Eleventh Year of Service

RADIO ENGINEERING

Vol. XI MAY, 1931 No. 5

IN THIS ISSUE

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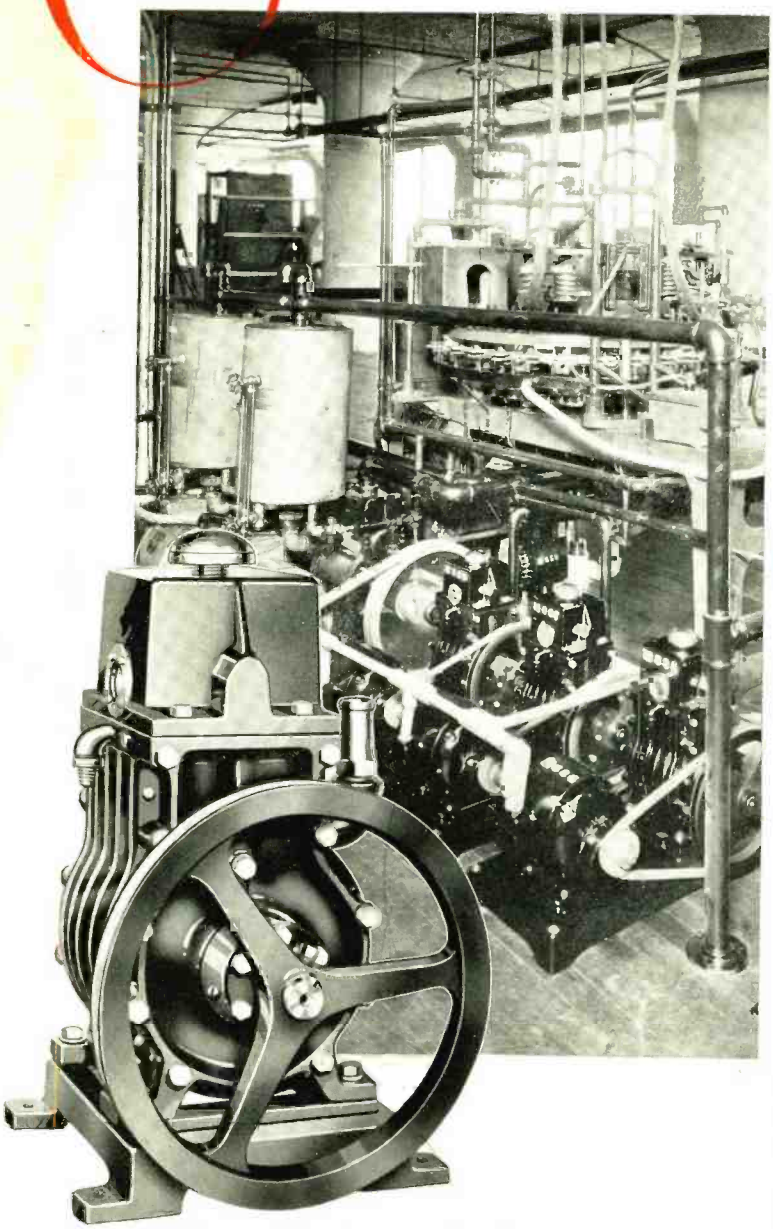
The Journal of the Radio Industry

Canada's fine tubes are Hypervac pumped



A photograph taken in the plant of the Rogers Radio Company, Toronto, Canada. A high speed exhaust machine is shown in the foreground with its complement of three Cenco Hypervac pumps—standard equipment for Rogers fine tube production.

ROGERS Radio Company is known throughout Canada as a leader in the manufacture of high grade receiving, amplifying and power tubes. Here a quality reputation is rigidly maintained to insure permanent markets—and costs are held down by extremely efficient production methods. Cenco Hypervac pumps are standard equipment in this plant and contribute both to high quality and to low costs.

Cenco Hypervac pumps were chosen because they combine high speed with high vacuum, they recover instantly after accidental breakage and they eliminate waste by uninterrupted, consistent operation.

For each of these repeatedly proven facts there is a definite reason either in design principle or in constructional feature. Every radio tube engineer will profit by investigating the effect on tube quality of Hypervac's consistent 0.05 micron vacuum. Every production man needs to learn about Hypervac's cost-cutting speed. For information address the Central Scientific Company, 460 East Ohio Street, Chicago.

Cenco Hypervac Pumps

CENTRAL SCIENTIFIC COMPANY
CENCO HIGH VACUUM PUMPS
Hyvac Megavac Super vac Rotovac Hypervac
NEW YORK - BOSTON - CHICAGO - TORONTO - LOS ANGELES

Depend on » » FORMICA

SOME of the most competent American electrical and radio manufacturers have done so for many years. Not a few of them have been continuously among Formica customers for 15 years.

That must mean that Formica is a high quality, uniform material. That the fabricating work done in the Formica plant is accurate and skillful. And that sufficient equipment is available to give prompt service.

All of those conditions do exist and you can depend on them.

Formica has the largest facilities for both the manufacture and the fabrication of laminated phenolic material. It has a well selected and trained organization concentrated for 15 years on improving and producing just one material.

Such concentration must bring results—and it has.

Try the service—send your blue prints for estimates.

THE FORMICA INSULATION COMPANY
4654 Spring Grove Avenue
Cincinnati, Ohio

FORMICA

RADIO ENGINEERING

Reg. U. S. Patent Office

Member, Audit Bureau of Circulations

Western Editor ULMER G. TURNER

Editor DONALD MCNICOL

Managing Editor F. WALEN

Vol. XI MAY, 1931 Number 5

Contents

Departments

TUBES IN THE MANUFACTURED RECEIVER

Wallace M. James, Engineering Department, RCA-Victor Company, Inc.

THE radio receivers manufactured during the year of 1930 created a market for thermionic tubes which is estimated to be in the neighborhood of between twenty-five and twenty-seven million. The large tube market is obviously possible because of the manufactured radio receiver.

On the other hand, the radio receiver industry is made possible because of the thermionic tube. Every important advance in radio receiver technique has been based on an improvement in thermionic tubes, or the development of means for utilizing their potentialities to a greater extent. Thermionic vacuum tubes have made possible the apparatus with which the performance of radio receivers may be measured. It is impossible to estimate the extent to which measurements have been responsible for improvement in the manufactured receiver. Without doubt, the ability to measure receiver performance with some degree of accuracy has been an important factor in the development of the art.

The watchword of the radio receiver industry can be expressed by four words, "Better performance—lower cost." The improvements in thermionic tubes are playing an important part in the achievement of this goal from year to year.

BRYAN S. DAVIS, *President*

JAS. A. WALKER, *Secretary*

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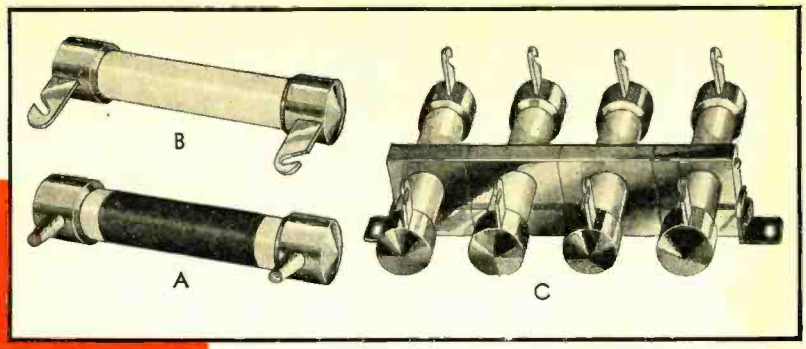


HEAT.. COLD.. MOISTURE.. OVERLOAD...

None

of these can disturb the accuracy of

METALLIZED RESISTORS

—with the NEW

TYPE 'K' FILAMENT

TESTS in our own and customers' laboratories have proved the above beyond question. They have demonstrated that the Type "K" *Metallized* Resistor possesses qualities never before attained in a resistance unit.

This new filament was evolved by I.R.C. engineers after years of search for materials that would provide permanent resistance values under any conditions, climatic or otherwise, confronting normal set operation. The result has exceeded their expectations. And with it has been achieved a *lower noise level* than was possible before.

Not only do we now offer this superior resistor, but we supply it in special designs and types, which make possible a marked

Saving in Assembly Costs.

A few of these types are shown above. (A) Equipped with special tips—recommended for use in panel mountings. (B) Equipped with lugs for ease in soldering. (C) Gang mounting, which materially reduces chassis assembly expense.

Several of our leading customers, by ordering these special I. R. C. types, have effected production savings running into big figures. Your own problems may have some special need which we can meet. Curves and data showing tests of the Type "K" Filament will be supplied on request.

INTERNATIONAL RESISTANCE CO., Philadelphia
In Canada, International Resistance Co., Ltd., 74 Wellington St., Toronto

IRC

Metallized

RESISTORS

ALSO PRECISION WIRE WOUND RESISTORS

Editorial

MAY, 1931

EIGHTEEN CENTIMETER RADIO AT ONE-HALF WATT

FOLLOWING on the heels of the wide use of short-wave beam radio transmission, engineers of Le Matérial Téléphonique, Paris, in cooperation with the International Telephone and Telegraph Laboratories, have demonstrated the utility of 18-centimeter waves with one-half watt power for radio telephony.

The demonstration, described elsewhere in this issue of RADIO ENGINEERING, was made between stations in France and England. Two-way telephony of commercial quality was carried on without evidence of the feared fading at minute wavelengths.

Of course, the demonstration reported was over a relatively short distance—across the English channel, where virtual optical visibility obtained between the stations.

Further experimentation may suggest a particular field for the new system—may possibly suggest modification of equipment now used for short distances.

▲

SELLING RADIO RECEIVERS

THERE are signs that those who sell radio receivers may yet live down the idea of selling sets about as neckties and walking sticks are sold — on their makeup and appearance.

Business in foreign travel would be dull should competing tourist agencies undertake to sell transportation on the basis of typography, design and texture of tickets. Desire for foreign travel is stimulated and developed by beautifully reproduced pictures of foreign lands and peoples and by vivid descriptions of life abroad. True, the actual payout on the part of the customer is for the ticket, but who cares what the ticket is made of! The ticket is simply the key to the delights beyond.

A radio receiver in effect is simply a switch by means of which one may "turn on" whatever in word or music is passing by one's habitation.

The desire to possess such a switch depends largely upon whether there is interest in what may be on the air from time to time. What is on the air must also be sold.

The organized manufacturers of radio receivers should be able to augment largely what individual manufacturers, as RCA-Victor, Atwater Kent, Stromberg-Carlson, Majestic, Philco and others already have done to present quality entertainment and high grade sponsored features.

If space in daily papers and fiction periodicals must be employed to foster sales of receivers there is more to be gained by giving publicity to what is on the air than to the make of tubes used.

▲

BROADCAST PUBLICITY AND THE PRESS

AT THE annual meeting in New York in April of the Associated Press much concern was expressed by members with reference to newspaper loss of national advertising to the radio broadcasting companies.

The publisher of the Syracuse, N. Y., *Post Standard* criticizes the use of Associated Press dispatches in radio broadcast programs sponsored by national advertisers. The publisher of the *Oklahoma City Times* expresses the opinion that broadcasting of news increases the circulation of newspapers.

If broadcasting increases the circulation of newspapers advertising therein should be more effective in sales results. When broadcasting causes an increase in the circulation of one newspaper while at the same time another newspaper in the same field loses ground, it might be well to inquire in a direction other than toward radio for the explanation.

Inasmuch as certain newspapers own broadcast stations and are in a position to gain facts and experience at first hand, it would seem not difficult to learn the truth.

To learn the news by reading a newspaper it is unavoidable that all other personal activities be for the time suspended. To learn the news as broadcast by radio one can at the same time be taking his morning exercise or be engaged in painting the kitchen—occupations which would preclude the simultaneous perusal of a newspaper. It is this view of the situation which perhaps contains elements which will have a bearing upon the future of daily newspapers and of broadcasting.

▲

BROADCAST ANTENNAS

TO BROADCAST station engineers we commend a reading of the paper in this issue of RADIO ENGINEERING by Nicholas Gerten, dealing with broadcast transmitting towers. The vast amount of practical experience engineers have now had with antennas and with antenna location will permit of planning more dependable construction for permanent operation.

Donald McNicol.

Editor.

559,750 metal-twisting JOLTS

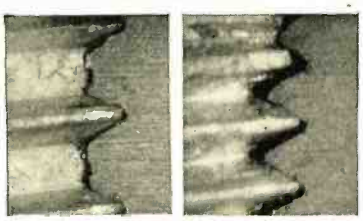
... but Self-tapping Screws DID NOT LOOSEN

From the Columbia University Testing Laboratories comes further proof that a manufacturer does not sacrifice assembly security when he takes advantage of the fastening economies afforded by Hardened Self-tapping Screws:—

By means of a special shake-test machine, a radio receiver taken right from the stock of the maker was subjected to exceptionally heavy vibration stresses. So severe was the vibration that many of the sheet metal parts of the set were twisted and broken. It was a stiff test for assemblies because vibration is the chief cause of fastening failure. The six assemblies made with machine screws could not stand such a jolting . . . they quickly fell apart. Yet not one of the 44 fastenings made with Self-tapping Screws loosened.

Other unbiased, scientific tests show that under tension and shear stresses, too, Self-tapping Screws hold better than the fastening devices they usually replace. The user of these unique Screws actually obtains stronger assemblies . . . in addition to fastening speed and economy, which results from eliminating tapping and other assembly difficulties. Send for our two free booklets. One tells all about the security tests. The other describes the way leaders in the metal working industries save money through the use of Hardened Self-tapping Screws.

These microphotographs tell the story



See tight engagement of Self-tapping Screw in metal

Note louse fit of machine screw in tapped hole

PARKER-KALON HARDENED SELF-TAPPING Sheet Metal Screws

PATENTED · APR. 1, 1919 — NO. 1299232 — MAR. 28, 1922 — NO. 1411184 · AUG. 14, 1923 — NO. 1465148 — FEB. 10, 1925 — NO. 1526182 — OTHERS PENDING

PARKER-KALON CORPORATION, Dept. L, 190–198 Varick Street, New York, N. Y.

Send me free booklets on the Security and Economy of assemblies made with Self-tapping Screws.

Name and Co._____

Address_____

·A·
POWER AMPLIFIER
PENTODE
NOW AVAILABLE

The RCA-247 has been designed for use in the audio power output stage of newly-designed AC receivers.

ONCE AGAIN the RCA Radiotron Company, Inc., gives the set designers a new tool to work with—the screen-grid power output pentode, RCA-247. Owing to the addition of a "suppressor" grid between the screen and plate, this Radiotron is capable of giving large audio power output for relatively small signal voltages impressed on the grid. The suppressor is connected to the cathode and is, therefore, operated at the cathode potential. Thus, the suppressor is effective in practically eliminating the secondary emission effects which limit the power output of four-electrode screen-grid types.

The preliminary ratings and characteristics are:

Filament Voltage	2.5 Volts	Plate Current	32 Milliamperes
Filament Current	1.5 Amperes	Screen Current	7.5 Milliamperes
Plate Voltage, Recommended	250 Volts	Plate Resistance	38,000 Ohms
Screen Voltage, Recommended and Maximum	250 Volts	Mutual Conductance	2,500 Micromhos
Grid Voltage	16.5 Volts	Load Resistance, Approximate	7,000 Ohms
Power Output	2.5 Watts		

RCA RADIOTRON CO., INC. ~ HARRISON, N. J.
A Radio Corporation of America Subsidiary

RCA RADIOTRONS

« « THE HEART OF YOUR RADIO » »

HERE'S THE ELKON NON-AQUEOUS HI-VOLT CONDENSER

WITHOUT THE CAN!

NO CAN protection is necessary with the Elkon Non-Aqueous Hi-Volt condenser because there is nothing to leak or spill. It's the ideal way to reduce your condenser costs and still have the highest standard of filtering quality.

—and here are ten more reasons why many leading set and instrument manufacturers (names on request) have adopted the Elkon condenser as standard equipment:

1 **Highest Filtering Capacity** *of any electrolytic condenser.*

2 **High Working Voltage:** *450 volts—withstands without injury transient peaks in excess of 575 volts.*

3 **Absolutely Dry:** *A condenser from which all water is eliminated.*

4 **Low Leakage:** *Normal rated leakage 0.1 mil per mfd. (After operating short period the leakage is 0.025 mils per mfd.)*

5 **Impervious to Low Temperatures:** *Operates efficiently from minus 40° F to 125° F.*

6 **Long Life:** *To reduce replacements and interrupted service periods to a minimum.*

7 **Self Healing:** *Transient peaks in excess of 575 volts do not injure the Elkon condenser.*

8 **Compactness:** *Smallest cubical volume per microfarad of any condenser on the market.*

9 **Stability in Operation:** *To guard against mechanical and electrical variation that would affect action of the circuit.*

10 **Low Cost Per Microfarad Per Voltage Rating:** *A large safety factor in volt rating for the same cost as lower voltage condensers.*

Samples in any combination of capacities you specify will be sent to all recognized manufacturers (metal cans will be supplied if desired). Booklet on request.

—and here's how you can use it to save money . . .

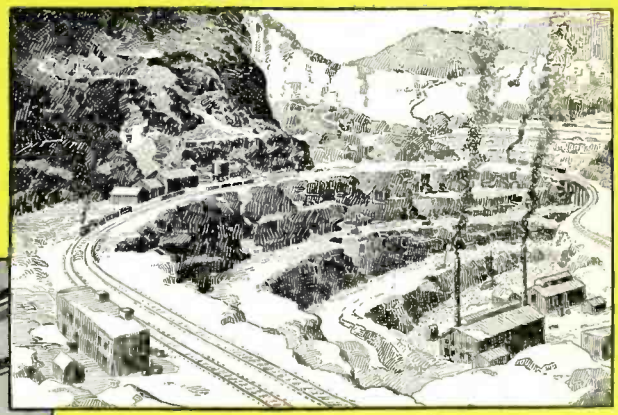
If your set is already designed for condensers on top of the chassis, the Elkon condensers may be placed under an inexpensive drawn metal cover.

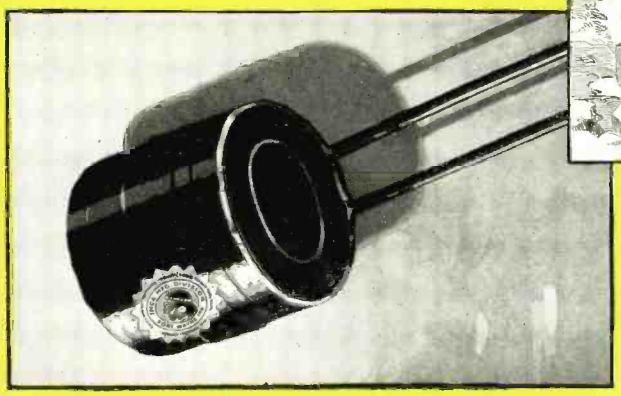
otherwise—

—the condensers may be mounted directly to the underside of the chassis eliminating the entire cost of metal can or cover.

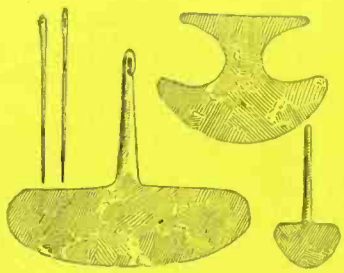
ELKON DIVISION
P. R. Mallory & Company, Incorporated
Indianapolis, Indiana

FROM THE COPPER MINE





. . . . TO THE FINISHED COIL



The articles shown above are interesting examples of the Inca's ability to create useful objects from raw copper ore. From left to right they are: two needles, two knives, and a shawl pin. These relics are now displayed in the American Museum of Natural History.

In the broader sense Inca wire is created, not just fabricated. For through National Electric Products and its associated companies . . . there is continuous control over the manufacturing processes from the mining of the ore to the labeling and packing of the finished coils.

The combined facilities thus employed are not merely adequate . . . they are outstanding.

Unusual, too, are the final wire drawing, enameling and coil winding operations at the Inca mills. Here the most modern machinery in the industry plays an important part in upholding Inca standards of accuracy and quality.

These broad facilities embody not only all that is desirable and valuable in the older methods . . . but many new production refinements which have been made possible through extensive research and long practical experience.

Here are definite reasons why the radio industry finds in Inca the characteristics which its exacting requirements demand.

INCA MANUFACTURING DIVISION

of NATIONAL ELECTRIC PRODUCTS CORPORATION

FORT WAYNE, INDIANA

Symbolic of the best in copper wire products.

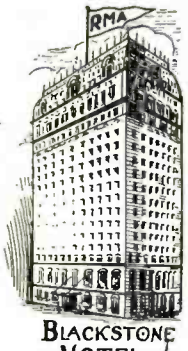
Eastern Office: 233 Broadway, New York, N. Y.

Western Office: 1547 Venice Blvd., Los Angeles, Calif.

STEVENS HOTEL
(HEADQUARTERS)

GO!

TO THE
FIFTH ANNUAL



BLACKSTONE
HOTEL

RMA *Trade Show*

AND 7TH ANNUAL RMA CONVENTION

CHICAGO

JUNE 8 *to* 12 *th*

RADIO MANUFACTURERS ASSOCIATION — RMA

BU$INE$$ FOR YOU WITHOUT BALLYHOO

EVERYBODY WILL BE THERE.

BuSineSS will be the key-note during "Radio Week" of June 8th. This will be a "buSineSS" show and buSineSS for *YOU*, buSineSS for everybody in radio.

The National Furniture Industry and the Music Industry also will be holding conventions and exhibits in Chicago, drawing thousands of visitors, during "Radio Week."

All the new radio products on display in the trade show. Every leading manufacturer of receiving sets, tubes, speakers and accessories has reserved exhibit booths in the trade show and demonstration rooms in hotels. There will be *more* new circuits, new tubes, new speakers, new cabinet designs, and new radio products, including home talkies, television, remote control, and other radio devices and products than ever before in one year.

Thirty thousand (30,000) square feet of radio exhibits in the Grand Ball Room and Exhibition Hall of the Stevens Hotel.

ADMISSION TO THE TRADE ONLY — NO VACANT BOOTHS — ALL EXHIBITORS *REQUIRED* TO SHOW THEIR MERCHANDISE.

Twenty-five thousand radio manufacturers, jobbers and dealers expected to attend.

Reduced railroad rates have been granted on all lines—one and one-half fare rate. Secure certificates from local railroad agents. RMA special trains from all sections.

Official hotels—Stevens Hotel (headquarters), Blackstone, Congress and Auditorium Hotels, with demonstration rooms of manufacturers.

INDUSTRIES AND EXHIBITIONS

Radio industries, June 8-12—RMA, National Federation of Radio Associations, Radio Wholesalers Association and National Association of Broadcasters.

Music industry convention and exhibits, Palmer House—June 8-10, during "Radio Week."

Institute of Radio Engineers annual convention, Sherman Hotel—June 3-6.

Annual national "Furniture Mart" with 25,000 furniture buyers, jobbers, dealers and manufacturers—June 1-15.

CONGRESS HOTEL

Business meetings and entertainment for visitors during entire "Radio Week"—June 8-12—RMA "stag" party Wednesday, June 10—Music Industry banquet, Tuesday, June 9.

Apply now direct to hotels for room reservations.

RMA invitation credentials mailed to the trade about May 1st. For information or credentials write to Bond Geddes, RMA Executive Vice-President, Stevens Hotel, Chicago, or,

RADIO MANUFACTURERS ASSOCIATION

11-W. 42ND ST. N.Y. CITY 32 W. RANDOLPH ST. CHICAGO

AUDITORIUM HOTEL

PROTECT

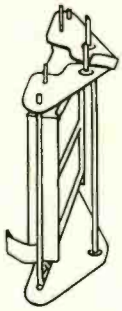
the Reputation of Your Set

Even though the tubes do not carry your trademark, the reputation of your set is actually entrusted to their quality so far as the general public is concerned. And the increasing recognition of this fact is bringing more and more manufacturers to appreciate the soundness of using Hygrade Tubes.

By standardizing on Hygrade Tubes, you secure the support and co-operation of an engineering staff and a manufacturing organization which have consistently demonstrated their ability to maintain mass production with quality and uniformity held to the highest standard.

Hygrade developments represent accomplishments only possible to a well financed, progressive institution. They are backed up by 30 years of growth and experience in the making of vacuum products.

Fortified . . .



The new fortified construction of Hygrade Tubes (patent applied for) makes it virtually impossible to break or injure the internal parts unless the bulb itself is smashed. Jolts and jars, vibration, the rough handling of shipping cannot injure the tube since the elements are held in positive, accurate space relation — fortified against breakage or distortion.

The illustration shows the new Hygrade method of bracing the elements top and bottom with a mica spreader. Only Hygrade offers this type of construction.

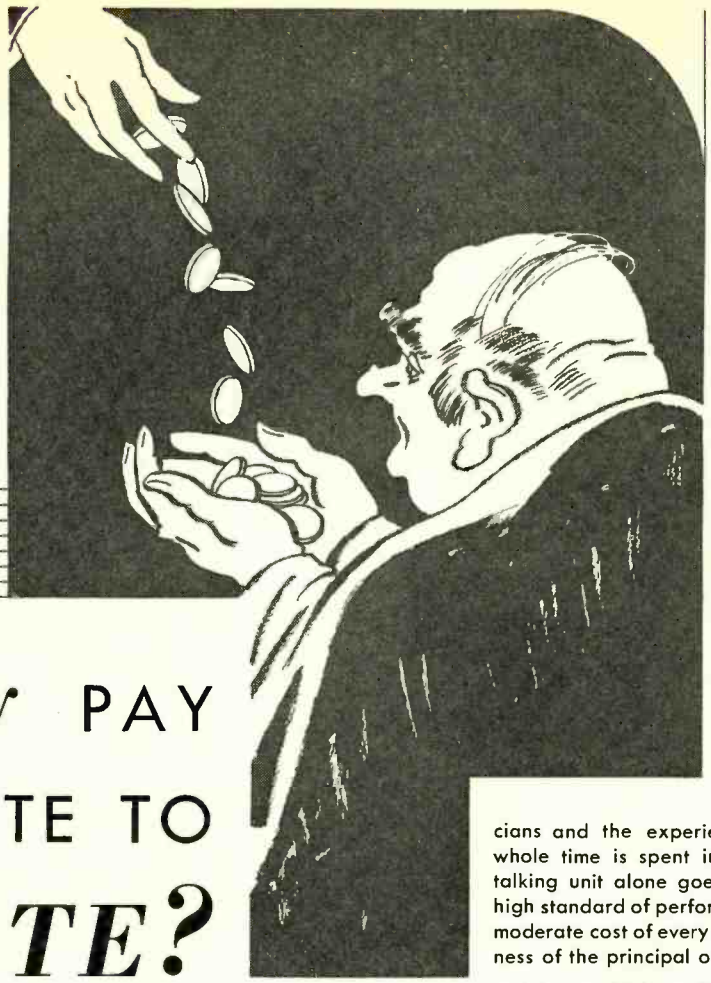
Set makers can now ship their sets with tubes installed in the sockets. Hygrade Tubes, fortified against breakage, will reach the consumer in perfect condition.

This feature is incorporated in all new Hygrade Tubes. Hygrade is constantly bringing out new developments and, because of a small inventory, improvements are immediately passed on to Hygrade customers.

