

OCTOBER, 1933

Radio Engineering

IN THIS ISSUE

◆
MOBILE RADIO

PROGRESS IN AUTOMOTIVE RADIO DESIGN

By Howard J. Benner

RADIO SURVEY OF THE CITY OF BOSTON

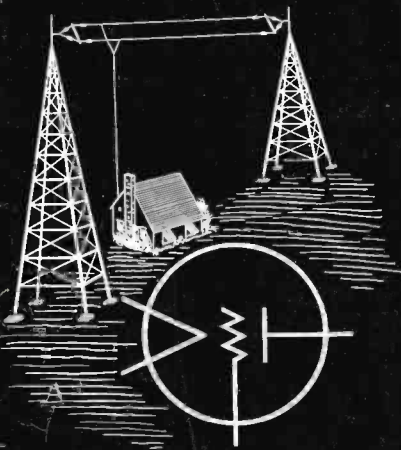
By D. E. Replogle

THE VELOCITY MICROPHONE

By A. Barbieri

NEW ELECTROPHONES FOR HIGH-FIDELITY
SOUND REPRODUCTION

By W. G. Ellis



The Journal of the
Radio and Allied Industries

Mobile Radio Tubes Must Be *rugged, accurate and dependable!*

SVEA METAL in a tube insures it of these three characteristics



RADIO tubes of today must withstand the hard usage of transportation. Automobiles, railway trains, aircraft and steamers exact special requirements of ruggedness, strength and resistance to vibratory shocks.

These tubes must function for protection, safety and health. They must respond to an SOS at sea, a police signal in a car or give warning of weather conditions to an airplane pilot.

Whether for pleasure in a ship's salon or of practical necessity, they *must perform*. SVEA METAL is the answer.

SVEA METAL makes better tubes that COST LESS.

9 types of tubes are proving particularly adaptable for mobile applications:

36	41	64A
37	42	67A
38	864	68A

SVEA METAL in these tubes means Strength, Ruggedness, Toughness, Elasticity, Shock resistance.

Swedish Iron &

17 Battery Place

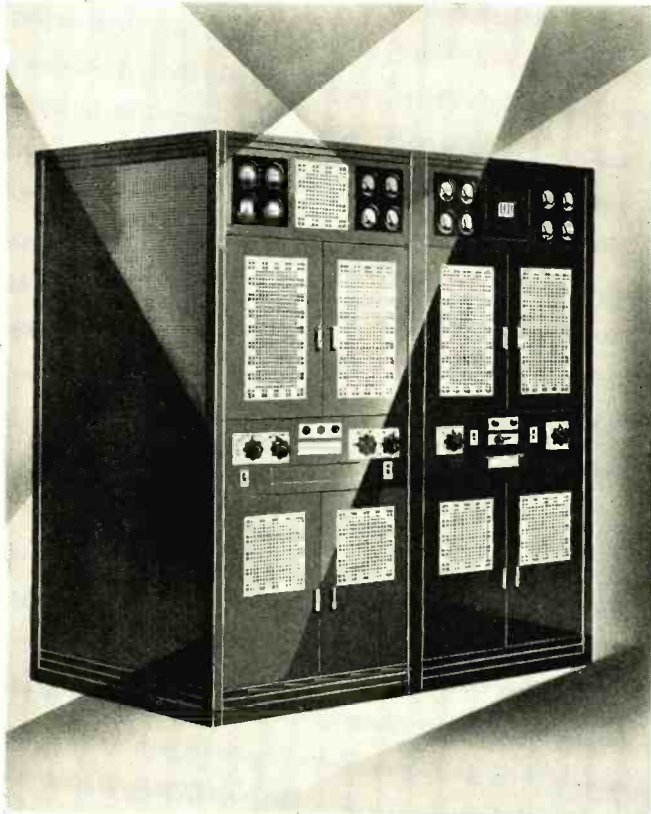


Steel Corporation

New York City

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





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.

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

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

- 1 — RCA 843
- 1 — RCA 865
- 5 — UV 203-A
- 2 — UV 845
- 2 — UV 872

AMPLIFIER UNIT

- 4 — UV 204-A
- 2 — UV 849
- 4 — UV 872
- 1 — Cathode Ray Tube



R C A V I C T O R C O M P A N Y , I N C .

C A M D E N , N . J . , U . S . A .

"RADIO HEADQUARTERS"

New York: 153 E. 24th. St.
Chicago: 111 N. Canal St.

San Francisco: 235 Montgomery St.
Dallas: Santa Fe Bldg.

Atlanta: 150 Walton St., N.W.

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

RADIO ENGINEERING

Reg. U. S. Patent Office



Western Editor
ULMER G. TURNER

Editor
DONALD McNICOL

Managing Editor
F. WALEN

Vol. XIII

OCTOBER, 1933

Number 10

Contents

	PAGE
A CHRONOLOGICAL HISTORY OF ELECTRICAL COMMUNICATION—TELEGRAPH, TELEPHONE AND RADIO, PART XXII	4
MOBILE RADIO	7
PROGRESS IN AUTOMOTIVE RADIO DESIGN	
<i>By Howard J. Benner</i>	8
RADIO SURVEY OF THE CITY OF BOSTON..By D. E. Replogle	10
VARNISHED TUBING FOR RADIO.....By Lester L. Jones	13
THE VELOCITY MICROPHONE.....By A. Barbieri	14
NEW ELECTROPHONES FOR HIGH-FIDELITY SOUND REPRODUCTION.....By W. G. Ellis	18

Departments

NEWS OF THE INDUSTRY.....	22
NEW DEVELOPMENTS OF THE MONTH.....	28
INDEX OF ADVERTISERS.....	34

THE NOVEMBER ISSUE OF RADIO ENGINEERING

THE November issue of RADIO ENGINEERING will contain a feast of highly important technical matter of direct interest to manufacturers of radio receivers, to broadcast station engineers, to airways and police radio officials. There will be up-to-the-minute contributions from some of the industry's foremost engineers and executives. On the editorial page will appear Mr. McNicol's comments on engineering topics uppermost in the discussions of the day among the country's radio engineers.

BRYAN S. DAVIS
President

JAS. A. WALKER
Secretary

Published Monthly by

Bryan Davis Publishing Co., Inc.
19 East 47th Street
New York City

SANFORD R. COWAN
Advertising Manager

J. E. NIELSEN
Circulation Manager

Chicago Office—919 N. Michigan Ave.—L. F. McClure, Mgr.
St. Louis Office—305 Star Building—F. J. Wright
Kansas City, Mo. Office—306 Coca Cola Building—R. W. Mitchell
Boston, Mass., Office—Lawrence Mitchell—80 Boylston St.

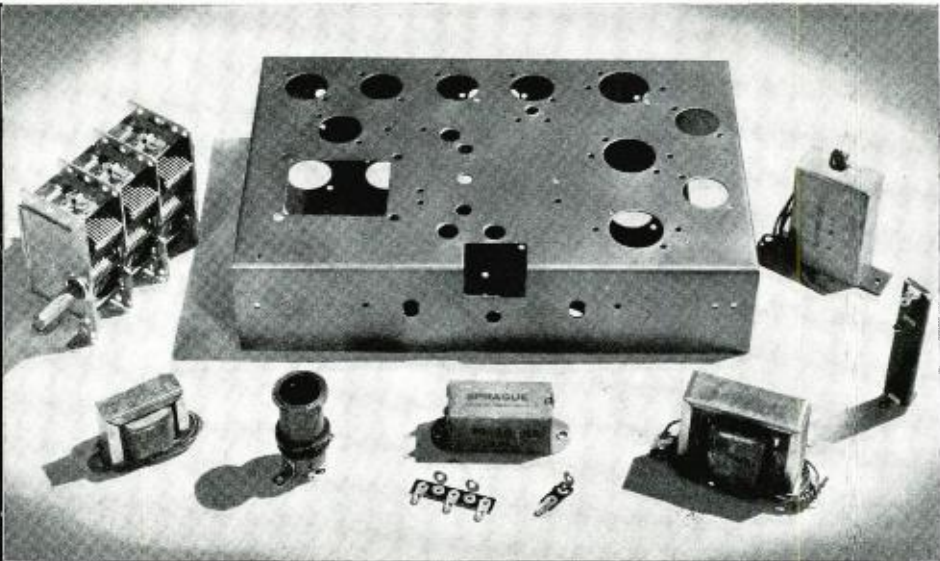


San Francisco Office—155 Sansome St.—R. J. Birch
Los Angeles Office—946 S. Broadway—R. J. Birch
Philadelphia Office—1513 N. 13th St.—H. S. Thoenbe.
New Zealand—Tearo Book Depot—Wellington.
Melbourne, Australia—McGill's Agency.

Entered as second class matter August 26, 1931, at the Post Office at New York, N. Y., under Act of March 3, 1879. Yearly subscription rate \$2.00 in United States. \$3.00 in Canada and foreign countries.

What is the Best Way to Mount these parts?

- ★
- ATWATER - KENT
- BOSCH
- COLONIAL
- CROSLEY
- FADA
- GRUNOW - U. S. RADIO
- MAGNAVOX
- MAJESTIC
- NOBLITT-SPARKS
- PHILCO
- R. C. A. - VICTOR
- SPARTON
- STEWART - WARNER
- STROMBERG-CARLSON
- WURLITZER
- ZENITH
- ★



The Leaders should know – and they do it with Hardened Self-tapping Sheet Metal Screws

YOU'LL find a considerable difference in the design of receivers and the production volume of the

sixteen manufacturers listed above. But for fastening condensers, transformers, resistors, coils, terminal mountings and other parts to the chassis, all use Parker-Kalon Hardened Self-tapping Sheet Metal Screws.

as large as on volume production. In some cases the savings are 50 per cent and more of assembly time and labor. Savings of from 15 per cent to 30 per cent are common.

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.



These Screws must offer the best means . . . they must make the fastenings the easiest, quickest, cheapest way, and hold more securely, to win year-after-year preference from so large a majority of leaders.

Try these unique Screws. See how they simplify the job of mounting parts and making other similar fastenings. Prove by any test you wish that the fastenings actually do hold better than fastenings made with machine screws, bolts and nuts, etc. Eliminate tapping . . . unhandy riveting . . . fumbling with bolts and nuts from your assembly work. Use the coupon to get a free "Money-Saver Test Bag" of samples, with recommendations.

A host of manufacturers with smaller production, and even custom builders, also use these cost-cutting Screws. And the unit savings effected are just

PARKER-KALON *Hardened* Self-tapping Screws

PAT. IN U. S. AND FOREIGN COUNTRIES

PARKER-KALON CORPORATION, DEPT. L, 190-198 VARICK STREET, NEW YORK, N. Y.

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.....



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.

◆

Part XXII

1893 (Continued)

- (861) Acting upon Oliver Heaviside's suggestion, telephone engineers in Europe and the United States experiment with loading coils to improve telephone transmission.
- (862) Van Duzer secures a patent covering the invention of a system of electric steering for steamships.
- (863) Edme H. Marie-Davy dies. (Born in France 1820.)
- (864) Alternating-current electric arc lamps, fed from the secondary terminals of transformers are successfully used in America.
- (865) At the World's Fair, held in Chicago, large two-phase generators, and induction motors; also three-phase motors and rotary transformers, are exhibited.
- (866) At the Electrical Congress held in Chicago, August 21-26, Charles P. Steinmetz presents an important paper on "Complex Quantities and their Use in Electrical Engineering." Silvanus Thompson presents a paper on "Ocean Telephony" in which he proposes the employment of distributed self-induction throughout the length of the cable used.
- (867) The Cutler, Hammer Manufacturing Company, Milwaukee, Wis., organized.
- 1894 (868) The Postal Telegraph-Cable Company builds a trunk line southwest from La Junta, Colo., to Mojave, Calif.
- (869) Sanford Fleming, of Canada, submits to the Canadian and Australian governments proposals for a trans-pacific submarine telegraph cable between these countries.
- (870) The patent granted A. G. Bell for a telephone receiver, expired January 30.
- (871) George B. Prescott dies. (Born U. S. A. 1831.)
- (872) The Postal Telegraph-Cable Company extends the use of the single line repeater invented by R. H. Weiny and Walter P. Phillips.
- (873) In New York City there are 15,000 subscribers' telephones in service.
- (874) The Great Britain and Continental Printing Telegraph Company is organized in New York with a capital of \$1,000,000. The company proposes to construct, equip and maintain lines of telegraph in England and the Continent of Europe. Abner McKinley, of Canton, Ohio, is one of the organizers.
- (875) In the United States 60,000 telegraph operators are employed by the telegraph and railroad companies.
- (876) Upon the expiration of certain of A. G. Bell's patents various electric companies begin the general sale of telephone apparatus.
- (877) Herman von Helmholtz dies. (Born in Germany 1821.)
- (878) Chicago Edison Company opens the Harrison Street central station.
- (879) The cables ship *Brittania* arrives at Hearts Content, Newfoundland, July 7, with the shore end of a new transatlantic cable to be laid by the Anglo-American Cable Company.
- (880) The Western Union Telegraph Company purchases the property of the American Rapid Telegraph Company, which has been operated under lease.
- (881) A. Siemens, of London, visits Canada and lays a proposal before the Canadian government for the laying of a submarine telegraph cable across the Pacific ocean between British Columbia and Australia.
- (882) There are now thirteen cables across the Atlantic ocean: six belonging to the Anglo-American Cable Company; one to the Direct United States Cable Company; one, Paris and New York Cable Company; two, American Cable Company, and three to the Commercial Cable Company.
- (883) The Postal Telegraph-Cable Company occupies its new building at No. 253 Broadway, New York.
- (884) For the year ending June 30, 1894, the gross revenue of the Western Union Telegraph Company was \$21,852,655, and the expenses \$16,060,170. The company now has 70,792 miles of line wire, and 21,166 offices. 60,000,000 messages per year are transmitted.
- (885) The Electric Selector and Signal Company, manufacturing code selectors for calls, and with an "answer back" signal, places its instruments in service on the Baltimore and Ohio Railroad, and other lines.
- (886) Sir William Preece lectures before the Society of Arts, London, on the subject "Electric Signaling Without Wires."
- (887) At Purdue University, a transformer is built having a secondary voltage of 10,000 volts.
- (888) Oliver Lodge, in London, at a lecture exhibits various forms of coherer tubes in operation.
- (889) The Telegraph Historical Society of America organized. (Later the name of the society was changed to The Old Time Telegraphers' and Historical Association.)
- (890) Both French Atlantic cable companies consolidate.
- (891) Rathenau, in Germany, experiments with a conduction system of telegraphy without wires, signaling three miles through water.
- (892) Heinrich Hertz dies. (Born in Germany 1857.)
- (893) An electrically operated bus 40 feet long is run between Chicago and Milwaukee.
- 1895 (894) The International Association of Municipal Electricians organized.
- (895) Franklin L. Pope dies October 13. (Born in U. S. A. 1840.)
- (896) The Railway Signal Club is organized, March 11, with W. J. Gillingham, Jr., president, and G. M. Basford, secretary. Other engineers who figure prominently in the organization are W. H. Elliott, H. D. Miles, W. B. Turner, and V. K. Spicer. (In 1903 the name of the organization was changed to The Railway Signal Association.)
- (897) The Circuit Court of the District of Massachusetts enters a decree, January 3, that patent No. 463,569 be cancelled. On May 13, the Court of Appeals reverses the District Court's decree. This is a decisive victory for the Bell Telephone interests.
- (898) Professor Alexander Popoff, St. Petersburg, Russia, presents a paper (April) before the Russian Physical Society, on the subject "Apparatus for Detecting and Registering Electric Waves."
- (899) James G. Biddle, in Philadelphia, establishes a manufactory of electric measuring instruments.

C R O W E

Airplane Type of Tuning Controls



ACTUAL SIZE

- No. 120—Airplane type. Ratio 12 to 1 in 180 degrees. Scale 3½ in. diameter.
- No. 121—Similar to above. Scale 4 in. diameter.

All with convex glass over scale.

Made in 6 sizes and styles, with three different ratios of speed. Laid out for use on consoles and the better compacts.

Illustrations and blueprints of all sizes will be ready for distribution soon.

These modern and up-to-date controls permit of a needed change in panel styles.

The plain style of escutcheon illustrated is favored by many but modernistic escutcheons are being designed and special styles can be made to order.

Other styles are as follows:

- No. 122—Double pointer style—one side for short wave and the other broadcast range, with double lighting.
- No. 123—Diameter of dial 2⅝ in. Wedge drive.
- No. 124—Smaller size diameter of dial 2-1/16 in. Wedge drive.
- No. 125—Friction drive. Special mechanism. Diameter of dial 2-1/16 in. A LEADER IN PRICE.

Remote Control for Auto Radios.

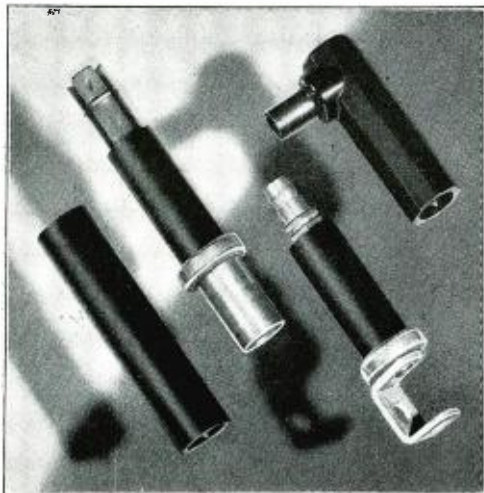


No. 101—One half size

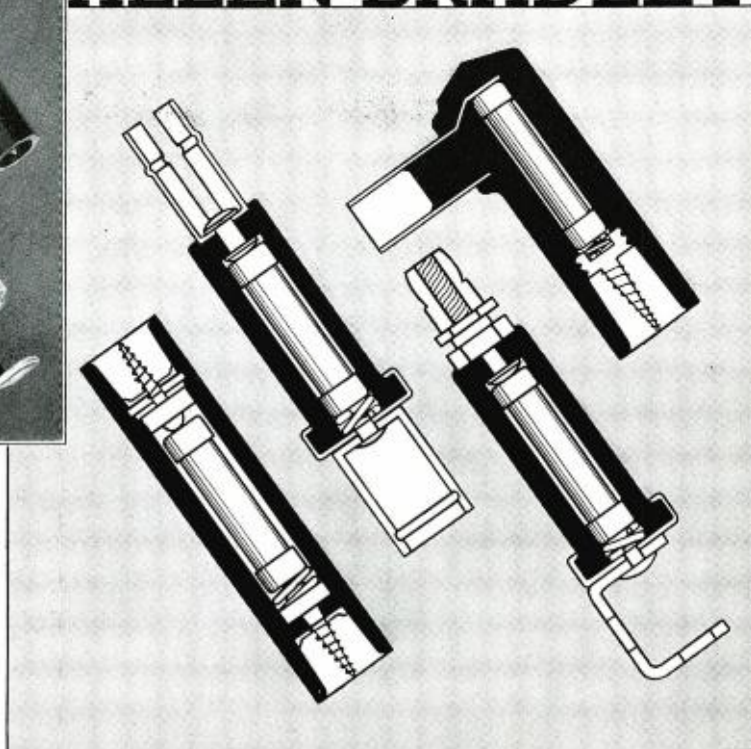
C R O W E NAME PLATE & MANUFACTURING CO.

