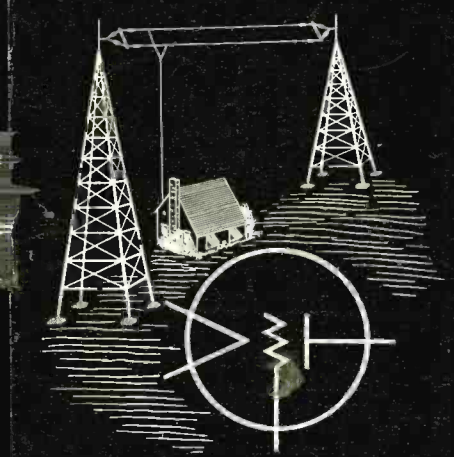
MARCH, 1932

Radio Engineering



IN THIS ISSUE

TWELFTH YEAR OF SERVICE

The Journal of the Radio and Allied Industries

3

ARCTURUS

50 WATT TUBES

•

New, Rugged Design.. Consistently Uniform

•

Bringing to transmitting tubes the same skill and quality shown in its receiving tubes, Arcturus announces these newest additions to its line of high-power tubes.

New—not only in performance and stability—but in construction. In developing these new power tubes, Arcturus has incorporated the "unitary structure" principle made famous by the *blue* receiving tubes.

In uniformity, performance and construction, these Arcturus 50-watters establish new standards. Seldom in the swiftly changing history of electronic research has a product been offered that represents such a decided improvement over existing devices. Yet these power tubes are interchangeable with corresponding type numbers, and their advantages are immediately applied to present apparatus.

Technical data bulletins on these three types, as well as Mercury Vapor Rectifiers E766 and E772, are available to interested parties on request.

Arcturus Radio Tube Company, Newark, N. J.

EXCLUSIVE ARCTURUS CONSTRUCTION

Note the extreme rigidity of these tubes. The Unitary Structure principle of interlocking the elements maintains the precise interrelation of parts through interdependence. Each rugged element is securely clamped at the top and bottom and the complete assembly is a sturdy unit — insuring constant uniformity.

This compact unit is supported by a rugged rectangular structure.

The increased area of the plate provides generous heat dissipation resulting in cooler operating temperatures.

ARCTURUS

Quality Tubes for Transmitting, Receiving and Industrial Uses

Is distribution sound? Does the advertising hit the market? How about overhead? *How about the product itself?*

Any radio manufacturer who asks himself these questions must come, sooner or later, to a consideration of the materials he uses. Which explains in part, at least, why Durez is being put to hundreds of new uses—not only in the radio industry, but in almost every other line of business!

A better product, at low cost

Durez frequently enables a manufacturer to make his product better, more quickly, and at less cost than he has made it before. A powdery, dust-like substance, Durez molds under terrific pressure to take almost any required shape, pattern or design.

That finished product is tough, hard, durable. It needs no laborious finishing or polishing. It seldom chips or cracks. It has high tensile and dielectric strength. Its surface is naturally as smooth and beautiful as burnished ebony. Studs and inserts can be imbedded in the one molding operation. Intricate designs, trade-marks, insignias are accurately reproduced.

People who "do it with Durez"

The list of Durez users in the radio and electric fields alone reads like a Who's Who of business. Stewart-Warner, Delco, Turner Timer, Wagner Motor, Ford, Westinghouse, Telechron, USL Battery —these are only a handful of hundreds of nationally known concerns who find Durez ideally suited to their needs. Remler Radio products, shown in the illustration, show how versatile this perfect molding compound really is.

We will be glad to point out how Durez fits into the plan of progressive manufacturers. Write now for information and free booklet. General Plastics, Inc., 35 Walck Rd., N. Tonawanda, N. Y. Also New York, Chicago, San Francisco, Los Angeles.

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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. XII MARCH, 1932 Number 3

Contents

Departments

THE R. M. A. AND TELEVISION

THE following is quoted from a statement issued from R. M. A. headquarters on March 1:

"Regardless of the present problems that confront the industry, there has been enough work done to justify some predictions which can be conscientiously made. With the development of the new short wave channels at frequencies higher than 35,000,000 cycles, reliable transmission of television can be predicted. Ample room for an adequate number of transmitting stations can be visualized in this short wave region. It is perfectly conceivable that a sight and sound service can be worked out to be received on a single receiver with a simplified tuning and control mechanism.

"As never before, the new art of television is going to require the rigid and sure hand of a governing body to set up the standards for both transmission and reception. Surely no better body is suited for this task than the Radio Manufacturers' Association, which embraces both transmitting and receiving set manufacturers. Because of this situation, television presents a real challenge to the R. M. A., which, if accepted, can and will bring new prosperity to its members, but only if this challenge is correctly and courageously met by the entire cooperation of its members."

BRYAN S. DAVIS *President*

JAS. A. WALKER *Secretary*

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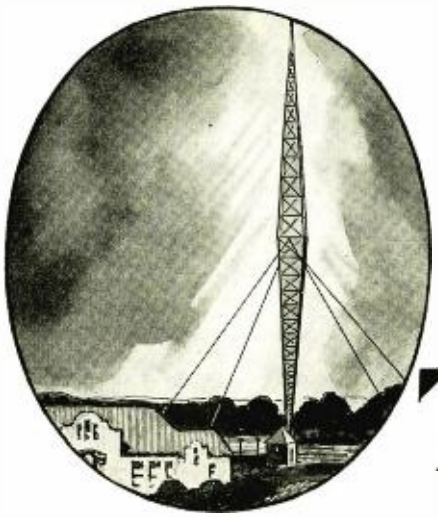

To comply with G. O. No. 116

Western Electric No. 1A Frequency Monitoring Unit

Consists essentially of Western Electric No. 700A Quartz Crystal Oscillator, two stages of screen grid amplification, detector and visual indicator which registers frequency difference between oscillator in transmitter and oscillator in monitoring unit.

. . . install a Western Electric Frequency Monitoring Unit!

General Order No. 116—issued by the Federal Radio Commission—states that before June 22nd all broadcasting stations must be equipped for positively testing adherence to government assigned frequencies.

The Western Electric No. 1A Frequency Monitoring Unit accurately checks the frequency of radio transmitters. It incorporates a precise source of radio frequency energy, which is used as a standard for comparison, and a mechanism for indicating deviation from an assigned frequency.

The No. 1A Frequency Monitoring Unit is engineered by Bell Telephone Laboratories—it is the product of years of experience in the crystal oscillator field. Made to Bell Telephone standards of precision by Western Electric—the world's leading maker of electronic and sound transmission apparatus.

Distinctive Features

1. All apparatus contained in a compact, metal cabinet, arranged for either desk or relay rack mounting.
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3. Improved modern temperature control circuit. New gaseous relay tube avoids use of mechanical relay and danger of overheating. Fixed mercury thermostat requires no adjustment.
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5. Direct audible as well as visual indication of frequency difference is available.
6. Inherent accuracy. Actual frequency difference utilized directly without intermediate steps. Accuracy independent of aging of tubes and input level. Frequency scale open and effectually utilized.

Western Electric

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Gentlemen: Please send me full information and booklet on the Western Electric No. 1A Frequency Monitoring Unit.

NAME .....

ADDRESS .....

CITY ..... STATE .....

Editorial

MARCH, 1932

EMPLOYMENT FOR RADIO ENGINEERS

DURING the year 1931 it was the privilege of RADIO ENGINEERING to find positions in the industry for about sixty men. It is true that the number of engineers in search of work exceeded considerably the openings that occurred. On the other hand there were several calls for men which were not filled because men who met the specified requirements were not available, or were not registered.

The very laudable work now being undertaken by the Institute of Radio Engineers whereby unemployed members of the Institute are given opportunity to register, and at the same time employers are invited to call upon the Institute for men when vacancies develop, will no doubt aid materially in correcting present unemployment conditions throughout the country.

Through the offices of RADIO ENGINEERING a considerable number of employed non-members have during the past year become members of the I. R. E. In a year of general depression this was a strengthening influence, both for the Institute and for the new members.

Employers needing men should register their requirements with Mr. R. H. Marriott, Institute of Radio Engineers, 33 West 39th St., New York. Those who have looked to RADIO ENGINEERING for leads may continue to do so. They shall be given every possible aid.

▲

RADIO IN THE POLITICAL CAMPAIGNS

IN A democratic country private undertakings of a commercial nature which prosper and continue throughout the years to satisfactorily serve the public, usually are managed with statistics, economics and experience as the bases from which are derived the facts which guide decisions. On the other hand, the vast business of government: national, state and municipal, is to a very large extent still managed by men who come to their respective posts of office through the avenues of emotion and passion.

The abilities of orators to inflame and prejudice the great mass of the electorate has in all too many instances placed in public offices which should be occupied by men of sound business training, men who are spellbinders only, or mainly.

Intruding upon this situation radio broadcasting has arrived. At the present time broadcast receivers are in service in more than twelve million American homes. Spared from the spell of gesticulation, heroics, tears and tonsorial effects, voters now may give undivided, undiverted attention to the plain logic of statements. Seekers of office reaching the voters by means of broadcast radio must now convincingly display particular knowledge of the duties and responsibilities of the offices they seek. Divested of opportunity to employ tricks of the stage in developing mass emotion, the office seeker must now address himself to the voter who is comfortably seated in his own home. The voter is in a position to exercise his own intelligence, undeceived by the organized applause of packed audiences.

During the coming summer and fall months radio is almost certain to reach new heights in its onward push to an ultimate destiny.

▲

STANDARD TESTS FOR TUBES

A COMMENDABLE piece of work is that accomplished by the R.M.A., sub-committee on life testing of vacuum tubes. The purpose of setting up standards of test for tubes is that manufacturers of radio receivers, and other purchasers of vacuum tubes, may have at hand practical means of determining the quality of tubes offered for sale.

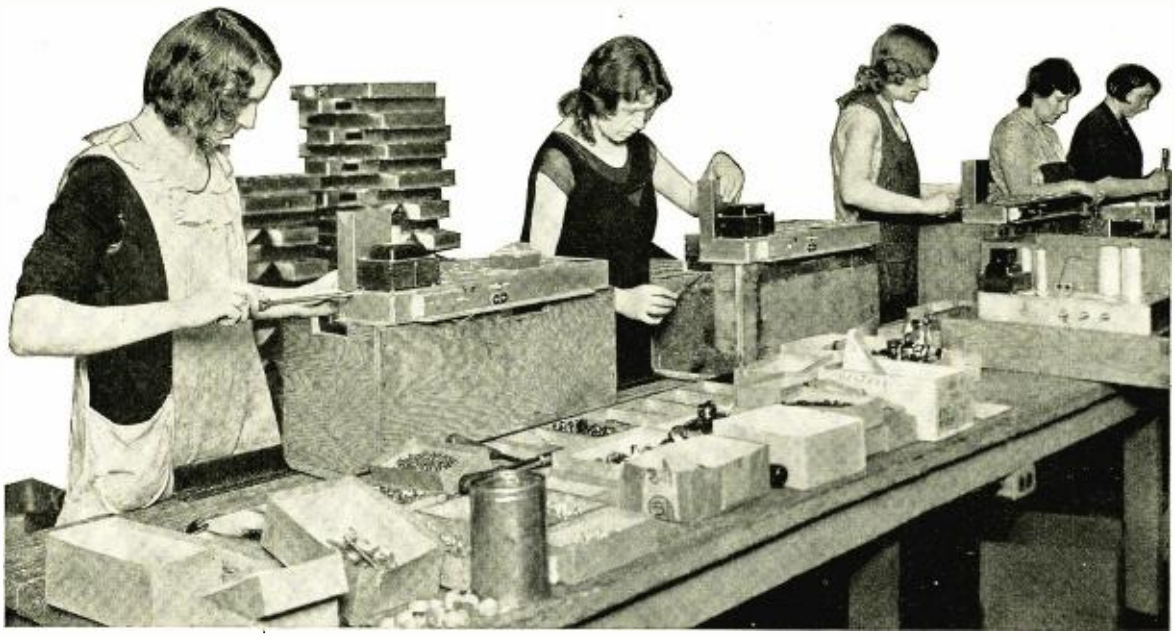
Mr. George Lewis is chairman of the vacuum tube committee, and Mr. George Rishell, chairman of the sub-committee on life testing. It will be a stabilizing aid to tube merchandising if the sub-committee's recommendations, now in the hands of the members for review, are adopted and put into practice by the Radio Manufacturers Association.

Donald McNicol

Editor

To get into Zenith Radios..

Self-tapping Screws had to do more than cut costs



Assembly security as well as economy was required

Zenith Engineers do not compromise on quality... nor did they have to when they adopted Parker-Kalon Hardened Self-tapping Screws to replace machine screws for fastening shields, condenser covers, brackets and other parts to the chassis of their fine 14 tube Automatic Receiver. For exhaustive tests satisfied them that these Screws not only gave them more secure fastenings but actually lowered their assembly costs by 15%. These savings were effected by avoiding an investment in tapping machinery, thereby also eliminating the cost of its maintenance, taps, etc.—releasing floor space for other purposes—reducing the transportation of parts to and from tapping equipment. Send for the interesting booklets "Why Self-tapping Screws make Stronger as well as Cheaper Fastenings" and "Modern Fabrication of Radio Receivers with Hardened Self-tapping Screws". Attach a description of one or more assemblies to the coupon and we will have our Assembly Engineers tell you whether or not you can use these Screws to advantage. It isn't necessary to have a large production to benefit... and you need no special equipment.

Type "Z" Hardened Self-tapping Sheet Metal Screws
For joining and making fastenings to sheet metal up to six gauge; also aluminum, die castings, Bakelite, etc. Simply turn Screw into drilled, pierced or molded hole. It forms a thread in the material as it is turned in. Can be removed and replaced.

Type "U" Hardened Metallic Drive Screws
This type of Self-tapping Screw is used for making permanent fastenings to iron, brass and aluminum castings, steel, Bakelite, Durez, etc. Just hammer the Screw into a drilled or molded hole. It forms a thread in the material as it is driven.

PARKER-KALON *Hardened* Self-tapping Screws

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← Application to well known radios.....Scientists Explain Fastening Security →

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☐ Send free booklets on Security and Uses of Self-tapping Screws in radio assemblies.
☐ Tell me whether I can successfully use them for fastenings described on attached sheet.

Name and Company.....

Address.....

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

▲

This history was begun in the January, 1932, issue of RADIO ENGINEERING, and will be continued in successive monthly issues throughout the year. The history is authoritative and will record all important dates, discoveries, inventions, necrology and statistics, with numerous contemporary chronological tie-in references to events in associated scientific developments. The entries will be carried along to our times.

▼

Part III

1828 (103) Harrison Gray Dyar, in America, erects an experimental telegraph line on Long Island, New York, using a frictional source of electricity and suggests a litmus paper receiving device. Dyar was prosecuted in the courts for attempting to beat the regularly established Governmental mail service.

1829 (104) Joseph Henry, in America, exhibits (March) a powerful electromagnet.

(105) Sir Humphrey Davy dies. (Born in England 1778.)

1830 (106) Washburn and Moen steel wire-guage devised by Ichabod Washburn.

(107) Samuel Thomas Soemmering dies. (Born in Germany 1755.)

1831 (108) Fechner extends the applications of and explains the general significance of Ohm's Law.

(109) Charles Wheatstone, in England applies the word "telephone" to a system of transmitting sound through wooden rods.

(110) Faraday (October 17) discovers how to produce magneto electricity. Later in the same year Faraday observes the discharge from a coil of wire possessing inductance.

1832 (111) Pixii constructs a primitive dynamo electric machine.

(112) Schilling, in Russia, invents a needle pointer telegraph, employing the deflecting power of the electric current upon magnetic needles.

(113) On board the packet-ship *Sully*, sailing from France to America (October 19), Samuel F. B. Morse while conversing with Dr. C. T. Jackson, a fellow passenger, first discusses the possibility of an electric telegraph.

1833 (114) Saxon, of Philadelphia, constructs a primitive electric motor.

1834 (115) Gauss and Weber, in Germany, conduct experiments with a short telegraph line.

(116) Thomas Davenport, a blacksmith, of Brandon, Vermont constructs an electric motor.

(117) Peltier's Law announced, to the effect that: "If a current of electricity from a battery or other source of direct current be sent through a junction of several metals, heat is absorbed at some junctions and emitted at others; the emission and absorption being reversed by reversing the direction of the current, the quantities of these thermal actions being proportional to the current strength."

(118) Lenz's Law announced, stating: "In all cases of electromagnetic induction the induced currents have such direction that their reaction tends to stop the motion which produces them."

(119) Jacobi, in Russia, constructs an electric motor.

1835 (120) Thomas Davenport, employs an electric motor to move a car.

(121) Morse's first demonstrations of telegraphy were made during this year.

1836 (122) John Frederic• Daniell, in England, invents a two-fluid type of primary battery, employing a porous cup to separate the fluids—sulphate of copper and dilute sulphuric acid—the elements employed being copper and zinc.

(123) Ampere dies. (Born in France 1775.)

1837 (124) William Robert Grove introduces nitric acid as an electro-negative fluid, or depolarizer, more powerful than copper sulphate as used by Daniell. A platinum negative element was used to withstand the destructive action of the nitric acid. (Grove cells were used in the operation of the early American telegraph lines.)

(125) Pouillet simplifies the operations of Ohm's Law.

(126) Edward Davy, in England, publicly operates a needle telegraph.

(127) Cooke and Wheatstone, in England, procure a patent (June 12) for a needle telegraph employing six wires and five needles. (The United States patent was granted June 10, 1840.)

(128) Morse gives a demonstration (September 2) of his electromagnetic telegraph at New York University.

(129) Morse's caveat prepared and signed October 3, and filed in the patent office on October 6.

(130) Masson's telegraph invented, employing magneto electricity and a deflecting needle.

(131) Steinheil, in Germany, employs the earth as the return portion of an electric circuit.

(132) Dr. Charles G. Page, in America, discovers that a bar of iron can be made to emit sound when rapidly magnetized and demagnetized.

(133) Jacobi, in Russia, propels a boat on the river Neva by means of an electromagnetic "engine."

(134) Alfred Vail, of Morristown, N. J., Morse's assistant, announces (September) the invention of a printing telegraph system.

1838 (135) The *Sirius* and the *Great Western*, the first steamships to cross the Atlantic ocean westward, reach the United States from England on April 23.

(136) Robert Davidson, in Scotland, employs an improved electric engine with four revolving armatures to draw a car sixteen feet long and four feet wide. The battery used consisted of forty iron and zinc elements. The total weight of the car and battery was five tons, and the speed attained four miles per hour.

(137) Faraday predicts that the retardation of electric impulses in a long underground or submarine cable will be found to be due to electrostatic capacity.

(138) Copper-plate reproduction of prints developed by Jacobi, in Russia, and simultaneously by Spencer, in England.

(139) Prof. Page, in America, makes important improvements in the electric engine.

(140) Cooke and Wheatstone erect the first commercial telegraph line in Europe, that between London and Birmingham.

(141) Morse gives an exhibition (January 24) of his improved electromagnetic telegraph over a ten mile circuit of coiled wire at New York University.

(142) Edward Davy, in England, perfects and patents his needle telegraph system (July).

1839 (143) Wheatstone, in England, patents his dial telegraph.

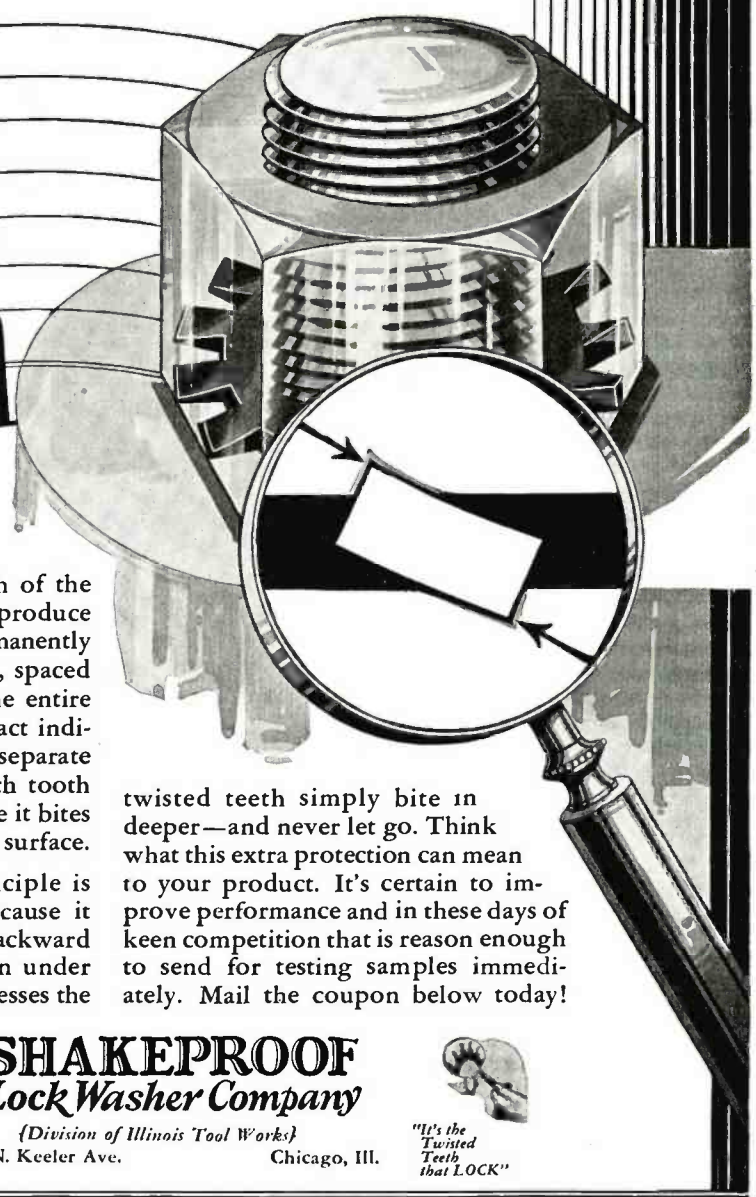
(144) A telegraph line is erected between Paddington and Drayton, England.

(145) Aurora borealis disturbances throughout the world (September 3) interfere with the operation of existing telegraph lines.

(To be continued)

SHAKEPROOF

Multiple Locking Defeats Vibration



THE patented twisted teeth of the Shakeproof Lock Washer produce a locking force that assures permanently tight connections. These teeth, spaced at regular intervals around the entire circumference of the washer, act individually to form a series of separate locks. And what's more—each tooth is a double action lock because it bites into both the nut and the work surface.

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1,604,122
1,697,954
1,782,387
Other patents pending.
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Type..... Size.....