HYGRADE
RADIO TUBES

"TUBES YOU CAN TRUST"

A Product of Hygrade Lamp Company, of Salem, Massachusetts, makers of Hygrade Lamp Bulbs



Why PAY TRIBUTE TO *WASTE?*

SET MANUFACTURERS who insist that the manufacture of speakers is also within their scope incur an unnecessary burden of overhead expense. For the cost of the department that develops and builds the speaker must be charged off before profits can be reckoned. This needless duplication of effort can be saved; the slim margin of profit of a highly competitive field widened by relying on the productive ability of seasoned engineers working with specialized equipment.

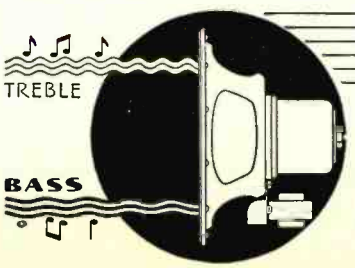
Only one product—radio speakers—is made at the Rola plant. In this modern factory are gathered the finest facilities and latest equipment for building speaking units. The ability of recognized technicians and the experience of engineers whose whole time is spent in the development of the talking unit alone goes into each speaker. The high standard of performance and the surprisingly moderate cost of every Rola unit attests the soundness of the principal of specialized manufacture.

To maintain a division to build speakers is to compete with these finely specialized focilities, is to pay tribute to waste! By specifying Rolo Speokers for your sets you eliminate experimental waste and lower your manufacturing cost. Makers of many famous radios use Rola Speakers exclusively for they know they secure better speakers at far lower cost than their own production facilities can effect. The fact that more than a million Rola Speakers are now in use testifies to their dependability.

More margin—less waste with Rola talking units in your sets. A full exposition of the advantages of using Rola Speakers awaits your request. Write today!

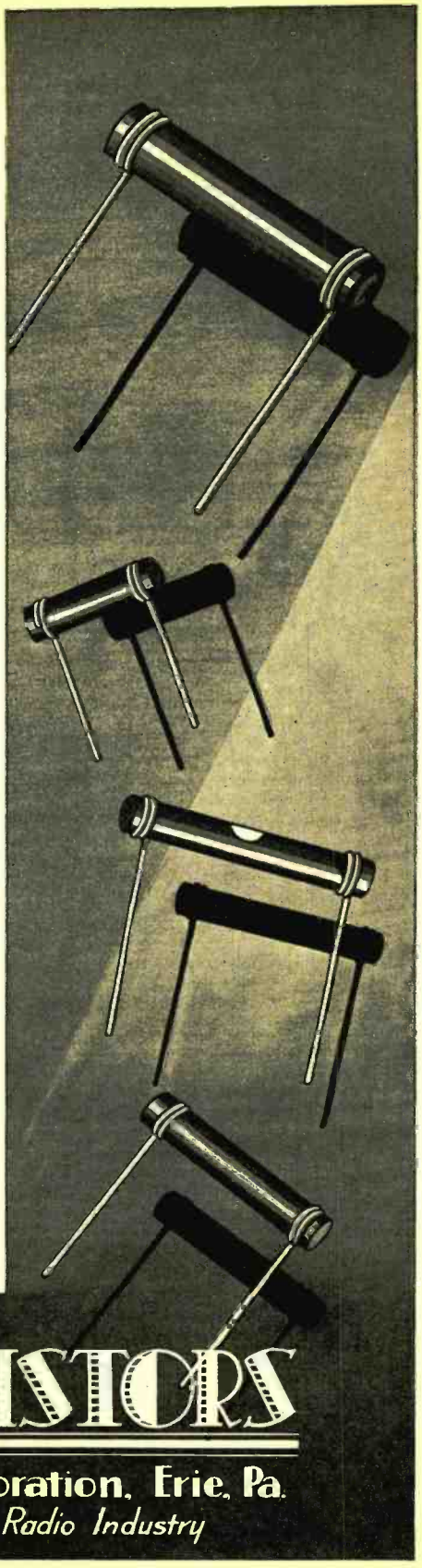
Visit the Rola exhibit at the R. M. A. Trade Show in Chicago, June 8—12. Booth BI-A in the Hotel Stevens Ballroom

ROLA SPEAKERS *for better Radio Reception*



THE ROLA COMPANY
2570 Superior Ave. Cleveland, Ohio

Manufacturers of Loud Speaker Units for Midget, Automobile and Console Sets. Also high power Loud Speakers for Public Address Systems and Talking Pictures.



Not affected by heat or cold

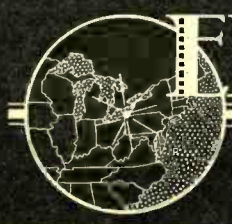
Users of moulded type resistors are familiar with the troubles caused by expansion and contraction from heat and cold.

ERIE RESISTORS are not affected by heat or cold. Their welded leads insure permanency under the varying conditions of temperature in which they must do their part to deliver perfect performance.

Open circuits are avoided by reason of the "one piece" construction which totally eliminates the possibility of variation in resistance values—in all temperatures.

COLOR CODE INDICATOR

We will be pleased to send you without charge a COLOR CODE INDICATOR which is a quick, handy and reliable guide to determine the resistance value ot moulded type resistors—it shows the Standard R.M.A. Color Code for any wanted resistance value and is of great help to the specification engineer in drawing up specifications in accordance with the R.M.A. Color Code.



ERIE RESISTORS

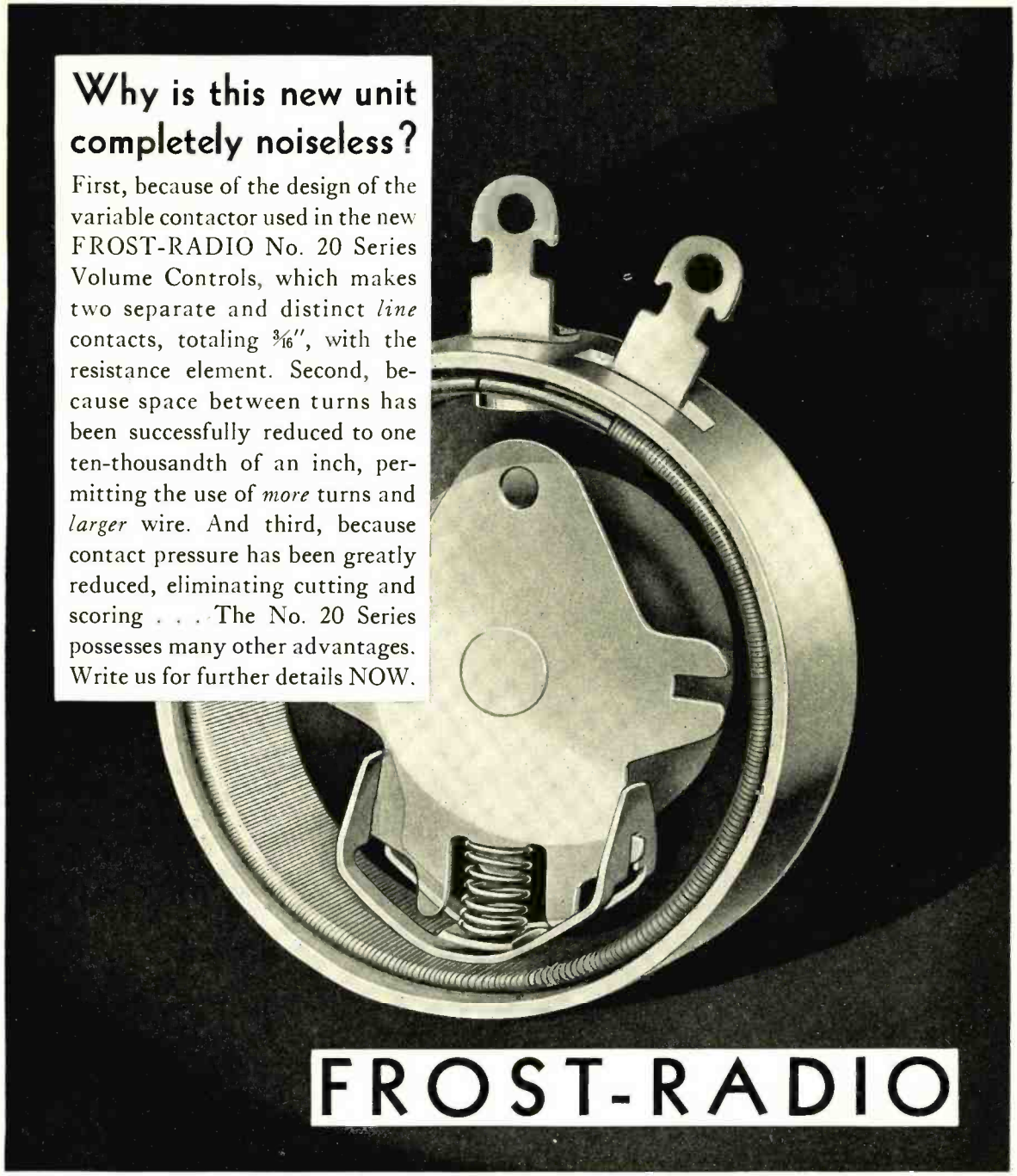
Erie Resistor Corporation, Erie, Pa.

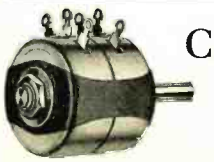
In the Center of the Radio Industry

Noiseless Action!

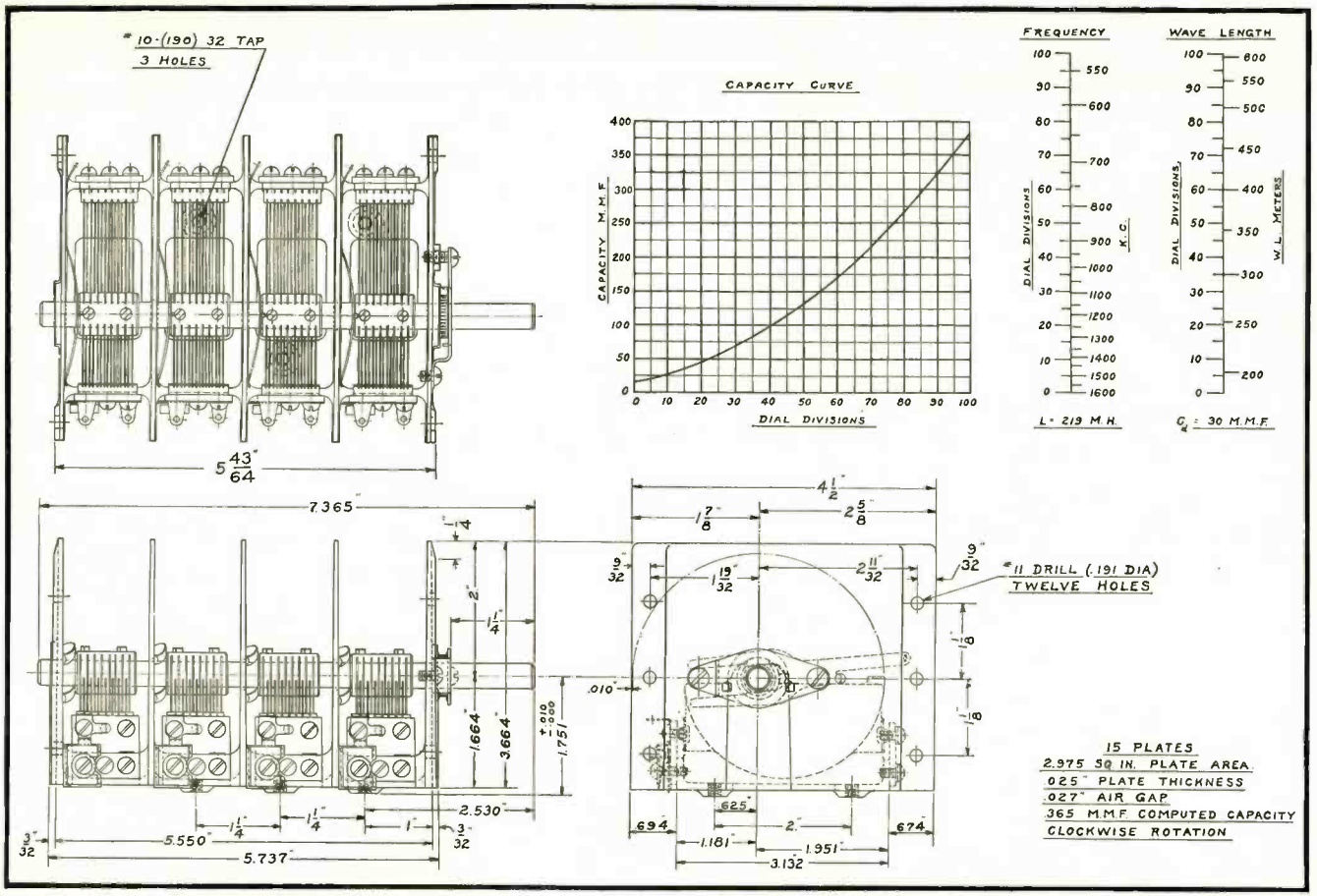
Why is this new unit completely noiseless?

First, because of the design of the variable contactor used in the new FROST-RADIO No. 20 Series Volume Controls, which makes two separate and distinct *line* contacts, totaling 3/16", with the resistance element. Second, because space between turns has been successfully reduced to one ten-thousandth of an inch, permitting the use of *more* turns and *larger* wire. And third, because contact pressure has been greatly reduced, eliminating cutting and scoring . . . The No. 20 Series possesses many other advantages. Write us for further details NOW.





CHICAGO TELEPHONE SUPPLY CO.
HERBERT H. FROST, Inc.
SALES DIVISION
General Offices ELKHART, INDIANA *and Plant*



THE diagram above gives the mechanical specifications and electrical characteristics of new Scovill 4-gang midget condenser with high shields.

This condenser can also be supplied with low shields, and as a 3-gang unit with either high or low shields.

For the heterodyne circuit these condensers can be furnished with a special section for tuning the oscillator.

Available in any quantity at moderate prices.

Scovill

SCOVILL MANUFACTURING COMPANY, WATERBURY, CONNECTICUT

New York, Philadelphia, Boston, Providence, Chicago, Detroit, Akron, Cincinnati, Atlanta, San Francisco, Los Angeles. In Europe: The Hague, Holland.

Impressions and Expressions

By AUSTIN C. LESCARBOURA

CONDENSER RIDDLES

ALL claims to the contrary notwithstanding, there are no true standards in the paper condenser industry. Or if there are any purported standards, they are susceptible of as wide a range of interpretation as a questionable partnership agreement at the hands of the proverbial Philadelphia lawyer.

Recently, we have been highly amused at certain diminutive filter condensers rated at a working voltage of 1000 volts d-c. These condensers are one-third to one-eighth the size of the usual condensers of similar rating. At first we were tempted to believe that the diminutive condensers represented some new development in dielectric or impregnation, but an analysis of two samples by condenser specialists soon revealed no innovations in the condenser art.

Since all condenser manufacturers employ substantially the same materials and methods although in varying degrees, it must be obvious that the interpretation of working voltage has much to do with production costs and selling prices. The industry has now reached the stage where the manufacturer with the most liberal interpretation of working voltage is in position to quote the lowest prices, while the manufacturer who still adheres to sound standards is just about out of the running.

Until condenser buyers insist on positive specifications as to what they are buying as condensers of given working voltage ratings, we are going to have chaos in the condenser industry, with the less scrupulous manufacturer stealing a march on his competitors.

▲

THE MULTIPLEX ANTENNA

ANTICIPATING the use of a plurality of radio sets in the average home, quite aside from the need for a group antenna in the average apartment house, several multiplex antenna systems have made their appearance during the past month. The principle is about the same in all cases, namely, a common antenna provided with a long down lead which is properly loaded so as to act as a radio-frequency transmission line and serving a plurality of radio sets through suitable coupling devices.

▲

THE PUBLIC LOOKS IN

AT last a serious effort to provide genuine television entertainment service! Above the din of the battle of conflicting opinions regarding the practicability of immediate television, there stands out the inauguration of a sight-and-sound program service from the very heart of New York City, due to the joining of hands of television Station W2XCR at 655 Fifth Avenue, and sound broadcasting Station WGBS at Astoria, L. I.

No longer can television be said to be just a laboratory experiment or again a demonstration. On the air four hours each week day, or three hours with synchronized sound and one hour silent, the Jenkins television studios are paralleling the work of Station KDKA a decade ago, when radio telephony remained to be converted into a recognized means of mass communication for the dissemination of worth while programs, thereby laying the corner stone of the radio industry.

Of course the pictures are far from perfect. They cannot be compared with motion pictures even of the home category. Yet the television pictures are sufficiently detailed for entertainment purposes, particularly in conjunction with synchronized sound available through the usual broadcast receiver.

If history repeats itself, television is now set for rapid development. It had to be placed in the greatest laboratory of all, the laboratory of everyday use. To keep it in the laboratory accomplishes no real purpose. The real development of this young art can only come through the combined interest and effort and collaboration of the lookers-in, who are willing to help foot the bill at this time.

▲

AUTOMOBILE RADIO

AFTER one or two false starts, the automobile radio idea is being groomed for this season's market. Indeed, the opening gun is fired as these lines are written, in the form of a full-page advertisement in our leading popular weekly magazine, featuring the offering of an aggressive radio manufacturer at $65.00 with tubes.

The automobile radio idea is sound. However, it did not get a fair start until now. First, it was launched at a poor time, when the public was hardly prepared to part with its money except for sheer necessities. Secondly, the earlier offerings were priced entirely too high. Thirdly, the sets available until now could hardly be considered sufficiently refined to warrant widespread acceptance.

It may be still too soon to expect much of the automobile radio idea, but just as soon as money becomes easier, we can look to a healthy sale of automobile radio sets. The old adage of trying again if success is not attained at first, certainly fits the case perfectly.

▲

BETTER BROADCASTING

IT is not necessary to see the frequency curve nor again the percentage of modulation data to know that leading broadcasting stations have noticeably improved their transmission during the past six months. The average listener, let alone the radio engineer and musician, is immediately struck with the marked improvements in broadcasting technique, as exemplified in greater volume, clarity and depth.

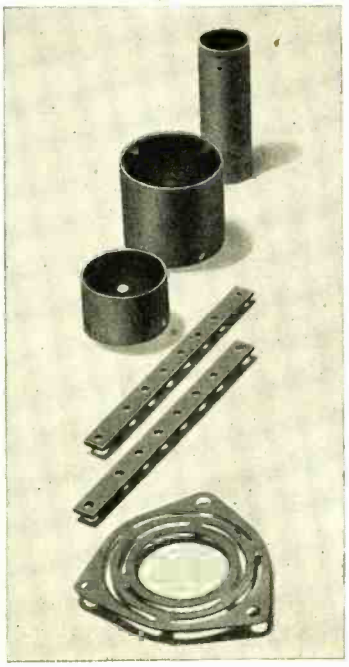
That broadcasters are keeping pace with receiver developments is quite apparent. A year ago, it would have been nothing short of a modern version of casting pearls before swine to attempt to place on the air the wonderful tone quality incorporated in the signals of some of our leading broadcasting stations. Today, however, with the tone quality of the average radio set such as it is, the greater frequency range and the uniform response of many transmitters are absolutely warranted and even demanded. Meanwhile, the growing practice of 100 per cent modulation makes for greater effective volume particularly in the instance of weak signals.

Quite logically, the radio industry can now point out that broadcasting has justified the 1931 radio receiver.

S E L E C T I V I T Y S E L L S S E T S

Listening to Your Favorite Radio Program Unmolested by Interference from Competing Programs

Textolite Safeguards Selectivity



PROGRAMS that once quarreled their way through now flow in with satisfying clarity — where the insulation is right. That's why some of the most prominent radio manufacturers have intrusted the right insulation of their receivers to laminated Textolite.

Here is a superior material that emerged fully tested from one of the greatest research laboratories in the world. It has proved its ability to preserve the original precision of tuning with unflagging fidelity. It possesses a practically constant power-factor under varying conditions.

Don't hesitate to request information on Textolite — in sheets, rods, or tubes — from the eastern or western fabricators, or from the Textolite specialist in the General Electric office of your vicinity.

General Fabricating Co.
37 East 18th Street
New York City

Electrical Insulation Corp.
308 W. Washington St.
Chicago. Ill.

GENERAL ELECTRIC

885-51

Sound Economics and Common Sense

TRADE ASSOCIATIONS' OPPORTUNITIES

AT the dinner of the Radio Trade Executives' Association, held in Washington, on April 30, in conjunction with the annual meeting of the Chamber of Commerce of the United States, a message from President Hoover was read which contains a million dollars worth of suggestions for the RMA and for the radio industry at large. The President said:

"As Secretary of Commerce, I wrote the foreword to a bulletin on trade association activities in which I said, while our industry and commerce must be based upon incentive to the individual, yet the national interest requires a certain degree of co-operation between individuals in order that we may reduce and eliminate industrial waste, lay the foundation for constant decrease in production and distribution costs, and thereby obtain the fundamental increase in wages and standards of living.

"Trade associations, like many other good things, may be abused, but the investigation of the Department of Commerce shows that such abuses have become rare exceptions. Within the last few years trade associations have rapidly developed into legitimate and constructive fields of the utmost public interest and have marked a fundamental step in the gradual evolution of our whole economic life.

"No facts have come to my attention which would cause me to change the opinions expressed at that time. Rather, every development of industry renders trade associations more essential to sound development of our economic system.

"HERBERT HOOVER."

▲

SOCIAL CONTROL URGED

A great social control of industry and commerce to bring about longer term planning to suppress excesses and to make the economic machine of greater service to the public was urged with a fair degree of uniformity by 100 speakers, addressing ten gatherings in the meeting of the Chamber.

The control, it seemed to be agreed, was to be in the hands of "business leadership," with government cooperating and avoiding competition. The principal agencies of social control mentioned were the trade associations, together with regional business groups working out better business practice by conference and agreement.

▲

THIS IS THE WAY TO DO IT

Radio Merchandisers Look to Broadcast Support.

AT the 1931 convention of the National Federation of Radio Associations, the National Federation of Radio Associations and the Radio Wholesalers Association placed themselves definitely on record in the following resolutions:

Industry Cooperative Advertising Fund.

Whereas, The radio industry has never, in our opinion, put into operation or sponsored, through cooperative effort, a definite and constructive program to broaden the market for radio receivers, and

Whereas, The history of American business is replete with examples of what has been accomplished through cooperative promotional and advertising effort by other industries, and

Whereas, We realize that such a plan properly conceived and properly executed would necessitate the creation of a promotional fund of considerable proportions,

Be It Therefore Resolved, That the N.F.R.A. and R.W.A. put themselves on record as being definitely in favor of the necessary steps to put the following plan into operation.

1. We recommend that every manufacturer of a radio receiver so adjust his list prices as to provide an extra net return per receiver for such a promotional fund.

2. That the N.E.L.A. and the electric power companies be solicited for contributions toward this fund.

3. That the national chain broadcasting companies, whose services to advertisers as a whole will be greatly enhanced through the millions of listeners who will be attracted to their stations because of the aforementioned advertising and because of the outstanding character of these programs, be solicited for their contributions toward this fund either in cash or in time on the air.

4. This promotional fund as received be turned over to a properly appointed body decided upon by a committee composed of members of the Directorates of the R.M.A., N.F.R.A. and R.W.A.

5. That this promotional fund be used:

(a) To inaugurate a regular bi-weekly or monthly broadcast program, as revenue will permit, of such national interest as to give that great mass of the American public that does not now own modern radio receivers, or receivers of any kind, the urge to buy.

(b) To carry on a consistent advertising campaign in national magazines and newspapers to inform the public of all programs of national interest and of other reasons why every American household, office and factory should possess at least one modern radio receiver.

(c) To furnish the radio retailer, by means of this activity, with a definite and concrete program which he can exploit and use to decided advantage in the profitable selling of radio receivers.

The convention at which this Resolution was adopted was known as the "Down to facts and remedies" convention.

Your Test Panels Need Jewell Instruments!

Your high-speed production test panels need measuring instruments that not only are accurate, but give dependable operation under the severe operating conditions that test panels must withstand.

The Jewell line of Miniature Instruments have proven their ability to retain accuracy and dependability under unusual service in countless production test panels.

This line of sturdy instruments is available in types and scale ranges suitable for incorporation in test panels for every test position on your production line.

All types are readily interchangeable, being mounted in non-scratching bakelite cases, 3 inches in diameter. Shatter-proof glass standard on some instruments; available upon all others if desired.

Write for the booklet listing the full line of Jewell Miniature Instruments.

JEWELL ELECTRICAL INSTRUMENT CO.
1642-P Walnut Street, Chicago, Ill.

31 YEARS MAKING GOOD INSTRUMENTS

JEWELL

MAIL THE COUPON

Please send me the Jewell Miniature Instrument Bulletin

Name .....

Address .....

City ..... State .....

RADIO ENGINEERING

Production, Administration, Engineering, Servicing

MAY, 1931

Radio towers and antennas

By NICHOLAS GERTEN*

Dependability of operation requires that modern radio transmitter installations be provided with antenna towers of substantial construction

RADIO is a giant industry touching intimately upon the lives of more people than any other. Its first hesitant steps did not foreshadow the giant strides of the last decade during which it grew phenomenally. Not so long ago it was the plaything of scientists and then later it was looked upon as a temporary expedient not as a final form of communication. Radio was to be an extension to wire service reaching remote places, new territories or pioneer camps where the telephone or telegraph would be impossible or unprofitable. Few visualized radio as a permanent and profitable means of communication; indeed engineers and business men alike expected to replace radio when traffic warranted with wire lines, except, of course, for ship to ship and ship to shore service. Today all this has changed. Radio is permanent. It competes successfully with older forms of message service in the most densely populated areas.

The early thoughts of the pioneer radio engineer had a profound effect upon the structures used. Buildings, antenna supports and even the electrical apparatus were designed with portability as the goal—erected here today and moved tomorrow. The antenna and its supports, of all major components suffered most from the early concept of radio and are just now emerging from obscurity and getting the study and attention they merit. Ten years ago most of the antennas were ill-designed and their supports were light, flimsy and easily dismantled. Today antennas are supported by more permanent structures.

The guyed mast was the first antenna support. It was popular both in Europe and America. Many ingenious designs were brought out and the patent office records the labor of many capable engineers who tried to meet the demands of the day. A German engineer patented an articulated design that affords instructive study and is noteworthy as the high point of portable mast design. He had developed a system of triangular units using steel pipe compression members terminating in ball and socket joints and using wire rope tension members. The system allowed the construction of different heights of masts using the identical units. The design is clever and the mast is portable but withal it is expensive to make, difficult to handle in the field and subject to rapid deterioration under the action of weather. Another variation was the wooden lattice mast designed in the United States. The wooden lattice mast, of which several were built, was a combination of timber posts and struts secured by steel rods and bolts. For a temporary structure the design is good, but like all masts its limitations were its guys. In C. F. Elwell's paper before the I. R. E. in 1915 he gave as the principal argument for the lattice mast the "uncertain tenure of radio stations." Then, in 1915, uncertainty was the principal argument for the lattice mast—today even that is gone.