1759 GRACE STREET

CHICAGO, ILL., U.S.A.



ALLEN-BRADLEY

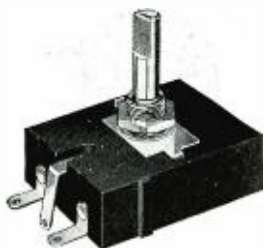


When you specify
Allen-Bradley
Spark Plug Resistors
you get the benefit of the
pioneer experience of Allen-
Bradley engineers who are
foremost in the field of radio
resistor design. Allen-Brad-
ley spark plug resistors are
covered by U. S. patents
1878014-1927185—other pat-
ents pending.



Bradleyunits

Bradleyunits are solid
molded resistors unaffected
by temperature, moisture or
age. All units are color-coded.



Bradleyometers

The Bradleyometer is a
potentiometer with approxi-
mately fifty solid resistance
discs interleaved between
metal discs.

The total number of discs
can be arranged in accord-
ance with any resistance-
rotation curve.

LONG-LIVED — PERMANENT — RUGGED

— three essential qualities that are
built into Allen-Bradley Suppressors

Allen-Bradley Suppressors are long-lived. They remain per-
manent in resistance values even after thousands of miles of
abusive automotive service.

They do not "open circuit" in service and thereby cripple
the engine.

They do not "drop" in resistance and therefore fail as
suppressors.

They do not have a "high voltage characteristic" which
sharply decreases the suppressor resistance during each spark
discharge and thus defeats the purpose of the suppressor.

They do not fail from exposure to oil and water.

They do not break due to car or engine vibration. Careless
mechanics are no terror to Allen-Bradley Suppressors, because
the resistors are enclosed in rugged, non-arcing bakelite cas-
ings—not in brittle ceramic material.

The superiority of Allen-Bradley Suppressors can be easily
demonstrated. Our engineers will gladly supply data and per-
formance curves on resistors for your requirements. Write us
today.

ALLEN-BRADLEY CO., MILWAUKEE, WIS.
General Offices—126 W. Greenfield Ave.

RADIO ENGINEERING

FOR OCTOBER, 1933



MOBILE RADIO— That Those Who Run May Hear

THE radio manufacturers early recognized the need for automobile radio receivers which would give radio reception in a moving car with the same pleasing tone quality and volume obtainable with high grade receivers used in homes, and other stationary locations. Under Chairman Wells of the RMA engineering committee and Virgil M. Graham, chairman of the association's special committee on automobile radio, improved installation of and operation of receivers for the purpose have been developed. There was concentrated engineering effort with respect to electrolytic capacitor betterment, size of chassis and speakers, mounting, and of antenna arrangements.

The engineers have had before them constantly the important factors of filament drain and dependable "B" power supply. That these problems have been worked out satisfactorily is evidenced by the fact that the automobile manufacturing companies have now recognized the permanent arrival of mobile radio and that some of the largest manufacturers are featuring car radio as standard equipment in new models.

The outstanding progress of the past year in the development of mobile radio for various services has been due in large part to circuit design, to advances in "eliminator" design and assembly, and to vacuum tube development. It was realized that advantage should be taken of the possibilities of the new tubes so that there would be a minimum number of tubes per receiver. However, a single pentode delivering one-half watt at an expenditure of ten milliamperes gives hardly enough radio output level above the noise attendant to higher automobile speeds. Due to recent improvements in tubes, Class B output averaging four watts may be obtained.

Keeping in mind the need for noise suppression, full automatic volume control is more easily obtained by employing the new double diode triode tubes.

Five or six years ago radio engineers and mechanics had in service widely scattered installations of radio receivers in private automobiles. The increase in the number of installations was not rapid in the following two or three years. There were various reasons for this but the main reason was that there was not generally available a type of receiver entirely suitable for the purpose.

In the beginning the purpose of installation was for

entertainment, but the somewhat spotty success obtained did not encourage extended use of the service. There was however, sufficient success to attract the attention of, particularly, police organizations and air transport lines. Forthwith began a wide application of mobile radio in these services.

Two years ago seventy municipalities were equipped with police radio installations. Almost immediately from all of these installations came reports that the mobile radio equipment had enormously improved police efficiency in the control of crime and of criminals. During the past two years there has been continuous increase in the number of police radio systems placed in service, in state, county and municipal police districts.

Airways

On a commercial scale airways radio dates from the formation of the Pan American Airways in 1927. At that time 10 watt, 100 watt and 300 watt sets were experimented with for both telephone and telegraph operation. Early in 1929 the company decided to establish its own communications department and work was started on the development of suitable equipment. The experience gained resulted in laying the foundations for the vast network of airline radio services now in operation, including direction systems and beam arrangements, which ushered in the day of night flying and of safe landing even where the surface of the earth is obscured by fog or smoke.

Spark

Although other means have been experimented with the simplest and most economical method of combating electrical disturbances to automobile receivers resulting from the unavoidable ignition sparks, is the use of what for the want of a better name are called suppressors.

The general shapes and dimensions of suppressors for gasoline driven mobile vehicles are now fairly well standardized. These units have been reduced to few parts and the present types of terminal fastenings have been designed to avoid the mechanical difficulties experienced with the models of a few years ago. Experience has taught the manufacturers of suppressors how to produce suppressor units which meet the needs of modern mobile radio, whether for police car, private automobile, airplane or marine use.

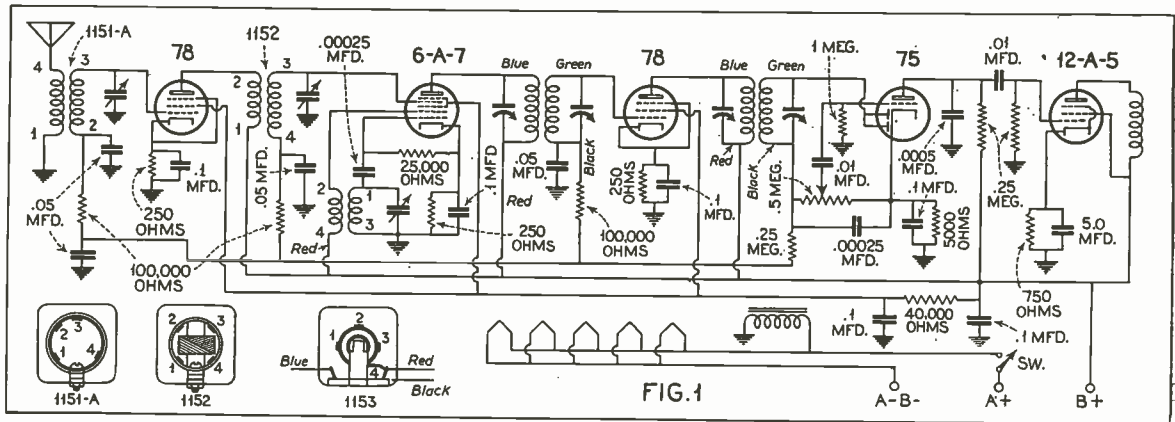


Fig. 1.

Progress in AUTOMOTIVE RADIO DESIGN

By Howard J. Benner

THE manufacturing of automotive radios represents a large portion of the receivers built this year, and it is quite apparent that next year will show a great increase over this year. This assumption is based on the fact that one automobile manufacturer is including a receiver as standard equipment, and in all probability others will follow.

This year has seen the advent of the single unit receiver due partly to the influence of the midget receivers which at present are so popular. These compact receivers combine in a single unit the receiver, speaker, power supply and in some cases the control, although it seems to be general practice to mount the control box either on the dash or on the steering post. The receiver and control box are connected by flexible shafts.

The superheterodyne is the basis of practically all modern receivers, due to the selectivity and sensitivity available where space is a factor.

Types of Receiver

The higher priced receivers are based on a five-tube, three-gang receiver, using 175 kc. intermediate frequency, although many deviations from this outline are made by

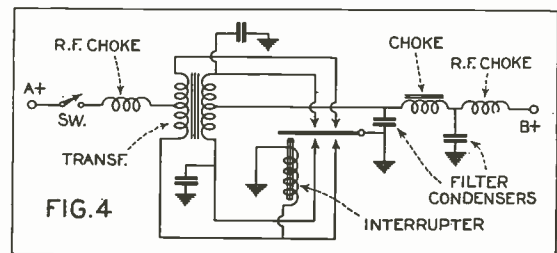


Fig. 4.

different manufacturers, such as adding an extra audio tube or using class B audio amplification. The circuit arrangement as shown in Fig. 1 uses a 78 tube for the radio-frequency stage, a 6A7 tube for the first detector and oscillator, a 78 for the intermediate-frequency amplifier, a 75 for the second detector and automatic volume control and a 41 for the output tube. The coils used are of the high gain type. The antenna coil primary is both capacitively and magnetically coupled to the secondary. The radio-frequency coil is of the impedance coupled

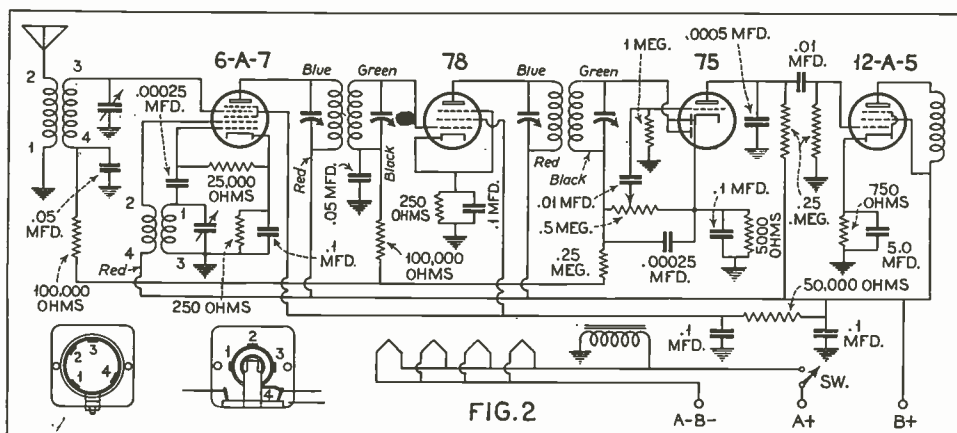


Fig. 2. Four tube, two-gang, 45b kc. i-f. type of receiver, typical of the smaller, compact units.

type, that is, the primary is mounted in a non-inductive relationship to the secondary, and a small capacity, approximately 15 mmf., is used for coupling between the plate of the radio-frequency tube and the grid of the first detector. The oscillator coil, the first intermediate-frequency transformer and its associated trimmers are mounted in one shield can. The second intermediate-frequency coil as well as the first and the oscillator coils previously mentioned are of conventional design. This arrangement when properly built will be very satisfactory from an image standpoint, and will have an overall sensitivity of one or two microvolts or better.

The four-tube, two-gang, 456 kc. intermediate-frequency receiver is generally the basis of the smaller and cheaper receivers, although, as previously stated, many deviations from this outline are made by different manufacturers. This receiver as shown in Fig. 2 uses a 6A7 for the first detector and oscillator, a 78 for the intermediate amplifier, a 75 for the second detector and automatic volume control and a 41 for the output tube. The antenna coil is of the high gain type with primary both capacitively and magnetically coupled to the secondary. This coil is generally wound with litzendraht wire to make the image ratio as high as possible with a single stage of selection ahead of the first detector. The oscillator and intermediate-frequency system is the same as explained in the previous circuit. The overall sensitivity of this receiver when properly built will be two

gang, 175 kc. intermediate-frequency receiver. A 78 is used for the radio-frequency amplifier; a 6A7 for the first detector and oscillator; a 6B7 for second detector, intermediate-frequency amplifier, audio-frequency amplifier and automatic volume control; and a type 41 for the output. The coils used are of a high gain type. The antenna coil primary is both capacitively and magnetically coupled to the secondary. The radio-frequency coil is of the impedance coupled type, that is, the primary is mounted in a non-inductive relationship to the secondary, and a small capacity, approximately 15 mmf., is used for coupling between the plate of the radio-frequency tube and the grid of the first detector. The oscillator and intermediate-frequency coils are the same as explained in the previous circuits. This circuit up to the diodes of the second detector works the same as the ordinary superheterodyne, and detection occurs resulting in an audio-frequency output in the plate circuit of the detector. This audio voltage is fed back to the control grid of the 6B7 through an intermediate-frequency filter which keeps any intermediate-frequency component from the control grid and is amplified by the pentode unit of the tube, resulting in an audio-frequency voltage across the audio-frequency load. This audio-frequency output is fed to the audio output tube. This arrangement when properly built will have an overall sensitivity of one or two microvolts or better.

B Power Supply

The principle of the vibrator rectifiers is based on a mechanical interrupter which breaks the primary circuit of a power transformer which in turn induces an e.m.f. in the secondary, thus producing an alternating current of a low frequency depending on the frequency of the interrupter. Rectification takes place in the secondary circuit of the transformer. This rectification takes place due to a second set of contacts in the vibrator which break the secondary of the transformer at the same time the primary is opened. By doing so, the negative half of the cycle is eliminated, leaving a rough d-c. voltage. The ripple is then removed by the conventional filtering system.

The interrupter type B eliminators can be divided into two types:

1. The full-wave mechanical rectifier as shown in Fig. 4, works on the principle previously explained.

2. The full wave electrical rectifier as shown in Fig. 5, uses a type 84 or similar tube which is a full wave rectifier of the 6.3 volt series. A mechanical interrupter breaks the primary of the power transformer, inducing an e.m.f. in the secondary. This alternating current is then rectified by the tube, resulting in a rough direct current. This direct current is filtered in the usual way.

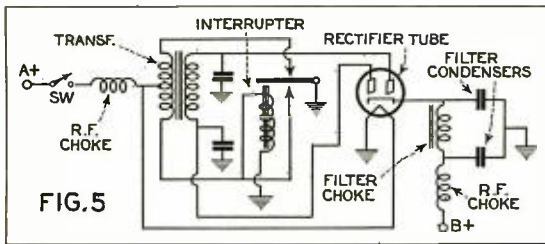


Fig. 5.

or three microvolts or better.

Fig. 3 represents another circuit, which, although not generally accepted by the majority of radio manufacturers, is the reflex circuit. This was made possible by the introduction of the type 6B7 tube which is a duplex diode and a pentode in a single bulb and which can be made to perform simultaneously the functions of intermediate-frequency amplification, detection, audio-frequency amplification and automatic volume control. The pentode unit is reflexed for audio-frequency and intermediate-frequency amplification.

The following description is of a four-tube, three-

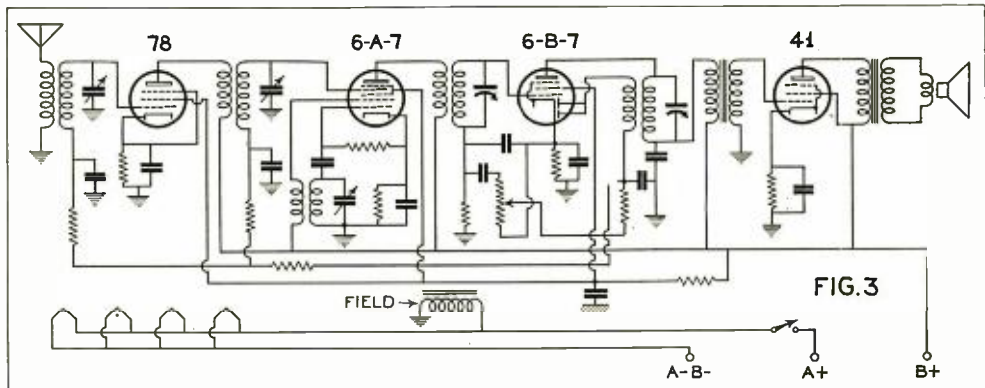
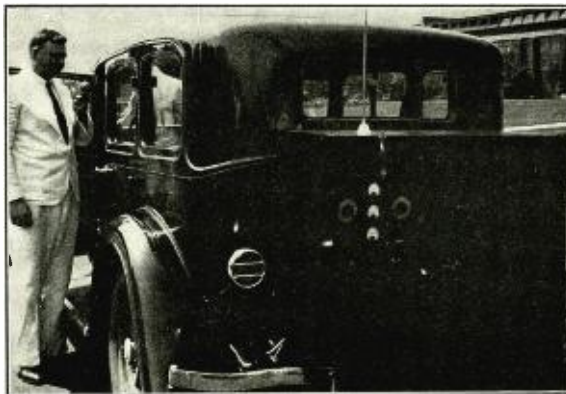


Fig. 3. Reflex circuit using the 6B7 tube of multiple functions.



D. E. Replogle tests the 2-way police radio cruiser radio transmitter herein described.

Radio Survey of the City of Boston

By D. E. Replogle*

RIVALING in importance the Bertillon system of finger printing, the use of radio for communication has given the police a new and most useful weapon with which to combat crime.

A few of the statistics given by the Federal Radio Commission in a recent analysis on police radio proves very decisively the value of radio. These statistics are listed herein.

With a receiver which will cover the range of from 1,500 to 2,500 kc. one can cruise the air every night and hear innumerable police instructions and messages routed to the actual patrolman or police authority on the ground.

From the breaking up of annoying gangs of boys to the apprehension of murderers and hold-up men, police radio has proven its worth time and time again and has enabled the police to meet the requirements of depreciated expenditures for police protection and yet provide more adequate protection.

Unfortunately, as the use of radio increased and its use became widely known, the criminals immediately installed receivers in their own cars so that they also would receive official police instructions and which would enable them to evade the officers of the law. Also, many receivers in the hands of private automobile owners will receive police signals with the result that when the information in regard to a crime or accident is given out over the air, the privately owned automobile also receives this information and rushes to the scene of action. This has often seriously impeded the police work.

Then, too, many cases have arisen where it was of utmost importance that police headquarters be apprised of information possessed alone by the officer on the scene

to whom a telephone was often inaccessible. These facts, coupled with the increased knowledge of the efficiency of the use of ultra high frequencies for coverage by radio of urban areas, have led the advanced police officer who is continually seeking the most efficient weapon with which to combat crime to investigate the use of the ultra frequencies (30,000 to 40,000 kc.), or short waves (10 to 75 meters).