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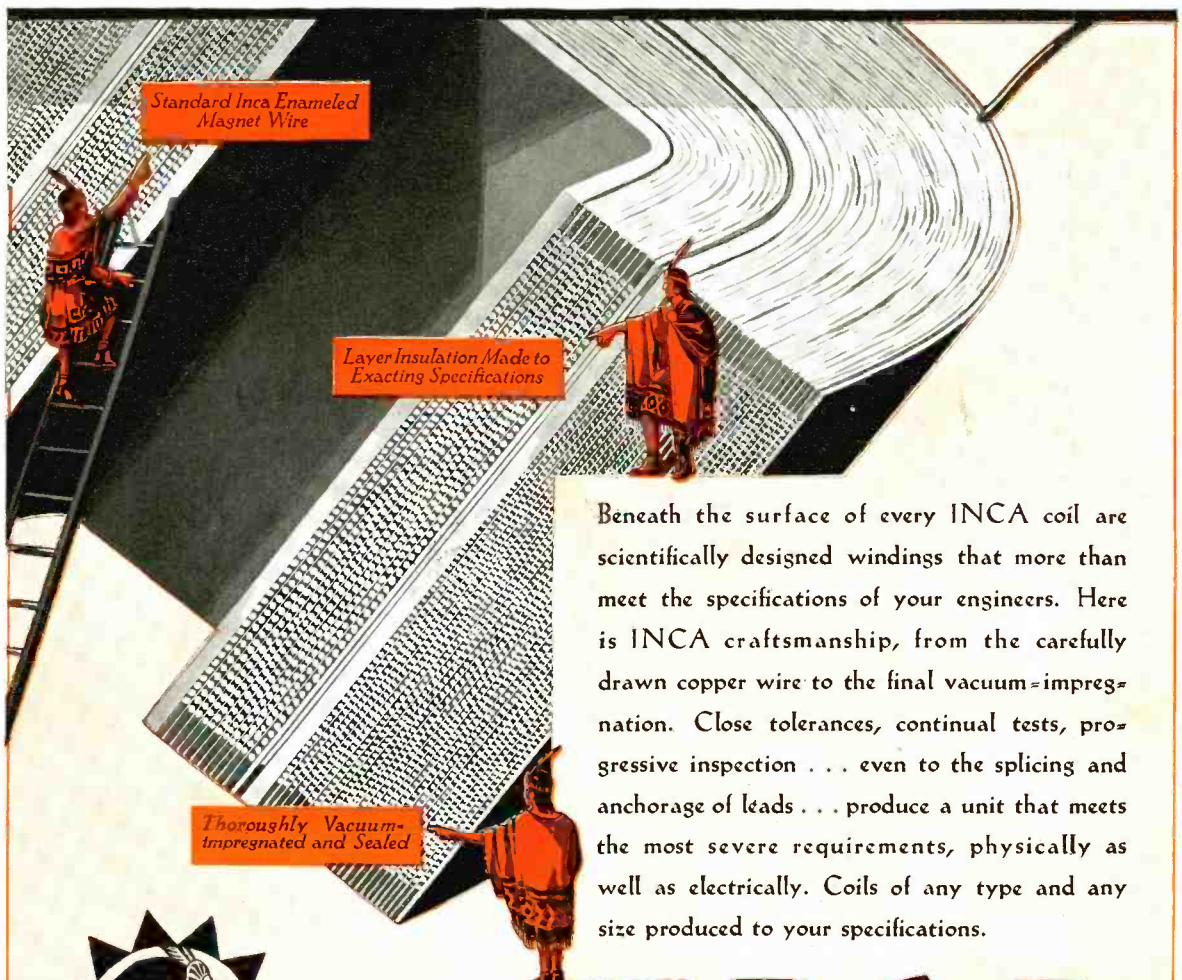

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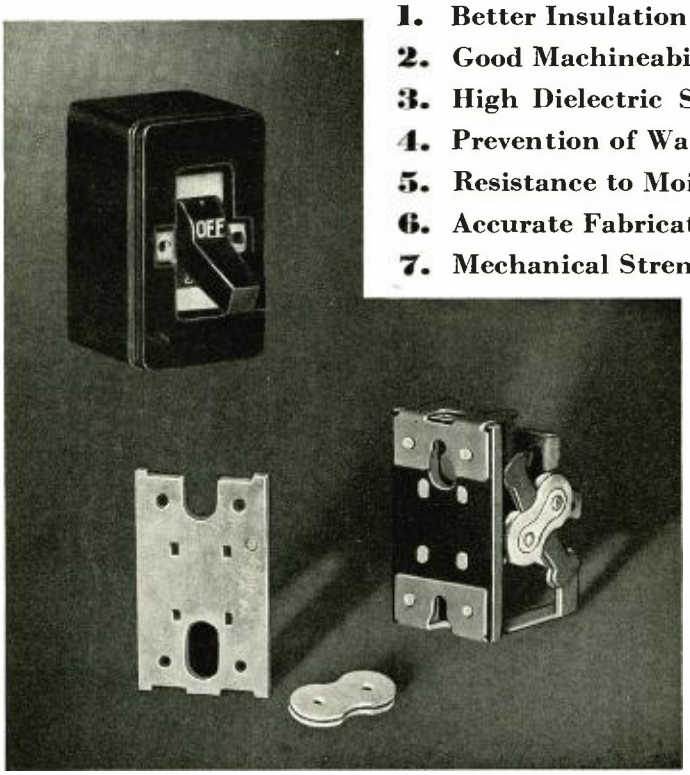
Seven Reasons Why this Switch Is Insulated with Textolite



Illustrating the insulating pieces, fabricated from Textolite laminated — the rear view of the Trumbull tumbler switch, showing how the fabricated parts are used — and the switch complete with its black Textolite-molded case

1. Better Insulation
2. Good Machineability
3. High Dielectric Strength
4. Prevention of Warping
5. Resistance to Moisture
6. Accurate Fabrication
7. Mechanical Strength

HERE are seven good reasons why the Trumbull Electric Manufacturing Company, Plainville, Connnecticut, changed to Textolite laminated for insulating its No. 7470 panel tumbler switch and other devices.

Textolite laminated is a General Electric product manufactured in sheets, tubes, and rods to meet the demand for better insulation in the electrical field and to supply a material of inherent beauty and mechanical strength in the industrial field.

Study the possibilities of adapting Textolite laminated to your product. You may be able to effect great savings for your company.

We shall be glad to send you a copy of our bulletin, GEA-1458. Simply address General Electric Company, Plastics Department, Meriden, Conn.

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GENERAL ELECTRIC

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RADIO ENGINEERING

Production, Administration, Engineering, Servicing

MARCH, 1932

Progress in television

By JOHN DUNSHEATH

IT has long been understood that the transmission and reception of moving pictures by radio by means of the transmitting and receiving gear so far in use will not produce entertainment results measuring up to popular requirements. The advent of home movies, and disc record reproduction through audio amplifiers and loudspeakers have not only served to tide over the period of waiting for television, but have established a generally accepted standard of entertainment value.

While television in the home will stand in relation to home movies about as broadcast radiophone reception stands in relation to the phonograph, the fact remains that such television as we have had in the past has lacked the perfection of development which telephone broadcasting attained shortly after its popular introduction in 1920.

True, the economic situation during the past two years has been such that purchasing power for television sets, as for other like conveniences, has been at a low ebb; not of a volume that would support the necessarily large expenditures on the part of manufacturers and of television broadcasting organizations.

There is now, however, improvement in two important respects. The general industrial index indicates improvement in business; in employment and, in time, purchasing power. Also, the passing stagnation of economic depression has served to invite thought in the direction of new ideas, new products and new facilities. In the year 1921 radio broadcasting lifted the country out of a deep valley of depression. Television as a by-product of radio is now viewed as a promising avenue along which concerns engaged in the electrical manufacturing arts may proceed with hope of some degree of industrial success.

Following a great deal of experimentation and of laboratory development television has progressed to a stage where the Radio Manufacturers' Association has prepared recommendations for the Federal Radio Commission's consideration, and for presentation as a subject at the International Communications Conference to be held in Madrid, Spain, in May this year. Chiefly, these recommendations concern frequency allotments. The desire appears to be to aim for the 2,000 kc., channels in the 35 to 85 megacycle band. It is thought that these frequencies would permit of detail of real entertainment value, and would perhaps reduce fading and blurring charged to indirect rays from the ionized layer of the upper atmosphere. Also, many more transmitting stations could be accommodated in a given zone.

Non-Radio Transmission

For some time engineers have been at work on a variety of transmission systems for television which contemplate employing ultra short waves, and beam carriers of the order of light rays. From the research department of the General Electric Company comes word that it is practicable to transmit images on a wavelength of a billionth of a meter. Transmission of this kind would have utility in sending pictures from a radiating system operating from towers of such height as to give direct beam coverage over a radius of, say, fifteen miles. It is quite possible that within a few years television services will be operated by various methods. For strictly local needs direct ray or powerful light arcs may meet many needs and cover a wide range of services. Obviously, of course, television will not be complete until its range is practically that of present-day broadcast stations.

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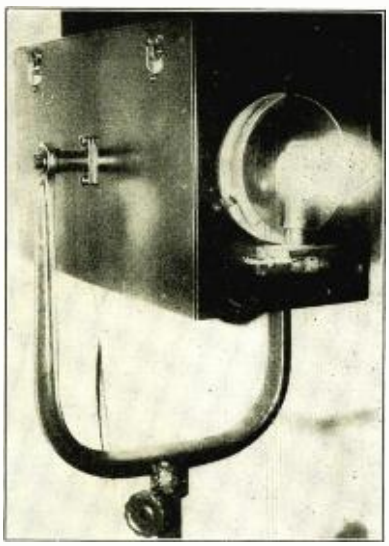
The present widespread attack upon the technical phases of television are likely to bring about noteworthy improvements within the year



Adjustable photoelectric cell unit employed for flying-spot pickup.

The General Electric Company's station WGY began transmitting television signals on a regular schedule nightly beginning May 10, 1928, enabling experimenters working on a 24-line picture to test their equipment. In the same year WGY, for the first time anywhere, broadcast a television drama, using the broadcast channel for the picture signals and simultaneously a short-wave channel for the voices of the actors. In August, 1928, engineers experimented with the first remote control television pickup, the picture of Gov. Alfred E. Smith, as he delivered an address accepting the Democratic nomination to the presidency.

The WGY Players, the oldest group on the air, was organized in April, 1922, and since that time the players have been heard nearly every week.

During the past two or three years the number of stations sending out television signals has grown to more than thirty, most of these on part-time schedules. The experience gained in these operations is pointing the way toward improvement. The difficulties of the undertaking are of such magnitude that in no other way could such noteworthy improvement have been accomplished as is now in evidence.

Engineers in general are not inclined

to tie television of the future too closely to what is possible with present-day apparatus. There are open minds for entirely new ideas and inventions. Quite practicable foundations have, however, been laid, and upon these systems will be constructed and installed which will in some measure approach in performance what most persons have in mind. There are those who favor the employment of cathode ray tubes for oscillographic scanning, and along this line worthwhile progress has been made. This, notwithstanding that disc scanning is more widely used. At the moment 1,200 r.p.m., 20 frames per second, 60 lines per frame, is a popular combination.

De Forest-Jenkins

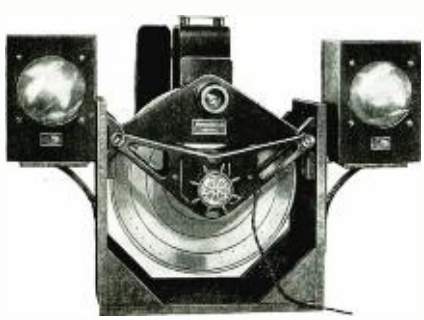
After a very considerable amount of pioneer work in television, the Jenkins Television Corporation has in admirable fashion continued to live through a prolonged unproductive period; experimenting, improving and exploiting, until now, backed by the resources of the De Forest Radio Company, it would appear that the company is in a good position to play a large part in the expansion of this new art. Stockholders of both the DeForest Radio Company and the Jenkins Television Corporation are being asked by their joint president, Leslie S. Gordon, to approve a sale of Jenkins assets to the DeForest Company by an exchange of stock whereby to effect the cancellation of inter-company indebtedness, a liquidation of the Jenkins corporation, and the expansion of the present DeForest company under the corporate name of De-Forest-Jenkins Radio & Television Corporation. Although both companies have been operating as separate entities, DeForest owns a controlling interest in Jenkins, acquired several years ago by exchange of stock.

In the statement issued to Jenkins Television Corporation stockholders, Mr. Gordon points out that the commercial development of television has been slower and more costly than was originally contemplated. Extensive and constantly extending activities have had to be carried on, as well as the maintenance of experimental television transmitting stations in order to insure for the company a proper place in television broadcasting should its commercial status be granted by the Federal Radio Commission.

Complete home receiver equipment, DeForest-Jenkins, for sound pictures.

In keeping with the changed financial outlook in general, as well as taking into consideration the activities of others in the television field, the valuation of Jenkins patents has been set at $2,000,000, as reflecting a more conservative view of their value and one which would justify the DeForest company in offering to purchase the Jenkins corporation's property and assets on the basis of one share of De Forest stock for two shares of Jenkins stock, according to Mr. Gordon.

"The management feels that, due to the advancement of the art and the public interest in television, the developments of the Jenkins corporation are about to bear fruit, and that it is necessary to protect the investment by insuring the future of the Jenkins corporation's assets, this being best done by combining the business of both companies in one corporate body.

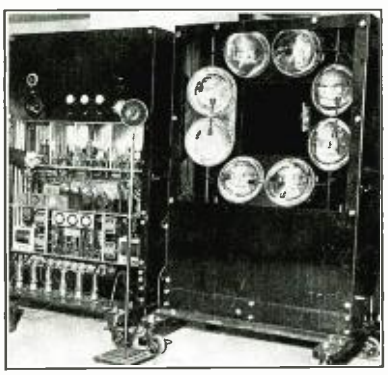


The Western Television Junior transmitter.

Western Television Corporation

Nothing could more conclusively point to the accelerated exploitation of television service than the present activities of the Western Television Corporation. Competent management and competent engineering have given this company commercial advantages which are aiding greatly in furthering the introduction of popular television.

Such transmitting stations as those of the *Chicago Daily News, Chicago Tribune, Milwaukee Journal, La Presse, Montreal,* Fairfax Air Port, Kansas City, and stations W9EXM and W9GHP, Chicago, are to operate with Western Television Corporation equipment. The company is marketing a junior transmitting outfit to sell for $250, and a receiving kit to sell for $59.50. The transmitter consists of five integral parts, completely mounted for use: a high-powered 1,000-watt lamp; a specially developed 45-hole scanning disc; a powerful 900 r.p.m. synchronous motor; an optically fine projection lens; a pickup unit consisting of two 6-inch super-sensitive photocells. Commercial activity of this order puts the matter squarely up to those who desire to participate in the introduction of television and who desire to keep pace with progress.



Sanabria's transmitter, amplifier and photocell frame.

Shortwave and Television Corporation

This company, of which Hollis Baird is chief engineer, has carried on consistent experimentation with cathode ray scanning. The cathode ray tube has a large flat end from which the glass tapers down like a cone to a small end. Here are produced the cathode rays, literally a beam of concentrated electrical energy which is affected by outside electrical influences as though it were made of metal, which travel across the flat end of the tube until it has been entirely covered by this beam.

Trying to swing a metal "pencil" back and forth would bring the problem of momentum and inertia of the swing-

ing rod, but the cathode ray beam has no inertia and can be swung as rapidly as desired. When this beam hits the flat end of the tube, it plays upon a coating of material which gives a light as long as the beam is hitting it. By applying an alternating current on either side of the beam through metal plates, the beam is made to swing back and forth rapidly. A similar but much slower current moves it gradually downward. The effect is then a complete coverage of the end of the tube just as one's eyes scan the page.

To get the different shades of light and dark in order to reproduce the picture, the beam is modulated at its source so that it hits the tube end with varying intensity which in turn produces more or less light as the beam sweeps across the end of the tube.

The problems of reducing this method of television to practice have been the need for getting an end surface coating which would give still more light and a means of modulating the beam to get better picture detail contrasts. Considerable progress has been made in the solution of both problems.

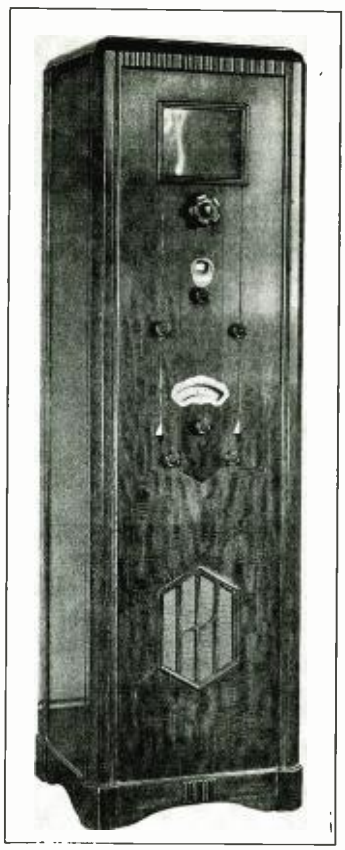
Little has been written about cathode rays for transmission, but this same swinging beam can be applied to a tube which, in place of the light-producing coating previously mentioned, is coated with a light-sensitive substance.

The end of the tube then may be compared with a photographer's plate. A lens is used to focus the desired scene upon the end of the tube. Then the cathode ray beam is started swinging back and forth, travelling downward, scanning the end of the tube. The beam in this case acts as a carrier of impressions and as each point on the tube end is touched, the amount of light focused there regulates the beam. By the proper application of this method in a circuit, a series of impulses carrying the picture, is obtained. This can then be transmitted and when applied to a cathode ray receiver at the other end will reproduce the picture focused on the tube at the transmitter.

Freed Television and Radio Corp.

Should the Federal Radio Commission accede to the requests of television interests and allot the waves between 35,000 and 80,000 kilocycles for television transmission it will permit of almost complete coverage of the nation without overlapping or interference, it is pointed out by Joseph D. R. Freed, experimenter in the field of radio and television and chairman of the board of the Freed Television and Radio Corporation. Absence of overlapping and interference is possible because of the quasi-optical nature of short waves in the waveband between 35,000 and 80,000 kilocycles, i. e., the signal will carry just as far from the transmitter as the eye can see. This is theoretically true, although some experiments indicate that the maximum distance over which such television signals transmitted on the quasi-optical waves may be slightly greater, and possibly up to about 50 miles. It is this attribute of the quasi-optical waveband that makes it possible to allocate the exact same wave on a full-time basis to stations located only 200 miles apart from each other.

With the exception of the waveband between 56,000 and 60,000 kilocycles,



Combination sound and picture receiver of The Trav-Ler Radio & Television Corp.

which has already been allotted to amateurs, the band requested by the television interests is available for television transmission. Thus we have cleared channels over a band 41,000 kilocycles wide. Mr. Freed states that it would be possible to have 20 stations serving each city area, presupposing that these stations would be permitted a band 2000 kilocycles wide. (Television stations now are permitted bands—100 kilocycles wide.) There are approximately some 600 stations on the air, broadcasting sound at the present time. Only a small portion of these have been allotted full time.

It is therefore very easily seen that the waveband requested by the television interests would permit of ample facilities for years to come for sound and visual entertainment. Moreover in this waveband it is planned to place sight and sound on adjoining carrier waves without interference, a condition at present impossible on the longer wave television channels used today.

It is announced that the Hotel New Yorker, New York, is to be equipped, in each de luxe suite, with a built-in loudspeaker and a small screen on which pictures will be projected from a complete television receiver built into the wall of the room.

Philco Television

The Federal Radio Commission has granted a permit for the Philco Radio Company, Philadelphia, Penna., to operate an experimental visual broadcasting service. The Philco Company is reported to be carrying on experimentation with the Farnsworth system of television, and, perhaps, with other systems. The interest of one of the largest manufacturers of radio receivers in extending the utility of television is significant.

Station WINS

Radio broadcast station WINS, New York, of which W. H. G. Finch is chief engineer, is now on a schedule daily from 3 to 5 p.m., presenting programs synchronized on television, within the broadcast band. The station is synchronized with W2XCR.

Combination Broadcast and Television Receiver

The Trav-Ler Radio & Television Corp., of St. Louis, Mo., has placed on the market a combination broadcast and television receiver which no doubt will have an appeal to radio listeners-in. The receiver contains two chassis. One, a short-wave unit to receive television signals and a superheterodyne unit to receive programs on the broadcast band. The picture is projected on a screen approximately 7 by 8 inches, which may be viewed from an angle. The Taylor arc lamp is used to project the picture in conjunction with a lens scanning disc driven by a synchronous motor.

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CROSLEY

CROSLEY RADIO CORPORATION reports net profits of $21,166 after taxes and charges in the nine months to December 31. This was equal to 4 cents on the common, compared with net loss of $445,958 in the like period of 1930. For the December quarter the net profit was $82,118, equal to 15 cents a share, compared with $84,005, or 15 cents a share, in the preceding quarter and $77,521, or 14 cents a share, in the December quarter of 1930.

Acoustic feedback in superheterodyne receivers

By Edgar Messing

MUCH has been written of the acoustical feedback or howl that may occur in superheterodyne receivers. The possibilities of this feedback occurring through the vibration of the plates of the oscillator tuning condenser have been extensively discussed, but little has been said of practical cures. It is the purpose of this article to present two methods that proved the only remedies to a particularly bad case offered by an all-wave superheterodyne.

Howl, without the many descriptive adjectives that were applied, is very easily created in a short wave superheterodyne regardless of whether the set is a straight superhet or an all-wave converter combination. The reason, of course, is that even a slight vibration of the oscillator condenser plates causes a large frequency change.

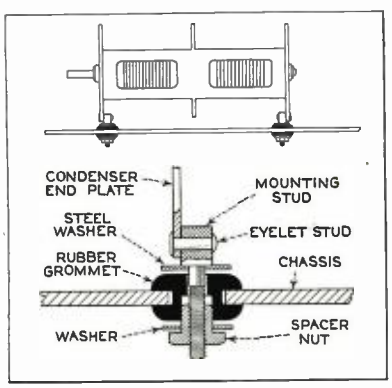

Fig. 1. Mounting of floating condenser.

The problem was encountered in the design of a converter which was to be part of an all-wave combination.

The first model incorporated a floating condenser as a matter of course; Fig. 1 shows the mounting used. But it was quite obvious that a real problem existed. With the broadcast set but two feet away there was serious feedback on only moderately strong signals. While it was possible to float the condenser even more liberally it is not advisable for short wave tuning. Additional tie-bars on the stator plates to make them more rigid contributed little or nothing.

The next step was to increase the number of oscillator condenser plates and the spacing between them. This was a great aid and seemed the complete solution. No howl was experienced on strong signals even with the b.c. set very close to the converter.

The trouble started all over again, however, when the converter and broadcast receiver were placed in the same cabinet. Reception was almost impossible; the howl began as soon as a moderate signal was heard and often started from noise level reception alone.

It was, of course, evident that the proximity of the speaker was causing the trouble. A suggestion that the variable condenser be put in a sound-proof room was immediately put into practical use. A steel cover was put over the condenser as in Fig. 2 so as to insulate it acoustically. This resulted in great improvement; only on very strong signals was it possible to create a howl. Heavier covers on the condenser were attempted but the gain was negligible.

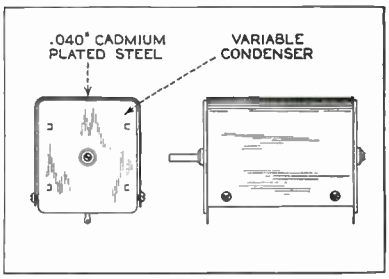

Fig. 2. Condenser with steel cover.

Since the condenser was insulated from direct air pressure variation the only other source of vibration would be through the unit as a whole or through the chassis. It was not possible to float the chassis due to the method of mounting but it was possible to float the speaker and this was done as illustrated in Fig. 3. While somewhat simpler methods were later adopted in production the figure shows the generic scheme.

The sponge rubber strip under the periphery of the speaker served as a baffle but insulated the cabinet so that no speaker vibration could be transmitted to the cabinet. The scrollwork comprising the speaker grill was reduced to a minimum. Howl was completely eliminated, and in production sets in which feedback was reported, was found in almost every case to be due to tight speaker clamping which would render the rubber useless.

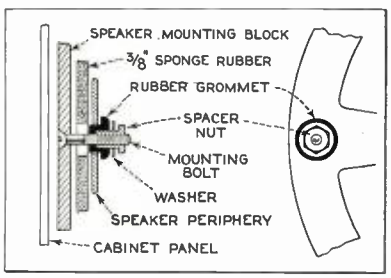

Fig. 3. Mounting for floating loudspeaker.

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Royal Canadian Signals operating twenty-seven radio stations

The Royal Canadian Signals, during the fiscal year ended March 31, 1931, had in operation twenty-seven radio stations throughout the Dominion of Canada. A new station was placed in operation at Fort Norman, N.W.T., during that period. The total number of messages sent including government and commercial was 47,850. Receipts were as follows: Gross $47,383.06 and Net $3,797.88 (Report of the Canadian Department of National Defence, Ottawa, covering Militia and Air Services for the fiscal year ending March 31, 1931, as transmitted by Commercial Attaché, Lynn W. Meekins, Ottawa.)

Dual loudspeakers for broadcast receivers

By W. Austin Ellmore*

THE increasing public demand for better tone quality, relayed to the receiver manufacturers through sales channels, has given radio engineers something to think about. There is still something to be done in the r-f., detector, audio, "B" power supply and speaker of the receiver. Much effort has been expended to lessen frequency discrimination in both sets and speakers, and during the past few years quality has been greatly improved. Further improvements may be hard to obtain, for apparently few seem to know just what is necessary. Tone quality in any receiver is determined to a large extent by the ultimate user or consumer. The writer recently had occasion to have a number of people individually tune and adjust the tone control on a t.r.f. receiver of very flat overall characteristics. All except one turned the tone control to a point where a little above 3000 c.p.s. was being heard. However, from an engineering point of view, the manufacturer cannot afford to produce sets without high response, and must continue to provide tone control for the many who want it.