Lattice Structure

Despite the many difficulties of design, the guyed mast continued to be studied and is yet seriously considered for high and medium high antennas. In Europe, the guyed mast attained its greatest development and there one finds many fine examples of lattice steel structures reaching to great heights. In the United States the best example is the guyed mast at Tuckerton, N. J. used by the Radio Corporation of America. The Tuckerton mast was German designed and German built. It stands as a monument to the courage of its designer and has stood well the ravages of time although an accident deprived it of its uppermost section.

Guyed masts are not and never can be determinate structures. Their design is but little more than an educated

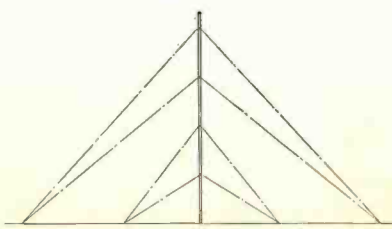


Fig. 1

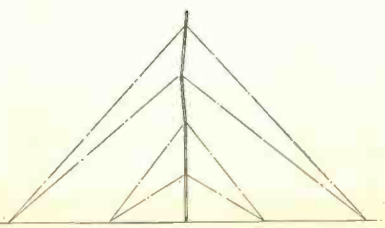


Fig. 2

*Vice-Pres., Blaw-Knox International Corp.

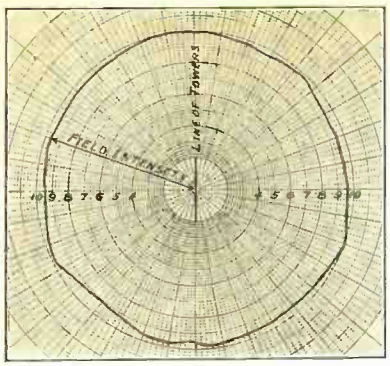


Chart 1.

guess which Roy A. Weagant, in a paper published in 1915, most ably proved. Mr. Weagant brought sharply to notice that all designs of guyed masts are based upon the assumption that the center line of the mast remains a straight line under all loads and stresses. Fig. 1 shows the condition upon which design is predicated. It is obvious that the ideal is never attained in actual practice as it requires; (1) that all guys are tightened to the same proportional stress at the time of erection; (2) that all loads are uniformly applied, and (3) that the guys all stretch proportionately the same under load. The first condition is impossible of attainment as no method has been devised that accurately measures the tension in large guys; the second we know to be untrue as the principal load is caused by wind pressure which is not uniform but varies at different elevations above the ground, and finally, wire rope until quite recently, was not obtainable with known and permanent moduli of elasticity. Actually, therefore, the guyed mast is strained into an irregular line as shown in Fig. 2. Every multi-guyed mast is full of unknown stresses beyond the scope of mathematics to compute and so it is inevitable that they are either a menace or loaded with excess metal.

Self-Supporting Towers

As the guyed mast approached the limit of its use in structures as high as 800 feet, the radio engineer looked with increasing favor upon the self-supporting tower. Many advantages are inherent in the self-supporting tower; the space it occupies is small, it can be designed to have a pleasing appearance, its cost compares favorably with the cost of guyed masts and finally, it is designed upon principles well known and often proved by tests on full size structures. Many engineers were led to believe the guyed mast cheap because any given amount of metal would build a mast higher than the same metal would build a tower. One must, however, consider that the additional metal used in building a tower is more than compensated for by the absence of expensive guys, guy anchors, the cost of guy erection and the very material saving in ground area. Tower construction for radio antennas commenced during or just prior to the Great War and the first towers were remarkably high, much higher than subsequent work. The United States Navy erected many tall structures at home, abroad and in our outlying possessions. The United Fruit Company was another pioneer user of high radio towers.

Most of the early high structures were of a triangular shape with rivetted connections and with a liberal use of rods for bracing. Today the prevailing design is four sided towers, all the members of which are structural shapes such as, angles, I-beams and channels. All connections are bolted instead of rivetted. The evolution of the early to the present type was taken in one step to overcome collectively all the known tower faults.

Triangular shapes were abandoned

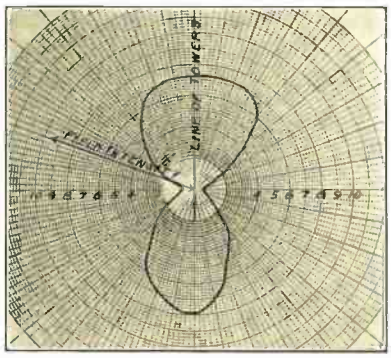


Chart 2.

because the saving in metal did not repay the sharp increase in cost caused by forming the 60° corner angles.

Angle Bracing

Angle bracing was substituted for rods because: (1) Rods are adjusted to length in the field by turnbuckles and this adjustment is a tedious and delicate affair. A slight misadjustment pulls the tower to one side or the other and the best authorities are of the opinion that no workman, however skilled, can exactly plumb a rod braced tower. (2) The discretion of the workman is relied upon to see that the rods are neither loose nor too tight. No one knows how tight or how loose the rods are so the initial stresses caused by tightening the rods forever remain unknown quantities in the design. (3) Rods are easily bent and damaged during transportation whereas angles are not. Rivetted connections gave way to bolted connections so the benefits of galvanizing could be realized.

The four-sided structural, galvanized radio tower was borrowed from the designs of transmission line towers. Many of the problems are identical and the methods of the design and manufacture are similar. Wind and ice loading on radio towers and transmission towers is identical. Antenna loads and antenna sags are similar to wire loads and wire sags encountered in transmission lines. Meteorological data is available for most of the world and it was consulted by the tower designers who at length standardized upon models and heights calculated to meet every condition of commercial communication and broadcast work. For more than ten years the designs satisfied every need and even now it is only unusual antenna systems that call for special designs.

The criteria of radio tower design are: (1) The tower must be capable of supporting the antenna under all conditions of weather. (2) Assembling must be easy so experienced and inexperienced erectors alike can build the tower. (3) Every member and each fitting must be protected against corrosion by hot-dip galvanizing.

Galvanizing

Galvanizing of the tower has been mentioned several times and it is probably well to discuss this important requirement more fully. Steel if not subject to corrosion is, above all, the ideal building material as it has high unit strength and is easily workable. We daily observe, however, the painter crawling and climbing over monumental bridges dressing them with a new coat of paint. This paint is not for beauty but it to defeat the omnipresent threat of rust—steel's greatest enemy. During all the years of steel experience, no better protection nor more permanent protection has been discovered than hot-dip galvanizing. In this process all pieces are carefully cleansed in an acid bath and then dipped in a bath of molten zinc which forms a lasting weather-resisting coat. Each piece must be separately dipped and all connections must be bolts or pins in order to avoid burning off the

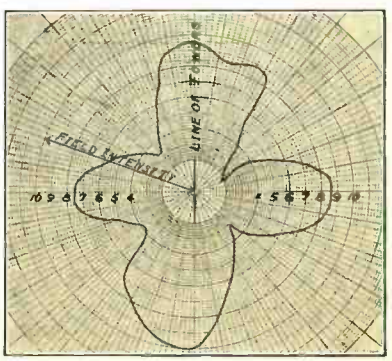


Chart 3.

spelter coat by hot rivetting or welding during assembling. The life of steel so protected is twenty to fifty years.

For more than fifteen years standard radio towers have been supplied. They have been erected in every climate and by all types of labor. Explorers with no steel experience did an excellent job for the Byrd Antarctic Expedition at Little America and the Chinese coolies did an equally good job at Shanghai. Thousands of structures in all parts of the world doing their work under the heat of the tropics and the cold of the poles establishes the supremacy of the galvanized structural radio tower.

Electrical Properties

Radio towers have electrical as well as structural properties. Lately the electrical properties have assumed a place of major importance and the problems arising therefrom are not of easy solution. While it was dimly realized that the towers exercised a direct effect upon antenna performance, it was not until accurate field intensity measurements were available that the magnitude of tower effect was known. Towers and antennas are component parts of an oscillating system and it is impossible to divorce one from the other. At times the effect of the tower is severe, greatly influencing the strength and direction of the radiated wave, often reducing the antenna efficiency to less than half the expected. When the current in the tower is a maximum, tower effect is resonant. The first step is to determine the resonant frequency of the tower or, given an assigned frequency, determine the height at which the tower is resonant. As the tower is a conducting structure, it obeys the laws of vertical antennas but because of its physical dimensions its resonant frequency is not calculable by the methods readily available. Recourse, therefore, was made to tests.

Towers of standard design were chosen and the effective transmission measured at several frequencies. So, there was determined the variations in field intensity distribution caused by the towers when they were resonant with the antenna frequency. There are reproduced three charts upon which are plotted the results of some of the data accumulated.

Chart No. 1 shows an intensity equal in all directions, or nearly so. It results from using towers favorable to maximum antenna efficiency. For this result the frequency of the transmitter wave is well below the resonant frequency of the towers.

Chart No. 2 illustrates what happens when the towers are resonant with the transmitted frequency. Not only is the pattern badly distorted with areas of low intensity but the losses due to the currents in the towers are considerable.

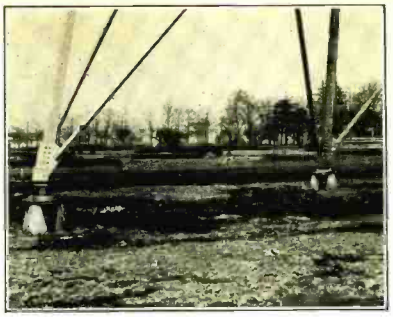


Fig. 3. Corner leg insulation.

Chart No. 3 was taken at a frequency greater than the natural period of the towers. Some improvement is shown over the field pattern of chart No. 2 but the results are far from desirable and certainly not a condition to recommend.

From the data an empirical formula was set up for determining the resonant height of towers. The maximum height recommendable for freedom from tower interference is somewhat less than the resonant height found by applying the formula.

Optimum Height

Effective field strength and height of antenna are closely related as Dr. Ballantine showed in his paper published in 1924. Ballantine's mathematical conclusions have since been confirmed experimentally so we may base our work upon the general theorem that as the height of the antenna increases above a quarter wavelength, there is a decided gain in the low angle or ground waves at the expense of sky-waves. This tendency continues until the optimum height for low angle waves is reached, which height is somewhat about a half wavelength. Low angle waves are effective power. They provide a direct field free from static and distortion. With low angle waves the maximum area can be served with a dependable program day and night and in all seasons of the year. Unfortunately the limit in height was set by tower interference so that the ideal antenna has never been realized in practice. We can, however, greatly improve performance by making higher towers available.

Higher towers free from detrimental influences were made possible by the expedient of insulating the tower from the ground. This practice follows the well-known laws of antenna which are: a grounded vertical wire oscillates as a quarter wavelength antenna whereas a free isolated wire oscillates as a half wavelength antenna. Towers obey the laws of antennas, in fact they are either grounded or isolated vertical antennas. The formulas available for determining the characteristics of vertical wire antennas do not apply to towers because of their considerable dimensions of width and thickness and also because of their high capacity to ground. The characteristics of the insulated tower, consequently, were determined by a series of tests similar to those described when discussing grounded towers.

Base Insulation

Station WJZ at Bound Brook, N. J., operated by the Radio Corp. of America was the first broadcasting station having self-supporting towers insulated at the base. Four especially designed insulators were mounted at the base of each corner leg as shown in Fig. 3. The immediate result was gratifying and the permissible height of tower was extended several feet. The use of insulators made it possible to use 300 ft. high towers at a transmitted frequency of 830 kilocycles where the maximum previous recommended height was 200 feet.

Simultaneously with the problem of insulation was the problem of antenna sag. All inclined and horizontal wire antennas sag. The sag is more or less, depending upon the distance apart of the supporting structure, the tension of the antenna, the temperature, and the weight of the antenna and its fittings either free or with its superimposed loads of ice and wind. Sag is frequently forgotten but it is an important factor because towers 400 feet high with the antenna sagging 60 feet are no better than towers 350 feet high with the antenna sagging 10 feet. To obtain the minimum sag and use the towers

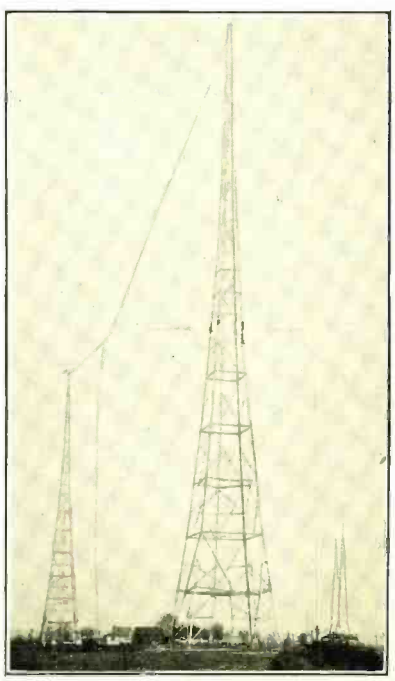


Fig. 4. Towers at WBBM. (Arrows point to sectionalizing insulators.)

most efficiently, the tension in the antenna should be applied through the medium of a counterweight system. A counterweight system properly designed provides a balance that relieves the towers during those rare periods of high winds, sleet, snow or extreme cold. The working tension of the antenna balanced against a counterweight may be as high as 60 or 70 per cent of the rated strength of the tower without danger of failure.

The field in the proximity of the antenna is most intense. Towers close to the antenna, therefore, are most apt to cause disturbances. In actual practice it has been found that the best results are obtained when the towers are spaced apart a distance at least twice their height. This rule applies for both grounded and insulated towers.

Considerable improvement in antenna performance was gained by the introduction of insulators and counterweights but the goal was still far away. Antennas were approaching only .3 of a wavelength in height instead of .5. Two means for further improvement suggested themselves; one, by increasing the efficiency of the base insulator and two, by sectionalizing the tower.

Increasing the efficiency of the base insulator was of greatest interest because any improvement there would benefit the greatest number of stations, both high and low power alike. An ingenious use of steel castings and a new design of insulator combined to make the revolutionizing single insulator mounting first used at station WKBH at La Crosse, Wisconsin. This pioneer installation proved of inestimable benefit to the broadcasting industry, vastly increasing antenna efficiency. Its importance can be gauged from the fact that the capacitance of the original insulator base is in the order of 1000 micro-microfarads per tower compared to a capacitance in the order of 250 micro-microfarads per tower of the latest insulator mounting.

Sectionalizing

Sectionalizing the tower means breaking its electrical length at one or more places by the introduction of insulators into the structure. The method of doing this is most easily understood by referring to the Fig. 4, showing the towers constructed for station WBBM at Chicago. Insulators used for sectionalizing are similar to the base insulators. Indeed, sectionalizing is only an extension of the principle of base insulation. Each insulated section is a separate electrical unit having characteristics all its own. When searching for tower interference, therefore, we consider the resonance of each unit and not that of the entire tower. So it is possible, by designs combining electrical and structural knowledge to build towers five hundred feet high with the same harmonic effect upon the antenna as towers 100 feet high. This accomplishment opens the way for gaining in full the added electrical advantages of high vertical radiators more than a half wavelength high.

The importance of antenna design and its relation to the supporting structures is of recent acknowledgment. Some of our best engineers have undertaken a serious study of this problem and we may look forward with confidence to improvement in this division of the radio art. The problem is worthy of our best attention because, after all, the antenna is the valve through which power is transmitted and the effectiveness of the transmitter is no better than its antenna.

PAN AMERICANS TO DISCUSS COMMUNICATIONS DEVELOPMENT

Expansion of communication facilities on the American continents will be among the subjects discussed at the forthcoming Pan American Commercial Conference. The week of October 5 to 12 will bring together commercial leaders from the 21 American republics under the auspices of the Union, and the subject of the development of international cable, wireless and telephone communications systems will be regarded as among the most important of the questions to be considered.

A study of the present development of communication services between the American republics would suggest that adequate cable and wireless facilities exist for present needs. The field for expansion of these facilities would therefore seem to lie in their internal development—augmenting the types of services handled by the lines, especially reduced rate week-end and deferred message development. Delays in the transmission of messages over national telegraphic systems would also seem to offer a subject for the consideration of the delegates to the conference. Expansion of international radiotelephony, while proceeding rapidly, suggests primarily the development of national services, inasmuch as the international lines are dependent upon local expansion for the ultimate success and growth of their own services. (Pan American Union, Washington.)

▲

MODEL T FORD SUGGESTS RADIO DIAL

ACCORDING to a recent announcement by the American Radiostat Company, engineers working on the development of the Stenode receiver have designed a special tuning dial on the principles employed in the planitary transmission of the old model T Ford car. The ratio of the dial is changed by holding an idling gear stationary or permitting it to revolve with the tuning knob. Thus a single tuning knob, permits the use of a rough tuning adjustment for the quick locating of a desired station and a fine regulation in the order of two hundred to one for the elimination of interference and background noises. The high ratio adjustment of the dial is sufficiently exact to take full advantage of the crystal controlled tuning with complete discrimination against heterodyne whistles and similar forms of interference.

▲

MERCURIC MUSIC

BETTY LEE TAYLOR, organist at a Schenectady theatre, sat in front of the large, complicated-appearing keyboard of the theatre organ. "Parade of the Wooden Soldiers" was the piece she was playing; with some parts loud and with the "brass" effect, and with other parts in the pure, deep, full tones of the true organ.

She stood up, turned around, and faced the audience. The music continued. From the balcony, the beam of the spotlight shot down to the orchestra pit, and showed Miss Taylor holding a toy piano in the crook of her left arm while she played the little instrument with her right hand.

The curtains on the stage parted, revealing a small, opened box resting on a pedestal. Within the box eight small tubes gleamed with the pale blue light that is characteristic of mercury. From the box, a pair of wires led to the toy piano and another cable led to the theatre's loudspeaker. The toy piano had been made part of a vacuum-tube organ.

Near the loudspeaker stood a radio microphone. It was carrying the program from Proctor's RKO Theatre to Station WGY, from where it was broadcast to the radio audience.

The Thyratron tube organ had been built by engineers of the vacuum tube engineering department of the General Electric Company.

Notes on superheterodyne design

By E. D. KOEPPING*

FOR the purposes of this discussion the superheterodyne is assumed to have the generic form of Fig. 1.

Signal Frequency Amplifier

The principal purpose of the signal frequency amplifier is to afford sufficient discrimination between transmission channels so that the phenomena of image interference is improbable under average conditions. Interference of this type is peculiar to the superheterodyne and is possible because a signal of a given frequency, S, can be converted to the intermediate frequency, i, at two different settings of the oscillator, namely when the oscillator frequency is greater than the signal frequency by i and when the oscillator frequency is less than the signal frequency by i. Now if another signal of frequency S_1 reaches the frequency changer while the receiver is tuned to frequency S, this would likewise be reproduced. Therefore, if the two signals are related so that $S+2i=S_1$ or expressed differently if $S+i=S_1-i$, the two signals S and S_1 will be reproduced at the same oscillator setting and image interference will result.

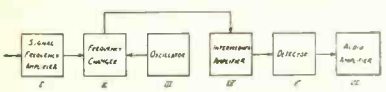


Fig. 1. General form of superheterodyne design.

* *Chief Engineer, Radio Condenser Company.*

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Point to Point Coordination in Receiver Design Makes Possible Loudspeaker Performance of a High Order

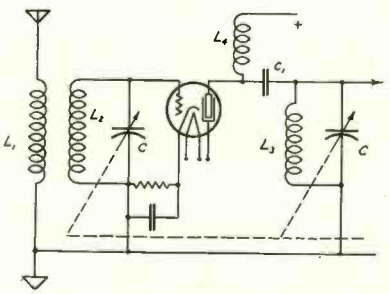


Fig. 2. Element of superheterodyne circuit.

The only practical way to eliminate image interference is to so design the receiver that the unwanted signal cannot reach the frequency changer. The higher the intermediate frequency is, the easier it is to accomplish this. When the intermediate frequency is of the order of 175 kilocycles, absolute separation of signals 350 kilocycles apart is required. This is not difficult, except in abnormal cases, nor is any very elaborate selector system necessary to accomplish it.

More than a single stage of signal frequency amplification is unnecessary. This stage should, however, be carefully designed so that approximately uniform gain is secured over the broadcast spectrum. There are several ways of accomplishing this and two of them are illustrated here. The underlying principle is the same in either case.

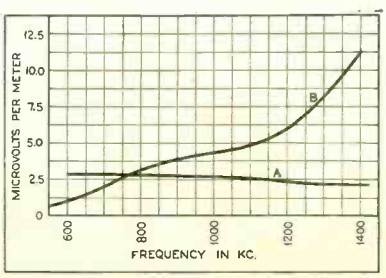


Fig. 3. Sensitivity graphs.

In Fig. 2 the inductance L_1 between the antenna and ground is large and with the normal antenna system resonates near 700 kilocycles. Consequently, the energy transfer to L_2 will tend to improve as the signal frequency decreases. The system L_4, C_1, L_3, C therefore will be designed to give increased gain with increased frequency. The overall amplification results in a remarkably even sensitivity from one end of the spectrum to the other, as is illustrated in Fig. 3, curve A. The sensitivity curve of another high inductance input system is shown in Fig. 3, curve B.

In the system of Fig. 2, L_2 is an inductance of low value, resonating at frequencies higher than any to be received when the normal antenna and ground system are used. In this case the system L_4, C_1, L_3, C is designed to give increased gain as the frequency diminishes. The sensitivity graphs of both are given in Fig. 3, curve A and in Fig. 4.

These three types of sensitivity curves cover practically all conditions. That of Fig. 3A, is the best general purpose curve and closely approximates the ideal, while the graphs, Fig. 3B and Fig. 4 meet particular local conditions.

Two types of signal frequency amplifiers are shown in Figs. 5 and 6. That of Fig. 5 requires a four-gang condenser and that of Fig. 6 a three-gang condenser.

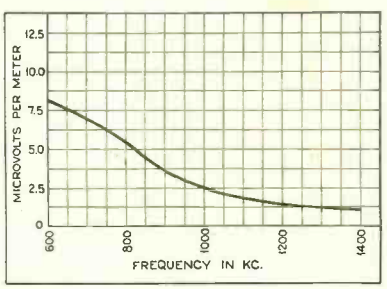


Fig. 4. Sensitivity with low inductance primary.

The sensitivity graphs of these two systems are given in Fig. 7.

Any signal frequency system may be chosen by the designer, but if it is to be used with the special superheterodyne condensers designed by the Radio Condenser Company, one limitation is imposed and that is the frequency distribution must follow the graph, Fig. 8, rather closely.

The Oscillator

Many types of oscillator systems may be used in superheterodyne design but the simple tuned grid oscillator answers every requirement. The oscillator may be coupled to the frequency

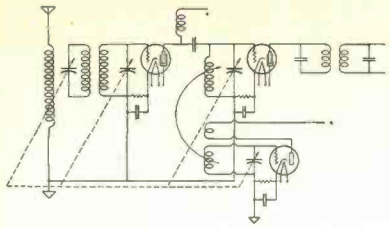


Fig. 5. Signal frequency amplifier with 4-gang condenser.

changer in several ways. It may be coupled inductively by a coupling coil, by mutual induction, by means of a high resistance and small capacity in series, by means of the screen-grid or the cathode. Of these ways mutual induction is the simplest and the one most economical of space and material.

It may be mentioned here that the designs have been worked out using shielded oscillator coils. Open oscillator coils really should never be used for broadcast superheterodyne receivers. The reason is obvious.

The oscillator should be so designed as to deliver considerable power to the frequency changer, and this voltage should be as constant over the spectrum as possible. With a little care the voltage change over the spectrum can be made less than 3 to 1. The r-f. voltage delivered to the frequency changer should be so adjusted, by varying the coupling to the oscillator, as to give maximum sensitivity without overload of the frequency changer at any frequency. The allowable voltage will depend upon the point at which the frequency changer is being worked.

Frequency Changer

The frequency changer, modulator or first detector is merely a grid bias detector (demodulator). Upon the grid circuit (preferably) of this tube two voltages are impressed, the signal voltage and the oscillator voltage, which differs from the signal voltage by the value of the intermediate frequency which, in this case, is 175 kilocycles. Inasmuch as the grid input circuit is

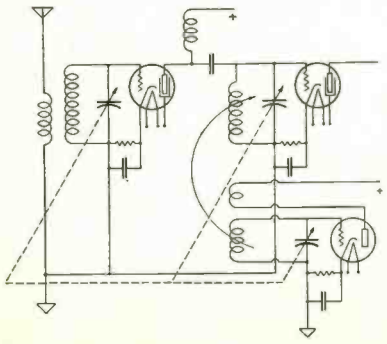


Fig. 6. Signal frequency amplifier with 3-gang condenser.

tuned it is apparent that the oscillator has to deliver a very considerable amount of power in order to impress on this circuit the necessary voltage at a frequency which is 175 kilocycles off resonance.

There is nothing unusual about the design of the input circuit of this tube. Usually a 224 is used, properly biased.

Intermediate Amplifier

If the design is good up to this point it can be preserved or ruined here. The intermediate amplifier is usually designed to use screen-grid tubes and in order to secure the proper degree of amplification it will be necessary to tune the plate and grid circuits, to the

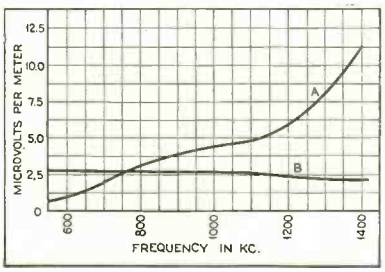


Fig. 7. Sensitivity curves of systems in Figs. 5 and 6.

intermediate frequency, if the required amplification is to be secured without using an excessive number of stages. Two stages should be ample.

The transformer design is worked out to have a large value of L to C, and small adjustable capacities are used to tune each winding to the frequency required. Many of the smaller designs contain only a single intermediate stage and for this single stage amplifier the transformer should be designed so that the stage will have a gain approximately seven times as great as when two stages are used. This can be done by winding the coils with litzendraht wire, keeping the ratio of L to C higher than the ratio for the two stage transformers. The mutual inductance between the windings is chosen so that the resonance curve will approximate a flat top, with band-pass characteristics.

The proper value of mutual inductance cannot be expressed as a certain distance between the primary and secondary coils, because this distance will vary with different amplifier designs. To secure the proper degree of selectivity it will be necessary, as a rule, to use less coupling between the tuned circuits of the first stage than is used in the succeeding stages. In cases where the physical dimensions of the shields have prevented sufficient separation of the coils to reduce the coupling to the proper value, small copper ring shields have been used between the coils with good success. These copper rings may then be bent until the coupling is again increased to the proper value. These ring shields should not be necessary in the succeeding stages.

As all the circuits of the intermediate amplifier are tuned, it is vital, in order to preserve the proper selectivity and amplification, that the adjustable tuning capacities have good electrical properties. They must also be mechanically correct so that they will permanently hold their adjustment without change in capacity value. If both these points are not carefully considered and mastered in the design, the receiver will fail to render satisfactory performance and will require constant servicing to keep it up to its standard performance. The mounting of these adjustable capacities should also be such that they cannot be affected by weaving of the chassis. This of course can occur both during manufacture and also in servicing.

A commonly used mounting for the small universally wound coils, which are satisfactory inductances for the tuned intermediate circuits, is wooden doweling. There is no objection to this material provided that it is impregnated with wax under vacuum, so that the wax penetrates entirely through the wood.

The intermediate transformer assemblies should be shielded.