Here they found a new field which, after investigation, seemed almost ideally suited for the purpose at hand, with the following real advantages:

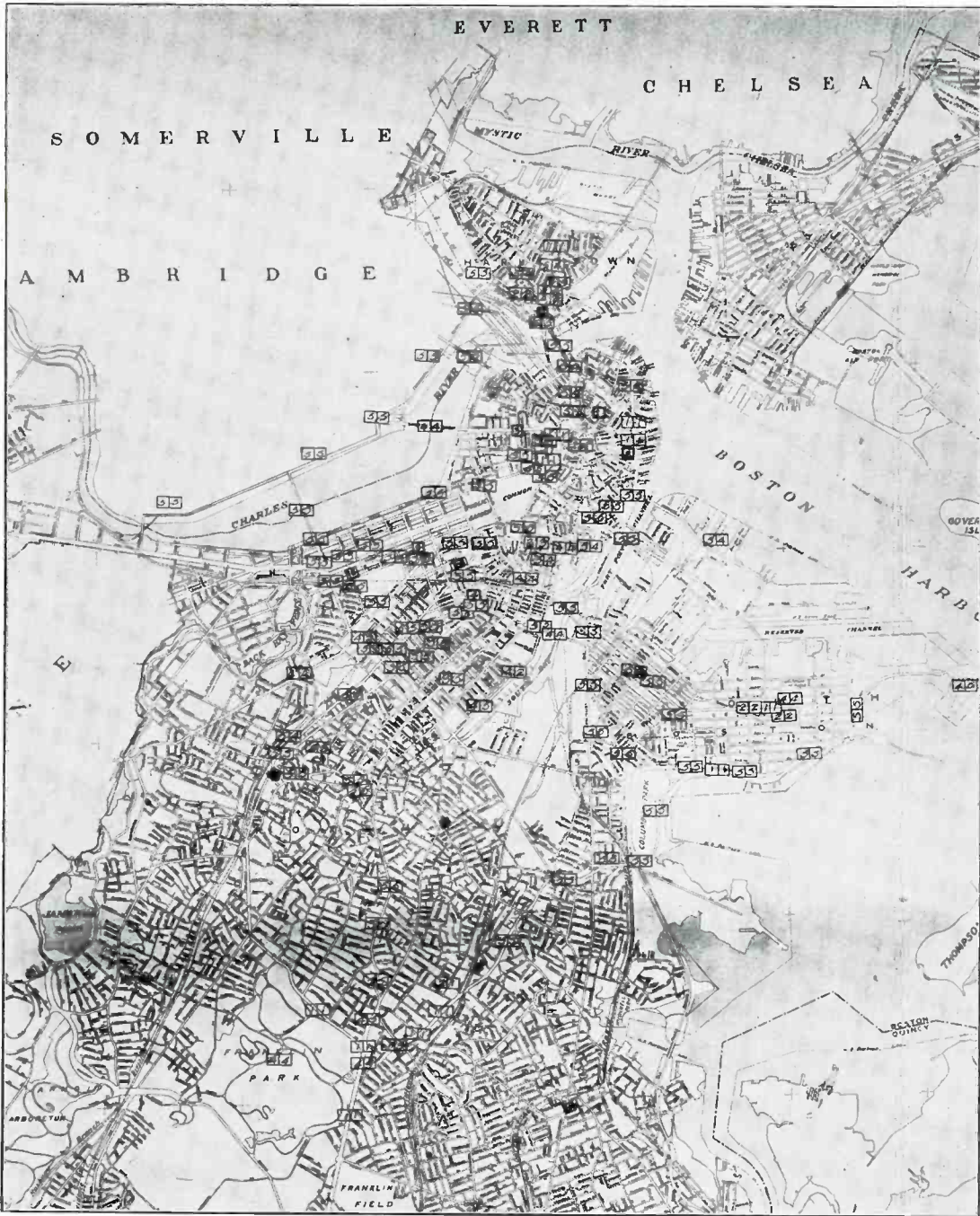
1. Excellent urban coverages on low power which simplified the cost and complication of the central transmitting equipment.
2. Confining the range of the transmission to the desired area only, thus eliminating interference and distant reception.
3. Making use of the fact that the public and criminal class as a whole will find it difficult to receive these high frequencies.
4. The possibility of installing an efficient and workable transmitter in a movable car to give two-way communication.

In regard to the first point, actual tests have been made with an output of 40 watts on 30 mc. Better coverage giving a usable received signal was obtained than from 100 watts operating in the 2,400 kc. band and the cost of the transmitter was approximately 50 per cent less.

2. Ultra high frequencies above 35 mc. give no distant effects as the angle of radiation is so sharp that they do not return to earth at a distance, but give excellent coverage of a local area.

3. High frequency receivers in the hands of the public are comparatively rare and there are no such receivers yet developed commercially for automobile installation. Then, too, a wide range of sidebands is available in the

*Chief Engineer, Electronics Department, Hygrade Sylvania Corporation.



This map of Boston shows the coverage obtained in a survey of the city using 30.4 mc. for broadcasting police signals and 40 mc. on the "answer back" from the car. On the right the square represents reception from headquarters. On the left the square represents reception from the cruiser. (1) Signal just distinguishable. (2) Signal just readable. (3) Signal easily readable. (4) Signal very easily readable. (5) Exceptionally strong signal.

ultra high frequencies and it would be possible to shift frequencies rapidly to give secrecy of communication which could not be provided for on the 1,500 to 2,400 kc. band due to space limitations in the ether.

4. A prominent police official described the need for two-way communication as follows:

He asked what would the captain of a battleship do if when he gave an order he did not receive the "Aye, Aye, Sir" from the one receiving the order. In police radio the same conditions exist. Headquarters must know that an officer is on the job and to do this they must have his "answer back."

Many are the instances where the officer on the scene possesses vital information and his report back to headquarters' aids, relieves, directs additional police activities in other parts of the city, etc.

For these reasons, Commissioner Hultman of the Boston city police has made a thorough analysis of a police system for the City of Boston—the object of which is to provide a communication system which will give every man, woman and child in Boston the services of a police officer, at any point in the city, within two minutes after an alarm has been given.

He found that the ultra high frequencies were admirably suited for his purpose and that it was entirely possible, by making use of the various substations of the Boston police as receiving posts for the signals coming back from the cars, to secure two-way communication.

With present developments and existing equipment the Hygrade Sylvania Corporation cooperated with the Boston police in making a series of interesting tests—data from which was used in drawing the above conclusions.

A 40-watt transmitter operating on 30.4 mc., crystal controlled, was set up at police headquarters at Berkeley and Stewart Streets, Boston, and a suitable high frequency receiving system was also installed in this location. A 10-watt self-excited transmitter with a microphone and the necessary modulating equipment was installed in a Chrysler sedan. Power supply was obtained from batteries through separate charging equipment and a suitable one-fourth wave antenna of the limber whip type was mounted on the car.

A receiver designed for reception on 30.4 mc.—the frequency of the control station—was mounted in the conventional manner under the front dashboard. This made use of the usual car antenna for reception. The transmitter was fixed to operate at a frequency of 42 mc. With this arrangement, duplex operation was possible. That is, it was possible to send and receive simultaneously at headquarters and in the car. Intelligible transmission both ways of suitable signal strength to be heard throughout the car on a loudspeaker and throughout the operating room at headquarters was taken as the necessary requirement for what would be considered reliable communication.

With this equipment set up and operating, a survey was made of downtown Boston and the surrounding territory as indicated on the accompanying map. Trips were made from headquarters to the west, through the Back Bay district. By going out at the points indicated on the map, the test car was taken into Cambridge, Charleston, South Boston, Dorchester, Roxbury, and Brookline, and the results as noted on the map were recorded.

At no point in the entire survey, to a distance of 12 miles from Boston, was reception from the central station unreliable, and numerous interesting phenomena were observed. In this connection, along a number of streets in Boston the elevated structures, entirely of steel, covered the streets. Under these structures, where automobile reception of normal broadcast reception usually

fades out, we found an increased signal strength on 30.4 mc. This we attributed to the high reactance to ground of these structures on these high frequencies. Sometimes under railroad bridges the signal strength would greatly increase while in a few cases under bridges the signal strength would decrease. There seemed to be no uniformity in this respect. It was also noted that on streets entirely covered by arching trees, reception was somewhat impaired and that the shadows of high hills could be definitely traced by the differences in the received signal strength from the main station. We also noted that in the downtown business districts, around Scollay Square, local traffic and electrical noises greatly increased, and while the signal was still legible, the signal strength was not as great. It was conceded that increased power at the central station would overcome this.

Our chief interest, however, was in observing the signal strength that could be obtained from the cruiser transmitter at headquarters.

This transmitter which operated on a frequency of 42 mc. gave excellent coverage as noted on the map in all places except where it was shielded by high hills or by high buildings, or by an archway of green trees. Of these three, the high buildings were less detrimental. Hills like Telegraph Hill in South Boston, Parker Hill in Brookline, Sundar Hill in Charleston, cast 100 per cent shadow. So, transmission from behind these hills was practically impossible to the central receiving station. Also, in Franklin Park, where the foliage was particularly thick, the car signal at headquarters was faint or not hearable. Oftentimes a movement of 50 feet along the road would shift the signal from nothing to complete intelligibility.

The results obtained from transmission under the elevated structures, steel railroad bridges were also of interest. It was found that in none of these locations was the signal strength at headquarters actually increased rather than shielded by these structures. This was true in the case of overhead trolley line networks, etc.

One most interesting experiment was conducted along this line. Commonwealth pier is a two-story building extending one-fourth mile into the bay. It is entirely metal and concrete in its construction. We were asked to drive along inside this building on the lower floor and maintain two-way communication with the central station approximately two miles away. Excellent communication was maintained throughout the length of this building. Even though the cruiser car was parked alongside a steel elevator construction which was considered to be entirely shielded, the transmission was considered satisfactory in this building. No radio transmission at any frequency had previously been received on this pier.

With these tests completed and enough data ascertained to prove the merit of the plans outlined by the Boston police, Commissioner Hultman invited Governor Ely of the State of Massachusetts to ride in the cruiser car and witness a demonstration of two-way communication. The author accompanied the Governor on this trip and after the Governor had talked back to headquarters and heard some reports given distinctly, the author was then asked to describe various cars and scenes along the road. These descriptions were received back word for word from the police headquarters' transmitter.

Conclusions

1. That 100 watts on approximately 30 mc. with adequate antenna systems would definitely cover the City of Boston with a usable signal level.
2. Reliable answer back range of available equipment
(Concluded on page 16)

Varnished Tubing for Radio

By Lester L. Jones*

AS "clothes make the man," so a smart cabinet proclaims the radio set. This goes as long as everything is working well, but when the man is ill, his clothes no longer count for much. And when the radio fails we look inside and dig around the tubes and wires. If the trouble is from a pinched wire or a worn spot in the insulation, a sense of relief and a short length of varnished tubing (spaghetti) together end the distressing incident.

Varnished tubing has been used in radio apparatus for more than 20 years, and has been popularly called "spaghetti" and "macaroni." It is essentially a woven cotton tube impregnated with an insulating varnish. When properly made, its electrical puncture value is high, usually over 5,000 volts. The uniform application of a large number of varnish coats, each thoroughly dried, is essential. This treatment is carried out in towers about 20 feet high, in which the cloth tubing is hung. The finished product is usually cut in lengths of 3 feet for sale.

Good grades of spaghetti are very flexible and will not crack with even the rough handling incident to difficult wiring. They retain their tough pliability for longer periods than rubber.

Good varnished tubing can be flattened hard between the fingers and doubled back on itself without cracking. The finish should be smooth and lustrous. A misty or cloudy appearance is generally indicative of faulty properties. The varnish coat should be tough enough to resist rubbing off under the repeated friction of powerful dry fingers. The best varnishes are scratched off only with difficulty by the thumbnail.

Spaghetti is available in sizes to neatly fit over all wires from No. 24 B. & S. gauge up. The manufacturers of this tubing have recently adopted a new numbering system for designating spaghetti sizes. This system will appeal to radio engineers because it is simple and easy to remember. The tubes are given the same size number as the B. & S. gauge number of the bare wire over which they will nicely slip.

For extra high voltages or for regions of excessive pressure or abrasion, adequate protection is economically possible by slipping a short length of larger tubing over the first. For example, No. 24 tubing slides nicely into No. 15 tubing, and No. 14 into No. 8 tubing.

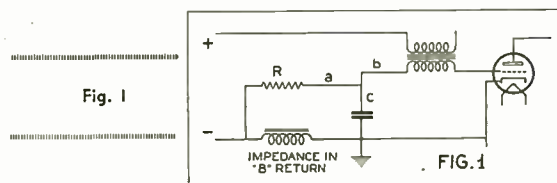
It is clear that one can rely on good varnished cloth tubing to prevent shorts or punctures on the high voltage wires in a radio receiver. Of perhaps greater importance, though, is the help it affords in preventing high resistance leaks.

Troubles from leaky insulation arise most often in the grid circuits of radio receivers, due to their high resistance and impedance values. The necessity for good insulation at the grid end of input circuits is too well known for comment. Occasionally, however, the cathode end is overlooked. When a grid bias system of the filter type is used, an insulation leak can become very trouble-

some and difficult to detect. The type of circuit referred to is shown in Fig. 1.

The wires a, b, and c should be insulated from their surroundings so as to have at all times a leakage resistance 50 times the resistance of R. (R is usually of the order of 1/4 meg.) When the wiring arrangement is such that high voltage plate leads are laid in with the leads a, b, and c, the leakage resistances should be of the order of 1,000 megs. If the insulation resistance is only of the order of 100 megs., it is easy to see how much the tube bias will be affected. With 200 volts on the plate lead, 2 microamps will flow into the leads a, b, and c. This leakage current returning to the source through R (assumed to be 1/4 meg.) will make the bias 1/2 volt more positive than it is supposed to be.

These high insulation values are difficult to maintain



in damp weather unless the critical wires are covered by a non-absorbing high insulation sheath such as varnished cloth tubing provides.

Soldering Flux Troubles

In much repair work and in some manufacturing the soldering fluxes used leave residues that are hygroscopic. The absorbed moisture penetrates easily into non-impregnated wire coverings, and slowly spreads an inch or more from the soldered joint. After several months and especially in damp weather considerable leakage can be detected through or along the wire insulation at points as far as one or two inches from the soldered joint. Where such wires cross metal panels or other wires it is good practice to reinforce the insulation with a short length of "spaghetti."

On a recent damp August day the writer measured insulation resistances from the wire to a point on the insulation 1 inch back from the soldered joint. In each case the wire had been soldered with a commonly used flux applied somewhat carelessly so that the flux spattered over the insulation. Results were as follows:

- No. 16 rubber covered lamp cords with mercerized cotton braid..... 7 megohms
- No. 16 wire in unimpregnated push-back type cloth tubing 6 megohms
- No. 16 wire in varnished cloth tubing .. Over 1,000 megs.

The insulation of the first two on an especially dry day improved to only 100 megohms.

Old-timers will remember the disconcerting way spa-

(Concluded on page 16)

*Consultant Engineer.

THE VELOCITY MICROPHONE

By A. Barbieri*

THE velocity microphone made its appearance in America only a short time ago, although it has been in use for a number of years throughout Europe. Its introduction in this country has created an enormous amount of discussion, mainly due to the fact that this new type of microphone employs an entirely new operating principle, and, in view of it, requires a new technique of placement in the broadcasting and sound-recording studios.

The most important difference between this new transmitter and the old type microphone, is due to the absence of any form of diaphragm with its inherent frequency peaks which had to be compensated some way or other, and the lack of this diaphragm produces a number of effects which are responsible for the characteristics of the ribbon microphone.

In Fig. 1 the theoretical construction of this microphone is shown. A is a very thin corrugated aluminum ribbon suspended by proper means within the field of a horseshoe magnet B. A sound wave reaching the ribbon causes it to vibrate and these vibrations, being in exact accordance with those of the sound waves, sets up a corresponding alternating current which, when properly amplified, reproduces the original sound with an uncanny fidelity due to the free and unhampered motion of the ribbon itself.

In Fig. 3 a commercial application of the same principle is shown. It is clearly seen, therefore, that the ribbon microphone is essentially an electrodynamic device, which is capable of transforming sound into electrical energy, while the carbon and condenser microphones may be considered a form of valve controlling a comparatively large amount of energy which is varied by the sound waves striking the diaphragm of the microphone.

Inasmuch as it is essential to the proper operation of

*Research engineer, Bruno Laboratories.

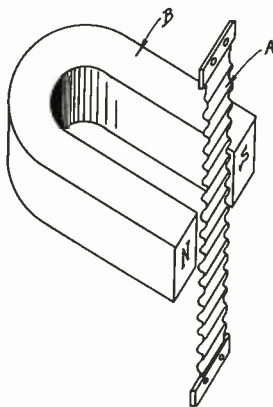


Fig. 1. Operating principle of velocity microphone.

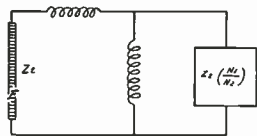


Fig. 2. Equivalent circuit of velocity microphone.

this device that the sound waves be allowed to continue their travel after striking the ribbon, it is important that the device be so designed as to obtain this effect. It is, therefore, necessary to avoid such construction as would produce cavities, which, as stated before, would produce certain frequency peaks so detrimental to faithful reproduction.

Theoretically speaking, a ribbon microphone can be designed so as to be able to respond to the entire audible frequency range of sixteen cycles to twenty thousand cycles; however, the limitation imposed by mechanical construction reduces this range somewhat, but it is still possible to obtain a frequency response much wider than with any other microphone so far developed.

The velocity microphone consists mainly of two systems. The first is an acoustical one which, in this case, is the air set in motion by the action of sound. The second is an electro-mechanical system which consists of a very light conductor in the shape of a ribbon so constructed as to be free to vibrate in a magnetic field produced by permanent or electromagnets. A mechanical system must by necessity have resistance, mass, stiffness, and by careful consideration of each and every one of these factors it is possible to control the range of frequencies to be registered by the mechanical system itself.

In the case of the velocity microphone the controlling factor is mass alone. The requirement of uniform sensitivity over a wider frequency range, is equivalent to specifying that the ratio of the generated e.m.f. to the pressure or velocity in the sound wave shall be independent of the frequency.

The expression of the generated e.m.f. will be $E = Blx$ where

$$\begin{aligned} l & \text{ is the length} & (1) \\ x & \text{ velocity} \\ B & \text{ flux density} \end{aligned}$$

In a mass controlled mechanical system, we have

$$\begin{aligned} F & = \text{periodic force} & (2) \\ m & = \text{mass} \\ w & = 2\pi f & f = \text{the frequency.} \end{aligned}$$

To maintain constant velocity, f must be proportional to the frequency. One way to accomplish this is as follows: The excess pressure and particle velocity are derived from the velocity potential ϕ as follows:

$$P = - \frac{a\phi}{at} \quad (3)$$

$$V = \text{GRAD. } \phi = \Delta\phi \quad (4)$$

The gradient of P is given by

$$\Delta P = - P \Delta \frac{a\phi}{at} \quad (5)$$

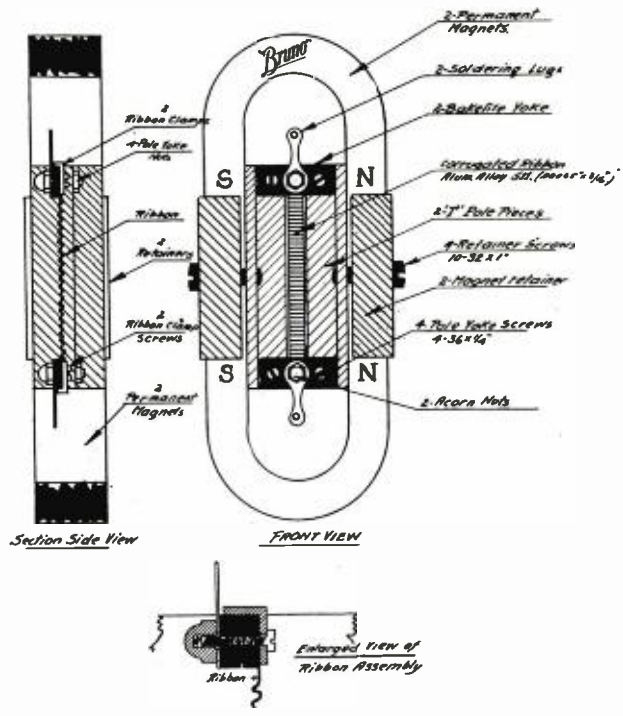
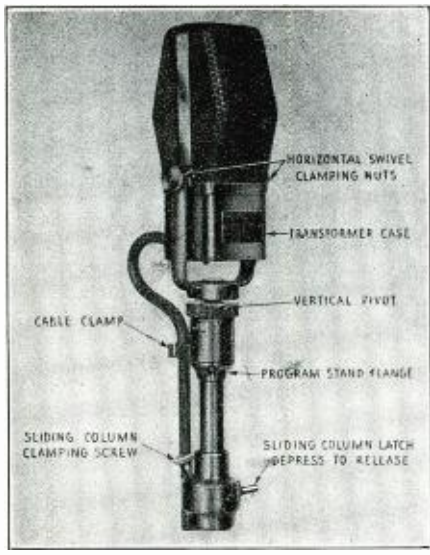


Fig. 3. Commercial applications.

