburg, New York.

EXPORT
Barber & Coleman, Ltd., Marsland Road, Brooklands, Manchester, England.
I. Meye & Company, Rotenawaldstrasse 94, Stuttgart, Germany.
R. S. Stokvis et fils. 20-22 Rue des petits hotels, Paris. France.

Lugs and Terminals

CINCH MANUFACTURING COMPANY
2339 W. Van Buren Street, Chicago, Ill.

CLAROSTAT MANUFACTURING CO. (See page 44)
285 N. 6th Street, Brooklyn, N. Y.

F. R. ZIERICK MANUFACTURING COMPANY
70 E. 131st Street, New York City.

PRODUCTS
Production stampings—lugs and terminals—hot tinned for easy soldering.

Metals

Aluminum

ALUMINUM CORP. OF AMERICA
New Kensington, Pa.

FAIRMONT ALUMINUM COMPANY
Fairmont, W. Virginia.

Phosphor Bronze and Nickel Silver

PHOSPHOR BRONZE SMELTING CO.
2200 Washington Avenue, Philadelphia, Pa.

RIVERSIDE METAL COMPANY
Riverside, New Jersey.

Brass and Copper

THE BALTIMORE BRASS COMPANY
Wicomico and Ostend Streets. Baltimore, Md.
(See page 58)

Metals (Continued)

PRODUCTS
Rolled Brass, Copper, Phosphor Bronze, Commercial Bronze, Nickel Silver, and other Non-Ferrous Alloys in thicknesses from .001 up, and in widths from 1/16" to 16". Above materials available hot tinned on both sides.

EXECUTIVES
President.....J. W. Pilling Vice-Pres.....J. W. Pilling, Jr.
Secretary.....G. S. Doherty

BRANCH OFFICES OR REPRESENTATIVES
G. F. Hohner, 15 W. 44th Street, New York, N. Y.
E. C. Grant, 1411 Webb Avenue, Detroit, Mich.
Aluminum & Brass Sales Co., 1675 W. Ogden Ave., Chicago, Ill.
Avery Curtis Co., Cleveland, Ohio.

Mica

WILLIAM BRAND & COMPANY
268 Fourth Avenue, New York City.

FORD RADIO MICA CO., INC.
830 Fourth Avenue, Brooklyn, N. Y.

MICA INSULATOR CO.
200 Varick Street, New York City.

Motors, Motor Generators, Turntables and Record Changers

BALDOR ELECTRIC CO.
4353 Duncan Street, St. Louis, Mo.

BODINE ELECTRIC COMPANY
2264 W. Ohio Street, Chicago, Ill.

DIEHL MANUFACTURING COMPANY
Elizabethport, New Jersey.

ELECTROMATIC RECORD CHANGER CORP.
2212 S. Paulina Street, Chicago, Ill.

ELECTRIC SPECIALTY CO.
211 South Street, Stamford, Conn.

GENERAL ELECTRIC CO.
Schenectady, New York.

THE GENERAL INDUSTRIES COMPANY
Elyria, Ohio.

JANETTE MANUFACTURING COMPANY
556 W. Monroe Street, Chicago, Ill.

THE OHIO ELECTRIC MFG. CO.
5900 Maurice Avenue, Cleveland, Ohio.

RCA VICTOR CO., INC.
Camden, New Jersey

WESTERN ELECTRIC COMPANY
50 Church Street, New York City.

WESTINGHOUSE ELEC. & MFG. CO.
E. Pittsburgh, Penna.

Oil Tubing, Saturated Sleeving, Varnished Cloth

WILLIAM BRAND & CO.
268 Fourth Avenue, New York, N. Y.

PRODUCTS
Turbo Oil Tubing (Varnished Cambric Tubing)
Turbo Saturated Sleeving
Turbo Varnished Cambric, Paper, Tape, Silk, etc.
Mica Condenser Films, Block Mica, Mica Plate
Bakelite in Sheet and Fabricated
Fibre, Fish Paper, etc.

EXECUTIVES
William Brand.....Production Manager
William Naurburgh.....Purchasing Agent

BRANCH OFFICES OR REPRESENTATIVES
Chicago—Albert Cox—11 S. Desplanes Street
Detroit—Nielson Clark Co.—2832 E. Grand Boulevard
Hartford, Conn.—Eugene Pack—647 Main Street
Cleveland—G. A. Morrell—501 Caxton Building
Rochester, N. Y.—G. Gislasan—124 Westchester Avenue

Paper for Condensers

C. H. DEXTER & SONS CO., INC.
Windsor Locks, Connecticut.

PETER J. SCWEITZER, INC.
Newark Avenue and Virginia Streets, Elizabeth, N. J.

FRED C. STRYPE
140 Lafayette Street, N. Y. C.

Paper Tubes

CHICAGO PAPER TUBE COMPANY
137 S. Albany Avenue, Chicago, Ill.