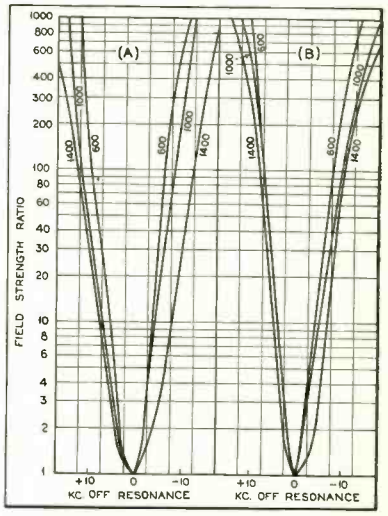


Fig. 8. Selectivity.

Second Detector

This detector should also be of the power type, and if two power tubes in push-pull arrangement are to follow the second detector it is advisable to use a Type 227 tube for this purpose. If only a single power tube is to be used a screen-grid, Type 224, tube may be used if resistance coupling or a special impedance is also used.

Audio Amplifier

In practically every case Type 245 tubes will be used, either in push-pull arrangement or a single tube.

Midget Designs

It is quite possible to properly design a superheterodyne of "midget" proportions and still retain the full complement of amplification as used in the larger receivers of this type. A design of this type can be engineered to outperform even the larger receivers, in everything but reproduction, and even here it would not fail if it had an equivalent amount of baffling for the reproducer. The manufacturing cost is only a little greater than for the more "skeletonized" forms and the results achieved should justify this small additional cost.

Several methods of creating smaller, cheaper models from the basic design which do not depart from good sound practice are as follows:

A total of 9 tubes (including the rectifier) are used.

(a) This may be reduced to 8 tubes by using a straight audio amplifier with a single 245 tube.

(b) Or the push-pull feature may be retained and one of the intermediate stages can be omitted, also giving a total of 8 tubes.

(c) One intermediate stage can be omitted and a straight audio system with a single 245 can be used, making a total of 7 tubes.

(d) The signal frequency amplifier can be omitted together with an intermediate stage and the audio amplifier can be a single 245 tube, thus reducing the total number of tubes to 6. By shifting the second detector from the power type to a grid-leak type, and by using an audio transformer of 3 or 4 to 1 ratio, a receiver of this type can be made to give fair performance, though in direct comparison with the previous ones it would be out-performed.

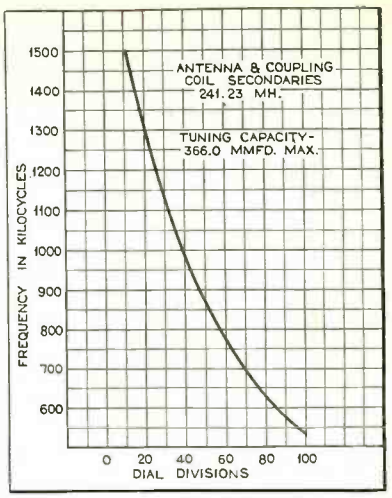


Fig. 9. R-F. tuner curve for 175 kc. i-f. superheterodyne antenna and coupling coil.

E. T. Cunningham, new president, RCA Radiotron

APPOINTMENT of Elmer T. Cunningham as president of the RCA Radiotron Company, Inc., tube manufacturing subsidiary of the Radio Corporation of America, was announced on April 9, by David Sarnoff, chairman of Board of Directors of the Radiotron Company.

T. W. Frech, former president of RCA Radiotron Company, Inc., returns to his former duties with General Electric Company as vice-president in charge of its incandescent lamp department.

Mr. Cunningham's election as president of the Radiotron Company, brings to the position an outstanding figure in the development of the radio tube business in this country. He has been identified with the manufacture and merchandising of radio tubes on a national scale for more than fifteen years. His present age of forty-two years ranks him as one of the youngest executives ever to attain a post of this importance in the industrial world.

In a statement made following announcement of his appointment, Mr. Cunningham said:

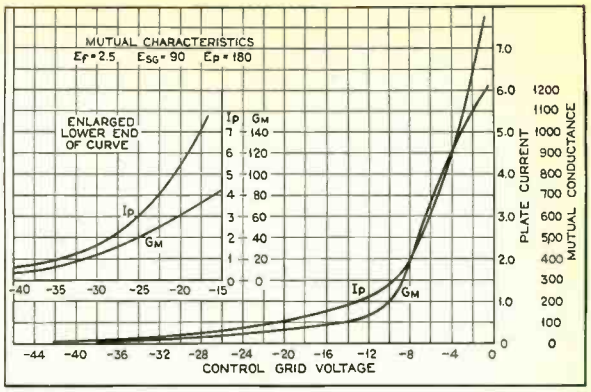
"Radio industry, in common with all industry, has been going through a difficult period. There is very definite evidence that the dark clouds are passing. In assuming the presidency of RCA Radiotron, Inc., I do so with a full appreciation of the important part the radio tube has taken, and must continue to take, in the development of radio in all its phases, and further, with a deep appreciation of the leadership held by the Radiotron and Cunningham radio tube organizations. In cooperation with the executives and personnel of these companies it shall be my earnest and sincere endeavor to assist them in accomplishing still greater service to the radio public. Radio gave a wonderful demonstration of its permanency and value last year when the public bought more radio sets than in 1928 and only slightly less than in 1929 although at lower average prices. This year's prices are still lower and are set to meet today's pocketbook. Radio entertainment is very definitely an essential and indispensable part of American home life. With today's low prices no home need go without a radio to tap the air's continuous store of music, entertainment and education."

ELMER T. CUNNINGHAM,
President, RCA-Radiotron Co., Inc.

The RCA Radiotron Company, Inc., of which Mr. Cunningham is the new president, was formed January 1, 1930 as a wholly-owned subsidiary of the Radio Corporation of America with headquarters at Harrison, N. J. The company operates factories at Harrison, N. J., Newark and Cleveland and has warehouses in Newark, Cleveland, Chicago, San Francisco, Atlanta and Dallas. Tubes marketed by the company are sold under the trade name of "Radiotron."

The E. T. Cunninghom, Inc., of which Mr. Cunningham is the founder, is likewise a wholly-owned subsidiary of the Radio Corporation of America. Its product is marketed under the Cunningham trade name through an entirely separate and distinct channel of Cunningham distributors and dealers. Warehouses and sales offices are strategically located throughout the country.

New and better tubes



Characteristics, Cable Radio Tube Type 551

By JOHN DUNSHEATH

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Lower list price levels introduced

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THE radio event of the first quarter of the year 1931 has been the introduction of new lines of vacuum tubes for broadcast receivers. The new tubes include types designated as variable-mu or super-control, for 2.5 volt operation; pentode tubes (output) for 2, 2.5 or 6.3 volt filament power, and tubes for automobile receivers.

Variable-Mu Tubes

The research work of Stuart Ballantine and H. A. Snow, of the Radio Frequency Laboratories, Boonton, N. J., which resulted in the appearance of the variable-mu tubes no doubt in time will prove to have been of real benefit to the radio receiver industry. It may be said that some manufacturers and sales executives, in view of the present merchandising situation, viewed the advent of the new tubes with mixed feelings, if not with some apprehension. However, there has for a year or more been general agreement that there is opportunity for the stimulus of betterment or innovation in the radio receiver industry. This the new tubes have undoubtedly supplied.

It may appear that there is some lack of agreement as to the best design of the variable-mu tubes, evidenced by the announcement of models 551 and 235. each intended for the same type of service, but not entirely interchangeable in placement. Some engineers feel that one of these tubes should be standardized and the other discarded; or that a compromise composite of the two should be adopted in service.

The 551 is quite similar in characteristics to the 224 tube at normal operating voltages, but due to the employment of non-uniform grids the plate current does not drop to zero as the grid bias is increased to the value of —10 to —12 volts, as is the case with the 224. Voltages —30 to —50 are required to yield plate current cut-off, allowing a wider range of grid voltage to be applied to the tubes.

In principle the advantage is that the bias applied to the tube may be raised to a high value in operation, resulting in a reduction of the mutual conductance. In turn this permits improved reception from local stations: the point is not reached where the curvature of the plate current-grid voltage characteristic is excessive. Local-distance switches and pre-selection circuits may be omitted from receiver design as strong signals from local stations may be applied to the grids of the tubes without introducing distortion.

Comparing the 235 with the 551, the former is shown with an unusual screen-grid of cone shape, wherein the theoretical advantages of the variable-mu principle are realized. It may be that the lowering of the plate resistance decreases somewhat the amplification obtainable in the r-f. stages, and in the i-f. stages of the superheterodyne receiver. However, the engineers thoroughly understand the situation and while the characteristics so far announced are tentative, if alterations appear in the products marketed these will have betterment in view, and standardization. It is no doubt safe to assume that receiver systems designed for the present super-control or variable-mu tubes will not have to be materially changed should slight changes be made in the present characteristics.

Characteristics

Tentative characteristics were given in the April issue of RADIO ENGINEERING for the RCA-235, Arcturus-551 and De Forest-451 variable-mu tubes. Since that announcement eight other major radio tube manufacturers have given out information about their 1931 new radio tubes.

Cunningham C-335

E. T. Cunningham, Inc., has announced to set manufacturers a new screen-grid tube designed primarily for use in radio-frequency and intermediate-frequency amplifier stages. This radio tube is not ordinarily interchangeable with any other Cunningham tube and must be used in circuits especially designed for its characteristics.

This tube, designated as C-335, is effective in reducing cross-modulation and modulation distortion. Its design is such as to permit easy control of a large range of signal voltages without the use of local-distance switches or antenna potentiometers, making the tube adaptable to automatic volume control design.

The tentative ratings and normal characteristics for the C-335 are:

Filament voltage, 2.5 volts

Filament current, 1.75 amperes

Plate voltage (recommended) 180 volts

Screen voltage (recommended), 75 volts

Grid voltage, —1.5 volts
Plate current, 9 milliamperes
Screen current, not over ⅓ of plate current
Plate resistance, 200,000 ohms (approx.)
Mutual conductance, 1100 micromhos.

Approximate Interelectrode Capacitances

Grid to plate, 0.010 mmf. maximum
Input capacitance, 5 mmf.
Output capacitance, 10 mmf.

Overall dimensions

Length, 4-11/16—5¼ inches
Diameter (maximum), 1-13/16 inches
Cap, 0.346-0.369 inches
Socket, C type (five prong)

This tube is designed for a-c. operation and employs a cathode of the quick heater type.

The remarkable ease of volume control obtainable with the C-335 is due to the gradual and smooth variation in mutual conductance over a wide range with change in grid voltage. The mutual conductance at —40 volts on the grid is nominally 10 micromhos, and at —1.5 volts, 1100 micromhos. This gives a useful mutual conductance ratio of 110 for a single stage.

National Union NY-235

The National Union Radio Corporation announces its NY-235 tube which tentatively has the same characteristics as the Cunningham C-335, except that the plate current is 7 ma. and the mutual conductance 1000 micromhos. Also, the grid voltage is —3 volts.

Sylvania 235

The Sylvania Products Company, Emporium, Penna., has introduced the 235 type tube aiming to retain the advantages of the '24 tube while eliminating some of the disadvantages of this tube which developed in service. The Sylvania 235 has a plate current of 5.75 ma.; a control grid bias of —3 volts and a mutual conductance of 1050 micromhos. It operates on a filament voltage of 2.5 volts, and a filament current of 1.75 amperes.

Speed 235 and 551

The Cable Radio Tube Corpn. in announcing types 235 and 551 state their belief that the new tubes will eventually replace the 224 type tube in new equipment. The characteristics are practically the same as the same type tubes of other manufacturers. The 235 has a plate current of 7 ma., and the 551 a plate current of 5.5 ma. The former has a mutual conductance of 1000 micromhos and the latter, 1050 micromhos. In the case of each tube the control grid potential is —3 volts.

National Carbon ER-235

The National Carbon Company has brought out a new screen-grid amplifier tube of the variable-mu type to be known as the ER-235. Its characteristics are practically the same as those already presented.

RCA-235

The tentative characteristics of the RCA-235 screen-grid super-control tube were published in the April issue of RADIO ENGINEERING. The operating characteristics and the inter-electrode capacitances are the same as those appearing in this article in connection with the Cunningham C-335 tube. The RCA Radiotron Company is located at Harrison, N. J.

The RCA-235 employs a cathode of the quick heater type, which should be operated at its normal rated voltage of 2.5 volts. It is pointed out that the performance of this type of tube is susceptible to variations of applied heater voltage, and it is therefore desirable to minimize such variations so far as practicable. Suggestion is made that with a transformer having no line voltage taps, the primary should be so designed as to give 2.5 volts across the heater at the socket for a line voltage of 113 volts. The cathode should be connected directly to the center point of the heater circuit. Where receiver design does not permit of this, the heater may be made negative with respect to the cathode by a potential difference not exceeding 45 volts. For maintaining the screen voltage constant at the rated 75 volts an r-f. choke filter is preferred due to the low d-c. resistance. This potentiometer, or bleeder circuit should draw several times the maximum screen current.

Arcturus 551

The Arcturus 551 variable-mu tube, the characteristics of which were presented in the April issue of RADIO ENGINEERING, has a plate current of 5.5 ma., operates on 2.5 volts and has a mutual conductance of 1000 micromhos. Tests conducted with this tube in several well-known makes of radio receivers indicate the following advantages:

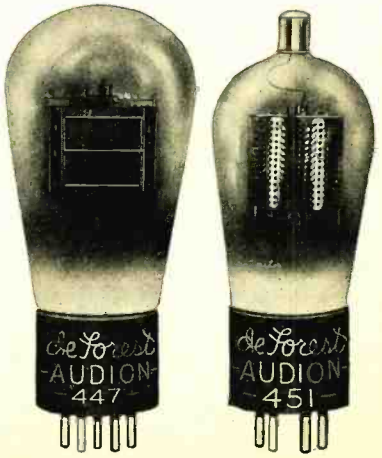
1. Increase of maximum allowable input voltage for distortionless operation by a factor of about 20.
2. Extension of the range of automatic volume control by a factor of 20.
3. Reduction of cross-talk by a factor of several hundred times.
4. Improvement in uniformity of control over the entire range of volume control.
5. Reduction of "hum on carrier" (modulation of carrier in r-f. tubes) due to incomplete power pack filtering.
6. Reduction in receiver noise. This is brought about indirectly. In receivers employing double pre-selectors (two tuned circuits between antenna and the first tube) for the purpose of reducing cross-talk the gain in voltage between antenna and first grid is comparatively low with the result that the "hiss" noise is high compared with the signal. The 551 tubes permit the replacement of the double pre-selector by a single tuned circuit with an increase in gain between antenna and first grid which reduces the hiss noise.

Tubes for Automobile Radio Receivers

New tubes are being brought out which will meet the conditions encountered in operating radio receivers in automobiles. Typical of these are the RCA-236, a screen grid radio-frequency amplifier tube; RCA-237, a general purpose tube, and RCA-238 a power amplifier pentode tube. The characteristics of the pentode follow:

The Pentode Tube RCA-238

Heater voltage, 6.3 volts
Heater current, 0.3 ampere
Plate voltage, recommended, 135 volts



Screen voltage, recommended, 135 volts
Grid voltage, —13.5 volts
Plate current, 8 milliamperes
Screen current, 2.5 milliamperes
Plate resistance, 110000 ohms
Amplification factor, 100
Mutual conductance, 900 micromhos
Load resistance, 15000 ohms
Undistorted power output, 375 milliwatts

Overall Dimensions

Length, 4-3/16 inches—4-11/16 inches
Maximum diameter, 1-9/16 inches
Cap, 0.346 inch—0.369 inch
Bulb, S-12
Base, Small UY
Socket. UY.

In addition there is the RCA-233, a new pentode for battery operated receivers. This is a screen-grid tube designed primarily for giving large audio output with relatively small signal input voltage on the grid. This is made possible by the addition of a "suppressor" grid between the screen and the plate. The suppressor is connected inside the tube to one end of the filament and is effective in practically eliminating the secondary emission effects which limit the power output from four-electrode screen-grid types. This tube operates on 2 volts, with filament current of 0.260 ampere; 135 volts plate and screen; grid voltage —13.5; plate current 14 ma., screen current 3 ma.; amplification factor 63, and with an undistorted power output of 650 milliwatts. The mutual conductance is 1400 micromhos.

The RCA-247 is a power output for a-c. receivers. It operates on 2.5 volts, filament. and has a power output of 2.5 watts.

De Forest 447

This is a 2.5 volt pentode having an amplification factor of 80. The filament current is 1.5 amperes, plate and screen voltage 250 and plate current 32 milliamperes. Its main purpose is for use in simplified broadcast receivers.

Arcturus PX Pentode

The Arcturus Company's PX pentode has generally the same characteristics as the De Forest 447. However, its plate current is 32.5 ma. and its amplification factor 95. Its output is 2.5 watts.

Reduced List Prices for Tubes

In line with the general reorganization of the plans for tube merchandising for 1931, the reductions in list announced on April 15, by the RCA Radiotron Company, Inc., and the Sylvania Products Company, are typical. These are:

	Old Price	*New Price*	*Reduction*
UX —210	$ 9.00	$7.00	$2.00
UY —224	3.30	2.00	1.30
UY —227	2.20	1.25	.95
RCA—230	2.20	1.60	.60
RCA—231	2.20	1.60	.60
RCA—232	3.30	2.30	1.00
RCA—235	3.50	2.20	1.30
UX —245	2.00	1.40	.60
RCA—247	3.00	1.90	1.10
UX —250	11.00	6.00	5.00
UX —280	1.90	1.40	.50
UX —281	7.25	5.00	2.25

The reduction will undoubtedly greatly improve the dealer's chances of making a complete tube renewal sale instead of merely supplying one or two tubes to replace burn-outs. And since a complete renewal is a practice strongly recommended by radio engineers, general reception in the home is bound to improve.

Uniformity of Characteristics of the New Variable-mu Tubes

Experience with the new variable-mu, or super-control tubes already has pointed to the advisability of changes in certain characteristics as originally set up.

The RCA Radiotron Company in a late announcement gives the following characteristics for that company's RCA 235 tube:

Heater volts	2.5
Plate volts	250
Grid volts	.3
Screen grid volts	90
Plate resistance, ohms	350,000
Mutual conductance (micromhos)	1050
Mutual conductance at —40 volts bias	15
Mutual conductance at —50 volts bias	1 or over
Plate current, milliamperes	6.5
Screen grid current, milliamperes	2.5
Amplification	370

The interelectrode capacitances remain the same as already given.

Centralized radio and public-address system in a large hotel

RADIO engineers who installed the radio equipment in Cincinnati's new $7,000,000—29-story hotel, the Netherland Plaza, introduced a number of innovations. It is claimed that the equipment in the new hotel, through which guests have the choice of four programs in any and all of the 800 rooms, is the first of its kind in the world. Probably the most unusual feature is that the master receiving set in the radio control room in the pent house atop the skyscraper hotel may be used at will for broadcasting, as well as receiving.

At the Netherland Plaza four programs are going constantly from 12 noon until 12 midnight. The loudspeaker is built into the wall in each guest room, and in the ceiling in the private dining rooms and various public rooms. There is a dial and volume control in each room.

The voices of the air, which may be heard at will from any one of all of the 800 loudspeakers, are brought into the hotel by means of seventeen strands of antenna wire, each 100 feet long, and a slender panel board, about eight feet in height and not more than six inches in thickness.

The board is made up of five separate panels. The center panel is the power control board, and the others control four separate channels. The unusual feature about these panels is that each can be used at will for radio, microphone or phonograph. Any one of them can be used for pickups in the Hall of Mirrors, the restaurant of the Pavillon Caprice, the night club.

Three stages of 250 amplification are used. The number 3 panel, known as the feature panel, is a miniature broadcasting station, having a power of fifty watts. It is used as a public-address system, so that programs originating in the public departments of the hotel itself can be broadcast to each of the 800 outlets in the building.

The panels tune themselves on and off automatically by means of a time clock, which operates a set of relays to control the incoming power. Each panel is equipped with power tubes and pilot lights.

The latter serve as an index to the condition of the tubes. If a tube goes bad, the pilot light immediately discloses it.

The 800 individual loudspeakers are connected with the central control board through thirty separate circuits. If any speaker gets out of order, it can be speedily traced in the radio control room by checking up on the riser on which it is located. All "inputs" and "outputs" are brought to a "jack-strip" on the central panel; and on this jack-strip it is possible to test for trouble. Microphone and phonograph may be cut in any one riser through the jack-strip.

The selector switch for selecting the different programs is a double pull selector, which assures getting the radio program clearly and at the same time eliminating all danger of cross talking, or interference of one station with another.

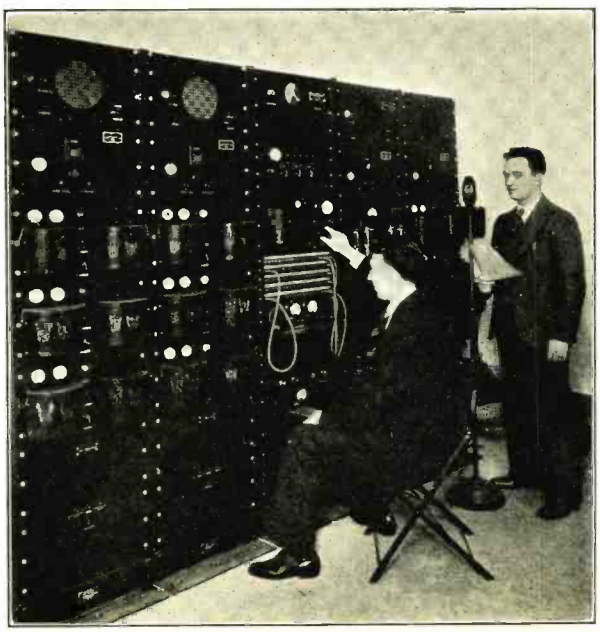
The operator in the control room is able to determine a maximum volume of power to distribute to all rooms. The guests may decrease this, but they cannot increase it. This obviates the danger of excessively loud reception which is apt to annoy guests in adjoining rooms. Four different programs may be going simultaneously in four adjoining rooms, without any one interfering with the others. The claim is made that all programs received through the central station are entirely free of static.

There is a level indicator in the control station which permits the operator to measure the volume going into any room.

The room speakers are aluminum-cast. The aluminum is used to cut down the ring of metal. The speaker unit itself is a short drive pin type, thus eliminating speaker vibration.

An important accessory in the radio control room is an automatic phonograph, electrically operated, encased in a sound-proof cabinet. It is used to fill in on any of the four panels if anything happens to cut off the station tuned in. The phonograph is equipped with 34 double-faced records, and it plays a program two and a half hours long before reaching the same records again. It requires no manual operation whatever after being plugged in on a panel and switched on for service.

Five panel control board.



A typical public-address installation of many to be installed in the near future.

Laminated Bakelite Products

Fig. 1. Sheets being placed in hydraulic presses for lamination under pressure and heat.

By R. R. TITUS*

LAMINATED Bakelite, one of the synthetic resinoid insulations which has developed so rapidly during the last ten years, has become an important factor in the electrical field. The demand for a structural insulating material embodying good electrical as well as physical qualities gave this product its first impetus. During the early years it was of interest almost exclusively to the radio trade. As the war developed airplanes, so the great demand for radio panels and parts started the development of laminated Bakelite.

Even in an industry as young as this, rapid advances have been made in methods of manufacture. Ten years ago there was no type of machine or equipment which was properly designed for application to the manufacture of this new product. Impregnating machinery was to a large extent built by the manufacturers themselves. Presses were in the main, adapted from types used in the manufacture of rubber, cement shingles, and other similar products. This makeshift combination produced results which, while satisfactory, showed a good many defects, principal among which was the extreme difficulty of producing uniformity in different runs of material. No one was really familiar with the intricacies of resinoids reactions, and there had to be considerable advancement made by the old process of trial and error before satisfactory equipment was developed.

Today it is possible to meet specifications accurately. Resins have improved substantially and certain methods of positive control have been developed which, in modern factories, insure uniformity.

* *President, Synthane Corporation.*

Insulation Materials for Radio Panels and Parts Are Carefully Made for the Desired Purposes

How Synthane Is Made

Synthane laminated Bakelite, as the name implies, is made from Bakelite resins in proper combination with the suitable structure of several layers of filler—either paper, as is most common, or canvas of varying weights, or asbestos. In all cases, these papers and fabrics must have specially absorbent characteristics on account of the necessity for thorough impregnation by the Bakelite varnish.

Impregnating the Filler

The paper or fabric filler is run off a parent roll through a Bakelite varnish solution, which employs alcohol or benzol, or both, as its main solvent. It then passes from the bath between accurately ground chilled iron rolls, and thence into a continuous dry oven. It is at this bath and subsequent squeeze roll operation that the varnish percentage of the finished sheet is determined. The most important factors are the characteristics of the filler itself, the specific gravity or viscosity of the varnish, and the setting of the squeeze rolls. It is most important that the squeeze rolls be set to a very close adjustment along their entire lengths, in order to insure absolute uniformity of pressure on the whole surface of the sheet. Any variance here will cause severe difficulties later on.

Impregnated Sheets Are Dried

The drying operation is most important, as it is at this point that quality is usually built into the product. Various resins and various gum percentages require correspondingly suitable temperatures and times. After the critical point has been reached, Bakelite resin reacts rapidly. If drying is overdone by either time or temperature, proper lamination of the finished sheet is impossible, as the resin on the sheet changes to an infusible state which no amount of temperature or pressure will change. On the other hand, if the drying operation is not properly completed and the solvent not driven off, two serious troubles result. First, these "green" or underdryed sheets will simply squeeze out of the press and crush. Next, if they are just dry enough so that they will crush, a sheet will be produced in which noticeable percentages of solvent still remain. The presence of this solvent in the final sheet cannot be checked by any inspection other than electrical, and sheets of this nature will vary between being a good conductor and a poor insulator.

Pressing the Sheets

After the coating and drying operations, the paper is sheeted and weighed before being put between copper or other suitable plates, for the pressing operation. The illustration, Fig. 1, indicates the type of press used in the more modern plants. The press head and main traveling platen are very heavy to avoid deflection. The plates are of rolled steel, drilled for the rapid circulation of heating and cooling media.

The drilling of these platens is of great importance, as the entire surface of the plate must heat and cool evenly if a uniform sheet of material is to be expected. After the proper heating period, cold water at high pressure is turned into the platens, until their temperature is down to approximately 160° F.

In each opening of the presses shown,

from one to ten sheets of material can be produced, the number varying, naturally, with the thickness of the sheet. The length of time in which the sheets remain under pressure varies with the thickness of the sheet and the number in each opening—from 15 minutes up to several hours.

The properly processed sheet comes from the press with finish permanently on it. In other words, the finish on the coppers against which the sheets are pressed is reproduced on the sheet—shiny, egg shell, sanded, and so forth. The color is also determined before the sheets are put in the press.

Various Types to Suit Various Needs

Like other raw materials, there is no more a standard laminated Bakelite than there is a standard piece of steel. Where in steel the carbon content, kind and quantity of alloy, degree of hardness, and so forth vary, so in laminated Bakelite the resin content, hardness, machinability, electrical, and other

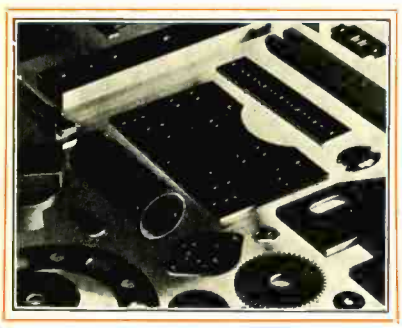


Fig. 4. Fabricated parts.

physical qualities vary to suit the customer's requirements. But after the requirements have been set by a manufacturer, every piece of laminated Bakelite should be uniform in meeting those requirements.