The velocity potential in a sound wave may be expressed by

$$\phi = AF(x, y, z) \cos R[ct + f(x, y, z)] \quad (6)$$

then

$$\frac{a\phi}{at} = -ARcF(x, y, z) \sin R[ct + f(x, y, z)] \quad (7)$$

compare (5) and (7).

The magnitude of ΔP is proportional to the frequency. Therefore if the pressure gradient is employed for actuating the mechanical system of a microphone, the resultant force is proportional to the frequency.

The equivalent circuit of a ribbon microphone is shown in Fig. 2.

The force required to generate i in the equivalent circuit is

$$F = Bi \quad (8)$$

The mechanical impedance due to the electrical circuit is

$$ZE = \frac{F}{x} = \frac{(Bi)^2}{Zt} \quad (9)$$

where Zt = total electrical impedance at point E.

The velocity of ribbon is given by

$$x = \frac{\Delta P}{ZR + ZA} \quad (10)$$

The generated voltage is given by

$$E = Bix = \frac{\Delta P}{ZR + ZA} \quad (11)$$

where ZR = electrical impedance
 XA = aperture impedance
 ZR and ZA , are negligible values which can be con-

sidered constant. This indicates that the generated voltage is independent of the frequency, and therefore it remains constant throughout the frequency range.

But while in theory it is possible to attain this result, a number of unavoidable factors tend to reduce the frequency range of this device which, however, is the only type capable of such wide response.

Fig. 4 shows a typical frequency response curve of the various types of microphones in use today. In comparison, the one pertaining to the ribbon is remarkably "flat" and the absence of peaks should be particularly noted.

It is to be regretted, however, that having the possibility of transforming sound waves into electrical energy with such uniform fidelity, it is impossible to take full advantage of this quality due to the limitations imposed by the coupling transformer necessary to the proper operation of this transmitter, and the unavoidable baffle effect produced by the pole pieces.

But while this transformer is a limiting factor, its use is indirectly responsible for two other very important advantages which this type of microphone has over some of the others.

The sole reason for employing a coupling transformer is, that due to the impedance of the ribbon being less than one ohm, it cannot be directly coupled to the grid of a tube. This seemingly unimportant characteristic, however, causes this type of transmitter to be impervious to climatic conditions while the absence of sealed chambers and diaphragm renders it unaffected even by rapid barometric changes. As a matter of fact, this microphone can be submerged in water and if the ribbon has not been damaged, no appreciable loss is detectable in both output and frequency response. Rapid changes of temperature varying from 0° to 100° C. and pronounced altitude variations have likewise no effects upon its operation.

The necessity of using the coupling transformer also makes it possible to place the pre-amplifier at a distance from the microphone itself. The possibility of using a

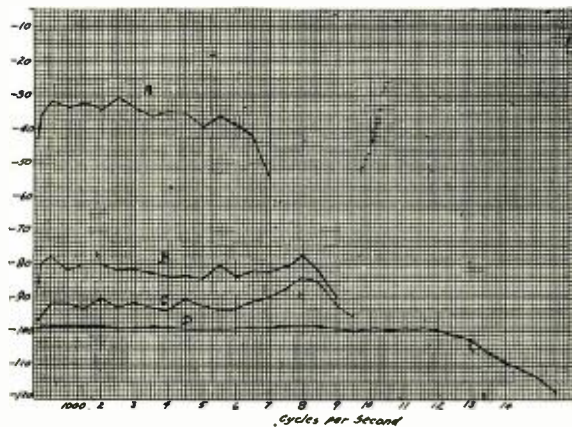


Fig. 4. A—carbon microphone; B—dynamic microphone; C—condenser microphone; D—velocity microphone.

pre-amplifier at a distance from the transmitter precludes the necessity of boosting each individual microphone. Therefore, when properly mixed, one pre-amplifier can be used for a number of microphones. In installations calling for a large number of units, the saving involved by the use of a single pre-amplifier, is a factor to be taken into consideration.

Ribbon microphones are now constructed capable of delivering 450 microvolts across a 250-ohm load when excited by a sound pressure of 10 dynes per square centimeter perpendicular to the plane of the ribbon.

CITY OF BOSTON INSTALLATION

(Concluded from page 12)

that would be practical for car installations would be three miles.

3. That it was entirely practical and desirable to use duplex communication rather than simplex.

4. That by making use of the 18 outlying substations as receiving points for the car transmitters and connecting each substation by telephone lines with the radio central, it would be entirely practical for the Boston police to install, operate and maintain at a reasonable figure duplex two-way communication at all times with its 75 odd cruising cars.

It should be stated that some of the results which first were expected by the Boston police after analysis of police radio seemed impractical at the present state of the art. We, at the Hygrade Sylvania Corporation, were surprised and greatly enthused by the results obtained and believe that the Boston police by their courage in insisting on the ultimate of modern science in police communication have opened the road to a far more efficient end for police use.

Commissioner Hultman, and Timothy A. J. Hayes, radio director of the Boston police, are to be congratulated on their work in arming the police with a weapon more efficient than any in use by the criminal, or for any other police system known today.

In the development of the apparatus used, W. G. McConnel, head of the transmitter section, and D. W. Short, directly assigned to this work in the transmitter section should receive credit for the excellent work in making the most of equipment available in

This is equivalent to an output level of -72 db. as compared with a zero level of 12.5 milliwatts, or -69 db. if the zero level is 6 milliwatts.

On an open circuit, therefore, and with an input of 1 dyne per square cm. the output of a ribbon microphone is the equivalent of -86 db. as compared to a zero level of 12.5 milliwatts.

From the above it is clearly understood that a pre-amplifier consisting of two stages is sufficient to boost the output level of this device to that of any other form of transmitter with the exception of the carbon type. The radical difference in operating principle and construction existing between the ribbon and the pressure type of microphone, is responsible for the novel technique necessary in order to take full advantage of the inherent qualities of this new device.

It is no longer necessary to "hug" the microphone. In fact, the source of sound should never be closer than two feet from the transmitter and a distance of 3 or 4 feet is to be preferred. At closer range, this microphone has a tendency to accentuate the low frequencies to such an extent as to make a voice sound "boomy." On the other hand, the placement of a soloist or a musical instrument off the center line of the microphone, will in no way affect the quality of the pickup and inasmuch as the microphone is bi-directional, it is possible to assemble the performers on both sides of the transmitter with equally good results.

But, a chain is as strong as its weakest link and it would be futile to expect marvels of sound reproduction if, in the long chain of components linking the microphone to the loudspeaker, there is even one link hampering the functions of this remarkable device.

securing the excellent results herein described.

Undoubtedly the data secured in this test will be reviewed with interest by all police authorities and the great advantage which can be secured by using the type of equipment described above will undoubtedly revolutionize the communication system of the police in various cities and counties throughout the country.

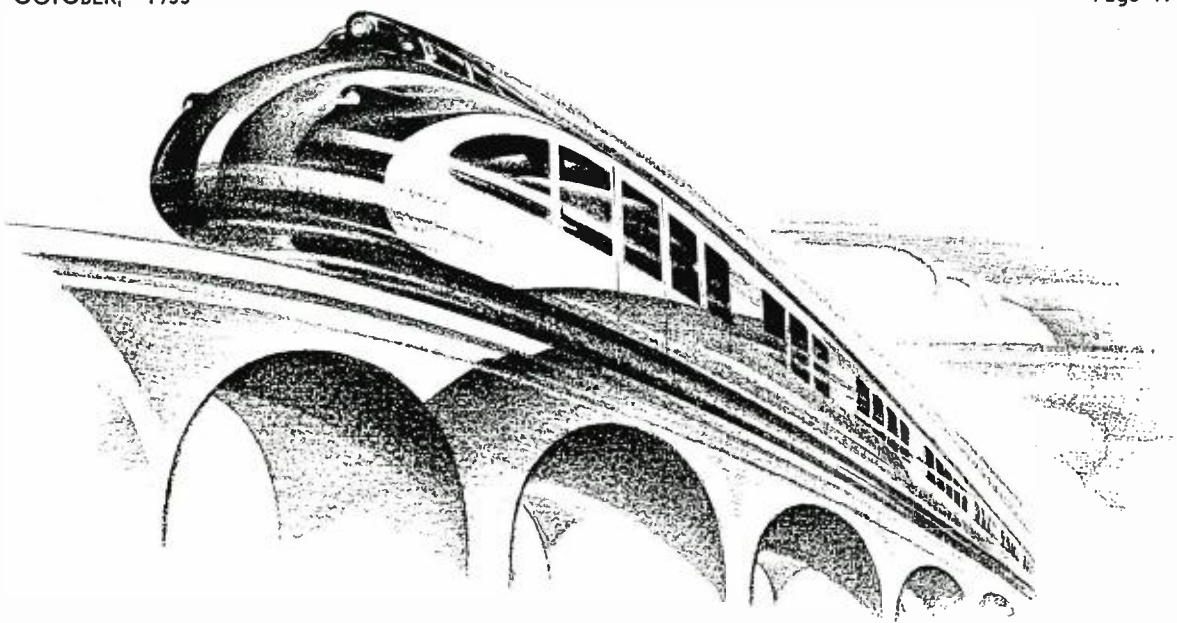
VARNISHED TUBING FOR RADIO

(Concluded from page 13)

ghetti had of bursting into a rapidly spreading and foaming blister when the soldering iron was applied just a little too long. The new varnished cloth tubings are much more heat resistant, and can not be made to do this startling trick. In fact the varnish, especially on the black tubing seems to stand up nicely even though the cloth be thoroughly charred.

Saturated Slewing

This high heat resistance of the black varnishes has led to the extensive use of saturated sleeving in radio apparatus. Saturated sleeving is simply a braided tubing thoroughly saturated with high grade insulating varnish and properly baked. It does not have quite the same high puncture values of the shiny coated varnished tubing but it is flexible, durable and moisture resistant. It is extensively used for protecting the leads in potted transformers, chokes and other radio parts where the windings are carried and sealed in a high melting point compound.



PROGRESSIVE

AS THE NEW STREAMLINED TRAINS!

TODAY, the forerunners of a new era in transportation are being installed in actual service. Tomorrow, these lighter, faster streamlined trains will completely supplant the present type! Science has anticipated needs of the future!

With equal progressiveness Hygrade Sylvania pushes research and development in the radio tube field. It was Hygrade Sylvania who pioneered in the development of the new 6.3 volt tubes that made automobile radios practical . . . and later in the complete 6.3 volt group of tubes!

By cooperating with leading set manufacturers in solving circuit and design problems also, Hygrade



Sylvania has been enabled to make numerous other contributions to the radio industry. Requests for service of this type are welcome. Our engineers stand ready to work with manufacturers in their own plants or in Hygrade Sylvania's modern laboratories. No obligation is incurred.

Dealers and jobbers who handle Sylvania Tubes realize substantial advantages in a line that always offers highest, up-to-the-minute engineering. They are assured, as well, sound merchandising support, fair price policies, and the backing of an organization whose credit rating has remained Aaa1 throughout all business booms and depressions! Hygrade Sylvania Corp., Emporium, Pa.

Sylvania

THE SET-TESTED  RADIO TUBE

© 1933, T. H. S. C.

New Electrophones

By W. G. Ellis*

IN spite of the steady progress in the electrical reproduction of sound which has taken place since the advent of radio entertainment broadcasting in 1921 the present-day commercial applications of this art cannot be said to be completely satisfactory. The majority of loudspeakers have two faults: first, their frequency range is restricted, the output falling off at the higher frequencies; and, second their frequency response is "peaky" and fluctuates widely in the range that they do cover. Furthermore, designs prior to Ballantine's discovery of the effects of diffraction and cavity resonance in condenser microphones have a defective balance between the high and low frequency response due to large errors in the older sound-measuring technique. Recent improvements in microphones and in the frequency range of other apparatus (amplifiers, sound-heads, etc.) have brought out these faults in glaring relief and have definitely established the loudspeaker as the "neck of the bottle." In view of this situation and the growing interest in high-fidelity reproduction the present brief description of some new electrophones of improved performance may be of interest. This apparatus was developed in the laboratories of the Boonton Research Corporation and is now being made available commercially by the Electrophone Corporation under license from that organization.

High-Frequency Electrophone, Model 4

For faithful reproduction over a wide range of frequencies the advantages of employing several electrophone units, designed to cover different portions of the spectrum, are well recognized.

The response of Model 4A electrophone extends to the upper limit of hearing (about 16,000 cycles). The Model 4B unit is purposely designed to cut off at about 8,000 cycles and will be useful where a limited response is desirable, as in radio receivers. The constructions of the two instruments are practically identical and they are interchangeable.¹

Fig. 1 is a central sectional view of the Model 4 electrophone. The instrument comprises three fundamental parts:

(1) The motor (transducer) element, consisting of a self-actuating piezoelectric diaphragm made up of Rochelle-salt crystals;

(2) A radiating element consisting of a small horn of exponential section, designed for a 1,000 cycle cut-off and having a mouth of ample size to avoid reflection;

(3) A transformer for reducing the impedance of the unit to match generator or source impedances of 2.5, 10 and 500 ohms.

The construction of the piezoelectric diaphragm is shown in Fig. 2. It is made up of four "bimorph" torque sensitive Rochelle-salt crystal elements of the type developed by the Brush Development Company at Cleveland.²

The method of forming these torque-sensitive units from shear-responsive plates is shown at the left in Fig. 2. If the crystals provided with foil electrodes are subjected to an electric force between foils, and the lower corners x and y are clamped the top tends to move in shear as shown by the arrow. Two plates, having opposite straining tendencies are now cemented together and act in opposition, as in the familiar bimetallic thermostat and produce a rotation of the corner d when the remaining three corners are clamped. Four of these units are cemented together at their edges to form a square diaphragm. The assembly is clamped around the periphery and when voltage is applied the four corners d in the middle of the diaphragm move in and out in unison.

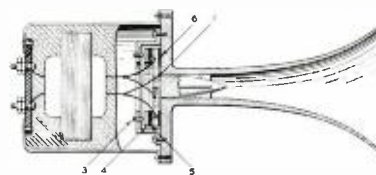


Fig. 1.

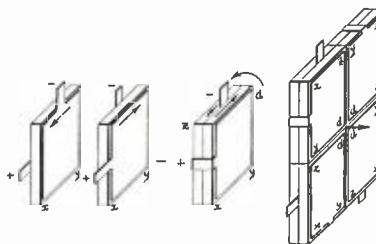


Fig. 2.

Proper throat clearance is provided by the annular spacer 6, Fig. 1. The diaphragm is clamped by the annular rings 4 and 5 and set-screws 3.

Sound is radiated by means of an exponential horn. A bullet-shaped insert, supported by longitudinal fins, is provided in the throat of the horn to form the usual annular throat passage. This is omitted in the Model 4B horn since response at the extremely high frequencies is not desired.

The sound pressures on the axis of the horn and at angles of 20 and 40 degrees from the axis are shown in Fig. 3 as a function of frequency with constant voltage across the crystals. The axial sound pressure increases approximately as the square of the frequency. The coupling transformer is so designed that the rate of rise of sound pressure with frequency is somewhat less rapid than this and corresponds to the rate at which the majority of "dynamic" loudspeakers fall off with rising frequency so as to secure the best match and a smooth combined output curve. A flat sound pressure characteristic may be secured by tuning the supply circuit with a series inductance. The circuit is resonated at a fre-

*President, Electrophone Corporation.

¹See "A Piezoelectric Loudspeaker for the Higher Audio Frequencies," I.R.E. Proceedings, October, 1933.

²C. B. Sawyer: Proc. Inst. Radio Engrs., 19, p. 2022 (1931) U. S. Patent 1,803,275.

for High-Fidelity Sound Reproduction

quency lower than the mechanical resonance frequency of the crystals.

The electromechanical conversion efficiency is high (about 70 per cent) but due to mechanical losses in the crystal the overall efficiency is lower. Overall efficiencies (electrical input to sound output) as high as 30 per cent have been obtained. These compare favorably with the efficiencies of units driven by a moving coil. For this reason the acoustic power output level of the high-frequency unit is about the same as that of the average low-frequency unit so that a balance is naturally obtained. In some cases, as for example with the less efficient direct-radiating cone type of speaker, it is necessary for balance to attenuate the input to the high-frequency unit or to use two low-frequency units to one high-frequency unit.

A triple unit, designed for higher power output and a better horizontal distribution of sound is illustrated in Fig. 4.

Applications

The Model 4 electrophone is intended for use in conjunction with an ordinary loudspeaker. Present loudspeakers of the cone ("dynamic") or horn types reproduce satisfactorily the tones of lower frequency but fail to respond to those higher frequencies.

The unit is designed for direct connection in parallel with the low-frequency speaker unit as shown in Fig. 5. No filters or other networks, ordinarily used with the dynamic type of high-frequency unit, are required to divide the power between the speakers. This is made possible by the fact that the reactance of the unit is inherently capacitive and when connected in parallel with a unit having an inductive impedance the power divides naturally. Moreover, connection of the capacitive unit directly in parallel with the inductive low-frequency speaker actually improves the power-factor of the circuit. This is especially valuable with output tubes having a pentode type of plate circuit characteristic. In this case the presence of the high-frequency unit has two bene-

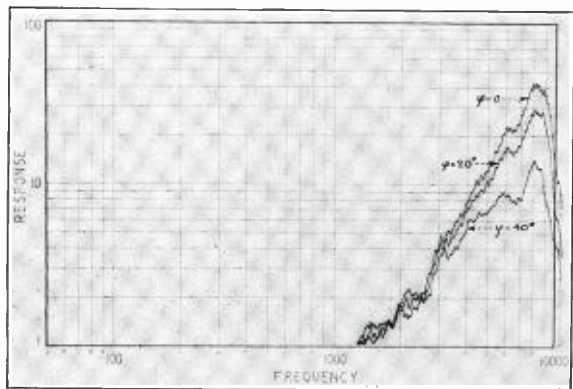


Fig. 3.

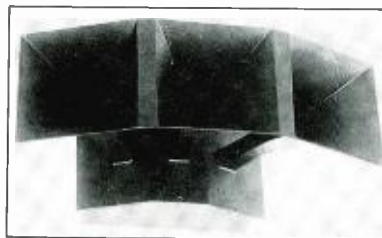


Fig. 4.