A single speaker can be made to cover a band of frequencies wide enough to please most listeners, but it still leaves much to be desired from the engineering and, at present, the sale point of view. The average purchaser favors a predominance of low frequency, if it can be produced without the "boomy" or resonant characteristic with which we are so familiar, and this is difficult to produce with but one speaker.

There are several ways of approaching the desired result with two speakers, and two of these methods will be described briefly:

Case No. 1. The use of one small speaker for highs and one larger speaker for lows; or,

Case No. 2. The use of two speakers of the same general characteristics, whether or not the same in size.

Utah Products Co.

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Improved tone range warrants the use of two loudspeakers where best quality desired.

Let us consider first case No. 1 in connection with the following important facts:

(a) Transmission lines on network programs are equalized for average frequency band of 50 to 7000 c.p.s.

(b) Many popular sets are "supers" with the audio frequency range cut off sharply at 5000 c.p.s. on the high end. If they were not, hiss and background noise would be predominant.

(c) Cabinets are of such size that little fundamental low frequencies are reproduced below 100 to 200 c.p.s. depending on size of cabinets used.

(d) The average broadcast listener uses the set with tone control adjusted to cut high frequencies.

Apparently, then, it is useless to produce speakers, dual or otherwise, which reproduce 30 or 10,000 c.p.s. with the same pressure output as at 1000 cycles. However, by using one speaker designed to give good low response (80 to 1000 c.p.s.) and another one for good high response (1 to 6 or 7 thousand) a much more natural quality of music is produced, due partly to having two sources of sound instead of the usual single source.

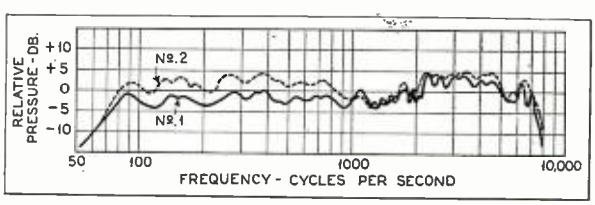
It is not advisable to try to use a large, low resonance speaker in conjunction with a small, high resonance speaker with overlapping middle ranges. In the region between the two resonance points, the pressure outputs are out of phase, and the response is decreased. Since in the popular price class the manufacturer cannot afford more than one audio channel, it becomes necessary to introduce a filter in the output circuit (between the power tubes and speaker) to admit the desired frequency band to each speaker. This in practice is hard to accomplish well and cheaply. The method, then, seems better adapted to the higher priced radios in which two audio channels can be used, with the filtering done in the grid circuits of the tubes.

Case No. 2. Referring to points (c) and (d), in case No. 1, let us consider two speakers of the same size with identical frequency response. Instead of increasing the frequency range, this method produces a relatively greater pressure in the low frequencies than in the highs, as compared to the response of a single speaker. Curve 1 shows the frequency response of a popular 8-inch speaker, in a medium size console cabinet. Curve 2 shows the same speaker with another of identical characteristics mounted on the grill beside it. An increase in pressure output of approximately 4 to 5 db. is obtained in the region of 80 to 900 c.p.s. Similar results are obtained by using one large speaker in the combination, and on ear test many have chosen this arrangement.

The manufacturing problem becomes more involved, as tests must be made for polarity between field and voice coil in order that the pressure outputs of the speakers may not be out of phase when installed in the receiver cabinet. It is quite necessary in most installations that the voice coils be connected in parallel, because a series hookup will feed most of energy into one speaker at its resonance point, if the two are not absolutely identical.

Many manufacturers have tried to use dual speakers without chassis or cabinet changes. Of course, this is to be expected in something that has sprung into prominence over night. Particular reference is made to the fact that adequate power for field supply has not been available in most of these cases. Best results cannot be produced when the fields of the speakers are operated so far under normal rating due to the prominence of the resonance peak, especially in conjunction with pentode tubes. With the 280 tube well up to its maximum load in many sets, it seems rather difficult to provide the extra 5 to 8 watts necessary. A number of tube manufacturers are considering the 580 (mercury vapor 280) as an aid to the solution of this problem. Of course, this necessitates drawing a few more watts from the power transformer, and means a few cents added to its cost. Even though we do not consider the actual improvements produced by the dual speakers, and are concerned only with the sales advantage, the extra expense involved may be warranted in added sales points.

Loudspeaker response curves.



Television progress from an engineering viewpoint

By Dr. Paul G. Weiller

Here is an analytical review of the engineering elements of present-day television. The way is pointed toward the most promising line of development.

OF the many methods of television proposed and tried, four different systems have had some measure of success.

These are the well-known pinhole scanning disc with the plate lamp; the lens scanning disc with a point source of light, recently dubbed "crater" lamp; the mirror wheel with crater lamp, and, the cathode ray tube system.

Most of the "television round the corner" prognostications are predicated upon the possibility of improving one or another of these systems to a point where the images obtained will be good enough to offer reproduction of entertainment value.

It is a peculiarity of some television sponsors that they look too far ahead —to television as perfect as sound broadcasting has become. Most of them overlook the fact entirely that some modest results will be obtainable by common sense improvements in present equipment without waiting for as yet uninvented devices.

In keeping with this trend of thought most of the discussions deal with attempts to increase detail in the picture by increasing the number of lines. That is, of course, difficult and accounts for much of the delay in making use of what is now practicable in the way of television.

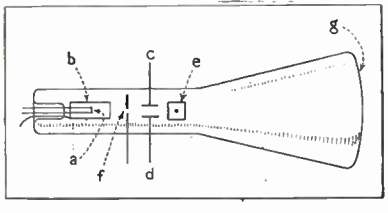


Fig. 1. Cathode ray tube.

If we try to free ourselves from a natural desire for sensational developments; and if we attempt to analyze from a purely common sense point of view what has been achieved and how much improvement would be essential to sell a reasonable number of sets to the public for say $150 each, the outlook is not hopeless at all, but the road to immediate progress most certainly does not lie in the direction of more lines and more detail in the picture.

More Light Intensity Needed

In examining the performance of commercial television sets, or even laboratory models, two general defects stand out markedly; particularly if the looker-in is one of the host of good citizens not having perfect eyesight. One is the fact that there is not nearly sufficient light for comfortable observation, the other is caused by the prevalence of interference.

There is no use worrying about image detail when there is not enough light to see the object, and so long as there is enough interference to destroy detail anyway.

The road to practical improvement therefore must be found first in the direction of providing more light for the receiver, then more power for the transmitter to overshadow the bulk of interfering signals. The latter is, of course, a matter concerning the transmitting station alone and is tied up with the selling of time for advertising purposes to defray the increased expenses of larger transmitters.

So far the Radio Commission has turned a deaf ear to all requests for permission to sell time.

More light from the receiver is not easy to obtain. The customary 1-inch square neon lamp as operated usually is, roughly, a five watt lamp. If we divide the surface of the lamp into elements the size of the scanning holes we are looking at each plate element only during 1/72000 of a second. As it takes an appreciable time for the retina of the eye to accept the image, and this time is longer than 1/72000 of a second we do not see the lamp in its full brilliancy. The resulting brilliancy might be that equivalent to a one watt lamp or less. That is not much light at best. The dimming effect of high speed scanning can be best observed on a lens disc receiver. With the disc standing still the image of the crater lamp on the screen is a very bright spot. If the disc is slowly rotated by hand with sufficient speed to trace subsequent lines on the screen the luminosity of the image decreases to a surprising extent. From these considerations it is clear that the luminosity of the light source would have to be increased by several hundred per cent. to give comfortable light intensity in the picture.

Lens Disc Systems

The lens disc outfits in general have a more promising reputation. It is true that the entire surface of the luminous discharge in the lamp, or nearly, is used. The greater distance of the lamp from the scanning disc and screen, the

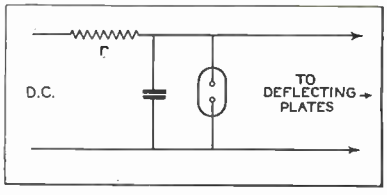


Fig. 2. Oscillator system.

absorption and diffusion of light by the screen and the spreading of the image over a large surface offset a good deal of the advantage gained by concentration of the light source and the greater aperture of the lenses compared with the pinholes.

The result is a larger image which can be viewed by several persons simultaneously, but again there is not enough light for comfort. The lens disc as a receiver element suffers also from the fact that it is impossible to use very good lenses because of their price, size and weight.

The lens disc offers great possibilities for commercial, large scale outfits for theatres where cost and bulk and complication are not a stumbling block. In this field we have seen the only case where television has been quite satisfactory.

The mirror disc did not find many sponsors in the United States, largely

because of mechanical difficulties. There remains the so-called cathode ray tube.

Cathode Ray System

"Cathode ray" is a misnomer. The moving element in the tube is not a ray but an electron stream. It is important to consider this in judging the possibilities of the tube for television.

If this element were a beam of light which travels in a straight line and produces a sharp and accurate image at its end, the cathode ray tube would offer such advantages over all other methods of image synthesis that we would be warranted in concentrating all efforts on its adaptation for television.

This is however not so. The natural tendency of an electron stream is to spread and not to concentrate in a spot.

Stray charges on the glass may cause electrons to travel in a most erratic fashion instead of in a straight line.

The accuracy of this method is no greater than that of the mechanical methods, probably not so good. It has, however, the advantage of no moving parts, and what is more important, more light.

The images on the screen of a cathode ray tube are of sufficient intensity to be viewed in a dark room without much eye strain. The tube is a modified Braun tube. The glass envelope is funnel shaped, 3 or 4 inches in diameter at the wide end. In the neck there is the electron source "a." A 227 heater of one-half standard length is quite suitable. "b" is a metal cylinder kept at a high negative potential. This is essential to concentrate the electron stream in a narrow thread. "f" is the anode connected to a source of 2000-volts modulated by the receiver output. "c" and "d" and "e" are two pairs of plates, each pair being placed at right angle to the other.

If an a-c. voltage is placed on one pair of plates the electron stream will be deflected, its direction being at any instant a function of the instantaneous voltage on the plates. The end of the stream will trace a line on the fluorescent screen at the wide end of the tube. The length of the line will depend, all other conditions equal, upon the voltage applied to the deflecting plates.

If the frequency of the voltage applied to one set of plates is sixty times that of the other set the electron stream will trace sixty horizontal lines across the screen. For television purposes the stream must cross the "frame" with the same speed as that of the scanning beam at the transmitter and must return to starting position within a negligible time.

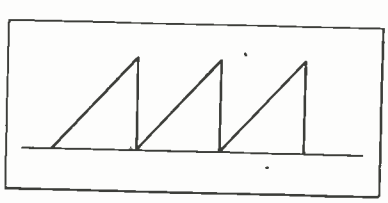


Fig. 3. Saw-tooth waveform.

The waveform is called "saw tooth" as represented in Fig. 3. Such oscillations can be produced conveniently by an oscillator of the general description of Fig. 2. The tube in the diagram is a cold cathode gas-filled one, the ordinary flat plate neon lamp being fairly suitable for the purpose.

Fig. 4 shows the same circuit but the gas tube is replaced by a hot cathode grid controlled rectifier. Operation is the same in both cases. The condenser is charged through resistor "r." When the ignition voltage is reached the discharge starts, but is extinguished when the condenser voltage becomes lower than the extinction voltage.

The output of such a combination is entirely dependent upon the difference between ignition and extinction voltage, and the capacity of the condenser. Neon lamps become luminous at about 150 volts. The extinction voltage is apt to vary from lamp to lamp. 130 volts is a common value.

With a grid controlled mercury rectifier the extinction voltage is always approximately 15 volts; the ignition voltage depends only on the grid bias and can be made several thousand volts if necessary.

The frequency is a function of resistance and capacity in the circuit. The duration of the vertical part of the saw-tooth voltage curves depends on the resistance of condenser and tube. It is instantaneous for our purpose.

To obtain a sharp image on the fluorescent screen the electron stream must be narrow and produce a small spot with a sharp outline on the screen.

Gas Tubes

In a high vacuum electrons will scatter instead of forming a thin stream. It is therefore necessary to introduce a minute quantity of gas into the tube to partially offset the effect of the space charge. The pressure must be high enough to produce some ionization, but not high enough to neutralize the space charge entirely.

The proper pressure varies according to the kind of gas used and other conditions, but it is not far from 1/1000 of a millimeter mercury. At this pressure the tube will stand the few thousand volts on the anode necessary for proper operation. A little more gas will bring the drop in the tube down to only 20 volts and make it useless as a cathode ray tube.

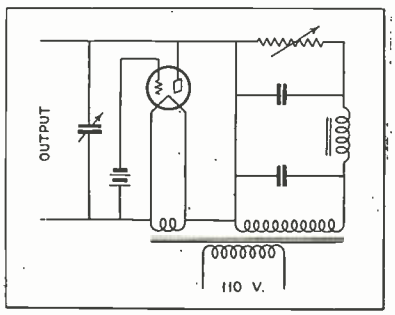


Fig. 4. Hot cathode grid-controlled rectifier.

A reduction in the gas pressure will make the beam scatter. This is one of the weak points of the tube as even rare gases will be absorbed in time by the glass walls.

The tube is, of course, limited to reasonable dimension. Tubes at present obtainable have a screen about 4 inches in diameter. They can be made somewhat larger but we should hesitate to think of a vacuum tube 2 feet in diameter to be sold at a reasonable price.

Neon Lamp Source of Light

There is one more method of television reception which appears to offer some promise in spite of certain mechanical difficulties. It is possible to produce a neon lamp of minute size to give a point of light about .020 inch diameter. This can be mounted on the scanning disc in place of pinholes or lenses. Such spot lights can be made very brilliant. There would be no loss of light as there are no lenses or apertures limiting the beam. The brilliancy would be quite satisfactory for direct viewing, and even for projection.

There will be some difficulties in centering the lamps and balancing the discs but these no doubt can be overcome.

One more consideration quite important in improving television sets should be kept in mind.

One would hardly try to operate even the smallest projection outfit with a five watt lamp, but that is just what television designers attempt to do. The output of the average short-wave set is certainly not over five watts.

Two of the new output tubes in process of development at present are about the size of the 245 but will give as much as 20 watts when used as class B amplifiers. There is real hope in this, but even then it will mean higher currents and voltages for biasing the lamp, which in turn means a good size power supply and filter.

(*Concluded on page 37*)

New fifty kilowatt transmitter for WGY

By means of improved remote control the station engineers will be enabled to maintain accurate check on transmission quality

WGY, the General Electric Company's broadcasting station at Schenectady, N. Y., celebrated its tenth birthday on February 20 with the announcement that it has begun installing at South Schenectady one of the most modern 50-kilowatt broadcasting transmitters in the United States. Approximately three months will be needed to put the transmitter into service, according to the announcement by C. H. Lang, of the G. E. company, and the work is to be completed by May 8.

This transmitter is designed by General Electric radio engineers for improved operating characteristics, particularly as regards frequency stability, quality of transmission, and continuity of operation. Many of these improvements are being incorporated as a result of the company's experience in operating and maintaining broadcasting transmitters for the past ten years. This experience has continually been used as a basis for continued improvements up to the present time. Throughout the earlier period new design features have been incorporated at WGY for thorough operating tests under actual service conditions before such features were included in transmitters manufactured by the company.

Not more than nine other stations on the air today can claim to be as old or to have had as active a part in the development of broadcasting as WGY. In the earliest days of radio broadcast experimentation the General Electric Company secured a license to operate a station, both to provide a medium for experiments and to promote programs valuable for instruction and entertainment. When the right of WGY to full-time operation and to an exclusive channel was threatened, the station's popularity was demonstrated by the thousands of letters from its hearers which poured into the Federal Radio Commission. Through its close association with radio engineering, WGY was able to pioneer in many essential developments —crystal frequency control in the transmitter, the condenser type of microphone, wave propagation tests, and other important adjuncts. From WGY signals of 50,000 watts were heard for the first time, and many listeners feared their receiving sets would be set afire and that their radio tubes would give way under the load. At a later date WGY experimented with 100,000 and 200,000 watts. Through the use of short-wave transmitters WGY has offered its listeners many unique programs.

The Power Amplifier

In the new transmitter the signals, controlled, metered, and amplified, pass through a power amplifier, the first stage of which employs a 50-watt tube. The second stage consists of two 250-watt tubes operating in push-pull. After passing through this stage, the signals attain a voltage level equivalent to ten times the voltage of the ordinary lighting circuit. Improved operation has been effected in the power amplifier circuits so that the correct phase relationship of the various frequencies is maintained.

Important from the listeners' standpoint is the fact that the radio frequency for the transmitter is obtained from one of two crystal-controlled oscillators. Both oscillators are operated continuously day and night and are instantly available for use. The highest degree of frequency stability is attained, and provides maximum assurance that interference with other high-power stations will not be experienced.

From the 50-kilowatt stage, with a maximum rating of more than 200 kilowatts, combined currents are sent to the antenna over a new type of three-wire transmission line and are then broadcast to the radio audience.

New Remote Control

In order that the operators may have proper control of the transmitting apparatus, it is essential that the functioning of the various parts may be readily checked. The new remote control room will be equipped with special monitoring loudspeakers which may be connected at various points in the circuit for direct quality checking by ear. Volume controls will be used for maintaining the audio currents within predetermined limits. Two different types of modulation indicating devices are provided for checking the modulating process. One of these is an oscillograph of special design by means of which either visual observation or permanent recording of the combined currents may be made. The second device is a modulation alarm indicator equipped with an automatic alarm mechanism, so that when a predetermined degree of modulation is exceeded, it is immediately called to the operator's attention by a buzzer. These precautions are elaborate, but recent tests have shown that if the modulation is allowed to exceed one hundred per cent an additional range of audio frequencies is produced which not only causes a loss of efficiency, but may cause interference in adjacent channels because of the increased width of the sidebands.

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Wireless for Indian railways

Wireless communication between important railway centers is to be introduced in India. The railway board has ordered from the Indian Radio Telegraph Co., Ltd., four sets of short-wave apparatus to be installed at important railway centers. The equipment will be capable of short-wave communication over long distances, and the use of wireless for these services is expected to result in a considerable financial saving, as well as providing a reliable alternative channel of communication when there is interference on the normal lines.

Personnel and equipment for the small manufacturer

By Zeh Bouck

BOOMS of all sorts are accompanied with chaotic conditions—a rule so invariable that apparently it dispenses with even the proof of exceptions. The anomalies concomitant with an engineering gold rush are consistent with this general disregard for verities and common sense. The radio boom of the early broadcasting days saw the meteoric rise of "circuits" and "engineers" of so dubious merit that, in respect to the genuine, reference to them must be garnished with quotation marks. We once took a kindly exception in print to some of these circuits, and became codefendant with the publisher in a two hundred thousand dollar libel suit—which, incidently, we won. J. H. Morecroft, in sympathy with our Augean efforts, asserted on the witness stand that the circuit in question was "just a little too complicated for a mere professor of electrical engineering."

Circuits today are fairly well standardized, and reference to the engineers who are responsible for them can be made without lingual pressure on the cheek. However, the exploitation of these circuits during the past year and a half, by a legion of small set manufacturers in recognition of the midget receiver boom, has once more created an army, of doubtful technicians. While the major part of the radio set business goes to the manufacturers of national reputation, the existence of the small manufacturer is justified by his persistence, for he apparently is meeting a demand. The encouragement of independent endeavor, however slight, is economically sound; and there are today a handful of so-called independent set manufacturers, who, riding in with the tide, have developed prestige along with square footage. And all of the remaining parts manufacturers derive a goodly portion of their income from sales to the many makers of midget receivers.

The small manufacturer, drifting from dress goods or candy making machinery to radio, is anything but discriminating in his selection of personnel. More often than not he is imposed upon by self-styled engineers reminiscent in ability and experience of those halcyon days of yore. Manufacturing procedure and laboratory equipment are concomitant limitations forming a vicious circle of inefficiency. The rather unsavory reputation of the small manufacturers can be traced directly to the ineptitude of their engineers.

The existence of these conditions has been impressed intimately upon the writer during his engineering associations with parts manufacturers. A first-hand incident or two will be eloquent.

Loose Engineering

A set manufacturer (of considerable magnitude, by the way, and well enough established to know better) made a midget receiver which was widely advertised. Particular stress was placed on a tuning range of from 1500 kc. to 550 kc.—when as a matter of solemn fact their "engineers" not merely couldn't make the set tune below 350 meters but had no means of accurately determining how high in frequency the set would resonate. However, with broadcasting stations as oscillators, they did ascertain that something was rotten in Denmark, and they were forced to turn to the manufacturer who supplied them with condensers for assistance—an assumption of *noblesse oblige* and the fact that the condenser manufacturer possessed wavemeters, calibrated oscillators and engineers who knew how to use them.

Rough inspection located the probable trouble in the shielded grid leads and a quick check with a capacity bridge confirmed the diagnosis. Without shielded leads the set was unstable—with them the tuning range was decimated. The engineer was disconsolate. We asked him what value of inductance he was using. But this too was a mystery as these had been designed by a coil company for use with the condensers supplied. Assuming a reasonable amount of circuit capacity, including a ten micromicrofarad shielded grid lead, it was a matter of a minute's work on the slide rule to designate a condenser and coil combination that would cover the required frequency band—values which this engineer studiously jotted down in his notebook after expressing amazement at the wonders that could be worked with a slipstick. We described in detail the type of shielded grid lead to use, and several days later an assortment was forwarded for test purposes. (Incidently, several hundred of these receivers had already been sold.)

Another small manufacturer ran into difficulty with some i-f. transformers. He admitted that, on measurements, they were superior to the type he had been previously using, but in the receiver itself they did not come up to standard. The i-f. units, he assured us, were unstable. It required considerable persuasion and explanation to convince him that other inadequacies of his circuit were incapable of handling the added gain.

A Receiver for Export

A third engineer designing a combination 200 to 600 meter, and 1000 to 2000 meter receiver for European use, was in a quandary as to the preferred method of testing the set on the long waves. Unable to convince the manufacturer that a trip to England would be beneficial either to the set or to his health, he seriously considered the possibilities of erecting a long-wave transmitter somewhere in the Adirondacks without benefit of the Federal Radio Commission. Once again the overworked parts manufacturer was called into consultation, and the mysteries of a modulated oscillator were unfolded—with negligible results, however, as the long-wave side of the receiver violated about every principle of intelligent design.

While it is possible to pick on a fairly simple and well standardized circuit, and order parts for the same from the parts manufacturers, this is hardly an effective method of receiver design. It places an unfair burden of engineering on the parts manufacturer, and makes no provision whatsoever for the solution of the individual problems which are the inevitable concomitants of any technical endeavor. It is the purpose of this article—after a rather lengthy introduction—to outline for the small manufacturer, the minimum in

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Herein are listed the staff and apparatus requirements of radio set manufacturers operating small plants.

the way of personnel and equipment with which he can hope to function efficiently and profitably.

The personnel, of course, is the more important consideration—for several reasons. Without a good engineer, good equipment is money wasted. The engineer is the primary consideration because he can designate the equipment with which he wants to work, and in many instances is capable of making it at a considerable saving to the manufacturer. Lastly, the manufacturer can seldom go wrong in the purchase of equipment, while the factors involved in the selection of an engineer are many and variable. A good Wheatstone bridge may be bought by trademark. The engineer must be judged by his theoretical training and experience—considerations which cannot be separated with any degree of definiteness.

Engineering Talent

The manufacturer employing an engineer must consider both of these factors. If the applicant possesses an engineering degree, his theoretical background is fairly well vouched for—whether he's a Ch. E. or an E. E. (However, if he is other than an electrical engineer, more attention must be paid to his experience.) There are many engineers with excellent theoretical training who are not college graduates, and their ability must then be determined by their experience and engineering associations. A full member of the Institute of Radio Engineers (wearing the blue insignia with gold lettering) is generally a man with an excellent theoretical training accompanied with many years of experience.

The majority of engineers at some time or another have had occasion to write technical articles. The demand for the writings of a technician is prima facie evidence of ability, and should be duly considered. An engineer who has been an amateur radio operator almost invariably has his heart in his work and has built up an engineering background from early youth.

The human element is an intangible thing, and it is difficult to tie down to a series of arithmetic definitions. However, a rough evaluation of an engineer's ability to handle the design and production of receivers for the small manufacturer may be tabulated as follows, with one hundred points the passing mark:

Qualification	Points
Electric engineering degree	50
Any other engineering degree	40
Member I. R. E.	50
Publication of 20 or more technical articles	40
Amateur radio experience	30
Other experience	?
Associate member I. R. E.	5
Associate member A. I. E. E.	10

The requirements for an associate membership in the American Institute of Electrical Engineers are a bit more exacting than those for similar admission to the I. R. E. Also the A. M. A. I. E. E. displays a broad interest in things electrical that is generally accompanied with greater experience and ability.