Fortunate for both manufacturers and users is the fact that the manufacturers, with representation in N. E. M. A., have agreed to use a common nomenclature in the description of their sheets. This will undoubtedly result in a minimum of confusion as to the various grades, and will enable purchasers to obtain competitive prices on qualities which carry the same specifications. The following nomenclature is to be adopted throughout the industry:

Grade X. For general use. Paper base, furnished in natural, chocolate brown surface natural core, and black surface natural core. Thicknesses from .015 inch and up. Punches up to 1-32 inch cold, to greater thicknesses when heated. Machines readily.

Grade XX. For electrical applications requiring low moisture absorption. Paper base, in natural or black. Thicknesses from .015 inch up. Machines readily. Low moisture absorption.

Fig. 3. Samples of punched pieces of Synthane.

Grade XXX. For extremely low moisture absorption and high dielectric strength. Paper base, natural or black. Thicknesses from 1-32 inch up. Extremely low water absorption. High dielectric strength.

Grade XP. For punching operations; electrical application. Paper base, natural, chocolate brown natural core, black surface natural core, solid black, chocolate brown with shiny or satin finish. Punches and shears cold up to 3-32 inch. In thicker sizes depending on design of die and temperature of material.

Grade C. For exceptional structural strength. Canvas base, natural or black. Punches readily a highly resilient insulation. Structural qualities make it usable where high tensile strength and transverse strength is required, in connection with good insulating properties; widely used for its mechanical properties.

Grade L. For fine machining. Linen base, natural or black. Thicknesses from .015 inch up. Not usually required over 1-8 inch.

Different manufacturers produce minor variations of the above general classifications to suit their individual customer's requirements, and in some cases have prefixed or suffixed the above symbols with symbols of their own.

Generally speaking, the price varies with the resin content, though not in direct ratio.

Tubes of Laminated Bakelite

Synthane laminated Bakelite tubes are produced in two general grades, called wrapped and molded. In the manufacture of wrapped tubes, paper impregnated with Bakelite resins is wound on a heated mandrel and simultaneously subjected to rolling pressure and elevated temperature from the rolls between which it is wrapped. Immediately after the wrapping operation, the tube is placed in an oven which completes the polymerization of the resin and the lamination of the layers. The mandrel is then withdrawn and the tube is ground to size.

In the molded tube, impregnated paper is wound on a heated mandrel, which is taken from the wrapping machine and placed in semi-circular grooved molds, where it is pressed at high temperature. The mandrel is then withdrawn and the molded tube is ground to size.

The essential differences between the two are principally in their physical characteristics. Molded is naturally

(*Concluded on page* 36)

Fig. 2. Trimming laminated sheets.

Remote control systems for radio transmitters

By CHARLES FELSTEAD

Operation of Transmitting Equipment from Operating Room Requires Connection Facilities

IN this article, we will discuss four different types of remote control systems to accommodate different transmitter power arrangements. The first and most simple remote control system is designed for use with a transmitter employing straight a-c. for the filament and plate supply of the tube, or for a transmitting set using a-c. rectified by a chemical rectifier. It is not lawful to use a transmitter with unrectified a-c. on the plate; and the diagram in Fig. 1 is given merely to illustrate the remote control arrangement in its most simple form.

The general idea of this remote control arrangement can be seen in Fig. 1. The leads connecting primaries of the filament and plate transformers to the 110 volt a-c. line are extended from the transmitter house to the control room. The lines in the drawing representing the wires that run from the transmitter to the control room are shown dotted. If large enough wire is used for these leads, there will not be a very great voltage drop in them, and the voltage at the transmitter will be practically the same as if the transmitter were connected directly to the power line. At the control end of the line are mounted the transmitting key, control switch, signal light, fuses, filament rheostat, and a 0-150 volt a-c. meter. They can all be attached to a half-inch-thick piece of hardwood of the proper dimensions, and arranged in the manner shown in Fig. 2. The heavy wires coming from the power line and the transmitter can be soldered to a binding post strip fastened to the back of the table on which the receiving set is installed, and large flexible leads run from this binding post strip to the control board. The fuse block can also be mounted at the back of the table. Heavy, stranded lamp-cord is excellent for this purpose. This permits the control board to be moved to the most convenient position on the operating table.

The Meters

As will be seen in the illustrations, two voltmeters are used. One voltmeter, which has an 0 to 15 volt scale, is connected directly across the filament terminals of the transmitting tube, as in all ordinary installations. The other voltmeter, the one with the 0- to 150-volt scale, is connected across the 110-volt leads that go to the primary of the filament transformer, but is placed in the operating room. After the installation has been completed, the higher range voltmeter is calibrated in terms of the other meter. That is, the filament rheostat, which is also in the control room, is varied, and with the transmitting tube in the socket, the corresponding readings of the two meters are noted and recorded.

Then the readings are marked down on paper in two parallel columns, or better yet, a graph of the readings is made. Thus, if the meter on the control board reads ninety-five volts, the operator knows that the voltage applied to the tube filament terminals, as indicated by the filament voltmeter at the transmitter, is, let us say, nine volts. If a fifty-watt tube is used in the transmitter, the operator can then increase the filament terminal voltage of the tube to ten volts by varying the rheostat knob until the voltmeter on the control board indicates the value that corresponds with ten volts on the lower-range meter. If the operating is always done from the control room, the filament voltmeter can be removed after the calibration of the control board meter has once been made. In fact, to save money, a low-range filament voltmeter may be borrowed and used just long enough to permit the calibration of the control meter. If the operator wants to go to more trouble, he can remove the scale from the higher-range voltmeter on the control board and replace it with a new scale marked to correspond in value with the readings of the filament voltmeter on the transmitter panel. The proper setting for the voltage can be indicated by a red line on the meter scale. Two shorter red lines on each side of this heavy line can be used to show the allowable limits of the voltage for best operation and longest tube life.

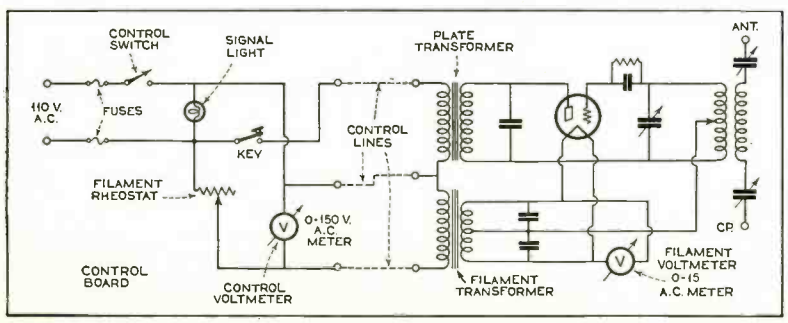


Fig. 1. General layout of remote control.

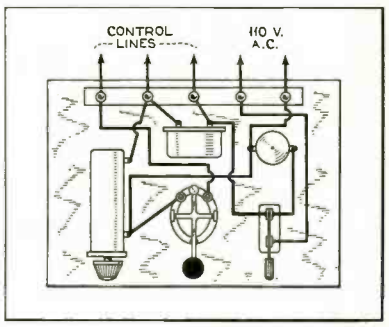


Fig. 2. Transmitting key, and switch.

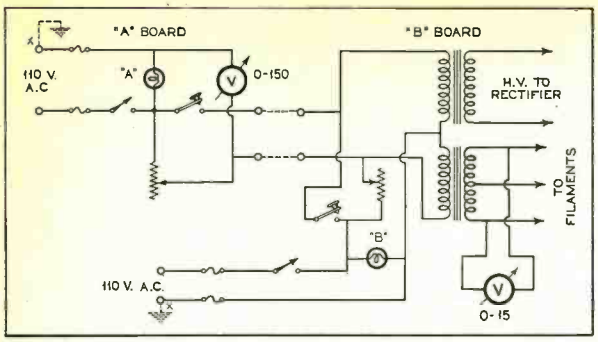


Fig. 3. Primary circuit connections.

Control Employing a Rectifier

A slightly more complicated remote-control scheme for a transmitter using a chemical rectifier is shown in Fig. 3. The main advantage of this circuit is that it eliminates one of the control wires, thus reducing somewhat the resistance of the control circuit. This circuit can be used if connection is made in the transmitter room from the point where the primaries of the two transformers are joined to the side of the power line marked X, as shown in Fig. 3. The control board must also be properly connected to the corresponding side of the power line in the control room. In this way, the return is made through the power line itself, instead of through a third control wire. It is easy to pick the same wire at each end of the line for making connection, because in most power systems one side of the line is grounded. It is best to use this grounded wire for the return circuit. It can be found by connecting an ordinary 110-volt lamp to two wire leads, one of which is connected to ground, and the other one touched first to one side of the power line and then to the other. When the lamp wire is connected to the "hot" side of the power line, the lamp lights, and when it is connected to the other side of the power line, which is the ground side, the lamp remains dark.

The ground on the power line is represented by the dotted lines in Fig. 3.

A separate control board, B, is also shown installed in the transmitter house. This control board is to enable the operator to control the transmitter when tuning it or when making changes in the circuit. The signal light B will light to full brilliancy when the switch on board B is closed; and to partial brilliancy when the switch on board A is closed. This will give the operator warning when he is working on the transmitter if some other person closes the remote control switch on board A, and may save him from getting a bad burn. The board B is a duplicate of the remote control board A, with the single difference that the control voltmeter is absent.

As will be seen by referring again to Fig. 2, an ordinary single-pole, single-throw (S. P. S. T.) knife switch is used for the control switch. The signal light is mounted in a porcelain lamp socket, and can be an ordinary 110-volt lamp of about ten watt size. It should be painted a dark red so that its light will not be bright enough to annoy the operator. Its purpose is to keep the operator from forgetting to turn off the transmitter.

The 0-150 volt a-c. voltmeter, either panel or front-of-board mounting, is fastened upright at the back of the baseboard by a suitable bracket. The rheostat should have a resistance of at least fifty ohms, and must be capable of carrying one ampere. An ordinary wire-wound transmitting rheostat may be used, or one may be made out of the heater element taken from an electric iron.

The Rheostat

An excellent type of primary rheostat of the carbon compression type for large transmitters is known as the Radiostat. If the transmitter is of less than ten watt size, a less expensive rheostat such as the Type E-210, may be used. Any regular telegraph or radio key that will carry the current may be employed. Smoother and less fatiguing sending can be accomplished if a relay controlled by a light-weight key is used.

The control wires should be standard weather-proof wire of about No. 14 gauge, although Nos. 10 or 12 gauge would be more suitable. The resistance of No. 12 wire is only 1.58 ohms per thousand feet. The wires can be suspended eight or more feet from the ground, on poles with convenient cross pieces, or run through a length of pipe buried in the ground. Placing the wires in a pipe in this manner is the most satisfactory method, for then there is no likelihood of an induction hum from them interfering with reception. It is always best to place all of the power wiring near a radio receiving set in grounded conduit.

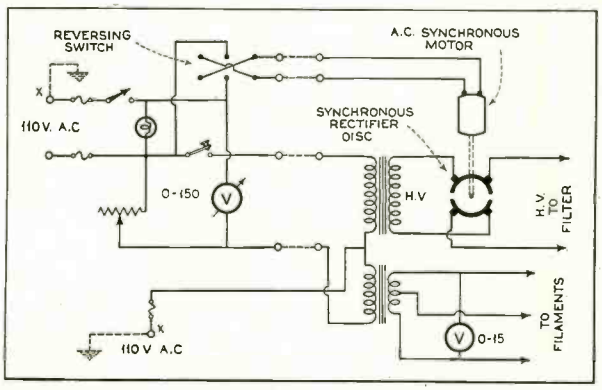


Fig. 5. Control wiring when rectifier used.

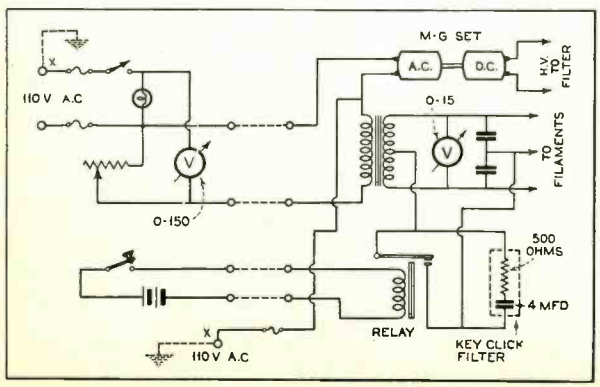


Fig. 4. Control circuit employing key filter.

Location of Sending Key

The remote control system just described cannot be used if the transmitter plate supply is from a motor generator, synchronous rectifier, or tube rectifier, unless some changes are made. If a motor generator or tube rectifier is used, it will be necessary to do the keying in the center lead of the filament transformer, as shown in Fig. 4, because the key cannot be connected in the main power leads when a motor generator set is used. A relay will have to be installed in the transmitter circuit and connected to a battery and key in the control room by two extra wires. A regular sending relay can be used, or one may be made out of an old telegraph sounder by soldering contacts to the sounder arm and to an insulated post fastened to the base. The relay control wires need not be very large nor well insulated. A light telegraph key may be used with this arrangement and will permit faster operating than with a heavy-duty radio transmitting key. The remainder of the circuit is much the same as that of Fig. 3. This relay arrangement will also have to be used when a tube rectifier is employed.

A key click filter is shown in the circuit diagram of Fig. 4. and is labeled "CC filter." It consists of a 500-ohm resistor and a four-microfarad condenser connected in series across the contacts of the keying relay. In general, the remote control arrangement shown in Fig. 4, is superior to those shown in Figs. 1, 3, and 5, because it permits a keying filter to be used. A bad key click is likely to be heard in nearby broadcast receivers unless a key click filter of some type is employed. In isolated districts, a keying filter may hardly be necessary, but in congested cities where there are many broadcast receivers, such a filter must be used in order to comply with the law.

Synchronous Rectifier

The circuit diagram given in Fig. 5 shows the control connections that will have to be used if the transmitter plate current is supplied by a high-voltage transformer and rectified by a synchronous rectifier. This control circuit also is practically the same as that of Fig. 3. However, two extra power leads will have to be provided for the synchronous motor that rotates the rectifier disc. These leads will have to be connected to a double-pole, double-throw (D. P. D. T.) knife switch which can be mounted on the control board. This is the switch which is for reversing the power leads to the motor. If the synchronous motor starts on the wrong half of the cycle, the polarity of the voltage applied to the plate of the tube will be reversed, and when the transmitting key is pressed no sound will be heard in the receiving set. Then, if the reversing switch is thrown to the other position, the polarity of the high voltage will be reversed, and the transmitter will oscillate, as will be heard in the receiving set, which with this arrangement acts at all times as a monitor on the transmitter.

NEW RADIOTELEGRAPH CIRCUIT TO BE OPENED BETWEEN NEW YORK AND VIENNA

The Mackay Radio and Telegraph Company has signed a contract for direct radiotelegraph service with "Radio Austria," the Austrian company which controls radio in that country. Service will be started about May 1 between New York and the Austrian station at Vienna.

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RADIO EMPLOYMENT AT PEAK IN 1929

A RECENT study of the radio industry made by the women's bureau of the Department of Labor reveals that in 1929, "during the peak of the season," more than 42,000 men and women were employed in thirty-eight radio factories, but "before the close of the year they were off the payrolls."

"These figures," said the bureau's report, "challenge the optimistic assertion so often made—that we may look to the radio industry, as to the automobile industry, to help absorb the growing numbers of unemployed throughout the nation."

It was estimated that figures obtained during the survey covered plants producing 80 to 90 per cent of all radio sets and at least 90 per cent of all tubes made in 1929.

In the readjustment of industry which has been going on during the past eighteen months it has become apparent that the radio industry should not be expected to absorb unemployed from other lines.

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LAMINATED BAKELITE PRODUCTS

(*Concluded from page* 33)

more dense and less water absorbent. The wrapped tube, however, is the more resilient of the two. Also the wrapped tube, properly made, is a more reliable dielectric for high voltage on account of the difficulty of avoiding a seam where the molded tube closes.

The manufacture of rods starts the same as the manufacture of molded tube. The impregnated paper is wound on a small mandrel, which is withdrawn from between the rolled paper after the winding is completed. The tube is then subjected to pressure in the same kind of mold as previously mentioned. This pressure, plus the proper amount of paper, closes the hole from which the mandrel was taken, so that a solid piece results.

One point to remember in connection with molded tubes is that by the very nature of their manufacture, it is impossible for any producer to guarantee concentricity of the outside and inside diameters. It is easily seen that as pressure is applied to the wrapped paper on a mandrel, it is practically impossible to keep the mandrel from shifting slightly, due to varied pressure between the two sides. Where concentricity in bushings is desired, the inside of the tube must be bored out.

The application of laminated Bakelite to many diversified purposes is rapidly widening. Every day new uses are being found for this material. More and more, manufacturers of electrical devices are turning to laminated Bakelite as the most satisfactory structural insulating material for their products.

I. R. E. CONVENTION

The Sixth Annual Convention of the Institute of Radio Engineers is scheduled for June 4, 5 and 6 at the Hotel Sherman in Chicago. A number of important technical papers are to be presented during the program. In addition to several inspection trips, an exhibition of component parts for broadcast receivers, measuring and laboratory equipment and other material of interest to engineers will be held.

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BOOK REVIEW

AIRCRAFT RADIO. By Myron F. Eddy. 281 pp. Cloth. Ronald Press, New York, 1931.

This timely book on aircraft radio installation and operation will meet the needs of radio engineers and radio operators who plan to engage in this service. The book contains much data of use to men in all branches of radio.

The makeup of an experimental television unit

By C. H. W. NASON

An Easily Understood Account of the Engineering of Television As So Far Developed

WITHOUT any doubt the man in the motion picture industry has more interest in the progress of television than the man in any other profession. Much has been written in scare head-line fashion calculated to stir the imagination of the motion picture technician by painting a false picture of the state of the art—and still more has been written to stifle the formation of a true idea of the tremendous advance which has taken place during the past two years both here and abroad. The writer has been in close contact with developments since the advent of the first rumors and if he fails to paint a picture at least accurate as to detail it is not through insincerity of purpose.

Television today is in the same position as was radio telephony in 1914. We know our problem—and better than that the solution is understood in a mathematical sense. To be sure success in the construction of apparatus capable of analyzing a scene with the close attention to detail which will eventually be necessary but has not as yet been attained, a sound foundation upon which to build has been set up.

A Statement of the Problem

In order to recreate a scene as an electrical impulse or series of such impulses for transmission over a wire line or radio channel we must first accomplish an analysis of that scene. The scanning disc of Paul Nipkow was patented in Germany in 1884—some few years prior to Hertz's classical experiments which led to the radio telegraph and telephone. With modern photo-electric tubes and amplifiers Nipkow might well have made television an accomplished fact at that early date for the majority of television systems in use today employ the simple scanning disc for analysis of the scene—either in its original form or in a mechanical or optical equivalent. The scanning disc employed by Nipkow consists of a rotating diaphragm having a number of spirally arranged apertures equal to the number of scanning lines into which the image is to be analyzed. This number is limited by the amount of light which can be passed through each aperture and by the frequency band which can be transmitted over the communication channel used. The simple system to be described will give excellent images over a channel designed to pass all frequencies from 15 to 30,000 cycles. The field is illuminated by high intensity lamps and projected upon the scanning disc by means of a photographic lens having a high degree of light efficiency.

If we place in the field of the lens a card upon which has been drawn 60 lines alternating black and white, the image of this card will appear upon the disc. The condenser lens behind the disc serves to concentrate all light passing through the scanning apertures upon one point on the sensitive wall of the phototube. As each aperture traces a line across the image, the value of the current flowing in the phototube circuit will vary as the portion of the image scanned corresponds to a black or a white line on the card. Each set of one black and one white line will correspond to one a-c. cycle or one complete variation of photoelectric current from maximum to minimum value. If the disc rotates at 900 r.p.m. the entire scanning operation will be completed fifteen times per second — rapidly enough for the "flicker" to be hardly noticeable. In choosing 60 elements for the test card we are assuming that the picture is to be 48 x 60 elements in definition. This corresponds to an aspect ratio of 1 to 1.25. A light shield between the lens and the disc will serve to limit the image to the required size and shape. The frequency of the transmitted electric wave due to the card is 30 (the number of cyclic variations per scanned line) multiplied by the number of scanned lines per image, multiplied by the number of complete images per second. That is:

$$30 \times 48 \times 15 = 21{,}600 \text{ cycles.}$$

This does not represent the high-frequency limit with this degree of definition as even narrower strips than those represented by the test card will be transmitted, although the intensity of each signal impulse will be lessened by the fact that the scanning aperture is physically wider than the change in light value evidenced in the image projected on the disc. The upper frequency limit will be considerably higher although the efficiency of the circuit will be lessened unless electrical networks are inserted to increase the response of the amplifiers at the higher frequencies. The degree of detail obtained with apparatus of the character described will offer a creditable image of the head and shoulders of a single person—the excel-

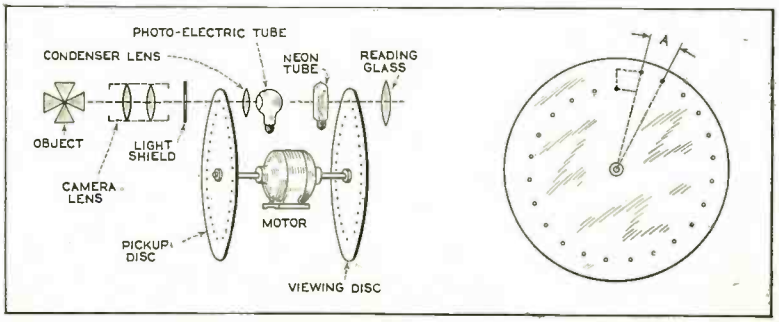


Fig. 1.

Fig. 2.

Simplified setup consisting of television receiver arranged compactly for study.

lence being greater if the proper equalizing networks are provided.

At the receiving end of the circuit the opposite occurs in the sense that a synthesis of the scene must take place corresponding in exact detail with the analysis performed at the transmitter. In so simple a presentation as this it is useless to enter into a discussion regarding the various means to be employed in synchronizing the discs at the two control points. Two synchronous motors operating at 900 r.p.m. may be used, or, in experimental work the two discs can be mounted on the same shaft as shown in Fig. 1. In the latter case it is not even essential that constancy of the motor speeds be atttained as any speed variations are common to both discs.

The lens specified is one of the best available for the purpose—having as great a *speed* or light efficiency as any on the market. Because of the low value of light available for the cell it is essential that every economy be taken advantage of. Red sensitive cells are obtainable having a high degree of sensitivity in the light range of ordinary incandescent bulbs. Incandescent lamps are best for lighting the scene because of the fact that their high thermal lag renders innocuous any variations in the supply voltage which would be apparent at the receiving point were arcs used.

At the receiving end the synthesis is accomplished by means of the second disc and a neon lamp which modulates its light output in accord with the amplitude variations of the signal. The six stages of amplification are sufficient to operate the standard type of neon tube having an electrode 1.5 inches square. It should be remembered that the current through the phototube, even with the best lens obtainable, is exceedingly small. Consequently the amplifier at the transmitting point must be well shielded against both mechanical and electrical disturbances.

In laying out the scanning discs the first choice after that of the number of scanning lines is the picture size. If we wish to use the full advantage of the image projected by the lens and of the neon tube plate the dimension A in Fig. 2 will be 1.5 inches. This means that a circumference drawn through the outermost aperture will have a length of 72 inches. This gives a radius at the outer aperture of 11.46 inches. Our image was to have an aspect ratio of 1/1.25. Therefore the B dimension will be 1.20 inches. Dividing this by 48 we obtain .025 inches as the dimension of each aperture. The light efficiency is much greater for a square aperture rather than a round. Since square apertures cannot as yet be cut with a twist drill it is necessary to make a punch having a cutting surface at the end .025 inch square. This may be made by grinding down a nail set or center punch. If the punch is hollowed out behind the cutting surface it will cut a clean aperture. Use thin aluminum for the discs and cut into a wood backing—preferably into the end grain. The radii through the opertures will subtend angles of 7.5 degrees or 7 degrees, 30 minutes. If the radii and the circumference through each aperture are carefully drawn the angle formed between the two may serve as a mark for the punch.

Readers are fairly well grounded in amplifier theory — otherwise the construction of a television transmitter would be a bit advanced and it is on this assumption of prior knowledge that we will avoid any technical discussion of the amplifier circuits involved. Because of the 180 degree phase reversal which the signal undergoes in traversing an amplifier stage it is essential that an even number of stages be interposed between phototube and neon lamp. If the signal at the neon lamp were reversed in phase a negative picture would result because of the fact that maximum positive potential in the plate circuit of a normally operated vacuum tube attends upon maximum negative potential in the grid circuit

The amplifiers shown have a frequency characteristic essentially flat to well beyond thirty thousand cycles. This is sufficient to cope with the highest frequency to be found in a 48 line picture. Where experimental scanning arrangements employ sixty, seventy-two or ninety-six lines it will be necessary to employ equalizing circuits to continue the frequency response out to still higher without loss.

The low frequency limit of a television amplifier is determined by the frequency of image repetition—in our present case 15 cycles. This naturally varies with the motor speed but not in a large enough degree to affect the design of the amplifiers. Failure of the amplifiers to meet the high-frequency requirements will result in lack of detail—failure to reach the low-frequency limit produces spurious shadows in the background.

It is impossible to employ d-c. amplifiers throughout a television circuit and for this reason the background and general tone of a scene will not be reproduced as in the original. Perfect reproduction as to tone value would of course be available with amplifiers which automatically regulated the base potential about which the a-c. variations took place. In general the operator at the receiving point has no idea of the tone character of the scene transmitted and must adjust the character of the background to the most pleasing effect. For this purpose the plate current of the output tube is made variable. Variation of both the plate voltage and grid bias is provided for as shown in the final stage in Fig. 4. In order that the

(*Concluded on page 52*)

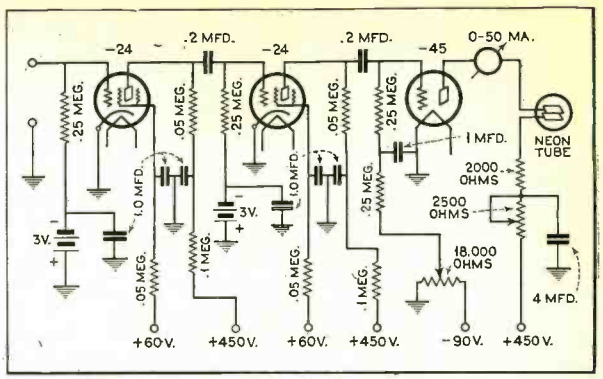


Fig. 4. Neon tube amplifier.

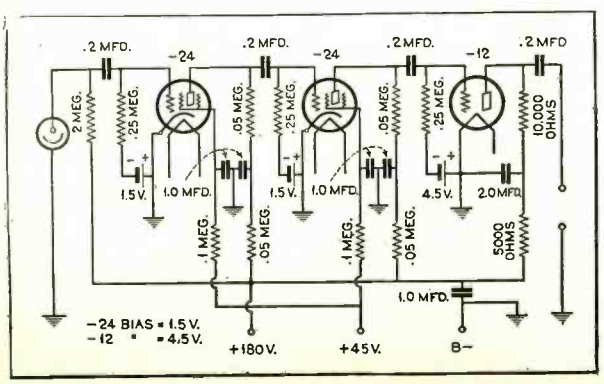


Fig. 3. Photocell amplifier.