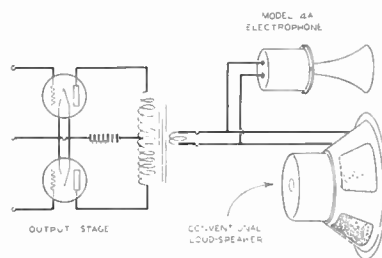


Fig. 5.

ficial effects. First, it helps to damp the mechanical resonant peak at low frequencies; second, the presence of the capacity in shunt limits the rise in response of the low-frequency speaker with increasing frequency which is characteristic of constant current supply.

The addition of this unit to existing equipment is further simplified by the fact that no polarizing voltages or field supply are necessary, as with other types (dynamic and condenser).

The following applications will be of interest to engineers, manufacturers, experimenters and service men: new radio broadcast receiver designs, present radio broadcast receivers, public address and sound reinforcement systems, sound-picture reproducing systems, high-quality monitors for broadcast and audition studios, electrical phonographs.

Radio Broadcast Receivers

The chief sources of frequency distortion in such receivers are: (1) sideband cutting in the radio circuits, and (2) non-uniformity of response in the loudspeaker. There has been a considerable improvement in the electrical fidelity of broadcast receivers in the past few years and newer receivers will undoubtedly appear which will be entirely satisfactory from the viewpoint of the first source of distortion. This leaves the loudspeaker as the remaining problem. A combination reproducer employing the Model 4A unit in conjunction with a regular speaker is proposed to radio manufacturers as an economical and practical solution of this problem. This will also be of interest to designers and producers of *de luxe* and custom-built receivers and to experimenters desiring to obtain the utmost in tone quality.

The tone quality of existing receivers also can be ma-

(Concluded on page 21)



For Mobile Radio, of course

CLAROSTAT

Resistors and Controls

No matter how rigid the test or how exacting the requirements, Clarostat Resistors and Controls are found standing the gaff day in and day out.

For automobile radio receivers, Clarostats have been standard equipment since the days when auto radio was a novelty.

Clarostats are in daily service in aerial communication, with its demands for non-failing, dependable operation.

In marine work and even in submarines Clarostats are being used under trying conditions of temperature change—with unfailing dependability.

Set Manufacturers, Engineers, Consultants and Purchasing Agents are invited to communicate with us. If it's a problem, we welcome it. Send us your specifications for samples or standard production samples will be furnished upon request.

Clarostat Manufacturing Co., Inc.
285-287 North Sixth Street, Brooklyn, N. Y.



NEW ELECTROPHONES FOR HIGH FIDELITY SOUND REPRODUCTION

(Concluded from page 19)

terially improved by the addition of a Model 4A unit, even though the results may not attain the utmost perfection due to the residual radio circuit distortion which may be unavoidably present.

Public-Address and Sound-Picture Systems

Since the Model 4A electrophones are designed for direct parallel connection to existing sound projectors and require no field or polarizing voltages, they may be easily added to present systems as installed by the operator, engineer or projectionist. In general one Model 4A unit will be required for each projector to obtain proper balance. In this manner wide-range reproduction can be obtained from existing equipment with a minimum of expense, and full advantage taken of the recent advances which have been made by the film producers in high-fidelity recording. A number of such installations have already been made and are giving excellent results.

Dual Electrophone, Model 3A

This comprises a high-grade direct-radiating coil-driven cone for the reproduction of frequencies up to

about 3,000 cycles in combination with a Model 4 unit for the reproduction of frequencies above this.

The unusual smoothness in the response of the low-frequency unit employed in this combination is the result of a rather thorough investigation of cone dimensions and angles, diaphragm materials, peripheral support and spiders which was undertaken after an examination of commercial units had shown that their performance was not good enough for the intended purpose. This investigation was considerably facilitated by the use of rapid automatic recording means³ for obtaining the sound-pressure frequency characteristics.

The units are mounted one above the other in order to obtain a better distribution of sound horizontally.

These electrophones are being used for monitoring and audition purposes in radio broadcast studios and wherever high-grade reproduction is desired. The unmounted unit is being applied to high-class radio broadcast receivers.

In conclusion the writer wishes to acknowledge his indebtedness to Stuart Ballantine, of Boonton Research Corporation, for technical information concerning the above apparatus.

³See *Jour. Acous. Soc. Amer.*, July, 1933.



NEW TUBES FOR SHORT-WAVE OPERATION

AT the October 4 meeting in New York of the Institute of Radio Engineers, a paper was read by B. J. Thompson and G. M. Rose, Jr., of the RCA Radiotron Company, on the subject of vacuum tubes of small dimensions for use at extremely high frequencies.

Demonstration of the new tubes was given using a miniature transmitter and receiver. The description was of the construction and operation of very small triodes and screen grid tubes intended

for reception at wavelengths down to 60 centimeters with conventional circuits. The tubes represent nearly a ten-fold reduction in dimensions as compared with conventional receiving tubes, but which compare favorably with them in transconductance and amplification factor. The interelectrode capacitances are only a fraction of those obtained in the larger tubes.

The triodes have been operated in a conventional feedback oscillator circuit at a wavelength of thirty centimeters

with a plate voltage of 115 volts and a plate current of 3 milliamperes. Receivers have been constructed using the screen-grid tubes which afford tuned radio-frequency amplification at 100 centimeters and 75 centimeters, a gain of approximately four per stage being obtained at the longer wavelength.

The meeting was attended by 520 members of the Institute. In the absence of President, Dr. L. M. Hull, the meeting was conducted by past president Donald McNicol.



FLASH OVER IN TYPE 83 TUBE EXPLAINED

MEMBERS of the radio trade and amateur station operators have been puzzled by the flash-over which sometimes occurs in the Type 83 full-wave mercury vapor rectifier tube. W. M. Perkins, chief of radio application department of National Union Radio Corporation explains this phenomenon as follows:

"In the handling and shipping of the Type 83 radio tube, the excess mercury often deposits itself in a film across

the stem of the tube, thus furnishing an electrical path between the electrode connections. It is the burning away of this deposit which causes the flash-over.

"For really ideal operation, the filament *only* should be allowed to burn for a period of three to four minutes. After this, the plate voltage may safely be applied. This burning of the filament will warm the tube sufficiently to drive off the condensation of the mercury on the stem. Amateurs should follow this pre-

caution as well as be careful not to overload.

"The Type 83 is designed to stand an applied voltage of 500 volts r.m.s. per plate and deliver 250 ma. d-c. output. Providing the tube is operated within this rating, excellent life will be secured, but overloading will cause early failure. The application of higher a-c. voltage than 500 volts per plate will give rise to electrolysis in the glass of the stem which results in stem rupture."



NEWS OF THE INDUSTRY

ELMET FACTORY RUNNING AT CAPACITY

Improved conditions in the radio field and increased demands for molybdenum wire have brought about an unprecedented demand for the product of the American Electro Metal Corporation of Lewiston, Maine.

Part of this demand is due no doubt to the new improved type of grid wire which this concern is able to offer because of recently installed exclusive patented methods of manufacture.

Orders for Elmet during September are reported to be the largest in the company's history and indications are that October business will exceed that of September by a wide margin.

In order to maintain production and to insure its customers of the usual prompt service this concern is making preparations to run three shifts instead of two under which they are now operating.

BREWSTER NOW CHIEF ENGINEER OF TRIAD

Oliver H. Brewster has joined the staff of the Triad Manufacturing Company as chief engineer.

Mr. Brewster has been connected with Westinghouse, CeCo and KenRad Mfg. Companies.

PACKARD GOES ALL RADIO

With their new 1934 automobile models, the Packard Company claims the distinction of being the first of the automobile builders to give full recognition to the radio receiving set as a desirable feature of the modern auto car. Other makers provide built-in antennas in the car bodies, and in some cases removable dash panels which afford space for the installation of radio receivers.

In addition to the several automobile manufacturers providing for the installation of receiving sets, even recommending them to car users, one offers a set as regular equipment on a recent de luxe model.

Packard 1934 models, however, are completely engineered for radio throughout the entire series. This involves a specially designed instrument board, shielded wiring and lead-in wires, provision for interference prevention, a larger air-cooled generator and other engineering features. The removable panel, designed for the panel and controls of the receiver, follows the characteristic design of the Packard radiator and becomes an ornamental detail in cars whose owners do not require the radio receiver.

FOUR TYPES OF SUPPRESSORS

The Allen-Bradley Company 126 W. Greenfield Ave., Milwaukee, Wis., manufacture Types W, X, Y and Z mobile ignition suppressor resistors. These spark plug resistors are being widely applied in the installation of automobile radio receivers.

INTERFERENCE CONDENSERS

Auto generator radio interference condensers in heavy metal cases with mounting strap in both $\frac{1}{2}$ and 1 mfd. capacity are announced by the Condenser Corp., of America, 259-271 Cornelison Ave., Jersey City, N. J.

BRUSH GRILLE TYPE MICROPHONES

The Brush Development Co., 3715 Euclid Ave., Cleveland, Ohio, has recently released information on their Grille Type Microphones, which are characterized by the following advantages for the recording, reproduction and measurement of sound.

Extreme ruggedness. Having no delicate mechanical parts, the Brush grille type microphone is almost unbreakable, is unaffected by vibration or shock and cannot be overloaded.

Transparent to sound. Being constructed of a number of "sound cells" arranged edgewise to form a grille, there is a minimum distortion of the wave front, no reflection or pressure doubling and no cavity resonance.

Improved fidelity. No low cutoff. Flat response over the whole broadcast range. To obviate the necessity of using a compensated amplifier the microphone is designed to have a rising characteristic from 6,000 cycles to 10,000 cycles.

Non-directional. Therefore ideal for studio work.

Electrical and physical convenience. Light and strong. It may be used in any position. Only two conductors, no field current or polarizing voltage, therefore free from background noise.

Several types are covered in the rather comprehensive descriptive literature which may be had by letterhead request to the Brush Co.

NATIONAL UNION OFFERS AUTO RADIO MANUAL

National Union Radio Corporation of New York has recently announced an automobile radio service manual, incorporating installation and service data on all principal automobile radio receivers.

ACRATONE PUBLIC-ADDRESS AND SOUND EQUIPMENT BOOK

An interesting public-address and sound equipment booklet has just been issued by the Acratone Products Co., 20 Murray St., New York City. This contains complete data on the installation of various types of public address equipment. The descriptions are technically complete and are accompanied by engineering curves and graphs.

It is the aim of the publishers of this book to place it in the hands of everyone who is interested in public-address work. It is available, free of charge upon request, to any RADIO ENGINEERING reader who writes to Acratone Products Company, 20 Murray Street, New York City, inclosing 10 cents to cover mailing cost.

CABINETS FOR RECEIVERS

A distinct contribution to the compactness, durability and fine appearance of various makes and models of the small size radio receivers has been the application of Bakelite Molded products. Bakelite Molded will not dent nor is it easily marred. Production economies are secured through the reduction of assembly operations, when Bakelite Molded cases are used.

AUTOMOBILE RADIO STANDARDS

R. S. Burnett, Standards manager of the Society of Automotive Engineers, has in hand the matter of standardization of ignition suppressor resistors, and other parts used in car radios. The Committee on Automotive Radio, Radio Manufacturers' Association, of which V. M. Graham is chairman, is cooperating with S. A. E. engineers.

FOOTE JOINS SYNTHANE

Synthane Corporation, Oaks, Pa., manufacturers of Synthane laminated bakelite, has appointed R. L. Foote to head their new engineering service department. Mr. Foote, a well-known mechanical engineer, will be in contact with manufacturers for the purpose of developing engineering applications of Synthane. He will make his headquarters at the Oaks office.

ANCIENT GAS BUGGY PLUS RCA VICTOR AUTO RADIO

The Aeolian Company of Missouri recently engineered a publicity and advertising stunt in connection with RCA Victor automobile radio that attracted considerable public attention and newspaper publicity space.

They dug up one of the oldest Ford cars in existence, of 1904 vintage, and installed a new M-34 instrument in it. A large sign advertising RCA Victor auto radio was erected on poles over the machine and with the radio going full blast the ancient gasoline chariot with the most modern automobile radio was driven through the streets of St. Louis for eight hours a day. Stops were made in front of RCA Victor dealer stores and in some cases, public-address systems were employed to give more detailed information.

CANDOHM RESISTORS

The Muter Company, 1255 South Michigan Ave., Chicago, Ill., has a line of Candohm resistors for automobile radio receivers in ratings from $\frac{3}{4}$ to 5 watts.

Factor of Safety.—All units, except type FH, dissipate their rated amount at approximately 120° F. and will stand a constant duty overload of 50% without exceeding 200° F. Location of unit in chassis causes this to vary somewhat.

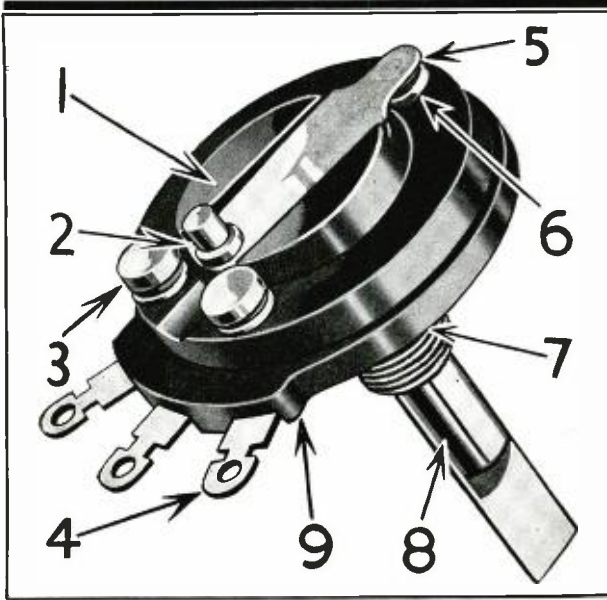
PHOTOELECTRIC CELLS

Continental Electric Co., of St. Charles, Ill., is now manufacturing a complete line of photoelectric cells.

9 engineered features are built into every

STACKPOLE

MOLDED CARBON VOLUME CONTROL!



We manufacture a complete line of high quality fixed resistors and automobile suppressors.

1. INSULATED BUSHING AND SHAFT
This bakelite hub carries the spring arm and the contact for the moving element and the shaft is molded into the other end of this bakelite hub, so the mounting bushing and shaft are fully insulated from the entire control resistor.

2. SWITCH OPERATING CAM
The cam dog which operates the a.c. switch on the switch type variable resistors, is assembled as a composite part of the moving arm member assuring accurate operation of the switch in respect to the resistance curve or hop-off value.

3. RUGGED STOP PINS
These rugged stop pins are accurately located through the resistor element and the bakelite frame and hold the entire assembly into one solid form.

4. LUGS EASY TO SOLDER TO
The three lugs on the variable resistor, as well as the two on the a.c. switch, are tin dipped to make it very easy to solder the connecting wires to them.

5. CONSTANT SPRING TENSION
The exact amount of downward tension is always maintained on the rotating shoe by this one-piece, special tempered spring arm.

6. SMOOTH ACTION—ABSENCE OF NOISE
This nickel chrome sliding shoe is highly polished, cannot corrode and assures smooth and easy rotation of the arm of the variable resistor.

7. STANDARD ONE-HOLE MOUNTING
The standard $\frac{3}{8}$ -inch brass bushing is fully insulated from the arm and resistor element.

8. NON-RUSTING SHAFT
This shaft is of cadmium plated steel and fits perfectly in the bored brass bushing to provide smooth and quiet operation.

9. AND A NEW, PERMANENT, MOLDED CARBON RESISTOR ELEMENT

Stackpole offers the first control of its type and the first compact variable resistor which is permanent and unaffected by humidity.

The thick molded carbon resistor element, mounted on bakelite frame, is made in much the same way as permanent carbon resistors. Its hard glasslike surface is the result of firing at high temperatures and assures imperviousness to humidity—hard usage and varying temperatures. Stackpole Molded Carbon Volume Controls will carry considerable current, are free from capacity effect, and have low heat and voltage coefficient. They are smooth and quiet in any circuit.

Made in any value from a few hundred ohms to a couple of megohms with any desired resistance taper and any hop-off or fixed value of resistance at either or both ends.

Send for our interesting 12-page booklet on Stackpole CONTROLS—RESISTORS—SUPPRESSORS which contains complete descriptions and technical data on these three important products. Included are circuit diagrams indicating the correct application of VOLUME AND TONE CONTROLS to every type of tube and circuit. A copy of this booklet will be gladly sent to you, upon request.

STACKPOLE CARBON CO. ST. MARYS PENNSYLVANIA

ANTENNAS FOR MOBILE RADIO

An excellent antenna for mobile radio receivers is manufactured by the Fishwick Radio Company, 226 East 8th St., Cincinnati, Ohio.

These antennas are available in three standard types. One is a tubular form 2½ inches by 36 inches with parallel coil construction and thoroughly waterproof. The auto top antenna, flat coiled to 9 inches by 36 inches, ¼ inch thick.

The running board type is flat, 9 inches by 36 inches with pressed steel brackets at the ends.

AUTO RADIO FILTERIZER KIT

Tobe Deutschmann Corporation, Canton, Mass., is marketing an auto radio filterizer kit of use in automobile radio equipment.

The kit is built around a shielded lead-in cable and impedance matching transformer. The shielded lead-in cable is used for carrying the signals from either a roof aerial or an under-car aerial to the receiver in such a manner that there is no possibility of inductive coupling between the lead-in and any of the car wiring. The impedance matching transformer is connected between the shielded lead-in cable and the radio receiver so as to improve the over-all efficiency of the system.

Tests conducted with a number of different types of receivers under widely varied installation conditions have indicated that the use of this shielded lead and impedance matching transformer practically always provides greater apparent signal strength because of the improvement in transmission ratio.

UNIVERSAL MICROPHONE BULLETIN

Sales Manual Covering Universal Microphones and Other Products has been issued by Universal Microphone Co., Inglewood, Cal., as a loose-leaf binder book. Compilation includes 1933 catalog, magazine reprints, blueprint circuits and diagrams, catalog supplements of the year, and two booklets titled *Care of Microphones* and *Home Recording*, which were published some time ago. Publication also includes data on hearing aid devices, Luboscope and Radio Owl, which are supplementary to microphone lines.

TRANSMITTING TUBES

The Hygrade Sylvania Corporation, 500 Fifth Avenue, New York, has issued a bulletin describing that company's new line of radio transmitting tubes, listing prices. This bulletin lists air-cooled and water-cooled tubes, rectifiers, grid controlled rectifiers and phototubes. Copies will be forwarded upon request to D. E. Replogle at the above address.

SHEA CHIEF ENGINEER OF FREED TELEVISION AND RADIO

R. F. Shea has been appointed chief engineer of the Freed Television and Radio Corporation. Mr. Shea is well known in the field through his former connections with the engineering department of the Pilot Radio Corp., and more recently as the head of the United Radio Laboratories.

RADIO PARTS AND ACCESSORIES

The Insuline Corporation of America, 23-25 Park Place, New York, have issued a new illustrated catalog, No. 180, listing an up-to-date line of parts for radio receiver assembly and for installation. Accessories for short-wave receivers and transmitters are included.