"Other experience" is indeterminate. Its evaluation may be either plus or minus several hundred points. The past experience of a combination E. E. and full member of the I. R. E., or the manner in which he acquitted himself, may be such as to disqualify him for the particular position in mind. He might be a world authority on piezo electricity, and yet make a mess of redesigning a midget receiver for pentode operation. On the other hand, I know an engineer who is not a college graduate. He is an associate member of the I. R. E., and I am certain he has never written anything more technical than a *billet doux*. He was never even an amateur radio operator, and he does not belong to the A. I. E. E. Yet his experience is such that I should not have the least hesitancy in placing him in full charge of design and production of a good quality radio receiver. He is however, let it be granted in justification of this article, a notable exception.

A good engineer can be hired for $75.00 a week—and less. He should be paid an adequate salary compatible with the financial condition of the manufacturer, with the understanding that his future salary will be determined only by the success of the receiver he turns out. He should have the assistance of at least one first-class radio mechanic and technician drawing from $35.00 to $50.00 a week.

Having selected a good engineer, he himself is best qualified to determine the necessary fundamental equipment. We outline the requirements more as a matter of corroboration than anything else—for engineers are often hard put to it to secure an adequate budget for what the manufacturer considers superfluous junk. However, a good engineer with poor equipment is almost as useless as the reverse combination.

Minimum Needs of Apparatus

The following expenditures are itemized in the order of their importance. One hundred dollars is a low sum of money to be spent on miscellaneous voltmeters, ammeters, milliameters and a galvanometer. A precision wavemeter with condenser calibration, should be the next investment and it costs $281.00. A general purpose bridge with resistance and capacity decade boxes follows a close third and totals $165.00. With the apparatus now on hand almost any radio receiver engineering can be accomplished by the clever engineer. Efficient radio and audio frequency oscillators can be constructed in the laboratory until money is available to purchase standard equipment. Additional apparatus is, however, highly desirable, and we continue the list with an audio hummer costing $34.00. An additional precision condenser makes possible a permanent bridge set-up at a price of $45.00. A high grade galvanometer with thermocouple takes another $44.00 of the budget, while a direct reading ohmmeter at $30.00, and a combination tube and set tester at $75.00, release miscellaneous meters for other important work.

The prices indicated are net to the radio manufacturer, and amount to a grand total of $774.00.

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TELEVISION CONSIDERED BY RMA DIRECTORS

An official and authoritative statement on the progress of television laboratory and broadcasting experiments will be issued soon by the Radio Manufacturers Association. A formal and detailed statement describing the actual present engineering status and future prospects of television was approved and ordered published by the board of directors of the Radio Manufacturers Association, meeting held in Buffalo, N. Y., February 19. The statement was prepared by Dr. C. E. Brigham of Newark, N. J., chief of the RMA engineering division, and D. E. Replogle of Passaic, N. J., chairman of the association's special television committee.

Television progress promises to be a feature of the eighth annual convention and trade show of the RMA at Chicago next May, for which plans were developed at the association's directors meeting. President J. Clarke Coit of the RMA presided and upon receipt of detailed trade show plans from B. G. Erskine of Emporium, Pa., trade show committee chairman, it was stated that success of the May 23-26 radio and electrical exhibit was assured.

"I feel the utmost confidence," said President Coit, "that next May we will have one of the biggest shows ever. I am very much encouraged over the outlook for radio business and I believe that our trade show in Chicago in May will be one of the most successful in a good many years."

Changing a t.r.f. receiver to a superheterodyne

SOMETHING new in radio; a converter which transforms a tuned radio-frequency type of radio into a superheterodyne and at the same time functions as a remote control unit, has been brought out by the General Motors Radio Corp., Dayton. O. The new device, known as the General Motors Radio superheterodyne converter with remote control, has been characterized as an outstanding development in the field of radio.

The converter is built to resemble a smoking stand, with an illuminated dial set into its beveled edge and operated by a small knob just beneath it. Volume also is controllable through another small knob. The converter is portable and connected with the receiver by means of a flexible cord 30 ft. long. It is constructed of antique brass and in itself makes an attractive piece of furniture for any room.

Remote control is accomplished entirely by electrical means, without any mechanical devices, motors or switches. Tuning is accomplished exactly as if operating the dials of any conventional type receiver and the entire range of stations may be tuned in at will, without preliminary setting of cams, levers. stops or the like. In other words, the operator tunes in his favorite stations exactly as if he were tuning in the dials of the main set.

In transforming the tuned radio-frequency type of set into a superheterodyne, the selectivity and sensitivity which are features of this almost-universal type of circuit are obtained from the old set. For persons already owning a superheterodyne type of receiver, the converter has all the advantages and convenience of remote control, giving the owner the most up-to-date features known to the radio art.

Only a few minutes are required to connect the superheterodyne converter, the average radio owner being able to make his own connections in from seven to ten minutes.

With from five to seven million tuned radio-frequency receivers still in use in the United States, the field for the new converter is widespread. while the remote control features increase its field still farther.

An attractive piece of furniture in itself, its antique brass finish blending evenly with any type of interior decorative scheme, the converter is utilitarian as well. It stands about 22 inches high and in its top is fitted a removable glass ash receiver. Evenly balanced, it is not easily tipped.

By using the converter, it is now possible to operate the radio from the bridge table, from the easy chair, from the bedside or from any other position desired with exactly the same facility as from the set itself. Also, the volume may be controlled, making it unnecessary to arise from the chair to turn the volume control down or increase it as is frequently the case in sets equipped with automatic volume control.

Superheterodyne converter with remote control.

There are thousands ot persons who have invested considerable money in expensive console types of radio receivers which today are out of date due to the remarkable strides that have been made. Tuned radio-frequency types in many instances have given way to the superheterodyne, due to the greater selectivity and sensitivity of this type. Naturally, owners of these expensive cabinets, which they bought as pieces of real furniture, hesitate about changing. Now it is possible for them to keep their old sets and bring them up to date through use of the new converter. At the same time. they have the additional feature of remote control.

General Motors Radio engineers, under the direction of Harry J. Nichols, chief engineer, have been at work on this new development for some time, recognizing the need of a device to modernize old sets and give additional pleasure and satisfaction to radio owners.

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Peck scanning system for television

THE reason his system of scanning gives a bigger, brighter picture in a compact space than is obtained with other means was explained by William Hoyt Peck, optical expert, in an interview in New York where Peck television is being demonstrated.

Mr. Peck pointed out that with the usual lens disc system, a spot of light large enough to cover several lenses was needed, if the spot was to be undistorted over the entire image, unless highly corrected lenses were used. In his system, on the other hand, the light from the neon tube is focussed to a single tiny spot on each lens in turn, as the scanning wheel revolves, and so all the light of the tube is utilized.

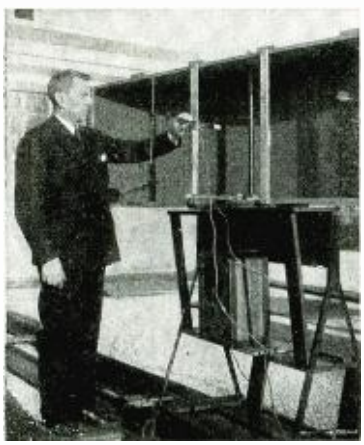
The lenses used in the Peck system are optically perfect, so that there is no distortion of the spot anywhere in the image. Further, the lenses are spherical on one side and flattened and silvered on the other, so that the light passes into them, and is reflected back through them. The angle of refraction is such that a picture a foot square is obtained at one foot from the wheel, two feet square at a distance of two feet. and so forth. This makes it unnecessary to throw the light long distances, or back and forth between mirrors in order to build up size. Cabinet space is conserved, so two sets (one for sight, the other for sound) can be housed in a single cabinet, along with the screen and speaker.

Through a system which he has developed, the cost of each reflecting lens, sixty of which are needed, can be kept to five cents, as compared with three dollars, the cost of producing a lens which will give equal results in other television systems.

Ultra short-wave signaling

L. R. Philpott is at the microphone, while G. Ross Kilgore watches for a light signal or some other indication that the message is being received.

WESTINGHOUSE research engineers are talking on a 42 centimeter beam from station W8XI, on top of the company's research building, to the roof of the engineering laboratory, more than a mile away, where a parabolic metal mirror gathers the waves, and passes them through a special detector tube to an ordinary radio receiving set, where they are amplified and made audible.



Dr. Mouromtseff is examining the detector detail which is perhaps the most important feature of the receiving apparatus.

"It is conceivable that the power we have succeeded in getting into our 42-centimeter beam is sufficient to pierce the Heaviside layer and travel the 35,000,000 miles to Mars," states I. E. Mouromtseff," research engineer. "It is possible that such small power may carry to such great distances, because of the fact that practically all of the intervening space is really a high vacuum and does not, therefore, absorb the waves, once they get through the earth's atmosphere."

In actual service, communication on the radio-optical waves is dependable and almost immune to theft, interruption and interference. Its operation cannot easily be "jammed," or crippled by an enemy, the beam must be found before its message can be detected and by means of reflecting surfaces, it can be sent long distances.

In a searchlight, the rays originate at one point, reflect from a parabolic surface and pass out in a narrow beam. In the newest achievement, the waves reverse this process by striking the parabolic mirror where they are reflected to a short antenna and detector tube located at the focal point corresponding to the source of light in a searchlight. Since intervening hills or buildings absorb both types of beams, a way has been found to reflect the ultra short radio waves so this handicap could be overcome.

Mouromtseff and his associates believe the ultra short wave will be adapted to many practical uses in the next few years and that it will prove of commercial value by supplementing radio and other present forms of communication.

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An engineer's viewpoint with respect to tube testers

By W. L. KRAHL*

IT has been a difficult problem for the average dealer to decide just what tests to give tubes to determine their efficiency and which tester will give the most accurate results, and hence the greatest customer satisfaction. There are two tests that need be emphasized, namely, a test of mutual conductance, and plate current.

The plate current reading is a most important gauge of efficiency as it is a monitor of the major tube characteristics which determine the efficiency of the tube. Plate current readings of tubes of similar design should be approximately uniform and come within the limits specified by the manufacturer. The trade should be cautioned against selecting tubes with an abnormal reading since this is an erroneous, though prevalent practice.

The filament emission reading is a check on mutual conductance. Mutual conductance, above all checks, determines the merit of the tube in so far as its ability to provide the required amplification or gain. Filament emission itself indicates the extent of useful life the tube may possess.

It is my personal opinion that outside of the above tests, there is no commercial test that will give the information desired.

Some attempts have at various times been made to check tubes in an oscillating circuit, but unfortunately no correlation between the ability of the tube to perform in a fixed oscillating circuit and its ability to function in a radio receiver has been established. The fallacy lies in the fact that an oscillating circuit used in a test board may be properly designed for one particular type of tube in one particular circuit, but still be valueless in testing tubes of other types in other circuits. Even the oscillating circuit in a superheterodyne will vary too greatly from a test board circuit to determine whether performance in one will indicate performance in the other.

The test meter which Arcturus is supplying to dealers through special arrangements gives the plate current and filament emission readings by a change in grid bias. Of all the electrical characteristics, these are the most important in tube operation and are the most indicative of a tube's ability to function.

* *Chief Engineer, Arcturus Radio Tube Company.*

Portable short-wave receivers

By A. Binneweg, Jr.

PORTABLE short-wave receivers can be used for many purposes. A portable short-wave set employing a relatively small number of tubes is quite effective, especially with the new dry-cell pentode at the audio end, and appeals to radio amateurs, motor boat enthusiasts, airplane pilots, modern policemen, etc.

The real value of the pentode tube is evident when incorporated in a portable set. The high amplification obtained, with relatively low input allows the use of fewer tubes and a smaller set. Pentodes were used in Europe for years because the sets there were taxed according to the number of tubes; however, the real advantages of pentodes lies in their use in portable sets.

Let us consider the factors that enter the design of a short-wave portable set of low cost. Some of the more important factors are:

Signal strength desired. Cost. Number of batteries. Weight.

Size

Cost is especially important at this time. The number of batteries required largely determines the weight. For ordinary use, a very light weight is not essential, although for airplane use any marked reductions are desirable. A good proportion of the "bulk" of a portable set is taken up by the batteries.

Suppose that we assume that good headset volume is sufficient. Another fixed factor, then, is that a dry-cell pentode will be used in the audio. From experience, or some simple preliminary tests, we decide that two tubes will give the desired volume, provided a regenerative detector is used. From the point of view of sensitivity and selectivity a regenerative detector is necessary. A regenerative detector is also essential for the reason that we desire to receive C. W. code also, which would be impossible with a non-regenerative detector. Also, a non-regenerative detector is essentially dead at short waves. One therefore arrives at a two-tube set consisting of a regenerative detector and one audio stage incorporating a dry-cell pentode. One could use resistance coupling between detector and pentode, but the amplification is less. A transformer-coupled stage is heavier, but the volume obtained, without increasing the dimensions or the weight of the set too much, is worth while. If quality is not so important, an audio transformer of a light weight can be used.

Eliminating Radiation

A regenerative detector will radiate unless a coupling tube is used. One can expect some amplification from a screen-grid, r-f. stage at short waves if the input is tuned. However, the additional condenser necessary is not desired so that a common resistance input is used. In such a screen-grid stage shielding is not necessary; the amplification is too small.

If the receiver is to be used only for portable use, the vertical construction is convenient. This allows the filament dry-cell batteries to be placed on a small shelf directly under the set, and the B batteries to be placed directly below these. If the case is made of sufficient size, the plug-in coils and the headphones can be placed inside the case. Two B batteries of the portable 45-volt size will give good results with phones, although 3 such batteries will give more volume.

The complete wiring diagram of the 3-tube portable receiver is shown in Fig. 1. A set of 4 plug-in coils is used for the 15-200 meter range. Distances up to 1,000 miles or more can be received on a portable set of this kind.

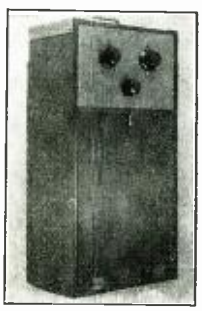

Fig. 2. An inexpensive, substantial, short-wave portable radio receiver.

The constants for the circuit of Fig. 1 will stand some little variation. The 30,000 ohm resistance may be anywhere between twenty and thirty thousand. The six-ohm rheostat may be 10 ohms. The .00015 mfd. condenser may be a midget variable. The antenna condenser may be two plates one inch square separated ⅛ inch. The .01 mfd. condenser in the L1 circuit may be of less capacity, say to .001.

L1, L2, set of plug-in coils to match the .0001 tuning condenser.

The set is arranged with the midget tuning-condenser at the left of the panel, the regeneration condenser at the right, and the rheostat knob at the rear. A small hook and eye is used to hold the case closed. A slot is provided on the door of the battery compartment so that it can be closed while the phones are being used outside.

The set is very convenient for field use, because the dials are about the right height for easy tuning. Dry-cell tubes are used throughout. Two dry cells furnish current for the filaments of all 3 tubes.

For plug-in coils, it is best to arrange a socket outside the case. This avoids the difficulty of an inaccessible interior. In the set shown in the illustration the coils are plugged into a socket at the top of the case. The antenna and ground binding posts are mounted on

(*Concluded on page* 38)

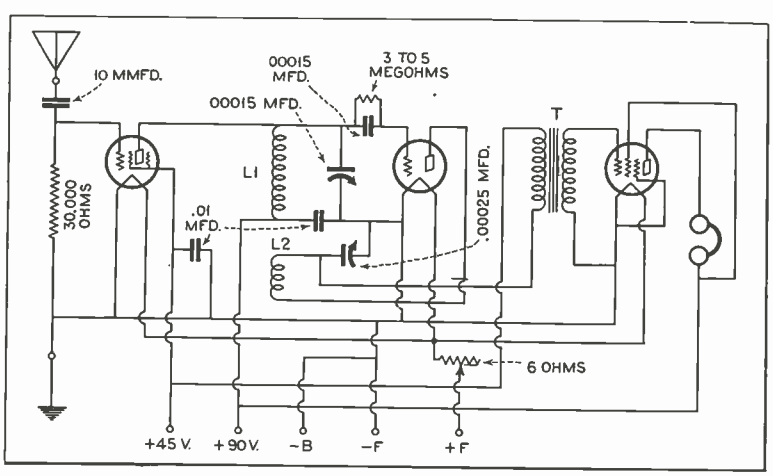

Fig. 1. Diagram of receiver circuits.

Methods of testing characteristics of electrolytic condensers

By W. W. GERSTANG*
Assoc. A.I.E.E., Assoc. I.R.E.

IN determining the worth of electrolytic condenser units there are four especially important factors to be considered. These four factors being. in the order of their importance, the capacity, the leakage, the resistance and the power factor.

All four of these factors can be accurately measured, but as a general rule such accurate determination requires the use of apparatus not always available and for that reason both the elaborate test methods suitable to the laboratory, as well as the more simplified

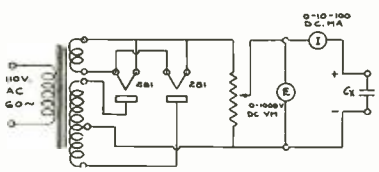

Fig. 2. Circuit for measuring current leakage of electrolytic condensers.

methods adaptable to economical production testing, will be described.

Capacity

The effective capacity of an electrolytic condenser is always slightly less than the electrostatic capacity due to the effect of the resistance of the electrolyte, this effect varying with frequency. For this reason and the fact that the anode or positive plate of the condenser must be maintained positive, with respect to the electrolyte, and further that there is always current leakage, ordinary capacity measurements are not suitable.

In all measurements of electrolytic condensers it is important to duplicate. as closely as possible, the conditions of operation in the actual circuit or filter networks in which these condenser units are used. For this reason it will be noted that all tests are shown as being made with a composite current consisting of the direct current with a superimposed alternating-current component.

One of the more commonly used methods of determining effective capacity is to pass an alternating current through the condenser which is connected in series with a standard mica or paper dielectric condenser and from the measurement of this current calculate the capacity. Such a measurement. however, is not of sufficient accuracy except for production testing as only the impedance of the condenser is taken into consideration with no allowance for the resistance of the electrolyte.

A circuit is illustrated in Fig. 1 and in connection with same the following formula is used:

$$C_x = \frac{I}{2\pi f E}$$

C_x = Capacity (farads) of unit under test.

I = Alternating current (amperes).

E = Alternating current (volts).

In using this test method the application of the formula is simplified by maintaining the a-c. voltage E at a fixed value—say 100 volts. In this manner a chart can be easily worked out for quick capacity determination. The direct-current voltage value is not important so long as it exceeds the peak value of the alternating current, E.

If 50 volts is used at E, the d-c. voltage should exceed E $(2)^{\frac{1}{2}}$, in this case 50 x 1.414 or 70.7 volts, say 100 volts d-c.

Example: Capacity measurement of an electrolytic section, marked, say, 8 mfd. Upon connecting the unit to be measured in the test network we get the following readings: I — 150 milliamperes. Applying this value to the formula we have:

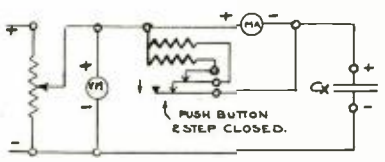

Fig. 3. Milliammeter shunt arrangement.

$$C_x = \frac{.150}{2 \times 3.1416 \times 60 \times 50}$$

$$= \frac{.150}{18850}$$

$$= .0000079 \text{ farads}$$

or $.0000079 \times 10^6 = 7.9$ mfd.

Leakage Current

The average leakage current of electrolytic condensers varies with the type of condenser and type and conditions of operation. The leakage current is generally specified accordingly. In general, however, there are a few factors that hold rather constant under all conditions. When a condenser unit has been out of use for some time, there is an apparent deterioration of the anode film, or rather a lowering of the film resistance. This results in an increase in leakage current which, however, drops to normal upon the placing of the condenser in service.

Increase in temperature causes an increase in leakage current, therefore, the maximum operating temperature should be considered as 50 deg. Centigrade.

Fig. 2 shows a circuit recommended for the measurement of leakage current. This high voltage is terminated with a 100-watt, 50,000-ohm potentiometer. The voltmeter is connected across the variable voltage section and a milliammeter connected in series with the condenser under test. It is recommended that a standard 0 to 1 milliammeter be used and arranged with shunt resistances for additional ranges of 0 to 10 milliamperes and 0 to 100 milliamperes as in Fig. 3.

Normally both resistance units are in parallel to the meter and the scale 0-100 ma. Pushing in slightly disconnects one resistance unit and the scale be-

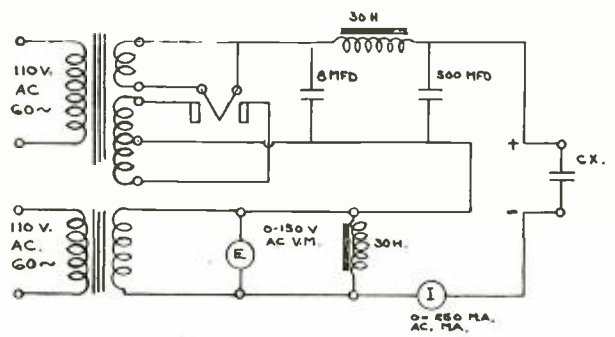

Fig. 1. Circuit for measuring capacity of electrolytic condensers.

*Field Engineer, P. R. Mallory & Co.

comes 0-10 ma., while pushing in hard disconnects both resistance units and the scale becomes 0-1 ma.

Resistance

The average resistance of an 8 mfd. condenser is approximately 8 ohms, although this varies with type of electrolyte, heat and frequency. The resistance is an important factor in the direct effectiveness of an electrolytic condenser for by-pass work in a filter network because a condenser's effectiveness is directly proportional to its impedance at any given frequency. In other words, the effectiveness of the condenser is proportional to the vector sum of the capacitative reactance and the resistance. The effectiveness then being equal to an equivalent pure electrostatic capacity which would give the same capacitative reactance as the total impedance referred to:

$$Z^2 = R^2 + X_c^2$$

This holds true only where the condenser is not used in a tuned circuit. In such a circuit the resistance becomes a vitally important factor. A quick and convenient method of measuring impedance is illustrated in the test set shown in Fig. 4. R is a standard decade resistance box, while C_x is the con-

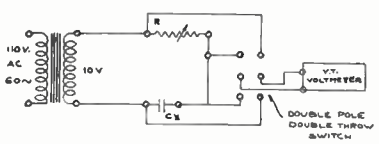

Fig. 4. Circuit for measuring impedance of electrolytic condensers.

denser under test. The procedure is to adjust R until the vacuum tube voltmeter reads the same when the double pole, double throw switch is in either position. When this condition exists the reading on the decade box is the impedance of the condenser.

For the accurate measurement of resistance it is necessary to use a capacity bridge and this is illustrated in a fundamental layout, Fig. 5. This bridge is an accurate means of not only measuring resistance, but capacity as well. In the use of the bridge the following relationship exists when the bridge is in balance.

$$\frac{R_2}{R_1} = \frac{C_x}{C_s}$$

R_2 and R_3 are standard decade resistance boxes, while R_1 is a variable resistance used to introduce resistance in series with a standard low power factor, paper or mica condenser C_s until a condition of balance exists in the bridge or when relationship

$$\frac{R_2}{R_1} = \frac{C_x}{C_s}$$

then R_3 will be of a value equal to the resistance of condenser C_x under test.

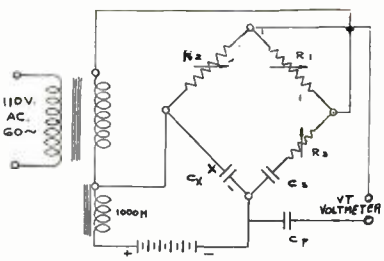

Fig. 5. Circuit for resistance measurement of electrolytic condensers.

In a like manner capacity measurements are made.

For more complete details of a bridge test network in which operating conditions of electrolytic condensers are duplicated there is included Fig. 6. Either 60 or 120 cycles may be used with little variation.

In all the diagrams where a vacuum tube voltmeter is indicated it is also possible to use an audio amplifier in connection with an output meter.

Should elaborate tests be desired with other frequencies than the 60 indicated then an audio oscillator may be substituted as the source of current.

Power Factor

The power factor can be ascertained from the other factors already discussed.

$$\text{Power factor} = \frac{R}{\sqrt{R^2 + (2\pi f c)^2}}$$

R = series resistance in ohms.
f = frequency.
c = capacity in farads.