Ten centimeter radio transmission

ON the cliffs at St. Margaret's Bay, Dover, England, on Tuesday, March 31, the International Telephone and Telegraph Laboratories, Hendon, England, in cooperation with the laboratories of Le Materiel Telephonique, Paris, France, gave an international demonstration of a new ultra short-wave radio telephone and telegraph equipment and circuit between Dover, England, and Calais, France. This equipment was largely developed by French engineers in the Paris laboratories. The demonstration at Dover was conducted by engineers of the International Telephone and Telegraph Laboratories and at Calais by engineers of Le Materiel Telephonique.

In this demonstration, oscillations of wavelengths as low as 10 centimeters designated as "micro rays" were used for the first time to provide a high quality two-ray radio telephone circuit. From distances covered and results obtained, it was quite clear that the equipment employed can readily beadapted to commercial use. Though a certain number of experimenters have already succeeded in generating and utilizing oscillations of such wavelengths nothing beyond what may be described as laboratory investigations has up to now resulted. The enormous advance in technique shown by the present demonstration definitely indicates that the range of wavelengths as low as 10 centimeters are now available for commercial radio transmission.

In the demonstration a link had been established between a station on the cliffs of St. Margaret's Bay, near Dover, and a similar station across the Channel at Blanc Nez, near Calais. The two-way radio telephone circuit using a wavelength of 18 centimeters was noteworthy for the quality of speech received. Not only was it well up to the standard of a high quality telephone circuit, but it showed no signs of being affected by fading, a disability from which waves in this frequency are apparently immune.

Compared with radiations of the more usual wavelengths, "micro rays" present many striking features. For example, their extremely short wavelength permits the use of electro-optical devices more usually associated with light, such as reflectors or refractors in addition to diminutive antenna systems. A further similarity between these radiations and light is that fog, rain, and such like climatic effects, as well as day and night, do not materially interfere with the propagation of the waves.

Two-way Operation

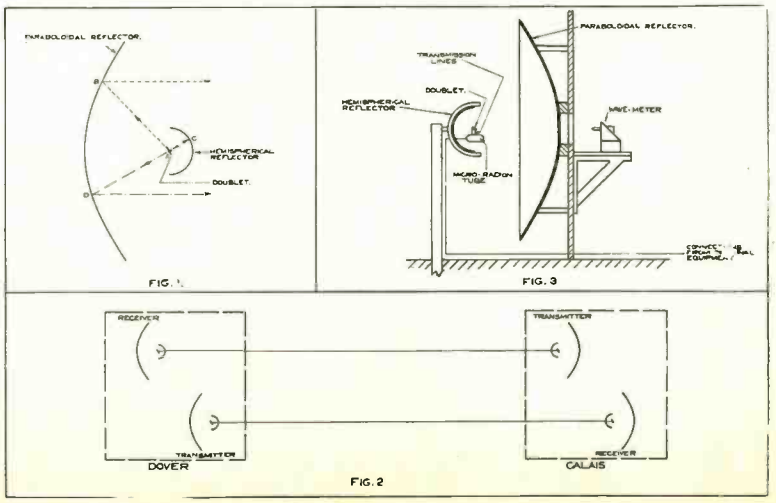
The two stations at Dover and Calais were in all essentials identical. Each comprised a transmitter and receiver with terminal equipment of normal design for connecting them together so as to give facilities for two-way communication.

French engineers demonstrate utility of micrometric wavelengths, and radiated power of one-half watt

Fig. 3 shows the essential features of the transmitter, and Fig. 5 is a reproduction of the photograph of the transmitter and receiver at Dover. The cutgoing signals are applied to a "micro-radion" tube in which the high frequency oscillations are generated. A short transmission line connects the "micro-radion" tube to the radiating system or doublet which is about two centimeters long, in contrast to the larger systems usually employed. The amplitude of this high-frequency current along the doublet at any instant is substantially the same. The doublet is situated at the focus of a paraboloidal reflector some three meters in diameter. After concentration of the rays by the paraboloidal reflector into a fine pencil of rays somewhat similar to light rays sent out by a searchlight, they are projected into space. In the reflector the relation between the focal length and the diameter is so proportioned as to insure maximum efficiency for the diameter used.

In order further to increase the efficiency of the system by the prevention of radiation other than in the required direction, a hemispherical reflector is located at the opposite side of the doublet to the paraboloidal reflector and having the doublet at its center. This serves to collect all the radiation propagated in a forward direction and to reflect it back again towards the source. The radius of the hemispherical reflector is so chosen that when the reflected radiations reach the focus again they are in phase with those being radiated at that instant. The appropriate length of the radius depends upon the wavelength, the relation being that it should be substantially a multiple of half wavelengths, namely, $N \frac{\lambda}{2}$. The factor "N" is so chosen that the radius shall be large enough to ensure that the reflector has satisfactory electro-optical properties, but not so large as to intercept unduly the radiations reflected forward from the paraboloidal reflector.

The function of this hemispherical reflector is illustrated in Fig. 1, the effect of diffraction being neglected in this description, although in practice it



Schematic of midget power, ultra short wave radio system.

must be taken into account. It will be seen that the direct radiations such as AB pass straight to the paraboloidal reflector and so are directed towards the distant receiver, whereas waves such as AC are reflected by the hemispherical reflector back through A onto the paraboloidal mirror at D, and so out in the required direction.

It is estimated that the gain due to the paraboloidal reflectors on one channel is of the order of 46 decibels to which the hemispherical reflectors add another 6 decibels.

Measuring Output

A further interesting point is the arrangement made for measuring the high frequency output at the transmitter. For this purpose an aperture is provided in the center of the paraboloidal reflector through which part of the radiation passes. By making the diameter of the aperture slightly smaller than that of the hemispherical reflector no loss of radiated power results. The radiations passing through the aperture

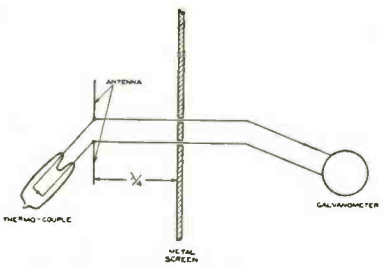


Fig. 4. 10 cm. radio measuring system.

fall upon the special measuring instrument employed, as indicated diagrammatically in Fig. 4. This takes the form of a wavemeter calibrated for and normally set to the transmitted frequency. It comprises a small receiving antenna in which the induced e.m.f. is used to act upon a thermo-couple junction. The readings of the associated galvanometer are an indication of the radiated power, while the distance between the antenna and metal screen, being adjustable, also enables wavelength measurements to be made. In the demonstration the wavelength used was 18 centimeters while the radiated power was about half a watt.

The receiver is a counterpart of the transmitter except that no high frequency measuring device is provided. That is to say, it comprises a doublet connected by a transmission line to the "micro-radion" tube where detection takes place. Paraboloidal and spherical mirrors exactly similar to those of the transmitter are also provided for concentrating the received waves upon this doublet.

To avoid coupling, the receiver is situated about 80 yards from the transmitter at each terminal and is arranged

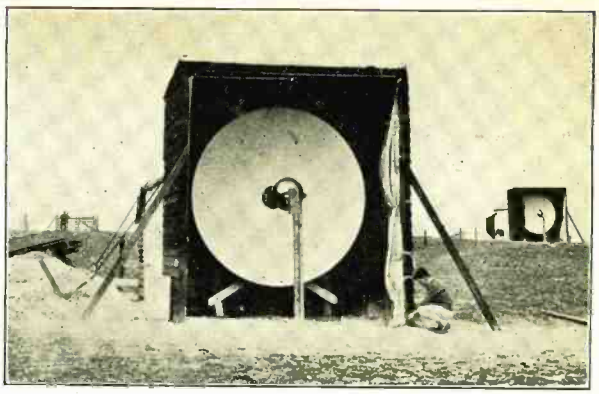


Fig. 5. The photo shows the transmitter and receiver at Dover. By means of apparatus associated with the 10 ft. reflector seen in front of the hut, rays oscillating sixteen hundred million times a second are projected into space.

to be in its electro-optical shadow, adequate allowance being made for diffraction. The arrangement will be apparent from Fig. 2. The same wavelength is used both for sending and receiving.

The success of this demonstration has definitely shown that a wavelength range as low as 10 centimeters is opened up. The importance of this from the point of view of ether congestion need hardly be stressed. Calculation will show that the range of frequencies available in the "micrometric" wave band (between 10 and 100 centimeters) is some nine times as great as in the whole of the ordinary radio field. Added to this is the fact that the radiations can easily and cheaply be concentrated into a small solid angle.

The frequency band available will permit the working of a very large number of permanent and continuous channels between the same places without mutual interference.

A further very important use will be for television transmission. The present difficulty with regard to television is the very large frequency range required for satisfactory definition of the object transmitted. It should now be possible to allocate as wide a band as is necessary for television without causing any other congestion.

For navigation purposes and especially for radio beacons the simplicity of the transmitters has obvious advantages.

Valuable applications seem possible in ship to ship communication, as the small size of the equipment would enable easy use to be made of its directional properties. In addition, the micro ray system affords a satisfactory method for virtually secret inter-communication between war vessels.

While this successful demonstration proves the practicability of the micro ray, further refinements are being carried on to prepare it for everyday commercial application.

It is interesting to recall that just forty years ago another pioneering departure, the first submarine telephone cable between England and France, was laid over practically the same ground.

METCALF SAYS "GO" TO RMA TRADE SHOW

Reasons why every radio dealer and jobber should attend the annual RMA convention and trade show at Chicago beginning June 8, are detailed in a statement just issued by President Morris Metcalf of the RMA.

"This year's trade show will be the most important from the dealer's standpoint that the RMA has ever held," said President Metcalf. "There will be more new radio products this year in the trade show than ever before. The trade show has become a fixture in many industries and dealers and distributors have come to realize that it saves them many times what they spend to attend it. The opportunity afforded to view new merchandise, styles and trends, to become posted on manufacturing and technical developments, to make personal contacts, get the gossip of the trade, and even buy and sell, is invaluable. It enables the entire selling organization to do in one week what would otherwise take many months.

"The rapid and extraordinary development of the radio industry makes a trade show a necessity, and in my opinion, no individual in the selling, engineering, or manufacturing division of the industry can afford to miss it. Practically everyone of any importance in these branches of the trade will be in Chicago the week of June 8, and it will take four of Chicago's largest hotels to hold them.

"The rapidly growing community of interest between the music and radio trades, and the simultaneous holding of the two conventions in Chicago, makes the importance of both shows doubly great this year, and I think it is not going too far to say that any radio jobber or dealer who is able to and fails to get to Chicago during the week of June 8, writes himself down as indifferent to his own best interests and his future relations with the radio business."

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SPRAGUE
Electrolytic CONDENSERS

Tubes and cells at work†

By CHESLEY J. SABIN

IN order to appreciate the present development of vacuum tubes, we should review their history. It was in 1883 that Edison was having trouble with his incandescent lamp. He experienced continual burnouts of the filament, and each, he noticed, occurred at the positive end. This led to his placing into an evacuated globe an anode and a cathode, to form the first vacuum tube. However, he did not make any use of this experience, and it was not until 1905, over twenty years later, that Fleming constructed a valve to use as a rectifier. His contribution acted as a stimulus, and several important advances followed.

In 1907, deForest presented the audion tube which found immediate use in the famous circuit created by Armstrong. The Armstrong circuit was used extensively by the Government during the World War, and consequently vacuum tubes found a large market. Thus the vacuum tube industry was given the much needed boost that has carried it up to its present heights. For immediately following the war, broadcast stations became very popular and served to furnish another outlet for vacuum tubes, replacing the market created by the war.

Glancing about, one is bound to see innumerable uses to which the tube is put. It has been set to work controlling manufacturing processes, turning on lights or large signs at dusk, ringing alarms in case of fire. It finds application in the field of medicine, communication, aviation and navigation, mining and metallurgy, scientific measurements, electric power transmission and motor control, and has many other uses. A list of only the general uses would fill several pages. The present paper will deal mainly with the photoelectric cell, which is a particular type of vacuum tube.

The characteristics of this tube are very simple. The principle of operation is analogous to the ordinary vacuum tube which depends on a heated filament to make it pass a current. The photoelectric cell can be accurately described as a light operated valve. Essentially speaking, its operation depends on a light beam shining on a sensitive inner surface. Just so long as the cell is subjected to this light, it will be a conductor of current. Further, the amount of current will be regulated by the amount of light entering the cell. By experiment, it has been found that the cell's response is instantaneous for all practical considerations. The current handled by the cell is very small, much too small to operate even a small relay. But two types of amplifiers are available to compensate for this deficiency. They are classed as vacuum tube amplifiers and grid-glow tubes. The characteristics of the latter are such that with the photoelectric cell it makes an almost ideal combination for many industrial applications. There are now available, cells which have a range of sensitivity from ultra-violet to infra-red. It only remains to choose the proper cell according to the particular use, or light used.

Various Types of Tubes Are Being Employed in Commercial and Industrial Operations

The Photocell

The operations of the photoelectric cell, classed under two heads, will include all industrial applications. First, most of the simpler uses depend on the "trigger action." Take for example, the counting of boxes as they move along on a conveyor belt. A cell might be placed near one edge of the belt and a light on the opposite edge to shine across the belt into the cell. Obviously, with suitable mechanical connections in conjunction with one of the amplifiers mentioned above, the sensitive cell could be made to record each interruption of the light caused by the boxes intercepting the beam. The mechanical part usually takes the form of a simple relay which is attached to control a reliable outside source of power. It is easy to see the many possibilities in such a combination.

The second class includes all those uses requiring an accurate evaluation of light intensities. Sound movies furnish a good illustration.

There are two systems used to produce the talking screen effect. One uses the synchronized phonograph record, which requires the attention of a skilled operator. The other makes use of the photoelectric cell. Sound is recorded on a portion of the film at one edge called the sound track. This track may be either variable density or variable area; both are adaptable to the same reproducer. Essentially, a talkie outfit consists of a beam of light projected through the film sound track into a photoelectric cell. The variations in the shaded track are accurately reproduced by the cell and impressed on a vacuum tube amplifier to be strengthened many times, finally issuing as sound from large horns placed in the rear of the screen. Many difficulties were encountered and overcome in the course of the development of talkies.

Due to the fact that the picture on the film is projected by jerks, it was believed to be impossible to obtain the necessary constant speed of sound track. However, this was accomplished by placing the sound reproducer ahead of the corresponding portion of the picture on the film. Freedom from vibrations is secured only by very elaborate precautions. To insure against fluctuations of light, a highly illuminated slit is used. The light comes from a special type of bulb whose filament operates at about 3,000° C. By using a condensing lens, very great intensity is secured at the slit. There are several variables, rate of film travel, highest frequency to be reproduced, and so forth, entering into the determination of the size of slit to use. By experiment, 0.001 inch has been found to be a fair compromise between fidelity and intensity.

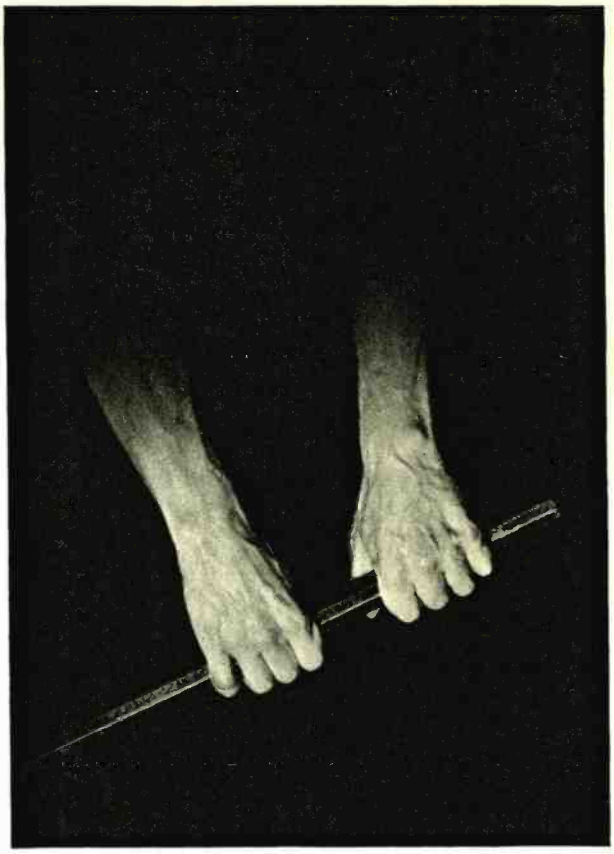
Amplification

The output of a photoelectric cell is small, around 0.01 microwatt. Since it takes as much as twenty watts to operate the speakers, it is evident that tremendous amplification is necessary, which must be linear over a frequency of 60 to 8,000 cycles. This problem has been satisfactorily handled with transformer coupling. Generally, the first stage is mounted close to the cell to eliminate capacity, while the rest of the amplifier may be located apart from the projection machine.

Yet, with all these difficulties to overcome, very good reproduction is secured as witnessed at almost any local theatre. And it is interesting to note that this enjoyable form of entertainment depends on the useful photoelectric cell as the core of its sound production.

Pick up most any technical magazine and you will find mention of the cell. Its uses are increasing. Industry has found an invaluable, efficient instrument, and is fast learning to relegate many routine tasks to the photoelectric cell.

† *Presented at AIEE Branch meeting, Univ. of Arizona.*



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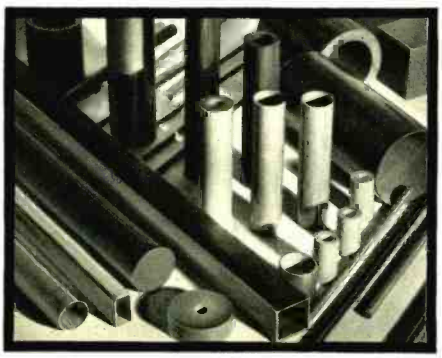
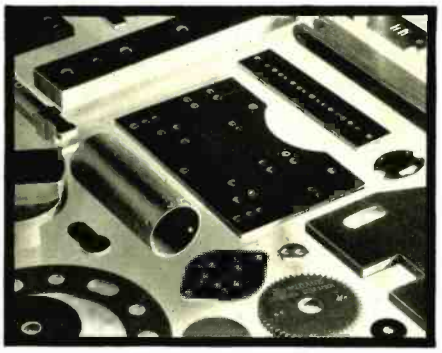


TUBES & RODS



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Signal Corps equips army transports with radio‡

By CARTER W. CLARKE*

FOR emotional appeal, there are few things which exceed thrilling rescues at sea. In many of these rescues, radio and the radio operator play the major role. From the "Titanic" disaster down to the present, the public is accustomed to depending upon radio in such emergencies, not alone for the broadcasting of the S O S signal, but also for keeping it informed of the progress being made by ships hastening to the rescue.

The United States army transport service, since the World War, has fortunately never been faced with a major emergency in which the ultimate safety of passengers and crew depended upon radio. There are few vessels afloat today, however, better equipped to meet such a contingency than these transports which carry our soldiers to our far flung foreign possessions.

The Signal Corps has just completed the installation of new intermediate frequency and high frequency transmitting and receiving equipment on the entire fleet of army transports. In this fleet are the "U. S. Grant," "St. Mihiel," "Chateau Thierry," "Somme," "Cambrai," "Meigs" and "Kenowis."

The radio equipment on each of these vessels is, with a few minor variations, identical. That installed on the "Cambrai" is typical. It consists of three transmitters, one operating on intermediate frequencies, and two transmitting on the high frequencies, each accompanied by modern receiving equipment.

The intermediate-frequency transmitter was designed especially for installation and operation on shipboard and embodies the latest features of mechanical and electrical design. It is a continuous wave and modulated continuous wave transmitter delivering between 500 and 750 watts to the antenna.

Radio Apparatus on U.S.A.T. "Kenowis"

Frequency Range

The frequency range of this transmitter is from 120 kc. to 500 kc. On the "Cambrai," however, the frequencies used are 159 kc. and 500 kc.

This transmitter is of the master oscillator, power amplifier type which assures constant transmitted frequency and prevents any variation which might be caused by changes in the antenna constants due to a high wind or the rolling of the ship. This also greatly increases the reliable transmitting range since the heterodyne note at the distant receiving station remains constant.

Of the high-frequency transmitters installed on the "Cambrai" one is also a master oscillator, power amplifier type designed for either cw. or kcw. telegraphy. It delivers 200 watts to the antenna and has a frequency range of from 2000 to 17300 kc. The frequencies used are 4255 kc., 8510 kc. and 12765 kc. The other high-frequency transmitter operates with a single 250 watt vacuum tube using a tuned plate, tuned grid, circuit. It has a frequency range of from 8000 kc. to 9000 kc. and uses a 500 cycle alternator for plate supply.

The high-frequency receiver is of very recent design. It has a frequency range of 1200 kc. to 25000 kc. and employs one stage of radio-frequency amplification, a regenerative detector and two stages of audio-frequency amplification. The intermediate-frequency receiver tunes from 40 kc. to 1000 kc. and employs a regenerative detector and a two stage audio-frequency amplifier.

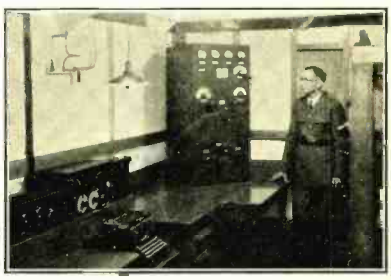
Three motor-generators, one for each set, supply power for the three transmitters. These normally operate directly from the 110 volt d-c. ship's mains but may be operated from an emergency storage battery. All radio equipment is installed in the radio cabin on the boat deck.

Antenna System

The antenna system consists principally of a "T" type flat top antenna 293 feet in length, stretched 96 feet above the water line. This antenna is used for the intermediate-frequency and certain of the high-frequency transmissions. There is also a voltage fed "Zeppelin" antenna used for the high-frequency transmissions from the 8510 kc. set. An inclined wire about 54 feet long comprises the antenna proper.

In addition to the transmitting and receiving equipment installed on these ships, the "St. Mihiel" and the "Chateau Thierry" are each equipped with a broadcast receiver, reproducing, and public-address system. The main units are mounted on a panel and consist of a tuner, specially built for this purpose and having no audio amplifier, a microphone amplifier, a phonograph turntable and pickup, a power supply or rectifying unit, and a power amplifier which accomplishes a gain of 15 decibels of undistorted power to the loudspeakers.

A system of switches places in operation any one of these units which may be desired and permits the output to be fed into the power amplifier. In



Radio room showing left to right the short wave receiver, the intermediate and long wave receiver and its amplifier, the short wave transmitter, and on the extreme right the Samson panel containing the broadcast receiver and power amplifier. The chief operator is Staff Sergeant Charles H. Grant, 4th Signal Co.

‡ *Published by permission of Chief Signal Officer, U. S. Army.*

* *First Lieut., Signal Corps, U. S. Army.*

▲

Transport ships are now equipped with modern centralized radio and public-address systems.

Loudspeaker in lounging room on the U.S.A.T. St. Mihiel. Large speaker in first class social hall. During pleasant weather this speaker is moved outside to the promenade deck and can be used for dancing

addition there is installed a bank of ten switches which permits the operator to turn on or off at will any loudspeaker throughout the ship. These switches are so constructed that, when any speaker is turned off, a compensating impedance is shunted across the line so that the load is constant at all times. This eliminates volume changes, provides smooth reception, and makes it unnecessary to readjust when speakers are turned off.

Dynamic speakers are used throughout the ship, the larger ones for the open deck and smaller ones for the dining salons and recreation rooms. The boxes and baffles for these speakers were built by the Signal Corps in the New York army base and consist simply of a box, 30 inches square and 16 inches deep, with a one inch celotex lining. Each speaker has a constant impedance volume control, which permits regulation of the volume at the speaker without disturbing the characteristics of the line.

On the "St. Mihiel" the speakers employ a-c. field excitation while on the "Chateau Thierry" 110 volt d-c. speakers are in use. Each ship also has a microphone cable with two outlets, one forward and one aft. These permit the ship's officers to broadcast announcements throughout the ship and to explain any items of interest to the passengers.

Prior to the installation of these new radio sets on the transport fleet, the radio equipment consisted of a 2 kw. Federal arc set and a 2 kw. Marconi spark set. The new installation presented several interesting problems. Due to the limited number of vessels in the fleet and the necessity for maintaining the announced sailing schedule it was impracticable to withdraw any ship from service. The installation on each of these transports, therefore, had to be made during the interval between the arrival of the vessel in port and its next sailing date. In some cases only a day or so was allowed for this work. In each case it was necessary to remove every piece of the old equipment except the main power cables. The new equipment was then installed, tested and inspected and accepted and not once did a ship delay from its scheduled sailing.

At the present time the vessels in the New York-San Francisco run are able to keep in constant communication with the War Department station WAR in Washington throughout the entire voyage and vessels in the San Francisco-Hawaii-Guam-Manila run are able to communicate with San Francisco from the time they pass through Golden Gate until they enter Manila Bay.

A "Noise" Measuring Meter

A FACT-FINDING instrument for radio fault-finders which takes the guess out of trouble hunting and accurately measures the quantity of electrical interference in microvolts per meter, has been developed by the general engineering laboratory of the General Electric Co.

The new instrument is called a radio noise meter and is not to be confused with meters made to measure noises audible to the human ear. This meter records the quantity of noise, generally described as electrical interference, made audible only by radio receivers.

The meter locates the source of the noise and measures its intensity. The need for a measuring instrument has been felt for some time, and such organizations as the National Electric Light Association, Radio Manufacturers Association and the National Electrical Manufacturers Association have been hampered in their efforts to improve radio receiving conditions by the lack of a standard testing instrument and a standard of measurement. The noise meter makes possible a comparison of the test results of different investigators; it gives manufacturers of electrical apparatus a means for measuring the amount of radio noise created by the apparatus, and the meter also gives an invaluable method of obtaining data upon which fair and reasonable rules and ordinances may be based.

Many municipalities, anxious to protect radio listeners from excessive electrical interference, have passed ordinances limiting "permissible" interference. The trouble, heretofore, has been to define "permissible."

The radio noise meter consists of two parts, a receiver unit to detect and indicate radio noise, and a calibrating unit to measure the intensity of the noise in microvolts per meter, which is the customary unit of measurement of radio signals.

The receiver is enclosed in an aluminum box and weighs thirty pounds. Six tubes are used. The pick-up is obtained with a rod antenna, two meters long. Using the meter a radio noise corresponding to a field intensity of three microvolts per meter may be measured. With the head phones it is possible to measure still lower noise levels. A search coil may be used to investigate noises around motor brushes, transformer ground leads, etc.

The calibrating unit is also enclosed in an aluminum box which is fastened to the side of the receiver. The calibrating unit is so designed that the radio noise may be measured with any antenna that may be used with the receiver. The output of the calibrating unit may be varied from zero to 10,000 microvolts per meter.