CROSS PAPER PRODUCTS COMPANY
2595 Third Avenue, N. Y. C.

THE PAPER TUBE COMPANY
1718 Damen Avenue, Chicago, Ill.

Rectifiers, Copper Oxide

LEO TAUSSIG
3245 37th Street, Long Island City, N. Y.

Relays

AUTOMATIC ELECTRIC, INC.
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J. H. BUNNELL & CO.
215 Fulton Street. New York City.

STRUTHERS-DUNN, INC.
139 Juniper Street, Philadelphia, Pa.

WARD, LEONARD ELECTRIC CO.
Mt. Vernon, New York.

WESTON ELEC. INST. CORP.
Frelinghuysen Avenue, Newark, N. J.

Shielding

GOAT RADIO TUBE PARTS, INC.
314 Dean Street, Brooklyn, N. Y.

HAMMARLUND MANUFACTURING CO.
424 W. 33rd Street, New York City.

SCOVILL MANUFACTURING CO.
Waterbury, Connecticut.

Screws

PARKER-KALON CORPORATION
Factories and Sales Headquarters, 190-198 Varick Street, New York City

PRODUCTS
Type Z Hardened Self-Tapping Sheet Metal Screws, Hex Head Hardened Self-Tapping Tap Screws, Hardened Metallic Drive Screws, Cold Forged Wing Nuts.

RADIO DIVISION
C. S. Trott.....Sales Manager

EXPORT OFFICE
Parker-Kalon Corp., 50 Church Street, New York City.

Solder

KESTER SOLDER COMPANY
4201 Wrightwood Avenue, Chicago, Ill.

Stop Nuts

AMERICAN GAS ACCUMULATOR CO.
Newark Avenue, Elizabeth, N. J.

Tape

JOHNSON & JOHNSON
New Brunswick, N. J.

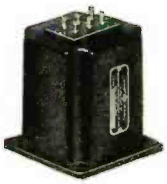
Waxes, Cement, Battery Compounds

CANDY & COMPANY, INC.
2515 W. 35th Street, Chicago, Ill.

TECHNICAL PRODUCTS COMPANY
Pittsburgh, Penna.

ZOPHAR MILLS, INC. (See page 56)
Court, Lorraine and Creamer Streets, Brooklyn, N. Y.

INDEX TO ADVERTISERS



KENYON
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Laboratory Standard Audio Components
All Purpose Amplifier Components
Universal Replacement Transformers
Manufacturers Type Audio Components
Power Supply Transformers
Automatic Voltage Regulators

BEING one of the oldest organizations in the broadcast and communications transformer field, our years of specialized experience have enabled us to develop a superior quality product whose record of reliability is well attested to by exacting users. All parts used in Kenyon products are manufactured at our own plant where every facility for the production of precision material is available. Only raw materials are purchased allowing a constant control of the uniformity of manufacture of the many components used. The electrical and mechanical characteristics of both raw materials and finished units are constantly checked by our completely equipped research laboratory.

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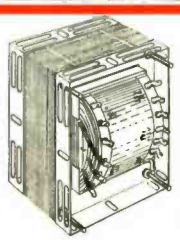
KENYON TRANSFORMER CO., Inc.
122-124 CYPRESS AVENUE
New York City



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GATES RADIO & SUPPLY CO.

Manufacturing Engineers

QUINCY, ILLINOIS, U. S. A.

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• TRIED • TESTED • PROVEN • INDORSED •
THE WORLD OVER SINCE 1922

KADETTE says...

....A Bakelite Molded case "retains its good looks through all kinds of service"

"IN THE HANDS of thousands of owners the original Kadette has proven the complete desirability of Bakelite Molded where continuous portability is essential. Bakelite Molded will not dent nor is it easily marred. It retains its good looks through all sorts of service." This is the endorsement of the manufacturer of Kadettes, who is again using Bakelite Molded for the case of his new portable model.

The manufacturer of midget receivers will find that Bakelite Molded has many other advantages too. Any design, whether simple or ornate, may be faithfully reproduced. A variety of effects may be obtained through taking advantage of the different colors of Bakelite Molded which are available. Production economies are secured through the reduction of assembly operations made possible by the use of this material.

Bakelite Molded is the ideal material for radio receiver cases and knobs. It is strong, has a rich, lustrous surface, resists moisture, and is unaffected by climatic conditions or changes in temperature. It also possesses high insulation value. To obtain additional information about this material and its possibilities write for illustrated Booklet 13M, "Bakelite Molded".

Don't miss the Bakelite Exhibit when you visit the Century of Progress Exposition.

New model Kadette with Bakelite Molded case and knobs. Product of International Radio Corp., Ann Arbor, Mich.

BAKELITE CORPORATION, 247 Park Avenue, New York, N.Y. . . . . 43 East Ohio Street, Chicago, Ill.
BAKELITE CORPORATION OF CANADA, LIMITED, 163 Dufferin Street, Toronto, Ontario, Canada

BAKELITE

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