In Fig. 7, an adaptation of the first method given to large production tests is seen. Here, a source, either generator or vacuum tube power pack is used. (It is difficult to state actual voltage on specifications for any test equipment inasmuch as condensers are manufactured in voltages ranging from 5 to 3,000 volts and capacities from ¼ to many thousand microfarads, but in this instance we will consider testing condensers rated at 450 volts and 8 mfd.) 500 volts is impressed on the system. A register of 25,000 ohms is in series with each condenser. A small neon

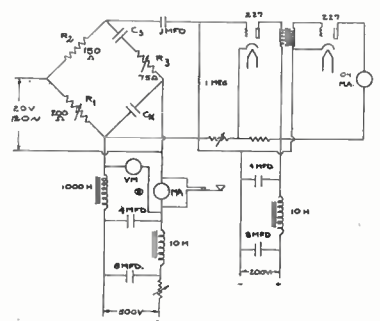

Fig. 6. Bridge method of measuring capacity, power factor and leakage.

lamp is attached across each resistor so that a condenser with high leakage can be spotted instantly. The lamp and resistor are also adjusted so that when the leakage falls below 4 milliamperes the drop across the resistor will be less than 100 volts, the lamp will go out and the leakage can then be read, by pressing a key, on the milliammeter in each circuit. The capacity section uses approximately 30 volts a-c. and is read by pressing a key.

As has been said, leakage and capacity specifications are individual requirements of the manufacturers, but with a normal production run of eight microfarad units rated at 450 volts, the condensers should be loaded on the rack, the circuits closed by means of

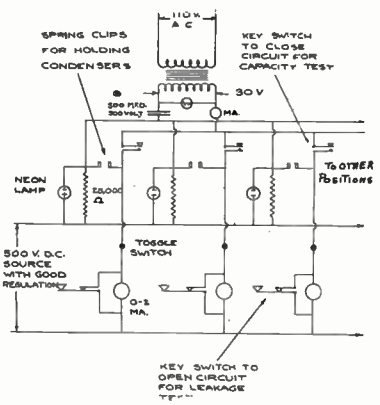

Fig. 7. Condenser test set for quantity test of condensers.

the toggle switches, and permitted to run five minutes before testing. At the end of this five minutes the leakage should not be over 2 milliamperes. This will also indicate that the condensers have 450 volts applied to them, as 2 milliamperes through the 25,000 ohm resistors would cause a drop of 50 volts. Any lower leakage would indicate that the condenser had come up to above its rated voltage.

This system for production has many advantages and particularly in the speed at which an operator may test. No definite time limit is necessary as the operator can judge the time by the speed with which the lights go out.

The capacity test may be calibrated either directly in microfarads or as a limit meter, depending upon the tolerance required by the manufacturers.

▲

CONVENTIONS

April 7-9, at Pittsburgh, Pa., I. R. E.

May 23-26, at Chicago, Ill., R. M. A.

Continuity tests of radio receivers

By JOHN F. RIDER

An analysis of comments received relative to published information covering continuity testing to be found in radio service manuals.

Definition of Continuity Testing

WE ARE not aware of any standardization relative to the accepted definition of continuity testing. Common practice implies that it covers the testing of a circuit to determine if it is open or closed or to determine its resistance. In view of the fact that an ordinary electrical test to indicate a continuous electrical path where such a path is required is of little value during radio service work, our definition as used in this paper refers to the measurement of the actual resistance. The exception to this case is the test made upon a fixed condenser, where it is necessary to locate the presence of a leak or a short circuit, both of which conditions are undesired and are signs of a defective state. Hence continuity testing if and when applied to condensers should be understood to signify a test to indicate an electrically satisfactory condenser without reference to capacity.

In order to relieve the monotony of repeated mention of the same descriptive phrase, continuity testing and resistance measurement when applied to continuous d-c. circuits are to be considered one and the same.

Classification of Subjects Related to Continuity Testing

Viewed through the eyes of the radio service technician, the subject of continuity testing or resistance measurement of the circuits in a receiver can be classified in somewhat the following manner:

1. Resistance ranges and requirements in radio receivers.
2. Apparatus available with which to make the required tests.
3. Information required to enable rapid and accurate tests.
4. Presentation of continuity test data.

Each of these classifications has several sub headings. Rather than call upon the reader to continually refer back to this part of this paper for these sub headings, they are omitted at this time, but will be listed as each of these classifications is being considered.

The immediately following paragraphs voice ideas and opinions of servicemen. In justice to efforts which have been made by men who have produced and are producing radio receiver service manuals, let it be known that many very closely approach the ideal. It is possible however that one or two minor items may have slipped the mind and mention may be of interest.

Resistance Ranges and Requirements in Radio Receivers

The prime reason for the mention of resistance ranges to be found in radio receivers is one related to the apparatus available for continuity testing, and for the great need for some form of standardization along such lines.

Investigation of receivers manufactured since the popularization of radio shows a fairly wide range of resistance values. These resistances include all forms, carbon, metallized, wire wound, etc., and also inductive and non-inductive windings. The range extends from .1 to about 5,000,000 ohms.

Of course this very great range of resistance is not to be encountered in all receivers, but since the two limits represent the actual values to be found in the ordinary run of receivers, they justify recognition with respect to whatever comment is to follow. The most commonly used range of values extends from about 3 ohms to about 500,000 ohms. A predominant value prior to the popularity of the grid biased detector was about 2,000,000 ohms. If one is to include the receivers manufactured during the past five years, with special reference to the detector grid leaks, the upper limit of the common range becomes 2,000,000 ohms instead of 500,000 ohms. However the importance of knowing the exact value of a 2,000,000 ohm grid-leak resistor is not very great. An idea of continuity indicating a fair approximation of this value is sufficient. Accordingly, we may continue classifying the upper limit as being 500,000 ohms.

If we accept this limit it is necessary to assume that whatever instrument is capable of measuring a 500,000 ohm resistor is capable of at least indicating the continuity of resistors in excess of this value. This is quite important because some means must be available when measurements or tests are desired upon the popular resistances rated in excess of 500,000 ohms. Of course an ordinary continuity test showing an electrical circuit is not very good practice, but since economy is a problem it is necessary to decide upon apparatus wherewith one would be enabled to secure the greatest amount of information at minimum expense. To demand an ohmmeter which will enable actual resistance measurement upon 1, 2 and 5 megohm resistances would greatly increase the cost entirely out of proportion with the number of times when such resistances must be checked.

The measurement of resistance in any part of the receiver must indicate the condition of the circuit or whatever unit is under test. It is difficult to prescribe tolerance limits. The actual tolerance is dependent upon several factors. Among these are the function of the unit, the tolerance during manufacture, the possible effect of a variation, the design of unit and the accuracy of rating. In a way all of these factors are related to each other. Thus a variation of 20 per cent in the resistance of a 50,000 ohm grid filter resistance is of little importance, whereas a variation of 20 per cent in the value of a bias resistance in a detector circuit is apt to be unsatisfactory. Now as far as the tolerance is concerned, one must remember that it is also important that the rating of the resistors be fairly accurate. A plus tolerance of 5 per cent when added to a possible error during the measurement will be productive of an indication which may differ from the rated value as to cast suspicion. In view of the fact that certain tolerance

†*Delivered before Radio Club of America, October 14, 1931.*

values are allowed during the manufacture of a resistor irrespective of type or during the manufacture of a transformer, certain tolerance values should be stated when resistance ratings are quoted. Whatever the tolerance, the measurement of the resistance should be made with equipment capable of accuracy better than 2 per cent. This fraction is quoted as a compromise between the very close and very broad tolerance values allowed during the manufacture of resistors and fairly high resistance windings.

There are certain places in a radio receiver where small tolerances are allowed and accurate measurement is required. Such places are the primary and secondary windings of the r-f. and i-f. transformers. By setting very close tolerances and by quoting very accurate resistance ratings, it is possible to determine a defect in the unit and have the measurement really mean something. At the present time, one has nothing but a complex method of locating shorted turns in transformers. Recognizing that a shorted turn in an r-f. transformer will cause much trouble, an accurate rating and an accurate measurement will enable the serviceman to decide whether or not the trouble is within the transformer without involving the use of searcher coils, etc. At the present time such searcher loops must be applied during the operation of the receiver and replacement is the only accurate check. The time involved in such operations can be greatly reduced by complying with the demand for very accurate and specific resistance data with stipulation of the method of measurement and close tolerance.

Apparatus Available With Which to Make Continuity or Resistance Tests

When considering resistance measureing apparatus suitable for application during radio service operations it is imperative to remember four controlling factors. These are: 1. Low initial cost. 2. Portability and conservation of space. 3. Ease of operation. 4. Attainment of the required resistance range. A major problem confronting the modern radio service technician is that suitable continuity testing apparatus is not available. Perhaps this sounds strange in the face of the many ohmmeters which are being offered for sale. The primary difficulty is one of resistance range. The Wheatstone bridge, whereby the required range and more than the required range is available, is out of the question for several reasons.

A survey of the products produced by meter manufacturers and intended for radio service work shows a dearth of equipment with resistance ranges sufficiently great to fulfill existing requirements. The popular units available today may be grouped into three classes according to the maximum values of resistance which are determinable with the instrument. These are 10,000 ohms, 50,000 ohms and 100,000 ohms respectively. One manufacturer has an ohmmeter which is a part of a diagnosing kit, with a range of 25 megohms. With this single exception, the aforementioned resistance measuring units are the only ones available as individual test units or as parts of test kits. Obviously these maximum limits are too low for the requirements of the radio service field. It is interesting to note that a great deal of correspondence has been received relative to the changes required to increase the range of commercial 10,000 ohm, 50,000 ohm and 100,000 ohm ohmmeters to a maximum of from 250,000 to 500,000 ohms. Of course all changes recommended referred to the latter maximum limit.

Another item of importance in connection with available test apparatus for radio service resistance measurement is that concerned with the ease of measurement and the visibility of the pointer indication. The accuracy of a measurement depends upon the degree of accuracy possible when reading the meter. Approximation is not harmful when the possible error is but a very small fraction, but when one is called upon to check a resistance and it becomes necessary to approximate some value lying between 50,000 and 100,000 ohms and a 25 or 30 per cent error is possible because the separation between the .05 and .1 meg. divisions is very small, the utility of the unit is small. Add to this the possible error due to parallax and the total error assumes substantial proportions. There exists a general demand for ohmmeters with more than two ranges, not so much in the case of resistance measuring devices which have low maximums, but definitely so in the case of instruments with maximum values of 10,000 ohms or more.

The majority of ohmmeters have two ranges. In the 100,000 ohms maximum instrument, the two ranges are from 0-10,000 ohms and from 0-100,000 ohms. Because of the characteristics of such instruments, it is difficult to accurately read resistance values between 50,000 and 100,000 ohms. The scale crowds towards the upper limit. Then again, it is a difficult matter to read the low values of resistance, say between 0 and 10 ohms, because of the high resistance in the circuit when the low range extends to 10,000 ohms.

It is true that a variation of from 5 to 10 per cent in a resistance rated at from 25,000 to perhaps 500,000 ohms will not cause grave results as far as correct operation of the receiver is concerned, but this is true only when the resistor or unit being tested is in good condition. If the variation in resistance as measured is due to a defect in that unit and the trouble seems localized in the stage incorporating that resistor, it becomes a highly important item to know that the ohmic value of the unit is not up to standard. Since these meters are calibrated in ohms, it should be possible to determine the resistance with an accuracy at least equal to the tolerance employed in the manufacture of the unit. This means that some changes are required in the scale distribution. If, as has been previously stated, close observation of the accurately rated resistance is to be observed, it is even more important that an accurate reading of the meter pointer be possible. The suggestion has been made that there be a reduction in the types of ohmmeters offered for use among servicemen and that one model be decided upon as a universal type unit. This meter should have five ranges, namely from 0-1000 ohms, 0-10,000 ohms, 0-50,0000 ohms, 0-500,000 ohms and 0-1,000,000 ohms. As previously stated it might be possible to dispense with the highest range as a separate scale by arranging that the 500,000 ohm division be so located that a continuity test of a 1. megohm resistor be possible. A meter of this type may mean the use of two batteries or two values of test voltage in order to allow simple and easy reading of the scale.

Much comment has been received about the low end of the ohmmeter scale. The modern receiver requires accurate measurement of resistances

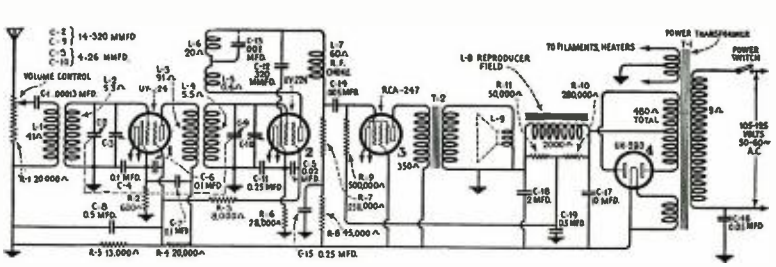

Fig. 1. Schematic circuit diagram of Model R-5.

between .1 and 10 ohms. The upper limit of this low range is discernible upon certain meters, but measurement approaching the lower limit is a virtual impossibility when the first division upon the meter is 10 ohms, as is the case with 10,000 ohm maximum scales. When we consider the number of items which are rated at resistance values not in excess of 3 ohms, the need for a maximum range of from 500 to 1000 ohms is evident. By proper selection of a maximum it is possible to spread the 0-10 ohm scale over a suitable portion of the dial.

Another significant item relative to standardization of design has been the subject of correspondence. This is the development of an ohmmeter wherein some form of adjustment is available whereby it becomes possible to use the test battery even if the voltage falls below the rated 3, 4, 5, 6, 22.5 volts, etc. Of course certain ohmmeters have provision for such voltage variations, but the demand is for standardization of this type in all such instruments.

Information Required to Make Rapid and Informative Tests

In a way this part of this paper can be said to be the most important, for it represents the reactions of many men to the work of a few men. There exists a difference of opinion among servicemen relative to the character and type of information required to enable a rapid and informative continuity test.

There have been signs of misunderstanding as to the definition of various types of diagrams. Our reference is to two types. Actually both are referred to as schematics. Both show the connection of the circuits. The major difference between them is that one shows the wiring between the electrical symbols representing the various devices or parts used and the other shows the wiring between the pictorially represented parts and at the same time shows the exact location of the various components relative to each other. The former is shown in Fig. 1. The latter is shown in Fig. 2. The former we shall refer to as the electrical schematic and the latter as the chassis or factory wiring diagram. There are several variations of the factory or chassis wiring diagram, but substantially they are the same, hence these samples should suffice to indicate what is meant by the term.

One group feels that the electrical schematic supplemented by the correct operating voltage values is sufficient data. The statement is based upon the claim that an experienced service technician equipped with such a wiring diagram and the operating voltage data can service the receiver by analyzing the measured voltage data and by checking the circuit under suspicion and the units shown to be part of that circuit. Suspicion is assumed to be cast upon any one circuit by the observed voltages and currents.

Some men do not dispute the claim that a receiver can be serviced with the electrical wiring diagram and the operating voltage data as the only information at hand. However they disagree with the statement as far as rapidity and accuracy of operation are concerned. Considering the function and purpose of the service technician the stand is well taken. Rapid operation and accurate operation are the two major requirements of the successful radio service technician. The ability to remedy a defect, major or minor, at short notice, is a paramount virtue. If the rapid repair is accompanied by accuracy, the ideal has been achieved.

A test question was submitted to a number of servicemen to determine the type of information they desired so as to enable rapid and accurate service operations. A tabulation of the responses would appear in eight items.

1. The electrical wiring diagram.
2. Electrical values of the parts.
3. Color coding of wires and parts.
4. Socket layouts.
5. Internal connections of units sealed in cans.
6. Factory or chassis wiring diagram.
7. Operating voltage data.
8. Tolerance limits in values and voltage data.

Knowledge of the Electrical Values Used in a Radio Receiver

Item 1 is an education in radio. It acquaints the serviceman with changes in design; with changes required when certain tubes are employed to replace other types; with the values commonly employed in certain parts of a receiver, thus proving of aid in the event that obsolete receivers must be repaired—in the event that a replacement unit is required in an emergency—in the event that correction of a certain fault must be accomplished at short notice.

Item 2 creates confidence on the part of the worker and eliminates the hazards of guesswork and the probabilities of trouble because an incorrect value is chosen.

Item 3 enables more rapid continuity testing because experimental adjustments of the test instruments is not required. When the rated ohmic value of a resistor is not known one does not know the adjustment of the range switch of the test meter.

Item 4 enables definite conclusion of the condition of the circuit and its components when the test shows an appreciable variation; also when the voltage test shows a normal condition, yet the defects exist as manifest by imperfect operation of the receiver. An example of this is a shorted r-f. transformer primary or secondary. The r-f. transformer is defective, yet the operating voltages remain unchanged and normal.

Item 5 enables the selection of test apparatus whereby the information may be secured with greatest ease.

Item 6 enables replacement. It obviates the need for extensive measurements to determine the correct value of resistance required in any one circuit in the event that the unit has been found defective and therefore cannot be measured to determine the correct value. (In connection with 6, the correspondent takes into consideration the replacement problem situation. He adds —in the event that conditions demand that a replacement unit be secured from the original manufacturer, and if this means a delay of several days because of the location of the nearest jobber or of the original manufacturer, knowledge of the electrical values enables the use of a temporary replacement unit and an operative receiver, with great satisfaction to the customer. Of course such temporary repairs are possible only in the event that the defect is not major.)

Since continuity testing represents the major part of the actual service work, whatever time saving can be effected must be in this direction. There can be no reduction in the charge made for the actual replacement because the price of the unit is fixed by the sales organization or the manufacturer. The price latitude is found only in the time required to make the repair. With a fixed charge and in some cases a fixed maximum charge above which it is impossible to levy because of competition and other factors, nothing but rapid and accurate operation enables the service technician to carry on. A saving of 15 minutes on each job during a day means the difference between success and failure at the end of the week.

What Electrical Values Are Desired

It might be well at this time to ascertain the exact significance of electrical values. As far as resistors are concerned, the actual resistance value is important for testing and replacement. If the receiver manufacturer has a lenient replacement policy, the wattage rating of each resistor is also necessary. For that matter the wattage rating is at all times important inasmuch as it is possible that the exact parts list showing the various parts numbers is not available and if two resistors of like ohmic value but unlike wattage rating are found in a receiver, confusion is apt to

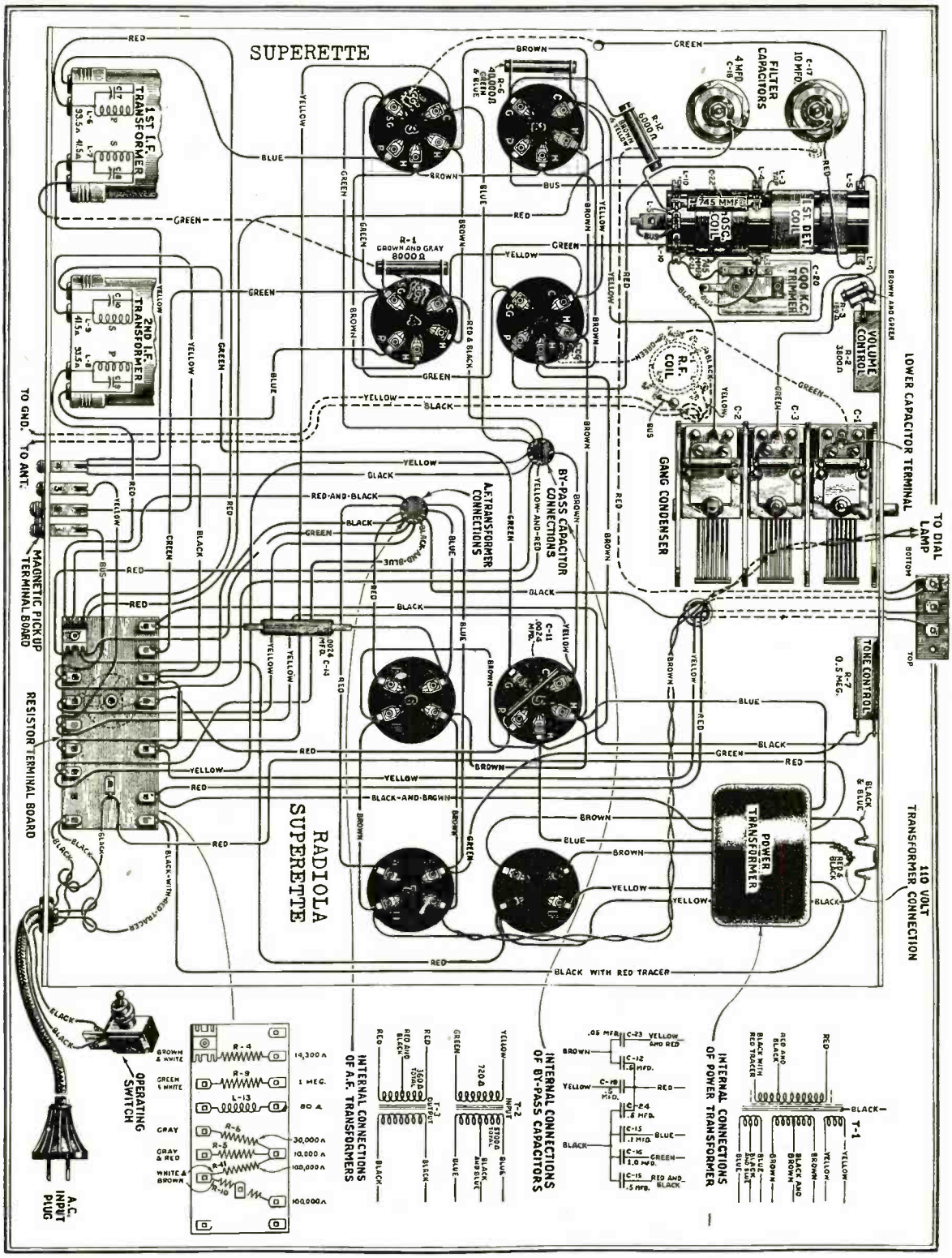

Fig. 2

result if, when ordering, the wattage rating is not mentioned.

Inductance values of windings quoted in henrys or fractions thereof have been stated as being of little utility in continuity testing or even general service work. Of infinitely greater import is the d-c. resistance of the winding. It is true that certain test kits incorporate inductance measuring meters but the resistance check is of actual importance during the work and has much more value than the inductance figure. The measurement of inductance is far more complicated than the measurement of resistance.

Knowing the rated resistance of a winding enables the checking of the circuit. Knowing the inductance of a winding means very little for several reasons. First, no service technician will attempt winding an r-f. transformer to replace a defective unit in the receiver. As a rule the r-f. transformers are replaced as a gang. Second, the service technician by making an accurate resistance test can ascertain whether or not a turn is shorted much more rapidly than if he must make an r-f. inductance test. The first check can be made without removing the r-f. transformers from the chassis. The sec- test requires its removal. The second check for inductance requires specially calibrated circuits and apparatus. In iron core windings the inductance is a variable depending upon the voltage applied.

Conditions which would tend to cause a deviation in inductance from the rated value, with the possible exception of current flow and damage to the core in iron core windings, would also tend to change the d-c. resistance. Thus, measurement of the latter would automatically show a variation in the former.

It is necessary to make mention of the place in a receiver where the inductance value is of importance. This is in the filter system of the power pack and possibly in the r-f. choke used as a part of the low-pass filter in the detector plate circuit or in the output tube plate circuit. Here both the resistance and the inductance are required. The resistance because of continuity testing and the inductance because of the tuning of the system and the need for accurate replacement. Since inductance is available in many shapes and many values of d-c. resistance, it is well to know both values.

We cannot omit the importance of knowing the resistance of a winding when that unit is sealed within a can and is but one of the units within that can. Individual access is impossible without disrupting the entire assembly, thus the only form of valuable information is the d-c. resistance.

As to condenser values, capacity and voltage ratings are equally in demand. This information is required primarily because of replacement work, although knowledge of the capacity is educational, and with capacity meters in test kits a more accurate test upon a condenser is possible. Response to the publication of filter and by-pass condenser voltage specifications has been very favorably received. The demand for the capacity rating of tuning condensers has been very slight.

Color Coding of Wires and Parts

Suitable color coding of wires and parts is very helpful during continuity testing because it enables rapid recognition of any unit which must be tested. It is also of aid because it enables more rapid tracing of the circuit.