BALANCING OUTPUT TUBES AND PUSH-PULL AMPLIFIERS

A unit with a one-watt rating and a range of 10 to 1,000 ohms employed by a number of manufacturers for balancing output tubes and push-pull amplifiers, is the center tapped M. H. potentiometer manufactured by the Clarostat Mfg. Co., Inc., 285-287 North 6th Street, Brooklyn, N. Y.

By the use of this control in the circuit such variations as plate current drawn by push-pull tubes and inequalities of secondaries on the input transformer may be readily balanced, thus eliminating a common cause of undesirable hum.

AIRPLANE RADIO

The Western Electric Company, Newark, N. J., has been having excellent success in airplane service with the many installations now in operation of the 12A receiver.

The 12A radio receiver is a superheterodyne receiver employing a total of eight tubes, seven of which are variable mu while the other or output tube is a pentode. The circuit is ultra selective, having been designed for use under the present crowded condition of aircraft frequencies. Positive frequency stability of the receiver is assured by means of an improved temperature controlled quartz crystal oscillator. If desired, the receiver may be operated without quartz crystals by using an electric circuit oscillator of the self-excited type.

Accessibility of all parts has been emphasized and rugged construction consistent with light weight assures reliability of operation.

The receiver embodies an automatic gain control which of itself covers a very wide range. In addition to the automatic gain control, a potentiometer is provided in the 8A control unit by means of which the output may be set at the level desired to be maintained. A newly designed ballast lamp, insuring correct filament current at the tubes under a wide range of battery conditions, is included in the receiver.

All control and electrical connections for the radio receiver, with the exception of the antenna, are made automatically when the receiver is placed in the mounting. This insures positive contact and also quick removal. All circuits are pretuned to two operating frequencies at the service station and the shift from the day to the night frequency is made from the cockpit by means of remote control.

The 2A receiver mounting is used with the 12A receiver. It is supported on shock absorbing feet which protect the receiver from the effects of plane vibration and landing shocks. It includes the jack by means of which connections are made to the receiver when it is placed in the mounting.

The 2A mounting employs the tachometer shaft or worm and gear methods for making the frequency shift. The worm is rotated by means of a flexible shaft in a casing which connects to the 9A control unit in the pilot's cockpit.

LOUDSPEAKERS FOR AUTO RADIO

The Rola Company, 2530 Superior Ave., Cleveland, Ohio, announces a new automobile loudspeaker unit. The unit is light in weight, is in an octagon shaped wood case and has a single stud mounting for quick installation, and is built in two sizes. The effective cone diameters are 4½ and 6 inches, the net weights 5 pounds 10 oz. and 6 pounds 2 oz.

84 TYPE TUBE RECTIFIER

RCA Radiotron No. 84 is a full-wave vacuum type rectifier having a 6.3 volt, 0.5 ampere heater which has application as a rectifier in the power units of automobile radio receivers. When so used the heater voltage should not exceed 7.5 volts.

MOBILE RADIO B SUPPLY

The Utah Radio Products Co., 812-820 Orleans Street, Chicago, Ill., is marketing a B supply unit of the full-wave rectifier type. The vibrator unit used in the eliminator is new in circuit and design and has no adjustments. Current is divided between two sets of contacts and will continue to operate through considerable battery voltage variation.

In connecting the storage battery to the input terminals it is not necessary to observe polarity requirements.

The unit is 6¼ inches high, 7¼ inches long and 2½ inches deep. The weight is 7½ pounds, packed in one carton.

RADIO USES ALSIMAG

In radio, Alsimag, manufactured by the American Lava Corporation, Chattanooga, Tenn., is being used for support insulators, coil forms, lead-in insulators, resistor spools, inductance forms, spacer bars, condenser supports, sockets, etc.

Alsimag incorporates in a quality ceramic the desired characteristics of high dielectric strength, low losses at all frequencies, rigidity, permanence and strength against mechanical shocks and heat.

IGNITION SUPPRESSOR RESISTORS

The Ohio Carbon Company, 12508 Berea Road, Cleveland, Ohio, manufactures three types of ignition suppressors for mobile radio installations. This company's standard test for these units is the equivalent of 100,000 car miles. Humidity tests also are given, also severe vibration tests, to the end that automobile radio receivers protected by these suppressors will give permanent satisfaction in service.

CINCH MULTIPLE PLUGS

The Cinch Manufacturing Corp., 2335 West Van Buren St., Chicago, has stocked a line of multiple plugs for cable connections in automobile receiver power supply lines.

Positive, dependable contact is provided in both male and female plugs. Neat locking cap allows for easy, simple assembling. More room is provided for soldering. Female plugs have "floating" contacts, plated with Cinch solder coating.

NATIONAL UNION APPOINTS

F. J. WESSNER

H. A. Hutchins, general sales manager of National Union Radio Corporation, has announced the appointment of F. J. Wessner as his second in command of sales.

Mr. Wessner has been engaged in sales promotional work with National Union since the formation of the company. Up to this time he had gained a broad experience in sales direction and promotional work in his previous posts as eastern sales manager of Ypsilanti Reed Furniture Company and assistant general sales manager with one of the country's large cotton goods houses.

In recognition of the outstanding services he has rendered in furthering the interests of National Union Radio Corporation, he has been assigned to his present post of assistant general sales manager.

ANNOUNCING



MODEL 4A

High-Frequency Electrophone

A high grade but inexpensive piezoelectric (Rochelle-salt) unit of scientific design for the distortionless reproduction of the higher audio frequencies.

For use in conjunction with ordinary cone or horn-type low-frequency loud speaker to obtain high-fidelity reproduction over the full audio range. Designed for direct parallel connection—no additional filters, special networks, field supply or polarizing voltage necessary.

An economical solution of the increasingly important problem of wide range reproduction immediately available for radio broadcast receivers, sound pictures and public address systems, both for new and existing equipment.

Acoustical engineering service available to manufacturers.

Built in accordance with design specifications of Boonton Research Corporation (see article by Stuart Ballantine, Proceedings of the Institute of Radio Engineers, October 1933).

Technical Bulletin 1C sent free on request.

ELECTROPHONE CORPORATION

2019C RITTENHOUSE SQUARE
PHILADELPHIA, PA.

Licensed under patents and applications of Boonton Research Corporation and Brush Development Company.

ROCHESTER FALL MEETING OF I. R. E.

For the past several years special district meetings have been held in Rochester and have become known as the Rochester Fall Meetings. They have always been held in November and this year the dates are 13, 14, and 15. The Hotel Sagamore will be the headquarters for the meeting and three days will be devoted to the presentation of papers on technical problems of particular interest to the broadcast receiver engineer.

All papers will be presented in the informal manner which has characterized these meetings in the past and while attempts will be made to secure the manuscripts for publication, it is highly probable that extremely few will have been prepared and released for that purpose.

A technical exhibition will be held and will offer the engineer an opportunity of examining and discussing with the producer an extensive array of components for broadcast receivers, measuring equipment, and manufacturing aids.

Reservations should be made in advance for hotel accommodations as during past meetings it has been impossible to obtain accommodations at the Sagamore. Consequently, those placing early reservations will find it to their advantage.

CORRECTION

In the Purchasing Guide Section of the September number on the R. C. A.-Victor list of executives, the name of Mr. E. A. Nicholas should have been included as Vice President in charge of Sales.

NEW WIDE AREA HORN

A horn capable of covering an area usually requiring two horns has just been announced by the Macy Engineering Company of 1451 39th St., Brooklyn, N. Y.

This horn has a bell opening measuring 50 inches in width by 23 inches in height. Tapering in exponential shape over a length of 4½ feet, the horn terminates in an aluminum throat threaded to accommodate a standard dynamic unit.

Material used in the horn is of a tough non-resonant wooden base character which



is joined at the seams by one-piece brass welding securely riveted at frequent intervals.

This horn is particularly adaptable for sound truck use, but may also be used for large area both in and out of doors.

The horn is pictured here with its new Macy mounting standard.

FLEXIBLE VARNISHED TUBING

Bentley-Harris Mfg. Co., Conshohocken, Pa., has recently released attractive literature covering their line of flexible varnished tubing and saturated sleeving. Both products are furnished in practically any color desired.

Bentley-Harris varnished tubing is impervious to acid, oil and water, and is the type of insulation suitable for radio work and low voltage electrical equipment, etc. Flexibility, elasticity and dielectric strength are maintained over long periods.

Bentley-Harris saturated sleeving being slow burning and heat resisting, is suitable for immersion in hot compounds without interfering with dielectric strength, ranging from 500 to 1000 volts. B-H saturated sleeving is especially suitable for insulation in radio sets, motor leads and other small electrical work where very high voltages are not encountered. It has the required stiffness to permit easy handling, which is essential to expediting production.

MOLYBDENUM GRID WIRE

The American Electro Metal Corp., Lewiston, Maine, in marketing Elmet molybdenum grid wire states that the special purity of the metal is made possible through an exclusive patented method of extracting the molybdenum trioxide from the ore. Elmet is stated to give exact percentage of stretch up to 25 per cent. throughout the extra long lengths in which it is available.

Use of the 1A6 Tube

THIS 2-volt pentagrid converter may be used as an oscillator-mixer and as a combination diode-tetrode. The application of this tube as a diode detector and an audio amplifier is practicable because of an arrangement wherein two elements perform the functions of a half-wave diode and certain other elements perform the functions of a tetrode.

(A diode is a two-element; triode, three element; tetrode, four element; pentode, five element tube. The pentagrid tube has five grids besides plate, cathode and heater.)

The 1A6, tetrode portion, when grids 1 and 2 are tied to the zero potential point of the filament, has characteristics as follows:

Filament voltage (E _f)	2.0 volts
Filament current (I _f)	0.06 amp.
Plate voltage (E _b)	180 v.
Control grid voltage (E _{c1})	-3 v.
Screen voltage (E _{c2} and e)	67.5 v.
Plate current (I _p)	4.0 ma.
Screen current (I _{c2} and e)	5.0 ma.
Mutual conductance (g _m)	525 micromhos
Plate resistance (r _p)	360,000 ohms

The construction of the 1A6 tube is such that in diode-tetrode service the No. 1 grid (oscillator-grid) may be used as a single diode anode. The No. 2 grid (anode-grid) may be tied to the filament to provide a slight shielding effect between the diode and tetrode elements. Conceivably, the No. 2 grid could be used as another diode anode to provide full-wave rectification, but such use would be unsatisfactory. Grids No. 3 and No. 5 (screen grid) act effectively to shield electrostatically the control grid (No. 4) from the No. 1 grid. The plate serves its usual purpose as a part of

the tetrode portion of the tube. This portion operates as a screen grid audio amplifier, audio voltage being supplied to its control grid by the diode. Used in this manner, the rectification efficiency of the diode approaches that of the diodes in such tubes as the 55, 2B7, and 75.

A point to be mentioned in connection with the use of the No. 1 grid as the diode anode is that, regardless of whether or not operating voltages are applied to the tetrode elements, the rectification efficiency is slightly higher when grid No. 2 is connected to the zero-potential point of the filament. Also, the rectification efficiency is, as expected, a little higher when no voltages are applied to the tetrode elements, that is, the efficiency is from 3 to 5 per cent higher when no plate and screen voltage are used.

Under the operating arrangement suggested, the plate current is approximately 0.36 milliamperes and the screen current, 2.0 milliamperes with no signal applied (zero bias on grids No. 1 and No. 2); hence, the cathode current is well within limits.

This arrangement may be found to be objectionable in that, with a modulated carrier on the No. 1 grid, a modulated electron stream is supplied to the tetrode portion of the tube. Although grids No. 3 and No. 5 serve to shield the No. 1 grid from the plate electrostatically and to prevent any capacity reaction, the action of the diode grid on the electron stream may result in undesired detection in the tetrode portion of the tube.

For this reason, another arrangement is suggested. Since the No. 2 grid, by design, has but little effect on the electron stream,

it may be used as the diode anode. The No. 1 grid is then connected to the filament. This arrangement is particularly useful, but involves some sacrifice in rectification efficiency. It should be noted that rectification will not occur when the No. 1 grid is tied to the filament unless tetrode voltages are applied. This is because electron emission from the filament fails to reach the No. 2 grid unless a sufficiently high screen voltage is present.

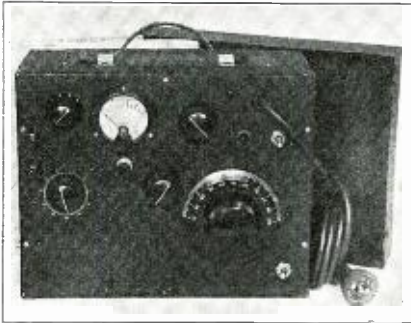
It is of interest to note that, when using No. 2 grid as the diode anode, the effect of contact potential and/or initial electron velocities is much less. This means that little or no bias voltage is developed across the diode load when no signal is applied.

Another possible method of using the 1A6 is that the screen-grid portion of the tube operates as an r-f. or i-f. amplifier to supply carrier voltage to the No. 2 grid as a diode through the medium of a tuned transformer. Since this circuit may have a tendency to regenerate or oscillate, suitable precautions should be taken in the circuit design and construction. It must be remembered that the d-c. plate load is practically zero and then, when no signal is applied, both the No. 1 grid and the No. 2 grid are at zero potential. In this case, both plate and screen grid current will be high if the voltages recommended for converter service are used. With these voltages, the cathode current approaches the 9 milliamperes specified as the absolute maximum for this tube. For average use, therefore, somewhat lower voltages are suggested.

In the assembly of the tube's elements grid 1 is next to the cathode, then grids 2, 3, 4 and 5, in turn, toward the plate.

Read what this Signal Generator does and judge for yourself.

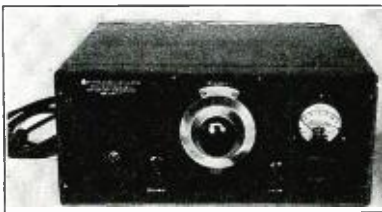
Believe it or not — it's true



The Model 310 Signal Generator incorporates every possible need necessary in set testing work. It attenuates down to 1/2 of 1 microvolt, it is entirely A.C. operated, has a frequency range of 100 to 1500 k.c.. Has measured modulation up to 100% with 6% distortion, at 80% modulation distortion is 2.5%. Also it has provision for external modulation, supplies a pure 1000 cycle note for bridge measurements and a variable measured 1000 cycle note with measured attenuation and ideally suitable as a source for checking the gain of audio amplifiers. All of this is inclosed in a small shielded container measuring 10" x 12" x 5 1/2" deep. Write for complete data describing this new instrument.

Price \$95.00

**MODEL 305
BEAT FREQUENCY OSCILLATOR**



The Model 305 Beat Frequency Oscillator has found its way into the largest radio organizations in the country. Compact, neat, a handsome instrument for show in the laboratory—it can quickly be converted into a most handy and rugged unit for portable work. This of course due to its being supplied with a waterproof canvas covered carry case. Can be supplied for battery or for complete A.C. 60 v. operation. Is entirely self-contained, has a straight line logarithmic frequency curve, has a check point at 60 cycles visible in the output meter.

Price A.C. operated \$155.00

NOTE
Our instruments are flexible in many ways. If our exact specifications do not suit, write us what your exact problems are. Frequency and attenuation ranges can be changed with ease.

WIRELESS EGERT ENGINEERING
INC.
179 VARICK ST. NEW YORK CITY

**MIGHTY MIDGETS,
MOLDED OF DUREZ
DESIGNED TO SELL
and SELLING!**



Two of the month's most successful small cabinets—both molded of Durez. The huge Coca-Cola bottle conceals a five tube Crosley. The words "Coca-Cola" serve as a grille over loud speaker opening. Tone value good. Display value overwhelming.

Jan Streng, New Yorker, designed the Colonial Compact of black molded Durez, and modern chromium fittings. When first announced, orders ran far ahead of production. Still selling fast—and profitably.

IF YOU have yet to use the perfect molding compound for your product—write now for full details! Scores of manufacturers find Durez superior. Because—details are reproduced faithfully. Surfaces are lustrous, rich, proof against warping, peeling, chipping. A variety of versatile effects can be obtained. Because it is the *modern* raw material, for a modern public. Let Durez help you win *new* markets—gain a surer grip on *present* markets. Your competitors use it. Why not you? Write to General Plastics, Inc., 1210 Walck Road, N. Tonawanda, N. Y. Also, New York, Chicago, San Francisco, Los Angeles.

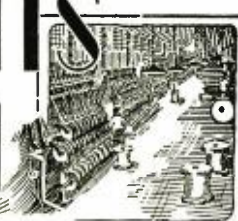
D U R E Z

Reg. U. S. Pat. Off.

THE PERFECT MOLDING COMPOUND

We supply the raw material to custom molders with whom you work. Contacts gladly arranged with molders and designers. Full cooperation.

NEW DEVELOPMENTS OF THE MONTH



THE VARIAC

Variac, pronounced "Vary-Ack," is the name of a novel power transformer that gives a-c. voltage control with the smoothness of a rheostat and the efficiency of a transformer, and more than any rheostat, it gives a continuous voltage adjustment between 0 and 130 volts when operated from a 115-volt, 60-cycle line.

The Variac has applications in both the laboratory and industrial fields. A few of its uses include:

- (1) Brilliance control on theatre and sign lighting installations;
- (2) Laboratory source of adjustable voltage;
- (3) Speed control on small motors, and
- (4) Over-



voltage and under-voltage testing on electrical household appliances of all kinds.

The novelty of the Variac is due to the design of a contact mechanism which eliminates the bogey of short-circuited turns which has heretofore made a continuously adjustable tapped transformer an impractical device. In the Variac the turning of a single knob covers the entire range from 0 to 130 volts.

The Variac is made in two models: Type 200-CM has a protecting case, an attachment cord, and an outlet receptacle and is intended for laboratory and experimental use; another model, without the case, is available for those who wish to build the Variac into other equipment.

The maximum current rating of this Variac is 5 amperes. Models for larger and for smaller currents are under development. This device is manufactured by the General Radio Company, of Cambridge, Massachusetts. The trade mark has been registered, and a patent has been applied for on the device.

AIR COLUMN SPEAKERS

The C. F. and M. Company, 388 Dorr St., Toledo, Ohio, announces a line of air column type loudspeakers. There are 25 watt units with frequency range from 30 to 10,000 cycles—peak load 50 watts. The company also makes 3½ foot and 6 foot all metal trumpets and 12 foot single and double all metal stage horns.

NEW DETECTOR-AMPLIFIER-OSCILLATOR TUBE

The Ken-Rad Corporation, Owensboro, Ky., announces the type 76 tube, which is a 6.3 volt heater type triode for service as a detector, amplifier or oscillator. This new tube may be used also as the driver of a class B amplifier. It employs a small 5-pin base. The heater current is .3 ampere, plate voltage 250 volts maximum, grid 13.5 volts, plate current 5 ma. The amplification factor is 13.8, plate resistance 9,500 ohms and mutual conductance 1,450 micromhos. The detector grid voltage is minus 20 volts, the plate current adjusted to 0.2 ma., with no a-c. input signal.

As grid-leak detector the grid condenser is .0025, the grid leak 1-5 megohms and the plate voltage 45.