"Standard" Noise

A feature of the instrument is the

(*Continued on page 52*)

OVER 4,000,000 IN USE

IF you would build radios forever free from condenser troubles, specify puncture-proof Mershons. For only Mershons embody twenty years' experience in electrolytic condenser development. Only Mershons have stood the test of ten years' service in radio—a far, far longer period than any other electrolytic condenser has been on the market. That is why the great majority of better radios built today are equipped with Mershon Electrolytic Condensers. *Mershons are a proven product, incorporating many exclusive features.* They are available in a wide range of capacities to suit the requirements of every make of radio.

Magnavox Company Ltd.

Executive and Sales Offices: 155 East Ohio St., Chicago, Ill.
Factories: Fort Wayne, Ind.

SUBSIDIARIES
The Magnavox Company
Electro Formation, Inc.

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MERSHON

ELECTROLYTIC CONDENSERS

SEE THE NEW MERSHONS, AND THE NEW MAGNAVOX SYMPHONIC SPEAKER, AT THE R. M. A. TRADE SHOW AND THE I. R. E. CONVENTION

What about sales cost?

By AUSTIN C. LESCARBOURA
Mem. I.R.E. Mem. A.I.E.E.

The Sales Department Is Next in the Trimming of Costs to Fit the Economical Order of Things

BUSINESS is rotten, you say. But is business really rotten? Not less than eight months ago, a friend of the writer heard Henry Ford expound the theory of over-production. He said in effect that there is no such thing as over-production. If your product is right and your price is right, you will sell anything you make. And the sales of the Ford organization bear out that assertion. When Ford sales go down, the price goes down to boost them up. And when the Ford sales still go down and price won't sell them, the product is changed. Henry Ford ran one model for many years, selling millions of cars of that model by cutting his prices slightly as the market decreased. When he was down to rock bottom on price, he changed his product and raised his price. He is selling Fords by the million again, occasionally dropping the price just a bit to stimulate sales.

What has that to do with radio? Let us see:

When the whole world wanted radio sets faster than the industry could supply them, any product was right and almost any price was right. But today that enormous demand for anything that will bring in a program has gone forever. The product must be right to sell a receiver today, and more important, the price must be right. The proof is not hard to find. Those who are selling their sets at what appear to be ruinous prices are selling sets right through the middle of the so-called depression. Some receiver manufacturers are selling sets and making a profit, and they are doing it largely on a price basis. The Fords of the radio industry are not losing money. While not every radio manufacturer can hope to go on a Ford basis, there are very few who can sell sets at the prices they are now attempting to maintain. Editorial bunkum and optimistic blurb to the contrary, you will again have an industry in radio when you turn to list prices more in line with what the public has learned is a fair price for your type of receiver. Those list prices must be lower than the present list.

Either the present list prices are entirely fictitious, in which case the sooner they are rectified and maintained the better, or they are legitimate, in which case the present orgy of dumping and price cutting is a grave loss to all concerned. Before you can set a fair list that can hope for success, however, you must get your cost down to a point that will give you a chance to make your price right and yet permit of a fair profit.

Is the Product Right?

First, let us see if your product is right. Too many of our manufacturers are making a mediocre product and then spending an extraordinary amount of money to sell that product to the public. The best salesman you can have on your staff is old man "Value." And the place to put value into a set is in the engineering and manufacture of that set. No super-salesman can add one cent's worth of value to your set. We have in previous issues gone into the matter of cost reduction in your manufacturing operations. A good cost accountant will work wonders in your plant, but your plant cost is not the major part of the cost of your product, even though it should be. Too often your sales cost is all out of line.

If your price at the plant is right, you should have little trouble in getting your sales cost right. The crux of the sales department is the salesman. It is to the salesman, then, that we turn to see if we can cut down our sales cost.

There are three ways in which you may remunerate the salesman: (1) You can place him on a straight salary; (2) you can give him a drawing account and a commission, in which case, if he fails to make his drawing account, he will sooner or later leave your employ; and (3) you can pay him a straight commission as earned, in which case if he cannot make a living he will quit. The straight salary is not widely used today in the radio field. It is the oldest and the newest way of remunerating a salesman. Drawing account and commission seems to be the most common practice and can be compared with salary and bonus in the factory. A straight commission, which is also common today, is also comparable to straight piece-work in the factory. The last two methods have become common practice on the idea that salesmen are being paid for results only—if they do not bring in the orders, they receive no pay.

Publicity

While the salesman was not employing any machinery in selling, and his efforts were largely a hand operation, so to speak, the commission form of payment was in line with the foregoing theory. Today, however, the average salesman uses machinery as costly, if not as tangible, as that operated by his friends of the factory. You have an enormous advertising bill, have you not? That is, if you are an up-to-the-minute company, you must spend a considerable amount of money each year for advertising. If you are trying to haul the merchandising wagon without a horse, you may not be an advertiser: but if you are one of those firms that are going to survive the present readjustment period, you are advertising to keep what market you have and, in addition, a share of other markets. That advertising bill is part of the machine your salesman is operating. Part of its action is calculated to promote sales in his territory, and if he fails to use that machine for all it is worth, you are paying great sums to sow in a market where an inefficient operator will not reap.

If one of your salesmen does not sell in his territory, the overhead wasted in that territory is greater than if one of your lathe hands does not operate his

Centralab Preferred

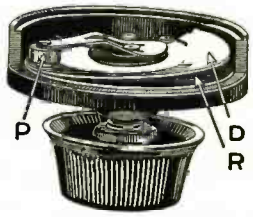
for those who can't afford to gamble!

In these hectic days when every one is stock market conscious even the man on the street considers himself an expert on "guessing the market."

Whether this stock or that is up or down is a matter of popular information. Those who feel the urge to gamble play hunches and tips. Those who can't, stay with the old reliable, time-tried manufacturers and radio servicemen who can't afford to gamble with inferior parts play "CENTRALAB PREFERRED."

More than twenty million Centralab Volume Controls have taken the gamble out of the volume control market. Hunches give way to accurate scientific engineering standards and tips are represented by the scores of successful manufacturers whose quality of products are made even better by the introduction of Centralab Volume Controls.

For the maximum efficiency of your present or contemplated radio receiver let it be CENTRALAB equipped.



This shows the exclusive rocking disc construction of Centralab volume control. "R" is the resistance. Contact disc "D" has only a rocking action on the resistance. Pressure arm "P" together with shaft and bushing is fully insulated.

Centralab (CRL) **VOLUME CONTROLS**

MAIL COUPON NOW

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928 Keefe Ave., Milwaukee, Wis.
Enclosed find 25c for which send me new VOLUME CONTROL GUIDE.

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R. Eng.

lathe. A punch press out of operation is a matter of concern for the whole operating staff, but what about the inoperative salesman? You spend certain sums of cold cash to teach the inefficient operator to be efficient, with time study and motion study. But do you do as much for your salesman? You are spending each day for space advertising, dealer helps, radio programs, railroad fares, sales letters, direct mail literature, and the hundred and one ways in which you try to supply the salesman the machinery to use in arriving at a sale. If he does not know how to operate the selling machinery, you simply fire him and probably take on another flop. There are not enough super-salesmen to sell the country's goods. You must organize so that the average salesman can sell your goods. But how?

Selling Success

Let us go to the method of those who have the greatest selling problem of this modern age. Let us see what the large organizations who are selling specialties, are doing. The Fuller Brush organization has set standards of retail sales. Those standards have been followed by a host of house-to-house sales organizations. The marketing of securities has been reduced to a fine art. In countless different lines the salesman has ceased to be a prima donna and has become, for the purpose of management, a factory hand.

Several years ago the Fuller Brush Man was paid 33⅓ per cent of his gross sales and turned loose on an unsuspecting populace. Later it was found that there was too much turnover among the free lance salesmen, so the company began training the men for their jobs. The success of the Fulller Brush organization at that time practically revolutionized selling.

Then we had the era in which it was thought that the volume of sales was all that was needed. Paying no attention to the fact that each salesman eats up a definite amount of money in overhead, we multiplied salesmen until we had a great over-supply of salesmen, too few of whom were really selling. The insurance business reflects this type of thinking. The writer honestly believes that our insurance friends should wear badges to keep from selling to each other. They are almost as numerous as bootleggers, if not as welcome. They really should combine their functions, thereby reducing costs.

In radio today, we seem to stick to the prima donna sales wizard and try to struggle along with two or three stars and a flock of constantly changing mediocre men who have it in them to be really competent salesmen if we could only take the time to train and guide them properly.

Statistics

You have read about the experts who can predict for the chain stores, by various and sundry statistical methods coupled with traffic counts and tests, just what volume of business can be expected from each store location. You are perhaps familiar with the proficiency of certain marketing experts in predicting sales of soaps and typewriters. The same function can be applied to radio if the radio trade has enough sense to settle down to reasonable standards of quality at a reasonable list price, instead of questionable quality, stage money list prices, wild discounts, dumping parties, and, in an all-inclusive sense, chaos. Some of the money that has been practically thrown away in high-pressure selling of questionable merchandise should be diverted from now on to developing the right product at the right price.

The salesman should be given good products, good prices, good market information, and shown how to sell his goods. He should be told how many units he can sell with reasonable effort in his territory, and held to that quota. He should be taught to follow a definite routine and make a set number of calls per day. He should be taught what to say when he makes these calls and he should be provided with ammunition for any contingency. Instead of trying to make each salesman a wizard, the backbone of the sales staff should be the average salesman who is getting a predetermined amount of business day in and day out. In other words, you should place your salesman on a production basis. How?

Personnel

In this function as well as in every other function in a business, the greatest task lies, of course, in finding *the* man. The man in this case must be capable of applying research to sales. He probably *will not be* a salesman. He may be an engineer. He may have had some experience with a marketing research bureau. He will be interested in *Gross Sales* and *Unit Cost* of sales, and he will work to push the first up and the second down. He will probably ask his men to supply the entire stock of good fellowship, new yarns, powerful talk, general pep and other accoutrements of selling, usually found in every sales force. He will not have time to go out on whoopie parties or golf games with favored clients, and as likely as not he will look on a consistent flow of small orders with more favor than he will upon the sporadic spurts of big orders. He will use the law of averages almost as much as the insurance actuaries. He will develop a sales *team* rather than a group of salesmen. His men will use all their tools all the time, and without any individual and spectacular results, the net outcome will be sufficiently spectacular to please any company.

All of which amounts to just this: the radio industry has had enough of the sales wizards and prima donnas. High pressure selling has proven too expensive and ineffectual. Too many radio lines have not been properly engineered and have not been "natural" sellers. Production costs have not been sufficiently studied, so that selling prices have been too high. There has been too much of a margin between list price and the net return to the manufacturer, due to too much selling cost. The engineer has not been interested in sales, thinking that his professional make-up would be quite out of place in the business field. The business end of the radio industry has failed to make sufficient use of its engineering personnel in the sales end. Statistics have been sadly lacking, and such as we have at our command, have been grossly neglected. Marketing data has figured very little in guiding production schedules.

Well, fellows, that is the story. Here is an opportunity. Many of you engineers have a place in the sales picture. Future successes in radio are going to be built up by creating a sales setup which can employ the ordinary run of salesmen rather than the big stars. And you are going to get in on some of the big money if you develop the proper merchandising mind. More about this important slant a bit later this year.

▲

NEW TUBE COMBINES CHARACTERISTICS OF MANY TUBES IN ONE

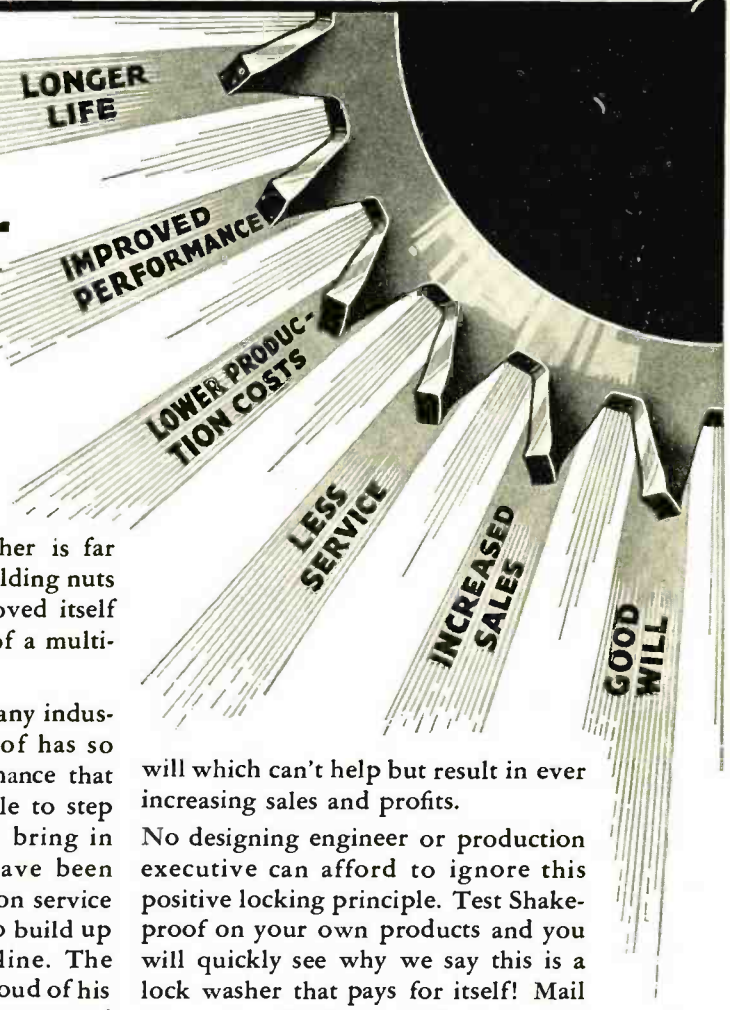
IN the eyes of the layman, the chief virtue of the new super-control screen-grid amplifier tube, Radiotron 235, just announced by the RCA Radiotron Company, probably lies in the fact that it makes for a definite improvement in all-round reception and greater ease of operation.

The super-control, for example, provides greater selectivity by reducing interference from unwanted stations. Maximum range in volume control is accomplished very easily with one knob by means of these new tubes.

The remarkable ease of volume control obtainable with the super-control is due to the gradual and smooth variation in mutual conductance over a large range in grid voltage. It has been designed to perform as though dozens of tubes of different amplification factors were connected in parallel. Because of this unique characteristic of combining the characteristics of many tubes in one, the new tube lends itself to simplification in automatic volume control design.

SHAKEPROOF

A Lock Washer that Pays for Itself!



THE Shakeproof Lock Washer is far more than just a means of holding nuts and screws tight. It has proved itself a real factor in the success of a multitude of products.

Leading manufacturers in many industries report that Shakeproof has so definitely improved performance that their salesmen have been able to step ahead of competition and bring in volume orders. Dealers have been saved thousands of dollars on service costs—which is a sure way to build up their enthusiasm for any line. The customer is contented and proud of his purchase—and that's creating good will which can't help but result in ever increasing sales and profits.

No designing engineer or production executive can afford to ignore this positive locking principle. Test Shakeproof on your own products and you will quickly see why we say this is a lock washer that pays for itself! Mail the coupon for free samples today!

U. S. Patents:
1,419,564
1,604,122
1,697,954
1,782,387
Other patents pending.
Foreign patents.

SHAKEPROOF
Lock Washer Company
{Division of Illinois Tool Works}
2509 N. Keeler Avenue, Chicago, Ill.

Shakeproof representatives are located in the following cities

New York City, Philadelphia, Boston, Pittsburgh, Schenectady, Cleveland, Detroit, Toledo, Cincinnati, Birmingham, Ala., Dallas, Texas, Milwaukee, Los Angeles, Seattle, San Francisco, Toronto, Ontario, Canada

Mail This Coupon for Free Samples

Firm Name.....

Address.....

City.....

State.....

By.....

.....

A "NOISE" MEASURING METER

(*Concluded from page* 46)

standard noise created and by means of which it becomes possible to measure the intensity of the interfering noise. Operation of the instrument consists in adjusting the intensity dial until the standard noise reads the same on the meter as the radio noise. The intensity in microvolts per meter is then read from a curve. Switching from standard to radio noise is accomplished by depressing and releasing a key switch. The standard noise is obtained by alternately charging a network of small condensers from a dry battery and discharging into the antenna in such a way as to produce a noise that closely imitates the usual transmission line noise.

The portability of the instrument makes it readily applicable to tests in the field, in the home or wherever the radio noise may occur. It is especially useful to measure radio noise on transmission lines, house wiring, around distribution points, or electrical apparatus of any description.

▲

R.C.A. SHOWING, FIRST QUARTER, 1931

TOTAL gross income of $24,843,371 and net income of $1,566,519 for the Radio Corporation of America and its subsidiaries for the first quarter of the year 1931 were announced May 5, by David Sarnoff, president of the corporation.

The statement disclosed earnings of $263,647 in excess of dividend requirements on the preferred stocks. Preferred stock dividends totalled $1,302,871.

The report in detail is as follows:

Gross Income:		
From operations	$24,562,682 68	
Other income	280,689 15	
Total gross income from all sources		$24,843,371 83
Less—cost of sales, general operating, development, selling and administrative expenses		20,821,011 12
Net income for the Period (before interest, depreciation, amortization of patents, and Federal income taxes)		4,022,360 71
Deduct:		
Interest	354,873 80	
Depreciation	1,875,967 32	
Amortization of patents	125,000 00	
Provision for Federal income taxes	100,000 00	
Total deductions		2,455,841 12
Net income for the period transferred to surplus		1,566,519 59
Dividends:		
On "A" Preferred Stock	343,500 00	
On "B" Preferred Stock	959,371 60	
Total dividends		1,302,871 60
Surplus for the period		263,647 99
Surplus at December 31, 1930		30,010,537 76
Surplus at March 31, 1931		$30,274,185 75

May 4, 1931.

▲ ▲ ▲

LIGHT REFLECTION OF ACOUSTICAL MATERIALS

TOO often are the purchasers of acoustical materials inclined to think in terms of sound absorption coefficients only. Many other characteristics merit consideration. Light reflection is a very important factor. This is emphasized in a recent article by A. L. Powell and C. L. Dows of the Nela Park engineering department of the General Electric Company published in the December, 1930, issue of the Transactions of the Illuminating Engineering Society. The article also reports tests on the light reflection of many acoustical materials.

Some time it is hoped that similar tests can be made on material over a considerable period of time. Such tests would show up another important characteristic of acoustical materials—paintability. The accumulation of dirt on the ceilings of offices is unfortunately a reality and if high light reflection is to be maintained painting at frequent intervals is essential.

▲

TENTATIVE PROGRAM FOR SPRING S.M.P.E. MEETING ANNOUNCED

THE tentative program for the Spring Meeting of the Society of Motion Picture Engineers to be held in Hollywood, May 25 to 29, just announced by W. C. Kunzmann, chairman of the convention committee, shows that every effort has been made to allow Eastern members to see as much of the studios as possible and also to permit the studio workers to attend meetings without interfering with their regular work.

Only one afternoon session will be devoted to papers, while the other three will be given over to trips to studios and other points of interest. Two technical meetings will be held at night so that studio workers may attend.

The banquet will be held on Wednesday evening in the Blossom Room of the Hotel Roosevelt, the convention headquarters.

All technical sessions will be held at the American Legion auditorium.

Peter Mole has been appointed chairman of the arrangements committee and a reception committee of twenty, chiefly composed of west coast people, will welcome eastern delegates. Ten Los Angeles women, headed by Mrs. Donald MacKenzie, will provide entertainment for the women present.

One of the features of the meeting will be an exhibit of new equipment developed in the last year and from the number of manufacturers who will display equipment, an exhibit of unusual interest is assured.

Golfing privileges have been secured at the Lakeside Country Club.

▲

THE MAKEUP OF AN EXPERIMENTAL TELEVISION UNIT

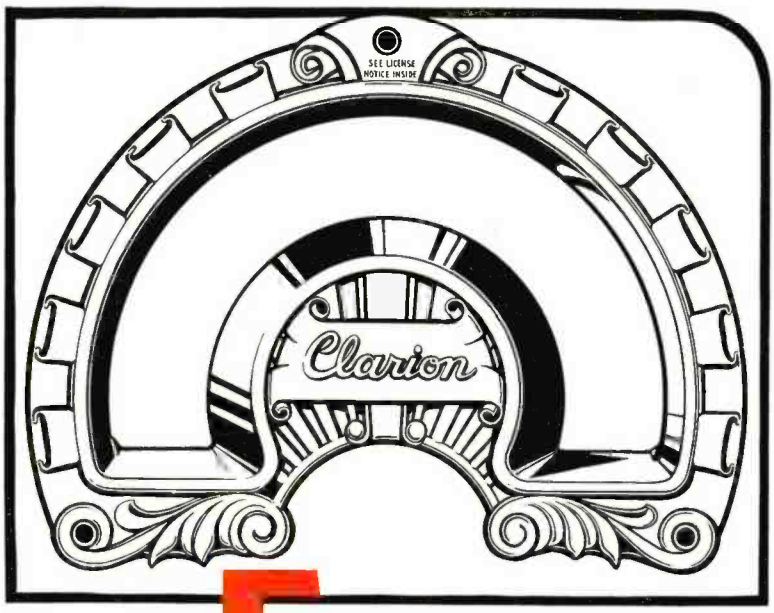
(*Concluded from page* 38)

optimum relation between the plate voltage and grid bias may also obtain a plate current meter is shown. Adjustment of the two voltage controls should be made for the relation that provides for the minimum observed variation in plate current under the influence of the signal.

No mention has been made of the design problems encountered in equalizing amplifiers for television purposes as this constitutes a distinct and separate subject. Neither has it been though advisable to consider the losses in detail due to the falling characteristic encountered in gas-filled phototubes.

This apparatus opens a wide field of endeavor to the experimenter and in these days when television signals are few and irregular offers an answer to a problem which harasses all workers in the field. The problems of television are also separate from those of radio communication and it is well for the experimenter to devote his entire efforts to one phase of the problem leaving the development of the radio channels to those who are grounded in electric circuit theory rather than in the field of light.

In the choice of a lens for this service it is essential that the light efficiency or "speed" of the optical system be excellent. The Hugo Meyer Kino Plasmat f 1.5, 2-inch lens is ideal for the purpose and is well within the financial range of the experimenter.



Escutcheons

Radio receiving set manufacturers who desire exclusive escutcheons of their own design will find our facilities ideal for their purpose. Our staff of expert die makers will carry out your own designs, or our designers will work to your specifications in creating an escutcheon that is new, distinctive, and up - to - the - minute.

The revolutionary changes now in progress in the radio industry demand a new trend in escutcheon design. Those who wish a new escutcheon for showing at the RMA Trade Show may have samples early in June if we are consulted promptly.

Our designers and representatives will be glad to call on you at your request. Telegraph or telephone at our expense.

CROWE

NAME PLATE & MANUFACTURING CO.

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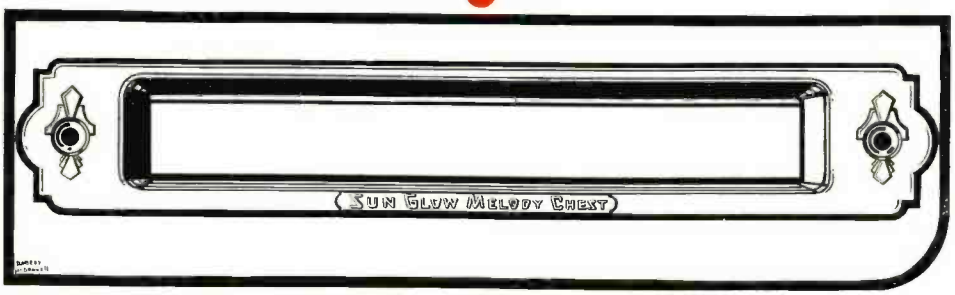

"Projection Engineering"

The Journal of the "Sound" Industries

Published monthly, and dealing with the manufacture, engineering, service, installation and operation of public address systems, centralized radio, theatre talkies, home talkies. Covering the subjects of design, production, materials, acoustics and the practical problems encountered by field engineers, contractors, installation men and service men.

A.B.C.
PAID
CIRCULATION
OVER 9,000
in the
Electronic
or
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Industries

A PRESENT MARKET OF PROVEN AVAILABILITY

Public Address
Sound Amplifiers
Sound Recording
Sound Pictures
Home Talkies
Visual Projection
Sound Reproducers
Acoustic Engineering
Automatic Music
Photo Tubes
Amplifier Tubes
Industrial Sound Applications
Industrial Visual Applications

Projection Engineering, with a paid A.B.C. Circulation of over 9,000 engineers, executives, technicians, contractors, service and installation men and projectionists, has the largest paid circulation of any publication among the *new*, radio associated, electronic or "sound," industries.

The editorial staff is headed by Donald McNicol, past president of the I. R. E.

The subscription rate is $2.00 a year (no newsstand circulation)—$3.00 for 2 years. ($3.00 yearly in foreign countries.)

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NEWS OF THE INDUSTRY

14 CARLOADS OF TUBES TO SET MAKERS

E. A. Tracey, vice-president of National Union Radio Corporation, issued a statement in April which would indicate that the vacuum tube business is distinctly on the up grade.

"In the past 23 days," says Tracey, "we have shipped fourteen carloads of National Union tubes. Our factories have been working on an overtime schedule for several weeks and have been unable to accumulate a warehouse stock in excess of immediate demand. We are most assuredly in an optimistic frame of mind regarding the business outlook for the balance of this year. We feel that the present situation bears out a statement we made eleven months ago, when we acquired the services of Dr. R. E. Myers and his staff of technical aides, to the effect that business would naturally flow in the direction of the manufacturer who made a uniformly precise product."

The carload shipments made have been to manufacturers of radio sets who are using National Union tubes as standard equipment.

▲

EASTON COIL MOVES

The Easton Coil Company of Easton, Penna., has moved its factory to 22-17, 41st Avenue, Long Island City, N. Y.

The new plant has additional capacities, totalling over 17,000 square feet of factory space. Deliveries of resistors, coils and transformers to radio manufacturers are already being made from the new plant in Long Island City.

▲

F. M. LASERSON TO ATTEND RMA SHOW

F. M. Laserson, managing director, Epoch Radio Manufacturing Co., London, England, plans to attend the RMA Show in Chicago in June. Mr. Laserson's headquarters in New York will be the New Yorker Hotel. It is stated that the Epoch Company will make purchases of American radio and talkie equipment.

▲

ELEMENTS FOR THE NEW TUBES

Keeping in step with the latest trends in types of radio tubes, Goat Radio Tube Parts, Inc., Brooklyn, N. Y., are turning out elements for the variable-mu, 6 volt and pentode tubes, the 235, 236, 237, 238 and 247 tubes.

Goat Radio Tube Parts, Inc., 33 35th St., Brooklyn, N. Y., also announce the addition to their staff of a sales engineer, J. Graboski.

Mr. Graboski was formerly with the Westinghouse Lamp Company and has since widened his experience in the engineering departments of various independent tube manufacturers.

▲

TELEVISION

Announcement has been made that the Federal Radio Commission has granted a license for the newly built experimental station W1XAU to operate with 500 watts on the experimental frequency of 1604 kilocycles.

This is to be used as the sound path for the television transmission of W1XAV which operates on the television band between 2850 and 2950 kilocycles with 500 watts power. A renewal license was granted to the latter station. Both stations are owned and operated by the Short Wave and Television Corporation of Boston, Mass. Synchronized programs are broadcast daily from twelve to one, three-thirty to four and seven-thirty to ten p. m.