Socket Layouts

Socket layouts are important because they indicate the exact tubes used and thus help select the respective circuits. It might be well to mention that a separate illustration showing the position and the types of tubes is not required when a chassis or factory wiring diagram is available.

Internal Connections of Units Sealed in Cans

Nothing in the way of a time loss is as great as the lack of such information. It is a conservative estimate to say that a serviceman wastes 10 to 12 hours a week if he is called upon to service a number of receivers which have units sealed in cans and the exact wiring is unknown.

Factory or Wiring Diagrams

Servicemen have repeatedly voiced the sentiment that the electrical wiring diagram even when replete with electrical specifications, color coding and part numbers, remains but part of the information required to enable rapid continuity testing. Of equal importance is the chassis or wiring diagram. In order to make a routine continuity test, the servicemen must locate the components of the suspected circuits. Since the electrical wiring diagram shows the various units located in each circuit, the technician has an idea of what he seeks, but where is he to seek these units upon the chassis? The arrangement of the tubes and parts indicated upon the electrical wiring diagram has no connection with the arrangement of the parts upon the chassis. The electrical wiring diagram of a midget resembles the electrical wiring diagram of a console model. The electrical wiring diagram shows the r-f. detector, a-f. amplifier and power-pack as a complete system. Yet an examination of the actual receiver shows the r-f. amplifier and detector in one part of the receiver and the power-pack and amplifier upon a separate chassis. To attempt to locate the corresponding units is productive of delay. The only means is to show the chassis wiring diagram so that when the occasion arises to check the receiver a diagram is available whereby one can instantly locate the *exact position* of any one unit upon the chassis.

The connection to the units are likewise of importance. This is necessary to avoid the trouble of tracing the circuit.

An analysis of service manuals shows three different forms of chassis layout presentation. These are:

1. The actual wiring diagram of the various units, showing the exact positions of the units, the color coding of the cables, the color coding of the resistors and condensers and the electrical continuity of whatever units are sealed in cans. (It is understood that the color coding is in the form of written comment rather than the actual color.)

2. A layout of the apparatus showing the containers only and the respective parts numbers.

A photographic reproduction of various views of the chassis with arrows pointing to the different units and printed legend designating the different units and their electrical values.

Of these three forms the first has been received with the greatest favor for several reasons. Several suggestions have been received relative to the type of information desired. The ideal would be a specification for the purpose of each unit, its electrical value and color coding. Naturally, all of this information is impossible due to the space limitations.

The concensus seems to recommend the omission of the actual function of resistors and condensers, but publication of data which will immediately designate the association between a part shown upon the electrical wiring diagram and a part shown upon the chassis wiring diagram. To show the electrical value of a resistor and its color code is satisfactory in the case of old receivers where solid colors were used. Even here difficulty may be encountered if more than one resistor of like size and design has the same resistance and the same coloring. A better arrangement is that used in some manuals, where an R designating letter followed by a number accompanies each resistor upon the electrical wiring diagram and a similar form of designation is used to indicate the same resistor upon the chassis wiring diagram. The electrical wiring diagram and the chassis wiring

diagram also carry the electrical value of that resistor.

The advantage of showing the electrical value upon the chassis wiring diagram is that it enables an immediate measurement of any one unit without the necessity of referring to another illustration for the electrical ratings. Standardization of color coding is still too recent to ask an individual to memorize the electrical equivalents. And if we recognize the fact that all types of resistors, inclusive of wire wound, are not yet standardized with respect to color coding, mention of the electrical value is by far the best method. Mention of the electrical value of a resistor or a condenser is not required upon the electrical wiring diagram if that value is shown upon the chassis wiring diagram, but since it is not yet standard practice to show chassis wiring diagrams, the electrical value should appear upon the diagram. Of course a parts list showing parts numbers which correspond with some designating symbol upon the electrical wiring diagram can be used, providing that this list also shows the electrical value, but such an arrangement requires reference to two sources of information. Furthermore, since it is possible to service a receiver without the chassis diagram, with only the electrical wiring diagram as the data at hand, it is best if the electrical values are shown upon the diagram. If some designating symbol accompanies each unit, this symbol should be listed upon the parts list and correlated with the part number.

Part Numbers

Mention of the part number upon the diagram is not a necessity according to the letters received. First because it represents printing and therefore complicates the diagram. Second, the need for the part number presents itself only after the defective unit has been located, therefore it appears in but one operation during the entire service procedure and is not of importance so far as continuity testing is concerned.

The information desired upon the electrical wiring diagram and the chassis wiring diagram is that which will enable the selection of a common reference point for the testing of any one circuit. What with the similarity of circuit structure of biased detectors and amplifiers, it is necessary that the tube function be indicated upon the electrical wiring diagram and the chassis wiring diagram, as for example first r-f., second r-f., oscillator, etc. This will enable the selection of some part of the tube socket as the reference point.

There exists a need for designation of the socket terminals upon chassis wiring diagrams. As a rule these diagrams show the underside of the chassis. This means that the terminals of the sockets are reversed with respect to the normal positions. This is confusing. Such designations would be H,H,F,F,P,Scr Gr, etc., depending upon the type of tube. This subject is of further importance because the exact placement of the sockets is not always the same and the various terminals are in different positions in different receivers; that is, with respect to the front or the rear of the chassis. All of this data enables the rapid selection of a reference point and further checking of the circuits.

Obviously the electrical wiring diagram cannot show the color coding of every wire used. But it can show the color coding of the power transformer cables. One of the most annoying problems is the tracing of the power transformer cables when the leads emerge from an opening in the power transformer housing and no designating data is given.

Mention of the color coding of the plate circuit leads upon the electrical diagram would be an advantage when the chassis wiring is checked because it would help locate the parts of that circuit. Mention of the color coding of all of the wires upon the chassis wiring diagram is desirable to allow rapid testing of continuity in any of the circuits. This is equally applicable with cabled wiring because it is possible to probe the cabled wires for the one with the required coloring and thus check the continuity of the wire itself.

Many chassis wiring diagrams show not only the shape of the various parts and containers, but also the electrical continuity of the parts within these containers. Of course the electrical symbol is used. This information has been considered of the utmost advantage.

Chassis layouts showing parts in pictorial fashion, that is, just the shape of the unit, and parts numbers without wiring information are considered to be of but limited utility. It is said that the chassis wiring diagram supplies this data relative to the location of the parts and that a tabulation in the form of a list giving the function of the unit, the part number, the electrical value and list price is of equal value. Of course the presentation of the part number accompanying the unit in the form of a chassis layout is easiest to follow, but the danger of poor printing resulting in imperfect recognition of the number and incorrect ordering is a hazard.

Photographic views of the different sides of the chassis have their functions but the comment received was favorable only when the photographs were fairly large and clear. The problems of photography where the color contrast between units is not very marked makes it difficult to recognize the various units. On the other hand photographs of the upper side of the chassis showing the various trimmer adjusting screws are in great demand providing that the proper legend accompanies the illustration. A photograph showing the various units but bearing part numbers only has been considered of little value. Further comment has been received relative to the screen used during the making of the cuts of this illustration. Rough screens used with reduced reproductions produced pictures which were of little help. Another comment relative to photographs of the underside of the chassis was that it did not show the color coding of the wires or the insides of the containers.

It might be of interest at this time to record several tests carried out to determine the relative efficacy and value of the electrical wiring diagram, the combination of the electrical and the chassis wiring diagram, and only the chassis wiring diagram. The defects produced were of the type which would interfere with the normal operations of the receiver, yet have no effect upon the operating voltages. The men were called upon to alternately repair these defects. The time spent was averaged. The routine voltage test consumed about the same amount of time in all cases and was not influenced by the type of circuit data available. The receivers selected were those which did not have automatic volume control tubes. The results showed a very great advantage in favor of the combination of the two drawings. Operating with nothing but the electrical wiring diagram and whatever test equipment the man required, the time consumed to locate the defect was about 60 percent longer than with both the electrical and the chassis wiring diagrams. In one instance, where the defect created was a short circuit across the r-f. transformer secondary, a low resistance winding, lack of knowledge of the correct electrical resistance of the winding caused the loss of so much time that the charge based upon $2.00 per hour for the analysis would have been entirely out of proportion with the initial cost of the receiver. Operating with nothing but the chassis diagram, the cost of servicing was so great as to be entirely out of the question.

Presentation of Continuity Test Data

Supplementary to what information is contained upon the electrical or chassis wiring diagram, great interest is evinced in the actual presentation of the continuity test data when it appears in tabular form. Information of this type has appeared in several forms among which are:

1. As the stipulated voltage to be found between two specified points, thus

indicating the condition of the components in that circuit between the two stated points.

2. As definitely specified resistance to be found between two stipulated points.

3. As a certain voltage indication upon a continuity tester consisting of a specified voltmeter (10 volts d-c. high resistance meter) and a 6-volt test battery, which system is connected between two specified points.

4. The same as mentioned in description number 3, except that the voltmeter is a 50-volt instrument (high resistance type) and a 45-volt battery.

5. The same as numbers 3 and 4 except that the meter is a 15-volt low-resistance type voltmeter and a 4.5-volt battery.

6. As a full or partial indication upon a voltmeter used with a battery.

7. As a definitely stipulated fraction of full scale deflection upon a certain specified voltmeter-battery combination.

8. As a certain indication upon a low range milliammeter (d-c.) which is used in one of several ways. One of these systems utilizes a simple series combination of the meter, a resistance and a battery. Another combination employs a variable voltage, a variable series resistance and several shunts.

Summary of Comments

The following is a summary of comments relative to these methods of checking continuity and the value of the tabulations. The voltage test made between any two points as outlined under heading 1, is the same as the conventional voltage test made with a set analyzer. The difficulty experienced with such a system is that a variation in voltage is to be found only under certain conditions, assuming that the test voltage remains constant during the test. These conditions are: A. when the circuit is of high resistance and carries current; B. when the circuit is of low resistance and carries appreciable current; C. when the circuit is open; D. when the normal voltage drop across the units in the circuit is appreciable. If the conditions A, B, C or D are fulfilled, a defect in the circuit will show a variation in voltage, but when the circuit is of high-resistance, but carries no current as in the grid circuits of amplifying tubes, a short circuit across that resistance will have no effect upon the voltage between the two points. The same is true when the circuit is of very low resistance and carries little or no current as is to be found in r-f. grid circuits or r-f. plate circuits across the r-f. transformer primaries. Thus the voltage measurement has certain limitations and is not universally applicable. As a matter of fact it is possible to have an open circuit in a system without interfering with the voltage indication. Such cases are open condensers in tuned r-f. systems, resistance-coupled audio systems, etc.

The resistance form of specification while not 100 per cent applicable, remains the best form of presentation. Its only point of failure is an open condenser. Obviously it is applicable to all resistors, r-f. chokes, transformers, a-f. windings, etc. Another advantage is that of economy. A single ohmmeter of suitable range is applicable as previously stated to all resistances commonly employed in a radio receiver.

The methods specified from 3 to 8 represent special systems and special meters. In the first place, each of these special systems and special meters is suggested for a certain receiver. The six systems are suggested for six receivers. Thus if a serviceman were called upon to test these six receivers and attempted to utilize the tabulated continuity test data he would require six different testing circuits, and several different meters. Since each meter is intended for a certain system, the calibrations for that system are not interchangeable with any other. Consider just one of these. A certain voltmeter and battery when connected between the plate of one tube and ground indicates 5.2 volts. Let us say that this indication represents 1,000 ohms. What is happening is that the 1,000 ohm resistance (the ohmic value of the circuit) acts like a multiplier for the meter. Whatever multiplying ratio is secured when the external resistance is 1,000 ohms with this meter of say 6,000 ohms resistance, will be secured only so long as the meter resistance is 6,000 ohms. In turn the voltage indication of 5.2 volts when the external resistance is 1,000 ohms is available only when the test voltage remains at its original value. The specification of 5.2 volts assumes that the test voltage remains constant. Any variation in test voltage will cause a variation in reading. The use of a meter with a different value of internal resistance will cause a variation.

On the other hand if the resistance of 1,000 ohms is specified as resistance without mention of voltage indication or any special type of meter, any ohmmeter with suitable range is satisfactory. The design of the meter is of no consequence. The test voltage is of no consequence. Nothing matters just so long as the ohmmeter is accurate and capable of indicating the required resistance.

The need for standardization of this type does not exist in the service shop of the jobber who handles but one line of radio receivers and the continuity test data as prepared is based upon a special type of meter which is assembled in the shop. But the need for standardization is repeatedly voiced by dealers and independent servicemen who may be called upon to service any one of a thousand radio receivers.

What is true in the case of the example cited is true in all of the others where special meters with special calibrations in other than ohms are recommended. Each of these systems is intended for a special case, at least the calibrations are special and in order that the meter combination be suitable for some other receiver, it is imperative that the continuity test data for the other receivers be based upon the same type of continuity test equipment.

Partial or full indications and fractional specifications are open to objections on the ground that too much latitude is offered during testing. The definition of partial or full is quite broad. If the meter is of the voltmeter-battery type, a full indication is impossible inasmuch as every series resistor will act like a multiplier. The extent of the range increase and therefore the deviation from the full scale reading depends entirely upon the resistance of the meter. As to partial indications, anything between zero and full scale is partial.

Viewing the subject from another angle, a voltmeter is much less expensive than an ohmmeter, but if several are required in order to service a number of receivers of different manufacture, the purchase of an ohmmeter is less expensive in the long run. Furthermore, portability of a single ohmmeter is simpler than that of a number of meters. In connection with ohmmeters, there exists no rigid regulation that they must be of the commercial type. The important item is that the continuity test data be given in the form of resistance values.

Methods of Testing

We cannot close without reference to two suggested methods of actual continuity testing. One system recommends a point to point test wherein each unit has two designating numbers and the test is made between these numbers. The numbers are marked upon a chassis layout showing the parts with or without wiring. The other system recommends a test between a common point such as ground and various points along a circuit until the point of highest potential above ground is reached, or until the point most distant from ground along that circuit is reached. Queries show that the latter is preferred because it is much faster and simpler. The fact that one test prong is fixed at the common reference point enables progressive testing.

Electrical characteristics of the hot-cathode mercury vapor tube

By Bernard Ephraim

Herein the theory of the mercury vapor tube is treated from atomic and electronic hypotheses.

THE electrical function of the hot-cathode mercury vapor tube may best be interpreted through the media of the electron theory. The electron, discovered by J. J. Thomson, has been recognized as a constituent part of all atoms, makes possible the explanation of the electrical nature of matter.

Regarding the electrical characteristics of the hot-cathode mercury vapor tube it has been found through extended research that some of the electrons which are emitted by the hot-cathode ionize the surrounding mercury vapor so that the positive mercury molecules tend to neutralize the negative space charge around the cathode; consequently, the emitted electrons are free to be attracted to the positive plate or anode and thus enable the tube to function as a rectifier with remarkable efficiency.

Theory of the Mercury Vapor Tube

The principle on which the tube is dependent for its operation is known as the phenomenon of ionization by collision; a hypothesis which has evolved from the electron theory and has been recognized as the most reasonable explanation for this particular phenomena. From investigations it has been discovered that electrons emitted by the hot-cathode in a mercury vapor tube are accelerated toward the anode with great velocity. These accelerated electrons move in the (electrical) force-free space between the hot-cathode and anode, in which space they collide with mercury vapor molecules, causing them to become "excited;" provided, that the velocity (kinetic energy) of the electrons is sufficiently great, which will result in the transfer of energy between the electrons and the internal mechanism of the atom. When this translational point is reached the collisions are termed as being "inelastic;" meaning, that the atom has either gained or lost energy. In this instance energy has been transferred to the atom which carries it to a state of higher energy. The potential at which this phenomenon first occurs is called the "resonance-potential," which is 4.9 volts. Mercury vapor may also be excited to resonance radiation by the absorption of its own line, lambda, equals 2,536 Angstroms, which is also equivalent to 4.9 volts.

At all potentials above the resonance potential inelastic collisions occur. However, the colliding electron has a surplus of kinetic energy remaining after the collision; therefore, it follows that increasing the potential (voltage), increases the kinetic energy of the electron which can excite the atom to another state of stability and so on. A new resonance-potential occurs with each transition of potential to a *new energy level.* These potentials beginning with the lowest may be classified as first and second and so forth. Collectively all energy levels except the one normally occupied may be expressed as excited energy levels. Eventually a voltage is obtained at which the colliding electrons can completely separate an electron from the atom, leaving a positive ion, which is eventually neutralized by picking up a stray electron. The lowest voltage at which this phenomenon occurs is 4.9 volts and, as said before, is termed as the resonance-potential. The potential at which ions are liberated is 10.3 volts.

Electron to Positive Ion

For the most part the foregoing discussion is coupled directly to the following statements: that the atoms of mercury vapor may become excited or ionized by bombarding them with electrons possessed with sufficient energy. If the energy given to an atom by such a collision is sufficient to expel an electron from its normal orbit to infinity, the atom may become ionized or excited. When an electron is separated from its normal orbit it leaves not as an electron, but as a positive ion. This freed positive ion will consequently be neutralized by the optional acquisition of a free electron. Finally, the free electrons will be attracted to the anode or plate as will the positive ions that have been separated from the mercury atoms, which collectively constitute the flow of current in the tube. The passage of ions and electrons cause more of the atoms to be broken up by collision so that the vapor becomes heavily ionized and transmits a considerable amount of current. Each electron and each ion carries a charge of $1.59 \cdot 10^{-19}$ coulomb; or for each ampere $629 \cdot 10^{16}$ electrons, or positive ions, must pass the given cross-section of the circuit per second. The voltage required for gaseous conduction of electricity between the hot-cathode and anode depends mainly on the gas or vapor pressure, and on the temperature and material of the electrodes. The temperature of the mercury does not form the cathode, but determines the pressure of the conducting mercury vapor. In conclusion, the electrons ionize the surrounding mercury vapor by acquiring enough energy in the impressed electrical field over one free path to knock the electrons out of the neutral mercury atoms in the vapor through the phenomenon known as ionization-by-collision.

Effect of Pressure Upon the Mercury

Variations in the pressure of the mercury vapor add resistance to the passage of ions and electrons from the hot cathode to anode which greatly modify the ionization-by-collision and space-charge effects. The space-charge effects are increased and ionization-by-collision decreased under very low gas pressures; while if the pressure be high the resistance offered to the acceleration of electrons by molecular interference becomes great. From researches it has been discovered that the optimum pressure is a few microns, at which

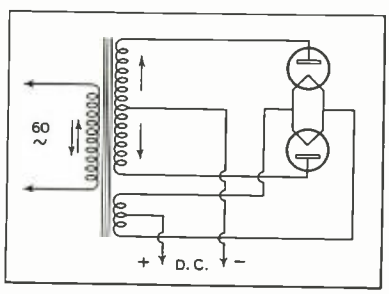

Fig. 1. Single phase, full-wave rectifier.

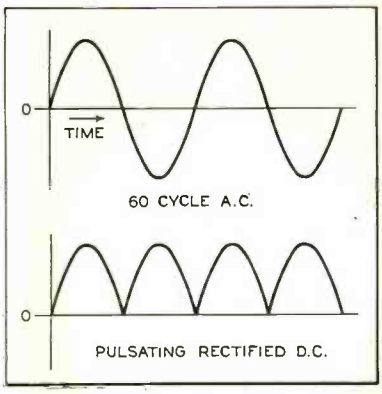

Fig. 2. A-C. impressed on rectifier, rectified pulsating D-C.

ionization-by-collision produces an abundance of current conveying ions and electrons. In addition, the gas-flow resistance and space-charge effects are comparatively small.

A-C. to D-C.

The hot cathode mercury vapor tube will change an alternating-current into a pulsating direct-current when the impressed voltage exceeds the critical voltage so as to allow the tube to become ionized, which results in the establishment of an arc between the electrodes permitting the transmission of an intermittent unidirectional current. The cause of the current flowing in one direction is attributed to the difference in potential between the cathode and anode; or during the negative alternation of a-c. the potential on the anode rises to a point which is greater than that of the accelerating electrons which causes the anode to repel the flow of electrons resulting in the momentary interruption of ionization, stopping the flow of current only to resume again during the positive alternation which is sufficient to attract the released electrons emitted by the hot cathode, which is in a state of rapid electronic emission, across to the anode. Thus is completed the circuit causing the current to resume its flow. In Fig. 1 is shown a modified electrical arrangement of a simple single-phase, full-wave rectifier; single and double arrows indicate the conventional direction of current flowing during each alternation. The wave shapes shown in Fig. 2, show the a-c. impressed on the rectifier and the rectified pulsating d-c. These shapes differ widely in practice and those illustrated are merely representations of a theoretically perfect full-wave rectifier.

Operation of the Tube

In respect to the operation of the hot cathode mercury vapor tube it is considered good practice to allow the filament of the tube to come up to full temperature before the plate voltage is applied. Otherwise, the active material may be knocked off the filament. The precaution given is merely this: that the space charges around the cathode reduce the fall of potential at the surface of the cathode so that the positive ions which are drawn to the hot cathode or filament do not have energy enough when they strike the filament to knock off the active material. It is the positive ions of mercury accelerated in the high field around the filament when there is large space charge that are attracted to the negative filament and injure its surface. To calculate the force of impact of the positive ion which causes this effect, it is only necessary to take the potential gradient (dV/dx) potential difference dV over distance dx in which the electrode finds itself, multiplied by the mean free path, lambda, and the charge e of the positive ion, gives $\frac{1}{2}$ mv^2, where m is the mass of the positive ion and v its velocity. This gives the following expression:

$$\left(\frac{dv}{dx} - \lambda e = \tfrac{1}{2} mu^2\right)$$

Every precaution should be taken to keep the mercury tube out of intense radio-frequency fields, because radio-frequency oscillations introduce potentials into the gaps between the cathode and anode of the tube which, superposed upon the conditions already existing, leads to ionization and changes of current when they are not wanted. If the mercury tube is operating critically, it takes little to produce the necessary ionization which is needed for its operation. The added potential introduced by means of radio-frequency currents playing between the electrodes is sufficient to start ionization that is not desired. The tube should likewise be kept out of magnetic fields as a magnetic field has the effect of changing the energies of the electrons in the atom by distorting their hypothetical orbits and making certain direction of motion easier than others. A magnetic field can also modify to some extent the ionization potential of the mercury atoms and, if the tube is operating critically this effect greatly increases stray radio-frequency currents playing between the electrodes; either of which causes an effect known as back-current. Much difficulty in filtering the output of the rectifier may be eliminated by isolating the power supply from the transmitter and shunting the power supply with a fairly high mica condenser preceded by an adequate radio-frequency choke. A condenser of .002 mfd. may be used advantageously for 40 meter operation.

The output of the mercury vapor tube is limited by the capacity of the leads through the stem. Great caution must be exercised when handling these tubes while in operation as there is enough energy which has the ability to pass through the stem of the tube to electrocute the unfortunate person coming in contact with the output of the rectifier. The output should be protected with fuses or circuit-breakers so that if a short circuit should occur the rectifier system or transformer will not be destroyed.

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BROADCAST STATION WGY PIONEER ENGINEERS

STATION WGY, Schenectady, N. Y., has offered many graduates from its technical department. Foremost might be mentioned W. R. G. Baker, who as engineer of the General Electric Company, was chiefly concerned with WGY's transmitters. Mr. Baker is now vice-president of engineering and manufacture for the RCA-Victor Co., at Camden, N. J. Harry Sadenwater, for years engineer in charge of WGY, and the man who supervised the location and construction of the transmitters for KOA, Denver, Colo., and KGO, Oakland, Calif., is now in charge of receiver design for RCA-Victor.

A. B. Chamberlain, once control room and remote control engineer for WGY, advanced through the Buffalo Broadcasting Corporation to chief engineer of the Columbia Broadcasting Company. Andrew D. King, another WGY alumnus, is now in Washington, D. C., as senior engineer of the Federal Radio Commission.

Other technical men, graduates of WGY are: A. R. Johnson, station engineer of WENR; Gerald W. Cooke, chief engineer of WBAL, Baltimore, Md.; Russell F. Hoff, engineer at WLW, Cincinnati; D. N. Stair, station engineer of WJZ, New York; Charles LaGue, station engineer KOA, Denver; Joe Chambers, chief engineer of WLW, Cincinnati; Robert Owen, engineer in charge of KOA.

These men look upon WGY as a sort of Alma Mater.