IMPROVED RESISTORS

The Erie Resistor Corporation, Erie, Pa., announces that they have improved the voltage characteristics of their complete line of resistors and ignition suppressors from 50 per cent to 60 per cent.

This marked decrease in the drop in resistance value at maximum rated voltages has been effected by advancements in manufacturing technique and the development of a new and highly efficient combination of raw materials.

This new "mix" does not in any manner adversely affect the other electrical and physical characteristics of Erie resistors.

A 32-VOLT D-C. ELIMINATOR

The Electronic Laboratories, Inc., 122 West New York Avenue, Indianapolis, Ind., is marketing a 32-volt d-c. eliminator for battery operated sets and a 110 volt d-c. converter which outputs 110 volts a-c. at 200 watts, also a 6 volt eliminator for automobile radio receivers. These units are



equipped with the electronic full-wave interrupter, identical for 6, 32 and 110 volt operation except for the actuating coil.

MOLDED RESISTORS

For varied radio purposes the S. S. White Dental Mfg. Co., 152-154 West 42d St., New York, is marketing molded resistors in the standard range from 1,000 ohms to ten megohms. Leading manufacturers are employing these resistors in their radio products.

RESISTORS AND SUPPRESSORS FOR MOBILE RECEIVERS

The Central Radio Laboratories, 900 East Keefe Avenue, Milwaukee, Wis., is marketing a modern line of variable and fixed resistors and spark suppressors for



use in automobile radio receiver installation.

A new variable high resistance volume control combines unusual stability under all conditions with small size. Measures only 1¾ inches in diameter, but has a resistor area greater than former Centralab controls 1¾ inches in diameter. Furnished



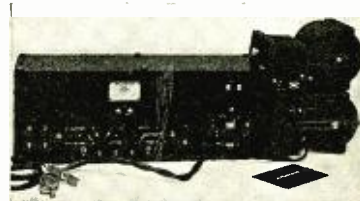
with any desired resistance taper, as a single or tandem potentiometer, with or without power switch. Single potentiometer with switch is illustrated.

NEW AUTOMATIC OSCILLOGRAPH

The Westinghouse automatic oscillograph, with the recent addition of a new positive or negative sequence current network initiating panel can now take care of all fault conditions on any one feeder. New resistance control units have been developed to extend the laboratory range of the equipment. Improved twin galvanometers so designed as to be externally adjustable allow the beam to be placed on the film as in the conventional manner. Also new fuses have been designed to give positive protection for the usual voltage supplies found in laboratories.

There are thirteen steps of convenient range in each unit of sufficient current capacity to take care of the entire vibrator line.

The PA automatic oscillograph can be



supplied with a new film holder that will take 200 feet of sensitized paper and arranged so film can be cut off in any length desired.

SYNTHANE

Laminated Bakelite

**Dependable Uniformity in Electrical
and Mechanical Properties**

DIELECTRIC STRENGTH · LOW WATER ABSORPTION

STRUCTURAL STRENGTH · LOW SURFACE LEAKAGE

CLEAN PUNCHING · MACHINEABILITY

IMPACT STRENGTH & APPEARANCE

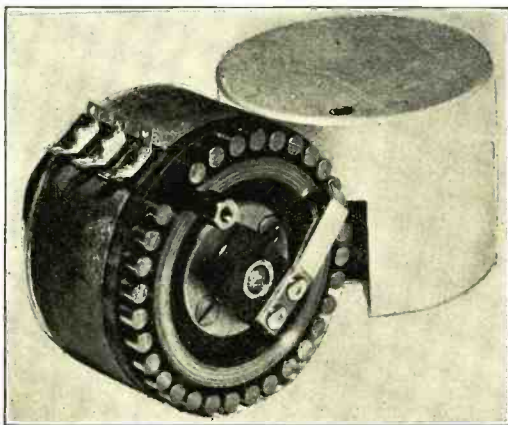


OFFICES IN PRINCIPAL CITIES

Sheets, Tubes, Rods, Fabricated Parts

Silent, Stabilized Gear Material

DAVEN SPEECH INPUT EQUIPMENT



The above mixer is new and entirely different. You will note by its unique construction that the resistance elements are entirely enclosed. No perishable resistance pile winding is used. The silk-insulated resistance wire is wound on thin bakelite strips and placed in a rigid position. The resistance strips are shielded at all times and cannot be tampered with unless taken apart. No tools, soldering iron, dust, water or stray wires can reach the resistance elements.

Price \$12.50

The Type No. LA 220 **LADDER ATTENUATOR**

SPECIFICATIONS

CIRCUIT: Ladder network.
NOISE LEVEL: 150 decibels or better.
NUMBER OF STEPS: 30.
MINIMUM ATTENUATION: 2.5 decibels.
MAXIMUM ATTENUATION: Infinite.
ATTENUATION ON NEXT TO LAST STEP: 45 db.
ATTENUATION PER STEP: 1.5 decibels.
FREQUENCY ERROR: Plus or minus 0.5 db. over the range of 30 to 10,000 cycles, and 1 db. from 10,000 to 30,000 cycles per second.
RESISTANCES: Unifilar winding on thin bakelite strips. Silk enameled resistance wire used throughout.
SHIELDING: Aluminum cover and front panel.
DIMENSIONS: 2 3/4" diameter x 2-1/16" in depth.
MOUNTING: Two mounting holes for No. 8-32 screws, 1 1/2" apart on horizontal center line.

The determining factor in the selection of any volume control should be its actual performance in service. The characteristics given herewith have been substantiated by the world's leading communication companies and broadcast stations. (Names upon request.)

Write for literature covering Daven Power Level Indicators, Output Meters, Fixed and Variable Attenuators, Decade Boxes, Meter Multipliers and other precision resistances and resistance apparatus.

THE DAVEN COMPANY

158-160 SUMMIT STREET, NEWARK, NEW JERSEY

NEW IRC DUAL RESISTANCE INDICATOR

A new IRC dual resistance indicator is announced this month by the International Resistance Company of Philadelphia. A new design with resistance rods wound with heaviest possible wire and enclosed in a sturdy metal case; ball-bearing slider insuring smooth, uniform pressure on resistance rods and a permanently attached slider knob that frees the user's hands and permits him to work elsewhere after an adjustment has been made.

The new indicator has two scales 0-10,000 ohms and 10,000-100,000 ohms. Quick, accurate reading from 100 to 100,000 ohms may thus be made and it is possible to extend the useful range of the indicator indefinitely by the addition of fixed resistors connected in series. The one slider serves for both scales. Exhaustive tests have shown no sign of wear after the slider had been moved continuously back and forth oftener than would



be the case in years of ordinary service use.

In determining resistor values, the indicator will give splendid results either when used alone or with a voltmeter. Used alone, it is only necessary to connect it in place of the defective resistor, tune the set and adjust the slider until the best tonal quality and volume are obtained from several stations. Other practical uses to which the indicator may be put range from use as a calibrated rheostat or variable resistor for adjusting voltage or limiting current; calibrated potentiometer or voltage divider; temporary heavy duty resistor up to 100,000 ohms; measuring unknown resistances by the substitution method and many others.

ACOUSTIC SYNCHRONIZER

The electro-acoustic synchronizer, is an ingenious equipment. An automatic record repeat mechanism, an amplifier and a series of relays are incorporated in the one cabinet. The animations are activated through a time delay circuit operating a sensitive relay which in turn controls a selective rotary switch changing the form of animation.

Any type of electrical device or mechanism can be operated and controlled. An ingenious method of wiring makes it im-



possible for the device to get out of synchronism and should the pickup head on the record repeat mechanism be accidentally moved, it will automatically send the selector switch to "home" or starting position. Likewise, if, for any reason, the selector switch should get out of synchronism, it will automatically return the pickup head to starting position.

The equipment is being marketed by the Electro-Acoustic Products Co., 2131 Bueter Road, Fort Wayne, Ind.

REMOTE CONTROL FOR AUTOMOBILE AND AIRPLANE RADIO

The Crowe Name Plate and Manufacturing Co., 1749 Grace St., Chicago, Ill., has a new remote control unit for automobile receivers, which with mounting changes may be applied to airplanes.

No. 102 style is made for use with the 6 to 1 in 360 degree geared variable condensers made by several condenser manufacturers and for a volume control mounted in the chassis, requiring two flexible shafts. Pointer movement 270 degrees. Tuning and volume controls reversible, either left or right if so ordered.

The steering post bracket is easily attached and the control may be placed in any desired position. The clamping band is adjustable for different diameters of steering posts and should be lined with leather or sheet rubber.

Special clamps can be supplied for attaching to the lower edge of the dash or instrument panel or the control can be readily fastened to the face of the instrument panel.

Two methods are used for fastening the shafts and casings in No. 102. One with the conventional set screws and the other with slotted shafts to engage the special flat ends on the flexible shafts. It also can be furnished with collet type of fastening at an extra cost.

ANTENNAS FOR MOBILE AND STATIONARY RECEIVERS

The Filtermatic Mfg. Co., 6913 Ditman St., Philadelphia, Pa., have recently announced 3 types of antenna units. The



Filtermatic Ferrenna uses ground capacity relation, desirable for car radio reception. It has well insulated lead wire and is easily installed and is constructed of tough polished rubber.

The Super Filtermatic is a spool-shaped device which can be placed outside of any radio cabinet and eliminates the necessity of an outdoor antenna. It is a cylindrical device about 3/4 inches in diameter by 3 inches overall. Weight, 1 lb. The Super Filtermatic contains a special coil condenser apparatus which has three electrical connections, two of which fasten to the antenna and ground post respectively while the third is fastened to the most convenient ground.

The Filtermatic antenna adjusting coil is another cylindrical device which can be placed inside of any radio cabinet. It is about 1 3/4 inches in diameter by 3 inches overall, weighs about 1/4 lb. It contains special series coils, and is easily connected with aerial lead in or across aerial and binding posts.

TRANSFORMERS FOR MIXING, LINE-TO-LINE AND AMPLIFIER INPUT APPLICATION

A new group of audio transformers, specially designed to meet the requirements of speech-input circuits, is offered by Shure Brothers Company, 215 West Huron Street,

Chicago, manufacturers of microphones and related equipment.

Two general types are available—mixing and line-to-line transformers, and microphone and amplifier input transformers. All units are mounted in fully enclosed cast-iron cases which provide thorough static and magnetic shielding. Windings are thoroughly impregnated and hermetically sealed in the cases. Standard designs are furnished with special grade high-silicon cores and have guaranteed transmission characteristics within 1 db. from 40 to 10,000 cycles.

Mixing and line-to-line transformers



have both primary and secondary windings split into two balanced sections, which may be connected in series or in parallel to accommodate a variety of terminal impedances.

SOCKETS, SWITCHES AND PLUGS FOR MOBILE RADIO

The H. H. Eby Manufacturing Company, Inc., 21 Street and Hunting Park Avenue, Philadelphia, Penna., is listing a line of switches, sockets, rubber-capped plugs and male and female plugs for use in assembling mobile radio receivers.

The Eby line of heavy duty rubber-capped plugs, when used with the newer rubber-covered cables, makes a combination which will stand severe usage. These plugs have been adopted by manufacturers for



mobile apparatus, and are being widely used for automobile radio power supply connection.

SUPPRESSORS

The suppressors for automobile radio, manufactured by the Erie Resistor Company, Erie, Penna., are enclosed in both porcelain and Bakelite tubes, giving protection from oil, dirt, moisture and mechanical breakage. In addition to the plug, screw and distributor types the new "L" type has been announced recently.

Service and laboratory tests show that Erie suppressor resistors do not change more than 10 per cent in resistance value in 50,000 miles of use.

BRAND

"Trade Mark Registered"

**TURBO*
OIL TUBING**

Impregnated inside and out—the finest spaghetti obtainable. The safest conductor for motor and transformer leads, etc. Make your own tests from free sample card; 30 sizes available.

**TURBO*
SATURATED SLEEVING**

Quality U Saturated Sleeveing has extremely high voltage breakdown resistance. Smaller diameters in 300 ft. rolls for easy handling. For sub-panel radio assemblies, small instrument, leads, etc.

**TURBO*
VARNISHED CLOTH**

In Rolls, Tapes and Cut to Size
Also Varnished Paper, Silk

Send for samples and for a copy of BRAND'S new Insulation Guide Bulletin No. 10.

OTHER BRAND PRODUCTS ARE:

MICA Super Grade Condenser Films; also MICA Plate in sheet, and cut to size and shape.

WILLIAM BRAND & CO.

264 Fourth Avenue New York City

CONTINENTAL— A Dependable SOURCE OF SUPPLY

SUPPRESSORS



CONTINENTAL 810

RESISTORS



New Flexo-Terminal Spark Plug Suppressor fits all cars and eliminates the need for numerous separate types.

Continental Suppressors are available in all standard types and may be quickly supplied to meet any special specification.

Isolanite housings, which have proven superior to any other substance under the severe heat, moisture and vibration of automobile installations, are used exclusively.

Complete kits including spark plug and distributor suppressors and filter condensers are supplied for 4, 6, 8 and 12 cylinder cars.

Continental has specialized in the manufacture of molded resistors since the beginning of broadcasting. Today Continental design, manufacturing processes and automatic machinery are leaders in the industry.

Thus Continental resistors are maintained at a standard of quality which would otherwise be prohibitive at their moderate cost. This superior quality costs you nothing extra—yet it has cut production costs for many well-known radio manufacturers.

Prove these facts yourself. Get a supply of Continentals for test today!

CONTINENTAL CARBON Inc.

13904 LORAIN AVE. • CLEVELAND, OHIO
Canadian factory • Toronto, Ontario

WRITE OR WIRE FOR SAMPLES AND PRICES

It's Free

Send for Your Copy
of this New Big
RADIO CATALOG
of
Sensational Bargains



MORE THAN 10,000 Amazing Values

ANYTHING AND EVERYTHING IN RADIO

Here is the latest, greatest catalog ever issued by WHOLESALE RADIO SERVICE CO. More than 10,000 Bargains are listed! Every latest development of the foremost manufacturers is here! SETS, TUBES, SPEAKERS, REPLACEMENT PARTS, KITS, etc.—all at **LOWEST WHOLESALE PRICES!**

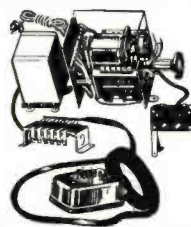
SHORT WAVE— PUBLIC ADDRESS

A most complete selection of short wave sets, converters, coils and equipment is displayed here. Nationally known makes such as National, Hammarlund and Lafayette are featured prominently. Public Address comes in for a big share of attention in this catalog. Amplifiers, Amplifier Kits, Complete Systems, Portable Systems and all kinds of equipment are listed at prices which are truly amazing.

SPECIAL FEATURES

covering Lafayette Receivers, Trustest Parts, Miniature A. C. Portable Sets, Testing Equipment are a few of the special features in this most complete Radio Catalog of the entire industry! Buy from Wholesale Radio Service Co. at lowest wholesale prices—where your satisfaction is guaranteed and where the promise of prompt service is performed.

3 BARGAINS FROM THIS GREAT BOOK!

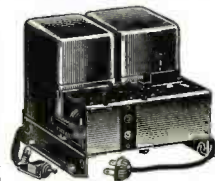


R.C.A.-Victor Automatic Remote Control

A Bargain that comes once in a lifetime! Attach this full automatic remote control assembly to your present radio chassis. Turns radio "on" or "off" and does not change present tuning of set. Accurately selects 6 different stations as well as adjusts volume. **Sensationally Low at \$12.50**

BOSCH Power Supply and Power Amplifier

Here is your chance to get a "real buy" on a fully guaranteed Bosch Power Supply and Power Amplifier. Can be used as a separate amplifier or power supply. Furnishes filament and plate voltages to the following tubes: 4-26s; 1-27; 2-71s—and 1-80 rectifier. Primary tapped at 105, 115, 125 V. 50-60 cycle. Equipped with toggle switch and plug. **Our Low Price \$4.95**



R.C.A.-VICTOR RADIO SPEAKER

This magnetic speaker is equipped with channel selection switch and volume control. Comes mounted in a walnut two-toned panel 13 1/2 x 11 1/2 x 1 1/4 ins., with brown metal ornamental grille, backed with bronze cloth. Features include special tone filter, special tapped impedance transformer, and selector switch. Natural reproduction with plenty of volume. **Our Low Price \$1.85**



WHOLESALE RADIO SERVICE
100 Sixth Avenue Dept. RE-103
New York, N. Y.

Gentlemen: RUSH your Brand New Catalog No. 55 to me.

Name

Address

City State

WHOLESALE RADIO SERVICE CO. INC.

100 SIXTH AVE. NEW YORK, N.Y.

**Here's the ANSWER to—
AUTO RADIO ANTENNAE**



Filtermatic

F E N T E N N A

Splash guard and antenna combined. The best antenna for all makes of cars and car radios. Makes use of ground capacity—the most desirable method for auto radio reception. Standard fender flap size. Installed in a few minutes. Chromium plated, a beautiful addition to any car. Works perfectly in all weather conditions.

Write for prices and complete details.

FILTERMATIC MFG. COMPANY
6913 Ditman Street, Philadelphia, Pennsylvania

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF RADIO ENGINEERING

Published monthly at New York, N. Y., for October 1, 1933.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared B. S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of RADIO ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24th, 1912, embodied in section 411, Postal Laws and Regulations, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Bryan Davis Publishing Co., Inc., 19 East 47th Street, New York. Editor, Donald McNicol, Roselle Park, N. J.; managing editor, F. Walen, Union City, N. J.; Business Manager, B. S. Davis, Scarsdale, N. Y. 2. That the owners are: Bryan Davis Pub. Co., Inc.; B. S. Davis, Scarsdale, N. Y.; Roy T. Atwood, Albany, N. Y.; G. R. Bacon, Douglass, N. Y.; M. V. Breitenwischer, Cleveland, O.; J. A. Walker, Richmond Hill, N. Y.; A. B. Goodenough, New Rochelle, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1% or more of the total amount of bonds, mortgages, or other securities are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where a stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also, that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) B. S. DAVIS, Business Manager.

Sworn to and subscribed before me this 1st day of October, 1933.

(Seal) J. A. WALKER, Notary Public.

Queens Co. Clk's No. 2982, Reg. No. 7176

New York Co. Clk's No. 655, Reg. No. 5-W-424.

Commission expires March 30, 1935.

America's Outstanding Microphone Values!



Model No. 77

THE LIFETIME CORPORATION introduces model No. 77 Condenser Microphone and Amplifier—a product of expert radio laboratory specialists giving the public, for the first time, a high quality instrument at a nominal price.

Lifetime Condenser Head is of special design using a special heat-treated duralumin diaphragm .001" thick, and is sealed after proper adjustment, thus assuring a long life and a dependable instrument.

The Head amplifier is housed in a black crystal cylinder and is especially designed for use with the Lifetime No. 77 Head. Each microphone head is perfectly adjusted and synchronized with the amplifier and tubes with which it is to be shipped so that it works perfectly as a unit.

The frequency range is practically flat throughout entire audible spectrum useful to modern broadcast and sound equipment. Output either 200 ohm or 400 ohm—200 ohm output is standard.