▲

INSULINE CORPORATION TO TAKE LARGER QUARTERS

The Insuline Corporation of America will abandon their old building at 78 Cortlandt Street, New York City, to occupy large and more modern quarters at 35 Park Row, on or about May first.

▲

G. K. THROCKMORTON HEADS E. T. CUNNINGHAM, INC.

The appointment of George K. Throckmorton as president of E. T. Cunningham, Inc., has just been announced. Mr. Throckmorton previously was executive vice-president and general manager of the Cunningham company. He is one of the outstanding merchandising figures of the radio industry at the present time.

GEORGE K. THROCKMORTON
President, E. T. Cunningham, Inc.

▲

CRC SOCKETS IN CANADA

The Central Radio Corporation, Beloit, Wisconsin, announces that they have completed arrangements for their radio sockets to be manufactured in the Dominion of Canada for the Canadian trade.

The sockets will be manufactured by Hale Brothers, Limited, Montreal, Quebec, who have for many years enjoyed a good reputation as manufacturers of Bakelite electrical specialties.

There is a very strong sentiment in Canada in favor of purchasing Canadian-made material, and, judging from the comments, which have been made by several of the Canadian radio manufacturers, the Halebro-CRC sockets will enjoy a large volume of sales.

Hale Brothers' head office and factory are located at 6224 Chambord street, Montreal, Quebec, and they are represented in the province of Ontario by A. C. Simmonds, 218 Front street East, Toronto 2, Canada.

▲

VOLUME CONTROLS

The Central Radio Laboratories, 16 Keefe Avenue, Milwaukee, Wis., has issued a new bulletin illustrating and describing a line of volume controls for sound installations. The bulletin contains a considerable amount of engineering data valuable to engineers.

▲

ELECTROLYTIC CONDENSERS

The Sprague Specialties Company, North Adams, Mass., reports their inverted type electrolytic condenser as being specified by many of the leading manufacturers of radio receivers. In perfecting filter circuits, this type of condenser is efficient and economical.

▲

HIGH FREQUENCY LABS, CHICAGO

L. S. H. Baird, formerly city representative for the Leslie F. Muter Co., Chicago, is now an assistant to the sales manager of High Frequency Laboratories, Chicago.

▲

FORD MICA IN NEW HEADQUARTERS

The Ford Radio & Mica Corporation, pioneers in the development of mica spacers and supports for use in the manufacture of radio tubes, are now located in their new headquarters, consisting of a large one-story plant located at 830 Fourth Avenue, Brooklyn, New York.

For the past two months they have been in continuous production on supports for the 235, 236, 237 and Pentode tubes.

▲

ARCTURUS HOLDS ANNUAL ELECTION

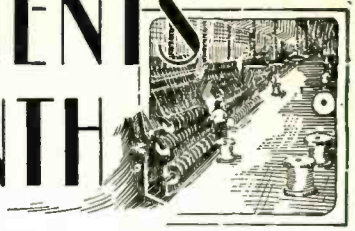
Elections of officers and directors of Arcturus Radio Tube Co. for the ensuing year were announced as follows after the annual meetings of stockholders and directors held in Newark, N. J., on April 21: Chester H. Braselton, president; George Lewis, vice-president; Charles E. Stahl, vice-president and general manager; Worcester Bouck, vice-president and treasurer; F. N. Norris, secretary; Frank I. Sparrow, assistant secretary; M. E. Dorn, assistant treasurer. Directors are Chester H. Braselton, George Lewis, Charles E. Stahl, Worcester Bouck and A. E. MacFarland.

▲

GOOD SOLDERING

The Kester Solder Company, 4201 Wrightwood Avenue, Chicago, Ill., are manufacturers of self-fluxing Kester Solder, widely used in the radio industry. The Company's operations are carried on in a thoroughly modern plant occupying an entire block. The president of the company is F. C. Engelhart.

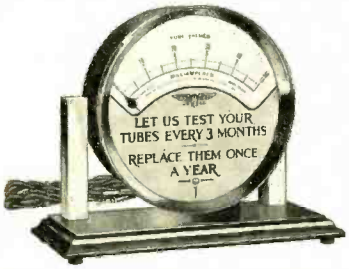
NEW DEVELOPMENTS OF THE MONTH



JEWELL TUBE-SELLERS

The new tube-seller just announced by the Jewell Electrical Instrument Company, 1642-U Walnut Street, Chicago, Ill., provides the radio dealer with a totally new method of merchandising radio tubes. These tube-sellers are "full vision" tube merchandisers. Tube values are read on two meters—a big easy-reading demonstration meter which faces the customer—a small meter on the test panel for the convenience of the salesman. Both meters read together and accurately indicate tube condition.

The big indicating meter wins customer confidence just as do the double scales on grocery and meat market weighing machines. Pattern 214 is an excellent tube merchandiser and tube checker for the radio



dealer. It is complete in every detail for rapid and accurate tube testing. Such features as a pre-heater and short checker, rotary filament voltage switch, and a means for testing output pentode tubes, are provided.

The Pattern 219 tube-seller offers the advantages of the large demonstration meter. Pattern 213, used in conjunction

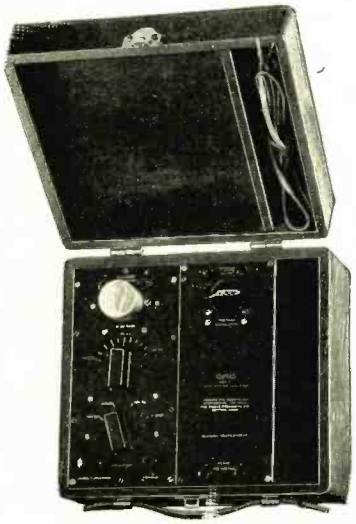
with a counter-type tube tester, the familiar Jewell Pattern 209. The demonstration meter is connected by a ten-foot cord. This instrument tests all standard types of tubes. Output Pentodes may be tested.

▲

JUNIOR OSCILLATOR

The Burton-Rogers Company, 755 Boylston Street, Boston, Mass., is marketing the oscillator herewith illustrated.

It has seven fixed broadcast frequencies which are the standards required by most manufacturers. These frequencies are 600, 750, 800, 1,000, 1,200, 1,400 and 1,500 kilocycles. There are also three intermediate frequencies for superheterodyne alignment;



130, 175 and 180 kilocycles, with vernier calibrated in one kilocycle steps from 170 to 183 kilocycles.

Completely shielded and equipped with a gradnated variable output control. The filament current of the '30 tube is supplied by 4 dry unit cells, while the plate current is taken from one 22½-volt B battery. Batteries are self contained. Connections are also available for external power supply if desired.

Suitable for aligning, tracking, neutralizing superheterodyne receivers such as RCA, General Electric, Majestic, Atwater Kent, Silver-Marshall, Philco, Westinghouse, etc., and all radio receivers using tuned radio-frequency stages, neutrodynes, etc.

▲

UNIVERSAL ADAPTORS

The Best Manufacturing Co., 1200 Grove Street, Irvington, N. J., are marketing the universal adaptor and trouble finder, made for both four-prong and five-prong tubes and sockets. By simply removing a tube from its socket, inserting the adaptor into the socket, and replacing the tube, means are immediately provided for making connections to any part of the tube or associated circuits. Cords with special tips are provided for plugging into the adaptor thus obtaining good electrical connections thereto.

The general circuits of the adaptors are so arranged that all connections from the tube elements are completed to the corresponding terminals of the tube socket by means of removable connecting links. Removal of a given link opens the particular circuit. For example, if the connecting link marked "P," meaning plate, is removed, the plate circuit of the tube is opened or the plate of the tube is isolated from the associated circuit. By removing a given connecting link two pin jacks are opened, one connecting to the tube element, the other to the tube socket. Now by attaching connecting cord No. 2066 to the two tip jacks the circuit is again completed between the tube element and corresponding electrical circuit but in addition an electrical connection is made to that particular tube element. If instead of attaching cord No. 2066, attach 1 cord No. 2067 to each tip jack, then connections are made, one to the tube element and the other to the tube socket and corresponding circuit, thus providing means for inserting another circuit element into the particular tube element circuit.

▲

TONE CONTROL

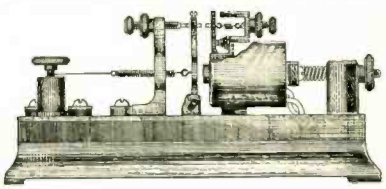
The Clarostat Manufacturing Company, Inc., 285 N. 6th Street, Brooklyn, N. Y., is marketing a completely bakelite encased tone control for panel mounting. It has an

extra long threaded bushing with two nuts for mounting on any thickness panel or cabinet. A ⅜ inch hole is required. The unit takes up but one inch space behind the panel, and is 2 inches in diameter.

▲

NEW ALTERNATING-CURRENT RELAY

The accompanying illustration shows a recently patented alternating-current signal relay which, in appearance, is the same as ordinary direct-current district service or main line telegraph relays. The adjustments are the same as with ordinary relays; that is, by movement of the electromagnets relatively to the armature and by means of a retractile spring attached to the arma-



ture. The armature, tongue, and trunnions are the same as in direct-current relays of the usual types.

This relay will operate satisfactorily on any current strength from ten to 200 milliamperes, and the current may be from a direct-current source, or from an alternating-current source of any commercial frequency and voltage.

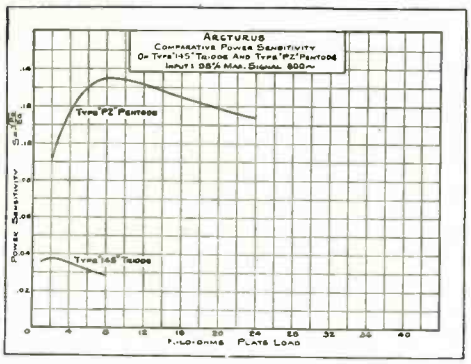
The view of the construction of the relay shown herewith illustrates a cushion contact in place of the solid contact used in ordinary direct-current relays. The cushion contact is so designed that it is substantial and introduces no trouble making complications.

When used with alternating current the relay armature remains in contact with the relay front stop so long as current flows through the relay coils. By virtue of the floating contact the armature cannot break contact, as the current changes from positive to negative at the zero point; the relay is noiseless, and a sounder, register, or bell operated locally by it, is actuated the same as when direct current is used; there is no fluttering of the sounder or register armature.

COMPARE

the POWER SENSITIVITY *of the* ARCTURUS PENTODE

TYPE PZ

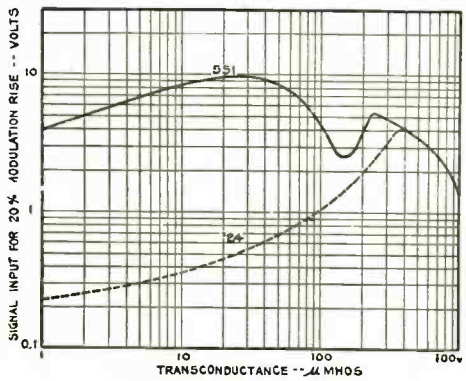


Because of its high "power sensitivity" the Arcturus PZ Pentode is almost 4 times as sensitive as the '45 power tube—a feature of decided importance when considering output, detector overload and plate supply arrangements. Greater volume, increased efficiency, and compactness of set design are the natural results.

COMPARE

the MODULATION DISTORTION LIMITS *of the* ARCTURUS VARIABLE-MU

TYPE 551



MODULATION DISTORTION LIMITS

These two curves show the maximum input voltages at which the Arcturus 551 and a typical '24 tube operate with practically undistorted amplification. The limits shown correspond to a rise in modulation of 20%. The 551 tube operates without distortion at about 20 times the voltage permissible with the '24 tube.

This and other features of the Arcturus 551 eliminate the need for double pre-selectors, dual volume controls, and "local-long distance" switches. Maximum cross-talk is divided by 500; receiver hiss is reduced. Circuits using this new tube are simplified as well as more efficient.

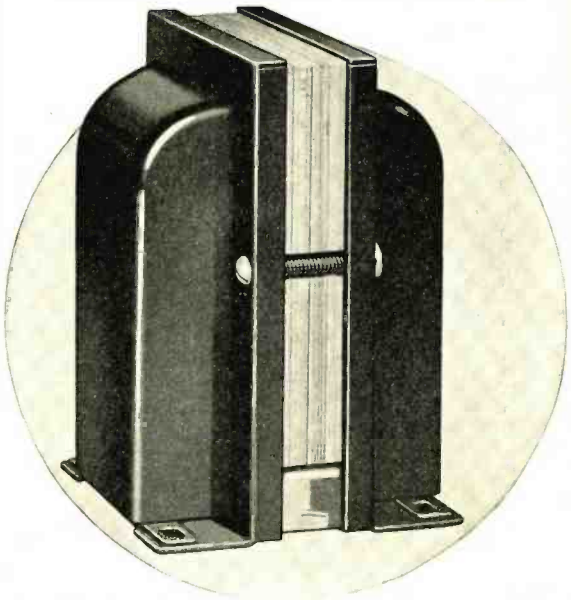
Send for Technical Bulletins giving complete performance data on the Arcturus Type PZ Pentode and the Arcturus 551 Variable-Mu Tube.

ARCTURUS RADIO TUBE CO., NEWARK, N. J.

ARCTURUS

***The* TUBE *with the* LIFE-LIKE TONE**

ELIMINATE COSTLY *EXPERIMENTS*



Benefits are made positive, drawbacks are erased, when you let Jefferson manufacture your transformers. You receive:

An experience that has been in on every small-transformer problem and development since the beginning of radio.

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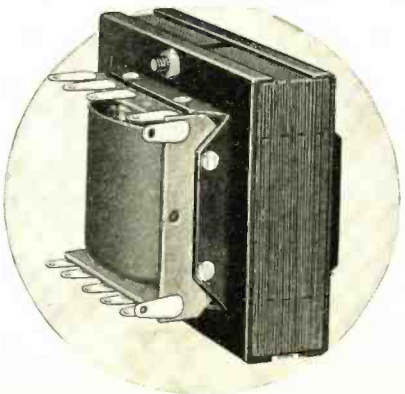
JEFFERSON TRANSFORMERS



(A-4956)

ROLA ANNOUNCES NEW DYNAMIC SPEAKER

A new dynamic loudspeaker unit designed to meet the exacting requirements of 1931 radio sets and home talkie outfits, has been announced by the Rola Company of Cleveland, manufacturers of electric reproducers for the radio industry.

The new Rola unit, to be known as Model F, is said to provide an astounding performance in a very small package, being

only eight inches overall diameter and weighing under five pounds.

B. A. Engholm, Rola's vice-president and responsible for the development of Model F, says "Our problem was to design a unit that would be more compact, more efficient and more economical to manufacture than existing types, and a speaker that would match the critical load requirements of the new pentode power tubes. Our new model F successfully meets these requirements."

▲

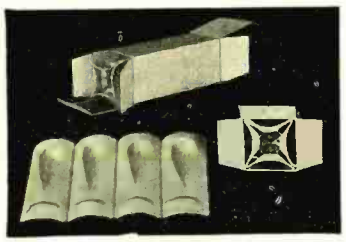
RHEOSTATS AND POTENTIOMETERS

The De Jur-Amsco Corporation, 95 Morton Street, New York, has introduced a line of heavy duty rheostats and potentiometers with ventilated shields. These well designed instruments are finding a ready market in the talking picture and sound fields

▲

RADIO TUBE PACKING

Herewith is illustrated the widely used wrapper for shipping radio tubes, manufactured by the Holed-Tite Packing Corp., 220 East 42nd Street, New York City. The wrapper is form-fitting and is designed for each size of tube. Tubes packed in these wrappers can be tested without taking them out of wrappers.



This new method of tube packing is an efficient application of the principles of suspension by means of moulded pulp wrappers and pads developed by the engineers of the Holed-Tite Packing Corporation (affiliated with the International Paper Co.) of New York City.

The new Holed-Tite carton pads are used in packing tubes in the standard 50-tube carton instead of excelsior which is commonly employed. These pads are also made of moulded pulp. A series of resilient cups around the edge of the pad act as a cushion in supporting the contents of the carton while the center portion of the pad acts as a spring-board against shocks caused in transit.

The use of the new Holed-Tite carton pad has also reduced the cost of packing material about 25%. Furthermore, when excelsior was used the packers could not keep up with production, thereby necessitating a great deal of overtime work. Now, with a smaller force, overtime work, due to inability to keep up with production, is practically a thing of the past.

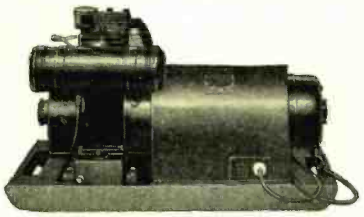
The Holed-Tite method has resulted in less returns, reduced packing material costs, simplified handling of shipments, and increased sales.

▲

MOTOR GENERATORS

Electric Specialty Co., 300 South St., Stamford, Conn., announces a new line of portable and semi-portable gasoline electric motor-generator units.

The portable unit here illustrated will furnish power to drive any combination of electric tools up to one horsepower. It may be wound for either alternating or direct



current, any voltage. Is mounted on an aluminum base with carrying handles. Weighing but 110 lbs. it may easily be carried by one or two men. The average gasoline consumption is one quart per hour.

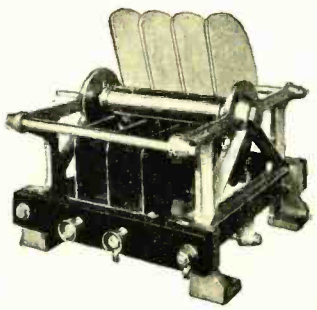
The semi-portable sets are heavier, being mounted on cast iron bases and supplied with slow-speed motors. There are more than 100 different combinations and sizes ranging from 250 watts to 6,000 watts. The line has been well developed to cover all fields such as electric tool supply for construction, lights, radio, battery charging, moving picture projection, and similar applications.

▲

HIGH VOLTAGE TRANSMITTING CONDENSERS

A complete new line of high voltage transmitting condensers has been announced by the Allen D. Cardwell Mfg. Corporation, 91 Prospect Street, Brooklyn, N. Y. These condensers are especially designed for use in high power transmitting stations.

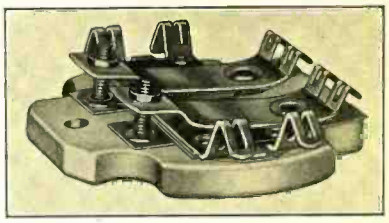
The variable condensers are available in two general constructional designs, the 166 B and the 1666 B. The former type condensers are of brass, except for monel



bearings, radion insulation, phosphor bronze contact brush, and steel ball trust bearing. In the 1666 B design, the end frames are of cast aluminum. All active parts are highly polished and electrostatic shields are attached to minimize corona losses and other strays. The stator is air spaced from the insulation, except at two points, keeping strains across air, rather than across the solid dielectric. Unusually thick plates provide exceptional current-carrying capacity. All condensers of the 1666 B design have plates of ⅛ inch thickness. The rotor plates have a radius of 5¾ inches.

INTERMEDIATE TUNING CONDENSERS

Intermediate tuning condensers in both dual and single style for superheterodyne and other similar circuits, are now being manufactured by The Hammarlund Manufacturing Company, 424 West 33rd Street, New York City. These condensers, which



are made specially for manufacturers' use, in the single style are known as the "ICS" and in the dual style as the "ICD" type.

The duals are made in two sizes, 1 15/16 inches for a shield 2 inches in diameter, and 2⅜ inches for a larger size shield. The single condenser base is 15/16 inch by 1¾ inches. They are made in capacity ranges of 10 to 70 mmf.; 70 to 140 mmf., and 140 to 220 mmf.

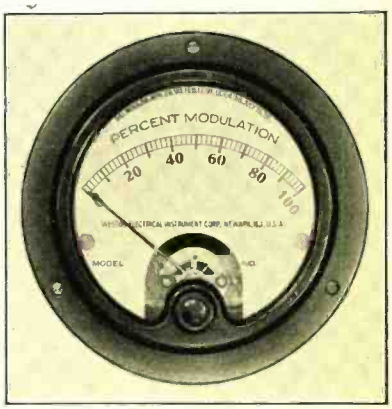
To afford stability, specially conditioned Isolantite bases are used. This material is treated immediately after withdrawal from the kilns, making it impossible for any moisture to be absorbed. Each base is individually tested for volume resistance and only those showing infinity resistance are acceptable. The mica dielectric films are of the best quality obtainable. About four out of every five are rejected in the rigid inspection required in the selection of films of the necessary quality.

The temper of the phosphor bronze flexible plate is controlled by sclerescope to insure uniformity of minimum, maximum and rate of capacity increase.

▲

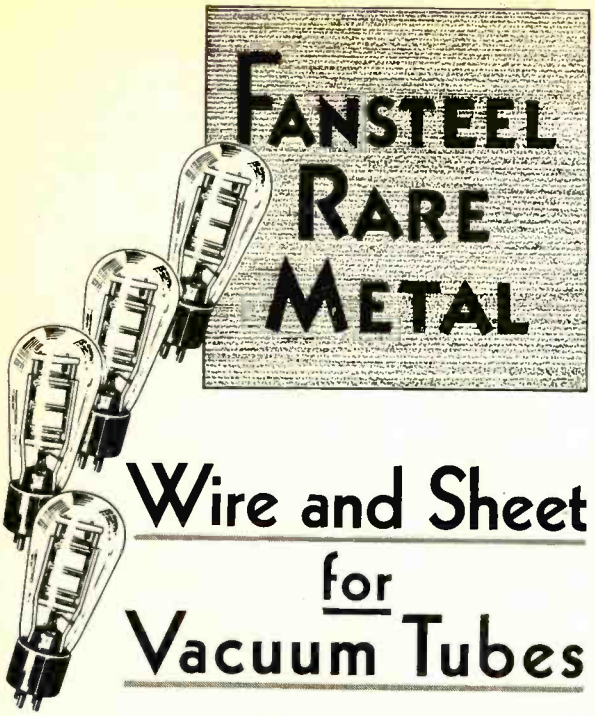
MODULATION METER BY WESTON

The Weston Electrical Instrument Corporation, Newark, N. J., has brought out a modulation meter, model 588, designed to give continuous indication of the percentage modulation averaged over short periods in



The indicating instrument is a model 301 rectifier type, enclosed in a box, which by-passes the current component. In ordinary use the instrument cannot be burned out.

radio transmitting sets. A technical description of this new meter, written by W. N. Goodwin, chief engineer of the Weston Company will be sent upon request.



Wire and Sheet for Vacuum Tubes

Fansteel Tungsten wire — most dependable for filaments and heaters. Try it!

Standardization on Fansteel Metals often results in reduced shrinkage and waste, while making better and more uniform tubes.

This is because Fansteel Metals are made specifically for use in tubes. Beginning with the refining of ores and basic salts, every process is carried out under the careful direction of ***men who know tubes.*** In the Fansteel research laboratory, various types of tubes are made and tested, and here much important development work has been done.

Fansteel Rare Metals and Alloys are pure, uniform, dependable—chemically, physically, electrically. Ample stocks of standard dimension wire and sheet are kept on hand, ready for immediate shipment. Wide assortments of "specials" are stocked, too, and those which are not stocked can be quickly made to order.

Write for samples and prices. If interested in receiving suggestions on some development problem relating to metals, write the Fansteel research staff.

FANSTEEL PRODUCTS COMPANY, Inc.
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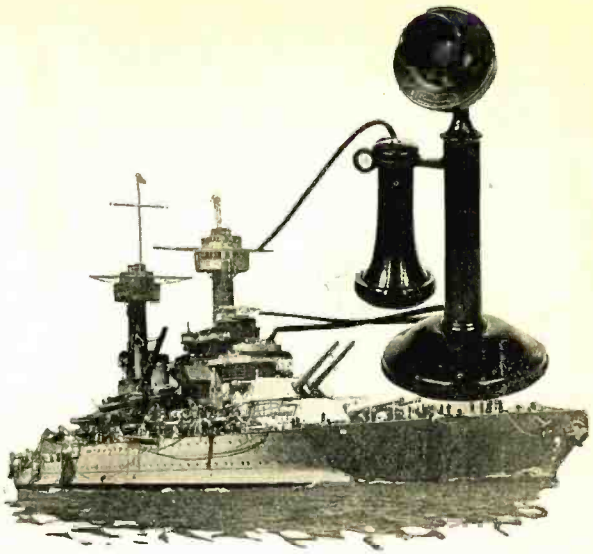
TANTALUM · TUNGSTEN · MOLYBDENUM
and RARE METAL ALLOYS



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A GRAPHIC example of the hundreds of uses of Felt. Felt gaskets in the mighty, throbbing turbines of the battle-wagon and a Felt pad between your telephone and desk.

Will you let us show you how Felt may be intelligently utilized in your business? The American Felt Company, largest felt manufacturers in the world, maintains a staff of experts anxious to serve you. It is only good business sense to avail yourself of such cooperation.

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INDEX OF ADVERTISERS

DONGAN

Seasons, Styles and Tubes May Change But

—you know from experience that Dongan can be counted upon to have the proper new design of Power and Audio Transformers to match perfectly with the very special requirements of Your Receiver.

This has been happening for years—ever since Radio started. Change is the very life blood of Radio. It's a virile, adventurous industry and has no place in it for the timid and procrastinating.

Back in 1922 the leaders among the manufacturers were using Dongan Transformers. Nine years later the leaders — different names however — still are. Dongan has always kept pace and regardless of the changes that take place each year Radio manufacturers have come to consider Dongan as the reliable source for the best in Transformers.

News of The Moment

Experimenters! Attention

Here is a new type Filament Transformer No. 908

is the number. 2½ volt, 3½ amp. with Center tap.

$2.50

Television

When you want a Power Supply Unit or Special type Transformer for Television we can Supply it.

Ask for Details

Dongan Electric Mfg. Co.

2991-3001 Franklin St., Detroit

TRANSFORMERS of MERIT Since 1911

Base of Bakelite Molded for Aminco Supersensitive Mercury Relay made by American Instrument Co., Washington, D.C.

One press operation

completes this attractive insulating base

Bases for sensitive electrical devices should be primarily excellent insulators. They must guard delicate working parts against current losses and short circuits. They must have strength to protect the device against chance shocks and blows. They also should be attractive in appearance, simple in design and economical in manufacture.

How well Bakelite Molded fills all of these requirements may readily be seen in the base of the Aminco mercury relay. This base is strong and attractive and provides exceptional insulation. Each base leaves the mold complete and accurate in every detail, with markings and lettering in sharp relief, and permanently lustrous finish. Drilling, machining and finishing are eliminated.

Bakelite Molded, because of its high dielectric and mechanical strength, its adaptability to multiple production and the simplicity and beauty it imparts to finished articles, is a most favored material for insulating all kinds of electrical, radio and electronic devices. Write for our illustrated booklet 38M, "Bakelite Molded", which further describes the material and its uses.

Bakelite Engineering Service—We manufacture a wide variety of Bakelite resinoid molding materials, varnishes, lacquers, enamels, cements, and other products. Twenty-one years experience in the development of these materials for electrical and other uses, provides a valuable background for the cooperation offered by our engineers and laboratories.

BAKELITE CORPORATION, 247 Park Avenue, New York. CHICAGO OFFICE, 635 West Twenty-second Street

BAKELITE CORPORATION OF CANADA, LIMITED, 163 Dufferin Street, Toronto, Ontario

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