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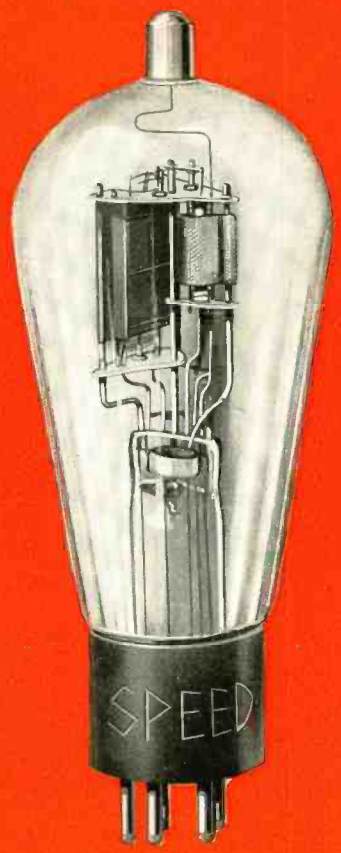
The SPEED "TRIPLE-TWIN," a combination power output and detector tube, far surpasses all recent developments and is comparable in importance only to the invention of the vacuum tube itself.

Its features are outstanding:

- Triple the 245's output and double the 247's without increased plate voltages.
- One "Triple-Twin" supplants complete DETECTOR and AUDIO System.
- Super sensitivity allows elimination of pre-stages in special applications.
- Flat frequency response, 30 to 50,000 cycles. A boon to television.
- Economy in chassis construction.

Complete engineering data available



Applications

- Radio Broadcast Receivers
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- Television
- Sound Projectors and Recorders
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THE MANY USES OF RADIO

AN idea of the wide spread of the services now being rendered by radio telegraphy and radio telephony may be gained by noting the renewal of license applications issued by the Federal Radio Commission in January, this year:

The list follows:

Class of station	Number of applications acted upon
Point-to-point telegraph	223
Point-to-point telephone	16
Coastal telegraph	59
Coastal telephone	1
Coastal harbor	4
Marine relay	38
Mobile press	3
Municipal police	48
State police	7
Marine fire	1
Aeronautical	91
Aeronautical point-to-point	57
Aircraft	384
Airport	5
Agriculture	9
Geophysical	102
General experimental	85
Special experimental	23
Experimental visual broadcasting	2
Motion picture	1
Broadcast pickup	3
Portable	2
Special emergency	22
Alaska (4 classes)	69
Assignments	20
Total less ships	1,275
Ships	493
Total including ships	1,768

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GENERAL FERRIE, OF FRANCE, DIES

GENERAL Gustave Auguste Ferrie, member of the Academy of Sciences, commander of the Signal Corps of the French army and scientific pioneer, died in Paris on February 16. He had been ill for five days of appendicitis. He was sixty-three years old.

At the outbreak of the World War, when he held the rank of major, he was placed in charge of the signal service of the 1st Army. Gathering about him a number of the most brilliant technicians in the country, he succeeded in providing the French forces with such an excellent communications service that France's allies, and even eventually the enemy, copied it. He was promoted rapidly and when hostilities ceased he was a brigadier general. He was later made inspector general of military telegraphs.

NEW RADIO TELEGRAPH SERVICE BETWEEN PARAGUAY AND ARGENTINA

ON November 17, last, a new radio telegraph service between Asuncion and Buenos Aires was inaugurated. It bears the name Radiovia, and is owned and operated by an Argentine citizen, Ingeniero Primitivo Padilla, under a concession granted him by the Paraguayan Government on January 16, 1931. The new service competes directly with Citradio (chiefly German-owned), which has been furnishing radio communication service between Asuncion and Buenos Aires since February, 1931. According to Ing. Padilla's concession, at the end of 25 years, the installations he has made will become the property of the Paraguayan Government. The Postal and Telegraph Service of Paraguay undertakes to supply him with office facilities in the building occupied by the post office. The Government shares in the revenues of the line. (American Minister Post Wheeler, Asuncion, Paraguay, 11-30-31.)

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TELEVISION PROGRESS FROM AN ENGINEERING VIEWPOINT

(*Concluded from page* 17)

Gassy power amplifiers which are sure to come in the near future may also prove useful for this purpose.

If the television set of the near future will produce even a fair image of a face with sufficient illumination to observe it without fatigue, a goodly quantity of such sets could be sold without waiting for greater perfection.

Sets heretofore obtainable have not come up to these modest requirements, but progress is being made.

Engineers who have the vision to realize that practical and profitable television is no doubt a certainty of the future should sense that the type of apparatus required must of necessity cost more than the elementary, amateurish outfits demonstrated and displayed in the past year or two.

TELEVISION TRANSMISSION FROM EMPIRE STATE BUILDING, NEW YORK

THE new equipment for television transmission from the tower of the Empire State office building, New York, has been installed and the transmitting frequency is reported at forty-four megacycles for sound and sixty-one megacycles for pictures.

RADIO INDUCTIVE INTERFERENCE

There has just been issued by the Department of Marine, Radio Branch, Ottawa, Canada, Bulletin No. 2, on "Radio Inductive Interference." The bulletin contains 102 pages, is well illustrated and contains a considerable amount of information of practical use to all persons interested in good broadcast reception and in the elimination of the many annoying disturbances which interfere with radio reception.

The bulletin was prepared by H. O. Merriam, engineer in charge, interference section of the department. C. P. Edwards, vice-president (1931) of the Institute of Radio Engineers, is director of the radio branch of the Department of Marine.

The price of the bulletin is 35 cents.

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ESTABLISHMENT OF FIRST TELEVISION COMPANY IN SOUTH AMERICA

AS a result of approximately a year's study of the possibilities for television, a company has recently been formed in Argentina under the title of the Baird Television, Limited (Argentine company) for the purpose of exploiting in Argentina, Uruguay, Brazil and Chile all of the patents of the Baird Television Co., Ltd., of London. This company will handle all the apparatus, transmitters, receptors and accessories of the inventor John Lagie Baird, and they intend to establish in the near future a combination television and radio telephone service in these countries. In Argentina this service will be established in conjunction with the local broadcasting station Radio Splendid. The initiators of the new Argentine company are Antonio C. Devoto, Benjamin Gache, Angel A. Perrone, Antonio F. Masetti, Alfio Arico and Ignacio Gomez. During the past year the company is reported to have carried on some very successful experiments and demonstrations. (Assistant Trade Commissioner Milton T. Houghton, Buenos Aires, Argentina, 1-4-32.)

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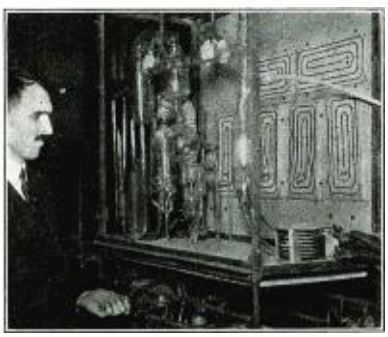
IMPROVEMENTS RELATING TO THE SEALING OF CONDUCTORS INTO ELECTRICAL APPARATUS

IN order to avoid oxidation of the surface of the metal during the molding of the insulator on to the metal, the contact surface of the metal is coated with a layer of non-oxidizing or reducing material, ex. nickel.——*British Patent* 354.082. *Issued*: *August* 6, 1931.

REMOVING GAS FROM METAL PARTS

IN the research laboratory of the General Electric Company at Schenectady they have taken a bit of gas only one-eighth the volume of the head of an ordinary pin—and weighing a hundredth of a millionth of an ounce; have put it through a special heating, evacuating and analytical system; and have announced that the speck of gas contained 43 per cent carbon monoxide and 57 per cent nitrogen.

How such a small quantity of gas was analyzed was explained in a paper presented by Drs. F. J. Norton and A. L. Marshall of the General Electric Laboratory at the New York City meeting of the American Institute of Mining and Metallurgical Engineers on February 16.



Apparatus for degassing metals.

Troubles occur if metal parts used in the manufacture of vacuum tubes—thyratrons, radio, photoelectric, pliotron, and various other members of the family—are not thoroughly degassed. Metals such as molybdenum must be heated to a high temperature in a high degree of vacuum in order to expel all of the gas.

The experiments showed that the gas is present throughout the thickness of the metal, and is not simply clinging to the surface. Tests made with molybdenum obtained from numerous commercial sources showed no differences in the nature of the gases present, the amounts, or ease of removal. It was found that the molybdenum parts should be heated at 1760° Centigrade (3200° Fahrenheit) in a vacuum of the order of a tenth of a billionth of atmospheric pressure, for a time depending upon the thickness of the metal, to produce a condition in which gas is no longer given off by the sample.

Having been so treated. the piece of metal can be handled in the air—provided it is kept clean, not touched with the fingers, and is handled with forceps. Then, when the part has been built into a device, it can be degassed readily, for any gas now present is simply a monomolecular layer on the surface—that is, the gas has formed a blanket, only one molecule thick, over the surface of the metal.

▲ ▲ ▲

NEW INVENTIONS

Improvements in Submarine Electric Cables for Communication Purposes

HYDRATED caoutchouc is proposed as insulation material in submarine cables, in place of gutta-percha. The material is produced by subjecting ordinary caoutchouc to a special process in which platinum, palladium or nickel may be used as catalysts.——*Felten and Guilleaume Carlswerk, Akt. Ges. British Patent* 355,945. *Issued*: *September* 3, 1931.

▲

Metallic Resistor

A METALLIC resistor including a plurality of straight resistor bars of channel cross-section throughout their lengths and connected at alternate ends, the flange of said channel resistor bars being located at a right angle to the normal plane of the resistor and extending outward therefrom, a supporting rod at each end of the resistor, insulator spools upon each supporting rod and clamping means at each end of each straight bar for detachable connection to one of the spools, each of said spools having an enlarged rib. and terminal connections for the resistor.——*F. T. Cope (Assigned to Electric Furnace Co.) United States Patent* 1,827,508. *Issued*: *October* 13, 1931.

▲

A Method of an Apparatus for Coating Filamentary Material

APPARATUS and process for coating, baking and flashing filamentary material to be used for electron emitters. Platinum-nickel alloy is cited as the preferred filament.——*Standard Telephones and Cables, Ltd. (Western Electric Co., Inc.) British Patent* 348,176. *Issued*: *May* 5, 1931.

▲

Platinum Coating Tungsten and Molybdenum Wires

MENTION that instead of platinum, a platinum-nickel alloy (50 per cent nickel) can be used.——*S. A. Wekschinski and K. B. Romanjuk, Russian Patent* 16.496. *Issued*: *August* 31, 1930. *Chem. Zentr.*, 1931-11, *pp.* 764-765.

PUSH-PULL PATENTS QUESTIONED

A SUIT was filed in the District Court, Southern District of New York, on February 8. 1932, by Thomas Bullitt Dixon, of Greenwood Lake, N. Y., alleging infringement of U. S. Patent No. 1,197,480 granted to the complainant on September 5, 1916. The application for said patent was filed on February 5, 1908, Serial 414,419.

It is claimed by the plaintiff that claims 48, 49 and 50 of his patent are infringed by patents 1,128,292, granted February 16, 1915, and 1,137,384; reissue 14,380 of October 23, 1917, issued to the American Telephone and Telegraph Company.

▲

PORTABLE SHORT-WAVE RECEIVERS

(*Concluded from page* 23)

the same insulating strip. To change tubes in the set illustrated, one of the brass side pieces is removed and the lid is lifted. The extra plug-in coils are carried on the same shelf as the filament dry cells. A row of clips is arranged under the small set at the top of the case, for the battery connections.

There are two common methods of coupling the antenna to the set. One consists in using a primary coil on each plug-in coil. The other consists in using a small antenna-series condenser. It doesn't seem to make much difference which method is employed. If an antenna-series condenser is used, common plug-in coils, consisting of primary and secondary windings only. can be used.

Tuning the Set

To operate the completed set, connect antenna and ground to posts provided. In a car, use the frame as ground and an antenna on the top of the car or. if more convenient, under the running boards. In the field, drive a piece of pipe into the ground and attach a ground wire to it. On wet ground, a pocket knife may serve as a ground connection. Results are good with antennas consisting of wires 5 or 10 feet long, although the signal strength is much better if a longer wire is used.

To tune any regenerative set of this kind, adjust the tuning condenser to the desired signal, maintaining the set just at the point of oscillation with the regeneration control. The latter point cannot be overemphasized; the increase in sensitivity is very great when the proper operating point is approached. If the set hums or starts oscillating with a click, try a different gridleak or readjust the filament voltage. The modern dry-cell tubes are very uniform and good results are obtained without trouble if the coils are properly designed.

When the set is carried, the phones and coils are slipped inside.

Tube progress

NEW FILAMENT PERMITS A-C. OR D-C. OPERATION

During the past few years considerable research and design study have been devoted to the small radio set for automotive service. This development resulted in the manufacture of a new series of indirectly heated cathode tubes which obtain heater power from the car storage battery. These tubes have greatly reduced physical dimensions to fulfill the need for a compact radio receiver.

This series of tubes, known as the 6.3 volt series, not only found immediate acceptance in automotive receivers, but the small dimensions and favorable electrical characteristics prompted their use in 110-volt direct-current receivers, compact 110-volt alternating current receivers and a number of special receivers and amplifiers.

The design of a heater for use at 6.3 volts dictates a filament length of approximately 4.5 inches, and based upon past experience, the first filaments were made by concentrating this long heater in the form of a helix and arranging it inside a tubular insulator.

The high temperature portions of the heater also fuse the ceramic when heated to produce the high cathode temperature essential to certain manufacturing operations, and the heaters or insulators are weakened during this processing so that the heaters burn out after short periods of normal use, or, abnormal and variable leakage takes place between the heater and cathode through the partially fused insulator. This variable heater leakage gives rise to extraneous noises that are evidenced in the output of the set to such an extent, in many instances, as to interfere with the desired signal.

To overcome these objectionable factors the Arcturus Radio Tube Company has contributed to the radio industry a new and more efficient design of heater structure in the form of an "M" filament. Each of the four vertical strands are threaded through a separate hole in an insulator that has an exceptionally high insulation resistance at elevated temperatures.

This "M" heater is so designed that its operating temperature is practically constant and the same in value as in the Arcturus 127 tube which created a nation-wide reputation for long life.

This form of "M" heater with its closely parallel wires carrying currents in opposite directions is practically non-inductive, thus minimizing the inherent tube hum and making the tube particularly well adapted for use in the design of receivers operating directly from alternating current sources.

The new 6.3 volt automotive series of Arcturus tubes therefore is suitable for general use in both d-c. and a-c. operated receivers. In order to emphasize this distinctive feature, the Arcturus Radio Tube Company has appended the letter -A to the standard type number.

The types available at present are:

Type 136-A, tetrode, screen-grid amplifier.

Type 137-A, triode, detector and amplifier.

Type 138-A, pentode, power output amplifier.

Type 139-A, variable-mu pentode, r-f. amplifier.

Technical data on each of these types is available upon request to Arcturus Radio Tube Company, Newark, N. J.

CHARACTERISTICS OF THE TRIPLE TWIN TUBE

The characteristics of the Triple-Twin tube manufactured by the Cable Radio Tube Corpn., 230 N. 9th Street, Brooklyn, N. Y., are herewith given.

The detector action takes place in the first section of the Triple-Twin. As its dynamic Eg-Ip characteristic has marked curvature, upon which the compensating action for the output section's grid current depends, plate rectification unavoidably takes place. Therefore, as any form of grid rectification would be 180° out of phase with this unavoidable plate rectification, only the latter can be used. Because of this curvature, it is not necessary for the plate current to be normally biased to cut-off, as in usual plate rectification, and consequently, nominal plate current variations between individual tubes have little effect on detector sensitivity. In order that the compensating action is not impaired, the plate current level for any one magnitude of unmodulated carrier must be the point of inflection for the changing load. This changing load will be remembered as variations in the input tube's load caused by the varying grid impedance of the second section, during the time this grid is taking current.

The detector-amplifier action has been worked out successfully. However, care must be exercised to prevent detector overload caused by grid current of the first section. This overload is identical to that usual in fixed bias detectors. An automatic volume control tube is a good expedient to limit this condition as it automatically controls the amplitude of the voltage arriving at the detector. A combination fixed and self-bias system has been suggested and further development is being carried on to perfect special circuits.

In a Triple-Twin amplifier, the output voltage varies as the square-root of the applied signal. In a Triple-Twin detector-amplifier, the output voltage varies linearly with the input. This means that, although the detector action follows a law higher than the first power, the overall relation is the same as linear rectification feeding into a triode amplifier. The characteristics are extraordinarily linear. Modulation versus output voltage is straight almost throughout the entire range. Carrier versus output voltage is quite linear.

The first tube of the Triple-Twin series, type 295, is designed especially for a-c. operation. Its great sensitivity and high power output make it ideally suited for broadcast receivers. The two sections are rated individually so as not to introduce circuit constants. Its characteristics are as follows:

Triple-Twin Type 295—
Heater voltage—2.5 volts
Heater current—4.0 amperes

Use—Amplifier

	Input section		Output section	
Plate volts	180	250*	180	250*
Grid bias (volts)	—10.0	—14.0	—2.5	—3.0
Plate current (ma.)	3.0	4.0	32.0	52.0
Amplification factor	14.4	14.4	13.0	13.0
Plate resistance (ohms)	12,500	12,000	3,550	3,000
Mutual conductance (micromhos)	1.150	1,200	3,650	4,350
Power output (watts)	...	...	2.25	4.5
Signal volts (full power —r.m.s.)	4.0	5.0	...	...
Load impedance (ohms)	12.500	12.500	4,600	4,000
Input capacity (mmf.)	3.5	...	...	...

*Maximum.

Use—Detector-Amplifier

Plate volts	180	250 max.
Input grid bias (volts)	—12.0	—16.0
Input plate current (ma.)	1.0	2.0

Note: For simplicity, remaining input characteristics will not be specified under these conditions. Output characteristics remain as listed above.

Overall length ..... 6 9/16 inches
Overall diameter .... 2 11/16 inches
Cap ..... 0.346 inch—0.369 inch
Bulb S-21
Base ..... Standard 5 pin UY

▲ ▲ ▲

A NEW SUPER-CONTROL PENTODE

RCA-Radiotron Company, Inc., and E. T. Cunningham, Inc., have announced a new tube designated respectively as RCA-234 and CX-234.

This new tube, a super-control r-f. amplifier pentode, is an addition to the line of 2-volt tubes and is designed primarily for service in receivers operating from dry cells or from a storage battery where economy of filament-current drain is important.

The 234 is recommended for use as a radio-frequency amplifier, intermediate-frequency amplifier, and first detector in battery-operated receivers. Its design is such as to make it especially useful in portable receivers.

It is effective in reducing cross-modulation and modulation distortion over the usual range of received signals. The design of the 234 is such as to permit easy control of a moderate range of signal voltages without the use of antenna potentiometers or auxiliary volume-control switches. This super-control characteristic makes the tube uniquely adaptable for use in the r-f. and i-f. stages of receivers incorporating automatic volume control.

The filament employed in the 234 is of the coated type. It is designed to consume as little power as possible consistent with satisfactory operating performance. This feature makes the 234, in combination with the '30, '31, '32, and/or '33, especially suitable for use in portable receivers.

Tentative Rating and Characteristics

Filament voltage	...	...	...	2.0 volts d-c.
Filament current	...	...	...	0.060 ampere
Plate voltage	67.5**	90	135	180 volts max.
Screen voltage, maximum*	67.5	67.5	67.5	67.5 volts
Grid voltage, variable	—3	—3	—3	—3 volts min.
Plate current	2.7	2.7	2.8	2.8 milliamperes
Screen current	1.1	1.1	1.0	1.0 milliamperes
Plate resistance	400,000	500,000	600,000	1,000,000 ohms
Amplification factor	224	290	360	620
Mutual conductance	560	580	600	620 micromhos
Mutual conductance at —22.5 volts grid bias	15	15	15	15 micromhos

Maximum overall dimensions	
Length	4 11/16"—5¼"
Diameter	1 13/16"
Cap	0.346"—0.369"
Bulb	S—14
Base	Medium 4—Pin
Socket	Standard 4—Contact

*Under conditions of maximum plate current.
**Recommended values for use in portable receivers.

SYNTHANE APPOINTS SOUTHERN REPRESENTATIVE

Synthane Corporation, Oaks, Pa., manufacturers of Synthane laminated bakelite, sheets, rods, tubes, fabricated parts and stabilized gears, has appointed H. Douglas Stier, 101 Marietta St., Atlanta, Ga., as sales representative. He will cover the territory of Georgia and Alabama, bringing manufacturers in these states in direct contact with the services of the Synthane Corporation.

Synthane Corporation, in addition to the Atlanta office, maintains representatives in Philadelphia, New York, Cleveland, Chicago, Boston, Detroit, Pittsburgh, Dayton, St. Louis, Minneapolis, Los Angeles and San Francisco.

▲

FASTENINGS THAT FASTEN

In the manufacture of radio apparatus, radio and public-address parts, and in shop operation there is more need today than ever before for low cost, dependable, permanent fastening screws.

The Parker-Kalon Corp., 200 Varick St., New York, has issued a new booklet which describes types of fastenings for all needs. These screws are widely used in radio manufacturing.

▲

ARCTURUS' WESTERN DIVISION OFFICE MOVES TO LARGER QUARTERS

Offices of the western division of Arcturus Radio Tube Company have been moved to the first floor of their present address at 1855 Industrial Street, Los Angeles.

This is a direct factory branch of the manufacturer of Arcturus blue radio tubes, under the personal direction of L. P. Naylor, who was previously sales manager of the company at Newark, New Jersey.

Mr. Naylor gives as the reason for the change, constantly increasing business and the ready acceptance of Arcturus tubes on the west coast. The new office—room 101—is larger and is the best situated one in the building.

▲

TALK ON VARIABLE CONDENSERS USED IN RADIO AND TELEVISION

In an interesting lecture, delivered before a group of New York radio engineers and servicemen, Allen D. Cardwell, chief engineer of the Cardwell Mfg. Corp., of Brooklyn, N. Y., explained some of the intricate problems involved in the design and production of variable condensers used for radio and television purposes.

Mr. Cardwell first showed why air dielectric condensers are used, not only as standards, but also wherever extreme accuracy is necessary. The capacity of a condenser with a solid dielectric changes with the frequency in an indeterminate manner. For this reason it is impossible to calculate the capacity at high frequencies from that measured at low frequencies. Air, however, is almost perfect as a dielectric and hence the air dielectric condenser shows no change in capacity with the frequency. Air condensers are also free from power losses. The ideal air condenser has zero phase difference. There is no current component in phase with the e.m.f. and hence the condenser acts as a pure capacity, without resistance. Only the most careful design, however, can produce an air condenser which approaches perfection. The two sets of plates must be supported and insulated from each other and this requires the use of a solid dielectric. Such a dielectric, being imperfect, introduces some capacity, hence a phase difference. The extent of this difference is controlled by the quality of the solid dielectric and the relative capacities of the solid and the air.

In a high-quality variable condenser, the capacity must remain constant and definite at any particular setting. Constant capacity calls for rigidity of construction, and this is impossible to attain in a cheaply made condenser. By correct design and the use of high-grade materials and through skilled workmanship, it is possible to combine light weight with maximum strength. Mr. Cardwell illustrated this point by showing how the new "Midway" variable condenser is constructed. This is a small featherweight condenser, designed for use in aircraft equipment, portable sets, etc. To attain the necessary structural strength, particular attention was given to design details. Wide surfaces at joining points in the frame insure rigidity, while cap screws and studs, securely held by lockwashers and nuts, afford permanent, steady tension at all times, at every important point. Only deliberate tampering can loosen this assembly.

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CENTRAL RADIO CORP. GRANTED CANADIAN PATENTS

The Central Radio Corporation, of Beloit, Wis., has been granted patents in Canada covering the company's series 500 model sockets.

The Central Radio Corporation is one of the manufacturing concerns which has maintained a fairly satisfactory volume of business during the past months of general business depression. The management took advantage of the opportunity to strengthen the company's position with regard to excellence of products offered to the radio and allied fields. W. T. Bracken is vice-president and general manager of the corporation.

▲

OHMITE EXPANDS

The Ohmite Manufacturing Company, 636 N. Albany Avenue, Chicago, announces that Ralph M. Hill has joined their organization as sales manager of the radio resistor department.

Mr. Hill, who was with the Yaxley Manufacturing Company for the past seven years, has been connected with the radio industry since 1922.