Special introductory offer to the trade. Model No. 77 Condenser Mike and amplifier, complete with 2 No. 864 tubes and 10 feet of rayon covered cable only **\$37.50**
List price, \$95.00

Another outstanding value is the Lifetime Model No. 99, Double button Carbon Microphone listing at \$50.00 and offered to the trade **\$14.95** at only

Lifetime Model No. 99 is a custom built microphone at a production price. Each microphone performs with perfect fidelity throughout entire voice and music range. Each unit is individually adjusted to conform to the highest standards of performance.

Precision machined of solid brass model No. 99 is 3-1/16" in diameter—2" thick overall and weighs 1 1/2 lbs. It has a gold spotted duralumin diaphragm .001" thick—gold contact buttons 200 ohms each, and is sufficiently damped to give outstanding performance.

A desk stand to match only \$2.25,
and a matching transformer at 1.95.

Write for our descriptive literature of our complete line of microphones and Electro-Dynamic Sound Equipment.

We have an attractive sales proposition for several good men to handle our line.

THE LIFETIME CORP., 1304 Dorr St., Toledo, O.



Model No. 99


**ON MY WAY TO
NEW YORK AND
THE PICCADILLY**



... best hotel I know!
Near everything, just
200 feet from Broad-
way. Modern, hospita-
ble, and comfortable.
Like the Manager,
like the rates—\$2.50
single, \$3.50 double,
for a room with bath!

**THE HOTEL -
PICCADILLY**

45th St. • W. of Broadway • New York
WILLIAM MADLUNG, Mng. Dir.



ELMET MOLYBDENUM GRID WIRE

IT MEANS BETTER TUBES!

SMALLER TOLERANCES

NRA
WE DO OUR PART



Because - ELMET is truly accurate throughout the extra long lengths in which it is available—we guarantee it.

Because - Due to its unmatched purity and our special methods of manufacture, ELMET discourages Grid Emission.

We control the production of ELMET GRID WIRE from the ore to the finished product and know that it will give you satisfaction.

If you want the best, order ELMET. Send for prices.

AMERICAN ELECTRO METAL CORP.
LEWISTON, MAINE

I. R. E.

Fall Meeting

Rochester, N. Y.

November 13-14-15

PIEZO ELECTRIC CRYSTALS

New Low Prices Effective Sept. 1st, 1933

BROADCAST BAND

Broadcast Band Crystals accurately ground to BETTER than .03% fully mounted for \$35.00 each. These crystals may be adjusted to exact frequency by changing temperature slightly. Prompt shipments and fully guaranteed.

COMMERCIAL SHORT-WAVE BANDS

Crystals in these bands also reduced in price. Write for prices. Same high degree of accuracy.

AMATEUR BANDS

Crystals in either 80 or 160 meter bands unmounted ground to within 5 kc. of your desired frequency with calibration accurate to .03% for \$10.00 each. \$5.00 additional mounted in our Standard Holder.

NRA
WE DO OUR PART

SCIENTIFIC RADIO SERVICE
"The Crystal Specialists"

124 Jackson Ave., University Park, Hyattsville, Maryland

RADIO is on the RUN



Aeroplanes — Police Systems — Autos — Trains . . . everywhere "Radio" is on the Run," and it's up to YOU to catch up with it . . . keep abreast with Mobile Radio and its varied lines. CREI graduates are employed in many police stations and airways.

For the Man Who Wants to Be MORE Than Merely an Operator

Our popular COMBINATION HOME STUDY—RESIDENCE COURSE offers the ambitious man the utmost in thorough engineering training . . . and also offers you an exceptional value by combining our regular Home Study course PLUS the special 10-week Residence instruction that gives you practical experience on actual equipment. Your inquiries are invited. No obligation.

FREE 36-PAGE ILLUSTRATED BOOKLET ON REQUEST

CAPITOL RADIO ENGINEERING INSTITUTE

CREI

14th and Park Road • Dept. RE-10 • Washington, D. C.

Bruno Laboratories

Present

MODEL RV3 VELOCITY Microphone




- 1—Excellent fidelity characteristics
- 2—Frequency response 60 to 14000 C.P.S.
- 3—Not subject to variations with humidity and temperature
- 4—No diaphragm
- 5—Highly directional
- 6—Reduces acoustic feed back
- 7—Affords higher gain
- 8—Ruggedly constructed

Manufacturers of a complete line of broadcast station equipment.

Price in U.S.A. \$55.00

BRUNO LABORATORIES
20-26 West 22nd Street
New York City

DeLuxe Bruno Microphone Stand

You should see THIS



Sleeving and Tubing Booklet

Copies available to Radio Engineers and Executives.

Bentley, Harris Company are pioneers in the manufacture of Varnished Tubing and Saturated Sleeving.

Their modern factory, devoted solely to the production of these products, is capable of turning out millions of feet of Braid, flawless and gauged to meet the most exacting specifications.

B-H Sleeving and Tubing is the highest grade it is possible to make. Inspect actual samples in this new booklet.

Write for Your Copy Today

Bentley, Harris Manufacturing Company
CONSHOHOCKEN, PENNA.

**In Tune with the Times
PIEZO-ASTATIC**



**Crystal Units
THE MICROPHONE**

The Piezo-Astatic microphone is a highly perfected general purpose instrument of exceptional fidelity. Frequency range —30 to 10,000 C.P.S. Output level— minus 60. It is rugged in construction and beautifully finished in chromium.

D-104

No button current, polarizing voltage or field current required. List price—\$17.50.

*The
Pick-Up*



S-8

The Piezo-Astatic pickup represents a distinctive advance in transcription instruments, light in weight, and freely damped. The greatest step forward since the advent of electrical recording. Rising low frequency response makes practical, for the first time, constant amplitude recordings. List price—\$15.00.

Licensed under Brush Development Co. Patents

Astatic Microphone Laboratory, Inc.
YOUNGSTOWN, OHIO

- **WAXES**
 - **COMPOUNDS**
 - **VARNISHES**
- For Insulation of Condensers

Transformers, coils, power packs, pot heads, sockets, wiring devices, wet and dry batteries, etc. Also WAX SATURATORS for braided wire and tape. WAXES for radio parts. Compounds made to your own specifications if you prefer.

● **ZOPHAR MILLS, INC.**

FOUNDED 1846 MEMBERS OF N.R.A.
Court, Lorraine and Creamer Sts., Brooklyn, N. Y.
Agents: Ralph B. Clark, 2007 Calumet Ave., Toledo, Ohio
H. A. B. Sneve Co., San Francisco, Seattle, New Orleans

Send for information.



Roof and Undercar Types

For Automobiles
Eight Years of Proven Superiority
FISHWICK RADIO CO., Cincinnati, O.

**A NEW LOUD SPEAKER GOOD TO
10,000 Cycles**

Thru new design, this new SYLVAN unit is capable of producing wide range and 25% increase in efficiency. List price \$25.00.

Mfgd. by C. F. & M. Co., 388 Dorr St., Toledo, O.

INDEX TO ADVERTISERS

<p>A</p> <p>Allen-Bradley Co. 6</p> <p>American Electro Metal Corp. 33</p> <p>Astatic Microphone Lab., Inc. 34</p> <p>Aurlema, Inc., Ad. 35</p> <p>B</p> <p>Bentley, Harris Mfg. Co. 34</p> <p>Brand & Co., William. 31</p> <p>Bruno Laboratories 33</p> <p>Brush Development Co., The. 35</p> <p>C</p> <p>Capitol Radio Engr. Institute. 33</p> <p>C. F. & M. Co. 34</p> <p>Central Radio Laboratories. 36</p> <p>Clarostat Mfg. Co. 20</p> <p>Continental Carbon, Inc. 31</p> <p>Crowe Name Plate & Mfg. Co. 5</p> <p>D</p> <p>Daven Company, The. 29</p> <p>E</p> <p>Electrophone Corp. 25</p>	<p>F</p> <p>Fishwick Radio Co. 34</p> <p>Filtermatic Mfg. Co. 32</p> <p>G</p> <p>General Plastics, Inc. 27</p> <p>Gilby Wire Co. 35</p> <p>H</p> <p>Hygrade Sylvania Corp., The. 17</p> <p>L</p> <p>Lifetime Corp., The. 32</p> <p>M</p> <p>Muter Company, The. 35</p> <p>P</p> <p>Parker-Kalon Corp. 3</p> <p>R</p> <p>Racon Elec. Co., Inc. Third Cover</p> <p>RCA Victor Co., Inc. 1</p>	<p>S</p> <p>Scientific Radio Service. 33</p> <p>Shakerproof Lock Washer Co. 36</p> <p>Stackpole Carbon Co. 23</p> <p>Swedish Iron & Steel Corp. Second Cover</p> <p>Synthane Corp., Inc. 29</p> <p>T</p> <p>Thomas & Skinner Steel Products Co. 35</p> <p>U</p> <p>Universal Microphone Co., Ltd. 35</p> <p>W</p> <p>White Dental Mfg. Co., The, S. S. Back Cover</p> <p>Wholesale Radio Service Co., Inc. 31</p> <p>Wireless Erect Engineering, Inc. 27</p> <p>Wire Stripper Co., The. 35</p> <p>Z</p> <p>Zierick Mfg. Co., F. R. 35</p> <p>Zophar Mills, Inc. 34</p>
--	--	--



**UNIVERSAL
Phonograph
Recording
Lead Screw**

For simultaneous grooving and recording—Cuts 80 lines per inch—Quick, easy installation—Machine cut gears—Accurate. Drives from center of turntable—Now offered at the extremely low price of \$10.00 List. Sold by dealers and jobbers everywhere. (Standard Discounts.)

Double Faced, Processed Aluminum Discs

for Phonograph Recording—either Blank or Pregrooved—Sizes, from 6 in. to 16 in. List Prices from 30 cents up—Special Prices in Quantities. Booklet "Simplified Home Recording" sent on receipt of 10c Stamps or Coin. (Standard Discounts.)

UNIVERSAL MICROPHONE CO., Ltd.
424 Warren Lane Inglewood, Calif., U. S. A.



**Use MOTOR DRIVEN
WIRE STRIPPERS for**

Faster, Better Work

Our machines are especially adapted for Radio Coil and Wire Stripping.

BRUSH TYPE STRIPPERS remove insulation from coil leads as close to coil as desired.

KNIFE TYPE STRIPPERS remove insulation from all wire ends.

Write today for Bulletin on these and other Insulated Wire Strippers.



THE WIRE STRIPPER CO.
1725 Eastham Ave. E. Cleveland, Ohio

**WE offer to manufac-
turers interested in**

EXPORT

**the services of a dependable organization,
well established in the entire foreign field**

AD. AURIEMA, INC.

Manufacturers' Export Managers

116 Broad Street, New York, N. Y.

LAMINATIONS

for Audio & Power Transformers
SPECIALIZED METHODS—YEARS OF EXPERIENCE
Wide Variety of Stock Standard Sizes

Dimension and Price Sheets on request
We Also Make

**PERMANENT MAGNETS—DIES—TOOLS—
METAL STAMPINGS**

Facilities for prompt service

... for Tubes • Resistors • Relays ...

Carbonized Nickel
Selvage Mesh
(Patented)
Filament Wire
Grid Wire



**RESISTANCE
WIRE**
Nickel Chrome
Copper Nickel
Nickel Wire
and Ribbon

GILBY WIRE

**MEANS
MAXIMUM PRODUCTION
With MINIMUM SHRINKAGE**

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

CANDOHMS

ARMOURED WIRE WOUND RESISTORS

WILL LOWER YOUR COSTS

OVER SEVEN MILLION IN USE
MAY WE SAMPLE AND QUOTE

THE MUTER COMPANY

1255 So. Michigan Ave. Chicago, Ill.

BRUSH

GRILLE-TYPE MICROPHONES

adopted as standard at A Century of Progress and the Canadian National Exhibition for their fidelity of sound reproduction; adopted for the Byrd Antarctic Expedition for their ruggedness and reliability.

Write for New Circular and Technical Information

THE BRUSH DEVELOPMENT CO.

3715 EUCLID AVENUE CLEVELAND, OHIO

For Your Experimental Department

A tube of 500 as-
sorted lugs and
terminals — hot
tinned for easy
soldering.

Price \$1.00

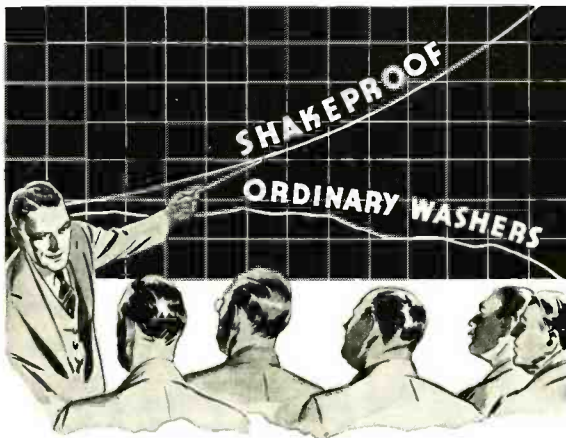
We are also pre-
pared to handle
production stamp-
ings.

*Write Us for
Quotations*



F. R. ZIERICK MFG. COMPANY
78 E. 131st ST., NEW YORK CITY

SHAKEPROOF



"*Vibration Control*"
ASSURES SMOOTH

ECONOMICAL PERFORMANCE

THERE'S nothing that destroys efficient performance as quickly as vibration. It strikes at vital connections and, if any nut or screw is unprotected, serious trouble is certain. No product can escape Vibration—but every metal manufacturer can use the Shakeproof principle of "Vibration Control" to keep connections tight. The twisted teeth of Shakeproof Lock Washers bite into both work and nut surfaces—and



Send today for your free copy of this complete Shakeproof Catalog. Explains thoroughly the many advantages that Shakeproof offers—also shows new patented Shakeproof products.



"It's the Twisted Teeth that LOCK!"

the greater the vibration the tighter they hold. Let Shakeproof show you how to improve your product and build into it extra years of satisfying, money-saving performance. Write for free testing samples today!

SHAKEPROOF Lock Washer Company

{Division of Illinois Tool Works}
 2509 N. Keeler Ave. Chicago, Ill.



U. S. Pat. 1,419,564—1,604,122—1,697,954—1,782,387—Other Pat. Pending—Foreign Pat.



"What-a-Man"



Holder of ALL records—takes the cup for superior performance on Every Test.

No wonder they out-perform and out-wear so called "just-as-good" fixed resistors.

Service men take note:
SPECIFY CENTRALAB

CENTRAL
 RADIO LABORATORIES
 MILWAUKEE, WISCONSIN

Centralab
FIXED RESISTORS

BROAD-BAND

New Standards of audio quality are being established by the latest RACON REPRODUCERS, designed to cover the broad audio spectrum from 30 to 12,000 cycles.



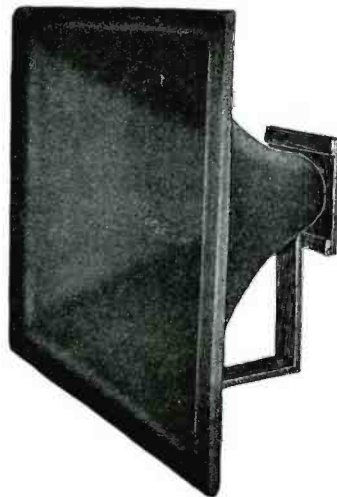
Illustrated: **Dynamic High-Frequency Loudspeaker.** An efficient and precision-built unit. Will reproduce faithfully all components present in the source from 3000 to 12,000 cycles, uniformly, without peakiness, shrillness or over-accentuation. This unit is not a modification of a low-frequency unit nor is it intended to introduce "psychological highs" that are not present in the source. It is a true high-frequency loudspeaker.

Supplied with horn, in one assembly, as shown. May be used in conjunction with a suitable low-frequency speaker of either the horn or cone type **and** the RACON Filter Network, which divides transmission at 3000 cycles for wide-range, high fidelity reproduction. Six volt or 110 volt field. 16 ohm voice coil impedance. Weight 3 lbs. Also available special tube rectifier field exciter for one or two units.

Low-Frequency Reproducers—Where dynamic cone-speakers are used for low-frequency reproduction the type of baffle and mounting is important. RACON Flared Baffles are the highest development in sound projectors for use with cone speakers. They are free from boominess, sturdy in construction and simple to mount.

A Flared Baffle of the type illustrated (1) increases the sound output efficiency of the speaker unit, (2) gives uniform and broad sound distribution without "squashing" of the waveform at low-frequencies, (3) aids in acoustic balance by establishing a definite cutoff.

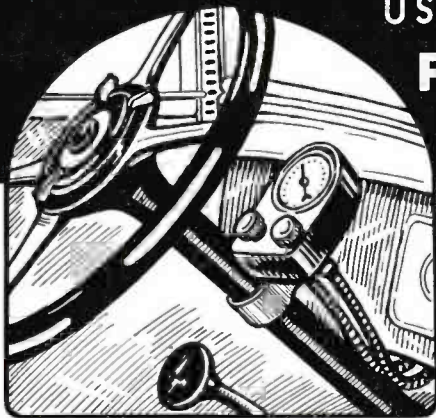
Flared Baffles are available in a wide variety of sizes from 18" x 30" to 8 feet x 10 feet, in single, two and four unit types. Openings accurately molded to fit cones from 8" to 15" diameter. Back enclosures furnished on order.



Write for catalog RE-10.

RACON ELECTRIC CO. INC. 52 EAST 19th STREET, NEW YORK CITY
LONDON, ENGLAND TORONTO, CANADA

Sales Offices in Principal Cities



USE

FLEXIBLE SHAFT operated remote control

. . . It's BETTER for all concerned

Leading auto radio manufacturers, including PHILCO, RCA VICTOR, GENERAL ELECTRIC, CROSLEY, WELLS-GARDNER, GULBRANSEN, FADA, UNITED MOTORS, UNITED AMERICAN BOSCH, PIERCE-AIRO, DETROLA, STROMBERG-CARLSON and many others, are using remote controls mounted on the steering column and operated by S. S. WHITE Flexible Shaft No. 150L53 designed and built expressly for this purpose. They recognize the advantages of this type of control.



Better for you, the SET MAKER

because: flexible shaft remote control simplifies the design and improves the performance of your set. It provides not only accurate and simple tuning control, but also remote control of volume and switch, permitting location of volume control in the set proper—the most desirable position in the circuit.



Better for your DEALERS

because: the flexible shaft controlled set can be easily installed in any car, giving wide latitude for locating receiver in the position that will avoid electrical, structural and physical interference, with control always convenient to driver. Control "stays put" and does not eat up profits in servicing.



Better for the OWNERS

because: Flexible shaft control provides effortless, accurate tuning and volume control. IT IS SAFE, for it brings the control directly under the driver's hand where perfect tuning can be accomplished without leaning forward or taking eyes off the road. It never gets out of order or adjustment.

WRITE FOR complete details about S. S. WHITE Special Remote Control Shaft No. 150L53 and Special Small-diameter Casing No. 170A1. Samples furnished to responsible manufacturers.

TO SET MANUFACTURERS

We will be glad to furnish names and addresses of manufacturers of remote controls using S. S. WHITE Shafting. These controls can be adapted to your set.

The S. S. WHITE Dental Mfg. Co. INDUSTRIAL DIVISION

152-4 West 42nd Street

New York, N. Y.