In his new work, Mr. Hill will contact both the manufacturing and jobbing trade. One of his first interests will be the promotion of the Wirohm red devil (a wire-wound, cement-coated resistor) as a replacement unit. This resistor, a recent development of the Ohmite engineering department, lends itself readily to the replacement field because of its high wattage and extensive range of resistance values.

The Ohmite Manufacturing Company is also well known as manufacturers of vitreous enameled resistors and rheostats which have a wide application in the radio and electrical fields.

The present method of distributing Ohmite radio resistors through sales representatives will be continued. However, the increased activity in connection with replacement units will probably necessitate additional representatives throughout the country.

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WIRE WOUND RESISTANCES

C. E. Mountford, manufacturer of Kroblak wire-wound resistances, is now located at Dumont, N. J. The company's New York office is at 310 Broadway, where John Killoch, metropolitan representative is in charge.

▲

MALLORY GRANTS ANOTHER DRY ELECTROLYTIC CONDENSER LICENSE

An announcement by P. R. Mallory & Co. reads:

"P. R. Mallory & Co., Inc., who pioneered and developed the field of dry electrolytic condensers under the Mallory-Elkon brand has granted a license to Magnavox Co., Ltd., through their subsidiary, Electro-Formation, Inc.

"Mallory, exclusive licensees under the basic Ruben patents on dry electrolytic condensers, previously granted one other license to Sprague Specialties Co."

▲

COLLOIDAL GRAPHITE PRODUCTS

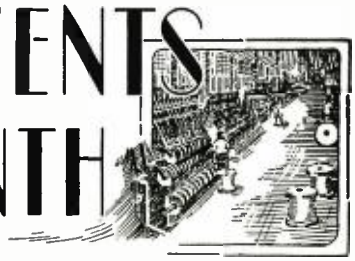
The Acheson Oildag Company, Port Huron, Mich., has on hand copies of an excellent technical paper by H. F. Church and H. A. Daynes, dealing with a method of making electrical contact with ebonite and soft rubber for insulation tests. Copies may be procured by writing to Edward A. Bodine of the Acheson Oildag Company.

▲

CINCH PRODUCTS

The Cinch Mfg. Co., 2335 W. Van Buren St., Chicago, has issued a new pamphlet listing the company's new line of soldering lugs, tube sockets, binding posts, and tip jacks. Copies will be sent upon request.

NEW DEVELOPMENTS OF THE MONTH



SPECIAL ISOLANTITE SOCKETS NOW PROVIDED BY HAMMARLUND

At high frequencies, low loss sockets are just as important as low loss coils or low loss condensers. Accordingly, the Hammarlund Mfg. Company, 424 West 33rd Street, New York City, have recently developed a new type low loss Isolantite socket.

As is well known, Isolantite is universally regarded as equivalent to fused quartz for almost every purpose requiring lowest losses and highest surface resistivity. Its electrical efficiency is not affected by either temperature or humidity.

The top and sides of the socket are

glazed. Perfect contact is assured by reinforced side gripping contact springs of rust-proof construction.

The sockets are made for either subpanel or base mounting and are available in four, five and six prong types. They are 2¼ inches long and 1⅝ inches wide, with standard 1 27/32 inch mounting centers.

These new sockets and the new Hammarlund Isolantite coil forms provide an ideal short-wave combination, guaranteeing maximum sensitivity and selectivity.

▲

ALUMINUM SOLDER

The discovery of an all metal solder that repairs aluminum, pot metal, die castings and steel, promises to be of decided importance to the radio industry. This solder is called Alumaweld and is a development of the Allied Research Laboratories of Glendale, Calif.

As the name Alumaweld implies, the solder actually breaks down the structure of the metal being repaired and fuses or welds with it to form a single, solid piece. It is not to be confused with a surface solder.

Alumaweld is applied to any metal with an ordinary soldering iron or blow torch. It melts at an exceedingly low temperature, but once applied, requires a much higher temperature to melt again. The fact that it has a tensile strength of 12,000 lbs., which is over ten times that of ordinary solder, indicates its permanency.

Alumaweld is now being used extensively in radio work for the repair of aluminum cabinets, aluminum housings, and other metal work. Average repairs take from 10 to 12 minutes, and there is no need to tear down the set or remove any parts. Alumaweld is quite ductile, machines easily, and will take a nice polish over which chromium plating or any other plating can be applied.

This solder can be used by anyone regardless of experience. It replaces welding at a fraction of the time and cost, without any danger of cracking during preheating or cooling. Alumaweld cannot possibly rust, inasmuch as there is no electrolytic action between the solder and metal. A free sample of Alumaweld may be secured by writing the manufacturers.

▲

A PORTABLE TUBE TESTER

The Apparatus Design Company, Little Rock, Ark., announces a new portable tube tester which it is claimed meets present-day requirements of tube testing. Each instrument is hand calibrated. The set is equipped with multi shunts.

The proper functioning possibilities of a radio tube can best be obtained if a device will interpret the condition of emission, plate impedance, spacing of elements and presence of gas. Any device not giving true interpretation of these conditions is not desirable in the present-day plan of tube merchandising. The tester should also automatically show short circuits and indicate the amount of resistance in possible shorts between such elements as the cathode to heater.

All of this is accomplished in the Confidence Radio Tube Tester together with simplicity of operation; confidence in interpretations and the direct and exclusive English reading method.

The meter scale as used in the Confidence comprises three readings; GOOD, BAD, GAS. This scale had formerly read BAD, POOR, FAIR, GOOD, GAS, but in the merchandising of tubes it was found that any tube reading POOR should be replaced and any tube reading FAIR would not be replaced by the customer, and therefore the scale reading was not simplified but became a better possibility of merchandising for the radio dealer.

▲

FLECHTHEIM CATERING TO TELEVISION STATIONS

A. M. Flechtheim & Co., Inc., of 136 Liberty St., New York City, manufacturers of a complete line of paper-dielectric condensers, announce that their new 7000-volt type ZX transmitting units are fast finding favor with television stations.

To date, more than 450 broadcasting stations in the country employ Flechtheim superior transmitting filter condensers, which are available in capacity sizes of 1, 2, and 4 microfarads in voltages of 1000, 1500, 2000, 3000, 5000 and 7000 volts d-c. Owing to the conservative rating of these condensers, together with their exceptionally high resistance and breakdown values, they have been adopted as standard equipment by many of the leading stations who require dependability.

For the television receiver and amplifier, the Flechtheim company has introduced a new type of 1000-volt filter condenser, of the smallest physical size, useful in capacity-resistance coupling, as well as in the filter circuit. These units known as type HSM are employed by an increasing number of condenser users.

The latest catalogs No. 23 and No. 24A containing useful information regarding all types of condensers for various circuit requirements will be sent on request.

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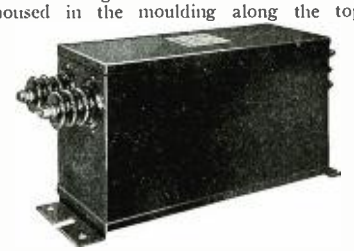
HIGH POWER FACTOR TRANSFORMERS

With the development of applications of luminous tubing to interior and outdoor display has come the requirement that the transformers to supply the energy be designed for adaptability as well as for service. Thordarson long ago pioneered the indoor skeleton sign transformer and the standing or combination types. Now Thordarson offers a complete line of thin type transformers. The thin dimension being as small as can consistently be made in a conservative design.

These transformers can be used for store front or cove lighting, either indoor or outdoor, wherever the "depth" dimension is at a premium. One suggested application for these transformers is in making a reasonably priced, double-faced outdoor sign. A single thickness of metal is used for the background and the transformer is housed in the moulding along the top.



Electrode receptacles are arranged so the glass can be readily plugged in. No angle frame work is required. The top moulding can be made waterproof to protect both transformers and electrodes. It should also be ventilated to permit adequate air circulation for cooling of the transformers. The complete sign would be light and easy to erect.

Thordarson high power factor transformers are recommended for installation on motor-generator sets or wherever local regulations require transformers of high power factor. They are conservatively designed to give years of service.

▲

NEW MESH FOR RADIO TUBES AND PHOTOCELLS

A high grade mesh for vacuum tube manufacture that does not necessitate change in dies or present tool set-up is announced by the C. O. Jelliff Mfg. Corpn., Southport, Conn. This is a quality product of superior electrical properties, and which is being marketed at a low price.

NEW!

Special plate supply for Class "B" Amplifier

T-5140. Special Plate Supply Transformer—black crackle finish. Size 6¼ x 6¾ x 10½. List price $24.50.

This special and entirely new plate supply transformer, T-5140, is designed for use with Class "B" amplifier. When used in the recommended circuit it supplies practically constant output voltage at the filter terminal over the rated load range.

T-5100. Special Input Transformer — black lacquered. Size 3¾ x 3¾ x 3½. List price $7.50.

For coupling transformers, we offer a special Input T-5100 and a special Output T-5101.

This group has met an unusual and enthusiastic reception for public address systems. It assures high audio output from small tubes. It makes for tube replacement economy and high efficiency. Thordarson circuit diagrams S-102 and S-108 should be followed to obtain best results. Sent free on request.

T-5101. Special Output Transformer — black lacquered. Size 3¾ x 4 x 4. List price $10.00.

Thordarson Electric Mfg. Co.
500 W. Huron St., Chicago, Ill.

THORDARSON
Reg. U. S. Pat. Off.
TRANSFORMER SPECIALISTS SINCE 1895 . . .

Jelliff Announces

A new wire mesh to meet the "up-to-the-minute" requirements of design engineers and manufacturers of radio and photo tubes.

A quality product of equal or superior electrical properties for less money than other material.

A material accurately manufactured and calendered, that will maintain it's strength, rigidity and shape.

A mesh that requires no change in dies or present tool set-up.

Mail the coupon for prices, samples and complete information.

The C. O. Jelliff Mfg. Corporation
MAKERS OF QUALITY WIRE CLOTH SINCE 1880
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Without Obligation, send Sample ☐ *Prices* ☐ *Quantity* ☐

Have your representative call at _____

Name _____

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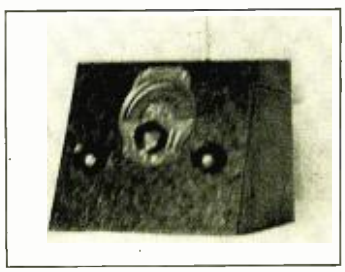
R.E. 333

A GOOD SHORT-WAVE CONVERTER

The United Radio Laboratories, 27 Howard St., Arlington, Mass., announce the introduction of the new United short-wave converter. Mounted in an attractive metal cabinet, with distinctive crystalline finish, this converter offers compactness and performance ordinarily obtained only with much larger and more expensive models.

The personnel of the United Radio Laboratories are specialists in short wave design, having created the original Pilot short-wave converter, and other commercial receivers. The new United short-wave converter is the result of months of intensive experimentation to develop a truly efficient, yet inexpensive short-wave converter.

This unit employs two tubes, one 227, and one 224, taking its power from the



associated receiver. It is fitted with an adapter whereby power is taken from the pentode tube, but in those sets which do not use this tube the adapter can be slightly modified so that power can be obtained from the speaker terminals. Thus the United short-wave converter can be applied to the great majority of modern receivers.

The United short-wave converter is an all-wave job, covering the range of 15 to 210 meters by means of a specially designed coil and switch arrangement, which is both efficient and foolproof. Three ranges are provided, giving maximum performances, without excessive sharpness of tuning.

The United Radio Laboratories will be glad to receive inquiries on this and other designs now in progress, and offer an up-to-date consulting service to radio manufacturers.

▲

NEW TYPE NEON LAMP FOR TELEVISION

Although, as was apparent at the recent radio show, the commercial television receiver of the coming season will be of the projection type the spiral scanning disc will still be used for experimental work and for the simpler "kits." Believing that the only road toward an answer to the many problems of television is one requiring infinite attention to the smaller details the Cable Radio Tube Corp., 230 N. 9th St., Brooklyn, N. Y., makers of Speed tubes, have added to their line a new type of flat-plate neon lamp for use with the scanning disc.

The flat-plate tube relies for its operation upon the formation of a glow discharge due to positive ion bombardment of a flat cathode which is generally backed with mica in order to limit the discharge to the front wall of the tube. The anode is usually in the form of a wire ring situated close to the rear surface of the cathode. During the course of operation a negative charge collecting upon the glass envelopes acts as a third electrode—a negatively charged grid—and operates to increase the de-ionization time of the tube. The result is that the device suffers greatly from frequency restriction, thus losing most of the high frequency components of the signal so necessary to the achievement of detail in the received image. In the new Speed wall-electrode neon lamp the anode is in the form of a metallic coating on the envelope of the tube itself. In this manner the effect due to the negative charge collecting on the wall is avoided and the tube is capable of a high frequency response not obtainable with the ordinary type. In addition, these tubes have operating impedances in the neighborhood of 4,000 ohms, about ten times that of the usual lamps available. They may thus be operated efficiently in the plate circuit of a vacuum tube without the necessity for impedance matching networks. Their efficiency as calculated with respect to the light obtainable with a given electrical power expenditure is also many times that of older models. Speed wall-electrode neon lamps may be completely modulated as to their light output when operated directly in the plate circuit of a single 171A tube.

The manufacturing operation attendant upon the deposition of the wall-anode automatically cleans up any residual gas prior to the admission of the neon. This tends to increase the operating life of the tube to a large degree.

▲

NEW SHORT-WAVE COIL FORMS

A new type of coil form, of extruded Isolantite, affording maximum efficiency at high frequencies has just been developed in the laboratories of the Hammarlund Mfg. Company, 424 West 33rd Street, New York City.

This new form answers the demand for a winding form complying with the exacting requirements of efficient reception on short waves. The Isolantite material employed closely approximates the qualities of fused quartz, the finest high frequency insulating material known to science.

The form is equipped with a black enameled handle, providing extreme convenience in removing and inserting. The top of this handle is broad and flat, to permit markings identifying the coils, wavelength range, etc. The surface of the form is "non-skid," eliminating the troubles encountered in winding on slippery surfaces. An abundance of wire terminal holes makes drilling unnecessary, and provides a

form suitable for space winding or the winding of any number of turns. A small groove is also provided at the bottom of the coil form for primary or tickler winding.

This new form is 1½ inches in diameter and 2½ inches long, exclusive of knob and prongs. Three types are made, one for four prongs, another for five and the last for six, to fit standard sockets or the new Hammarlund low loss Isolantite sockets.

Incidentally, these coil forms are now used in the new Hammarlund all-wave superheterodyne, the "Comet," another recent development of Hammarlund.

A NEW "B" ELIMINATOR

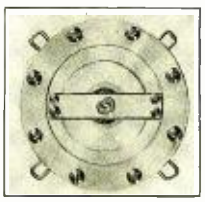
A new departure in B power units is announced by the Pines Winterfront Co., 1135 Cicero ave., Chicago, Ill. This B battery eliminator for automobile radio is an original and entirely new invention designed to insure constant high voltage for the operation of a radio set in an automobile, bus, airplane or home.

It consists of a very efficient motor in combination with a rotary transformer. It receives its operating current from the regular "A" battery, which, through the medium of a rotary transformer, is stepped up to the required high a-c. voltage, rectified, and filtered through a filter pack which is self-contained in the eliminator, and delivers a smooth d-c. voltage to the radio set.

▲

A NEW CARBON MIKE

The Electro-Voice Mfg. Company, Inc., 338 East Jefferson Blvd., South Bend, Ind., announces a new type of carbon microphone which has important features. The microphone is illustrated herewith.



Its response range is from 30 to 7000 c.p.s. Its output is 39 db. The size is 1 3/16 x 3¼ inches, and weight one pound.

▲

STANDARD TRANSFORMER CORPORATION

The Standard Transformer Corp., of 860 Blackhawk Street, Chicago, Illinois, announces the appointment of sales representatives in the following territory:

Marthens, Schroter & Company, 54 Dey Street, New York City, to cover Metropolitan New York.

W. S. Reid, 308 E. 17th Street, Kansas City, Missouri, to cover Kansas, Missouri and Oklahoma.

Arthur S. Detch, Security Building, Portland, Oregon, to cover Washington, Oregon, Idaho and Montana.

These representatives have found it profitable to promote the sale of the Stancor line of replacement transformers, which is said to be a complete transformer line sold through radio distributing channels, and which is meeting success.

▲

A "B" ELIMINATOR

A new device for automobile radio sets from the factory and laboratory of the Motor Car Devices Co., 1455 Venice Blvd., Los Angeles, comes in the form of the new patented Aut-O-Bee. It is an eliminator, weighing less than five pounds for shipping, and 4½ x 4½ x 3½ inches in dimension. The device occupies but an eighth of the space which it took to house the B battery set under the old-style arrangement of B-C battery hookup.

Besides being adaptable to use on automobile sets, the Aut-O-Bee is said to work equally as efficiently on sets installed in airplanes.

Its use on police radio cars is expected to open up another new field of distribution. Farms and other locations where electric current is not available will also furnish potential markets.

INDEX OF ADVERTISERS

TELEVISION NEXT---

THE Junior Western Television Transmitter is a real sight broadcaster, developed far beyond the first stages of experimentation and is *now* in readiness for general radio station use. This equipment, though compact and portable, is professional in every sense of the word.

●

Equipment consists of five integral parts: (1) a high powered lamphouse; (2) an accurately made scanning disc; (3) a synchronous motor; (4) an optically fine projection lens; (5) a pickup unit consisting of two highly responsive photocells.

The mechanical and optical parts are mounted rigidly in their proper relative positions on a special chassis frame. In view of the fact that the scanning unit may often be placed on the same table or bench as experimental equipment, the chassis frame is rubber insulated and prevents vibration being transmitted to sensitive amplifiers and delicate electrical equipment.

The photocell units may be located in the proper position on each side of the scanning beam in order to pick up a maximum of light from the transmitted subject. The position of the photocell may be varied to suit the ideas of the experimenter on the proper angle of pickup for his own special work. The effect of the photocell placement on the television picture is as if the photocells were flood lamps illuminating the subject from a similar position.

Illumination for scanning is furnished by a 1000 watt Mazda projection lamp mounted in a compact ventilated lamp house with reflector and condensing systems for concentrating the light. The lamp is inserted in a pre-focus socket, aligned at the factory for greatest efficiency. Replacement lamps will align without adjustment. This feature allows quick replacement.

The condensing lens system, consisting of two high-powered plano-convex lenses is held in a removable unit. When this unit is inserted in the hole provided, it is the correct position for efficient concentration of the light through the apertures of the disc.

The "Junior Western" comes complete —light, sturdy, *practical*—ready for actual operation.

●

What it will do! Once you have installed a Junior Western Television Transmitter, hooked it into any of the many circuits suggested, you can broadcast complete television programs —programs that can be received within the normal broadcasting range. *Springer, of Ft. Wayne, Indiana, with less than 100 watts power, was picked up at Indianapolis and Chicago. Hruska, at Cedar Rapid, Iowa, has transmitted pictures to a Chicago suburb.*

●

Not only is the Junior Western complete in itself as a television broadcasting transmitter building prestige for the station — it offers radio station engineers, amateur radio operators, radio schools and research men good, practical, moderately priced equipment for experimental, research and development work on television problems.

●

Suggestion: If you want to know what the Junior Western Television Transmitter can do for you—what you can expect from it, just write.

SOME WELL KNOWN USERS

The practical use of Western Television equipment is fully indicated by the following partial list of installations:

●

WALTER J. LINDSAY
Chief Engineer
WMAQ and W9CDN, Chicago, Illinois

CARL MEYERS
Chief Engineer
WGN and W9DN, Chicago, Illinois

DAN GELLERUP
Chief Engineer
WTMJ and W9EVE, Milwaukee, Wis.

LEONARD SPENCER
Chief Engineer
CKAC and VE9EC, Montreal, Canada

G. L. TAYLOR
Chief Engineer
W9ATU, Kansas City, Kansas

ROLLIN H. STEWART
Indianapolis, Indiana

M. H. LUDLOW
Madison, Wisconsin

EARL W. SPRINGER
W9BWI, Ft. Wayne, Indiana

SAM SNEAD
Madison, Wisconsin

HARRY KERLIN
Birmingham, Alabama

E. C. DWYER
Glen Ellyn, Illinois

BERTHEL BERG
W9EXM-W9GHP, Highland Park, Illinois

STATE UNIVERSITY OF IOWA
Iowa City, Iowa

●

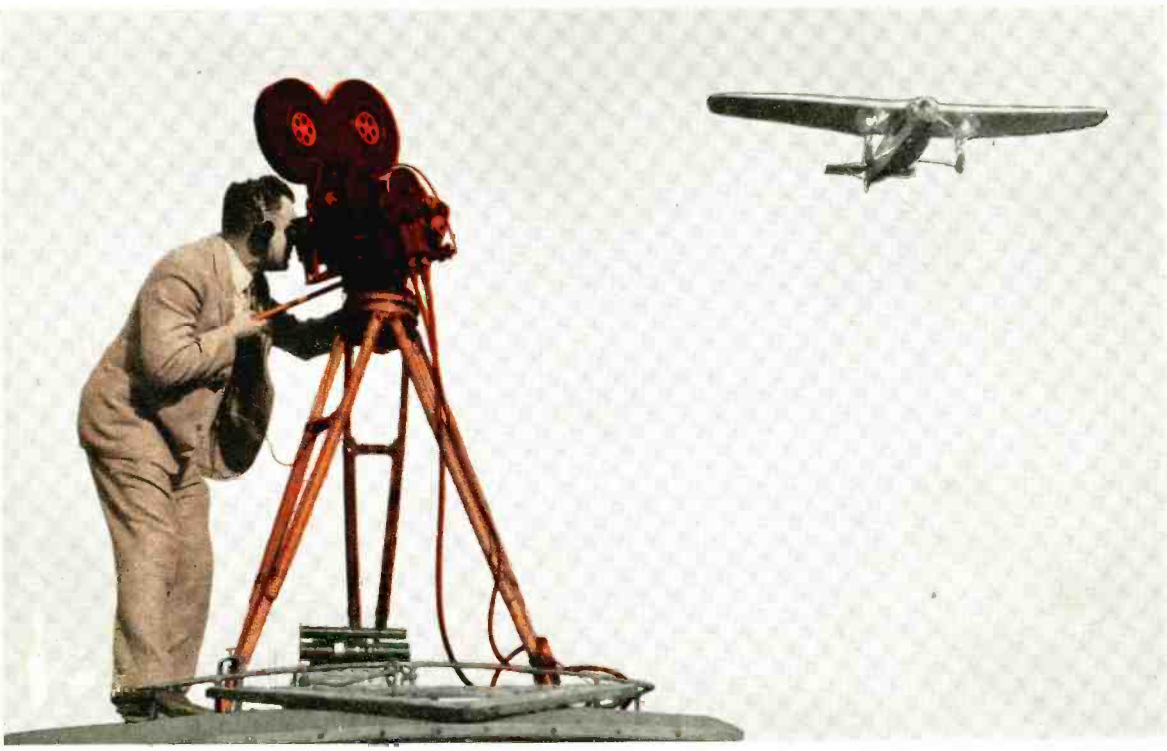
New names are being added to this list every month. *Television with Western Television equipment is practical.*

This is worth looking into. Your further inquiries are invited.

WESTERN TELEVISION CORPORATION

400 WEST MADISON STREET

CHICAGO



On location with the talkies– insulations must be light and strong

Talking pictures revolutionized the motion picture industry in more ways than one. For example: they introduced new uses for electricity and new problems of insulation. The camera, whether shooting an indoor set or the action of a speeding plane must be effectively insulated, and all insulating parts must be both light and strong.

Within the theatre, the myriad of electrical reproducing devices opened another market for dependable insulating materials. Drawing on past years of experience, engineers chose Bakelite Materials for hundreds of these new applications. Light weight without sacrifice of strength, high insulating efficiency and resistance to variations of temperature and moisture conditions made these materials the logical choice.

Long favored by radio engineers for their efficiency and dependability and for the economy with which they may be produced, insulating parts made of Bakelite Materials continue to follow the progress of the electronics industry. With each new development or new device, Bakelite Materials provide solutions to difficult insulation problems.

Write for our illustrated booklets, 12M, "Bakelite Molded," 12L, "Bakelite Laminated" and 12V, "Bakelite Varnish". These booklets contain valuable information concerning the properties and uses of Bakelite Materials. There are also many special materials developed to solve particular insulating problems. Call upon us for information about any of them.

BAKELITE CORPORATION, 247 Park Ave., New York ... 635 W. 22nd St., Chicago

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

BAKELITE

REGISTERED U. S. PAT. OFF.

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THE MATERIAL OF A THOUSAND USES